

13TH INTERNATIONAL POSTGRADUATE RESEARCH CONFERENCE 2017

CONFERENCE PROCEEDINGS

14-15 SEPTEMBER 2017

FOREWORD

Welcome to the 13th International Postgraduate Research Conference (IPGRC 2017) hosted by the School of the Built Environment at University of Salford, UK. This year's IPGRC is organised as part of the International Research Week 2017- 'Shaping Tomorrow's Built Environment: Construction and Design for the Modern World' and also the year we celebrate the 50th anniversary of Salford as a University, which makes this year's conference very special. This conference creates a unique opportunity for researchers from Salford and other parts of the world to share their research interests, and outputs and to network and interact within a professional and friendly environment, with high profile academics and leaders within the built environment.

This year's conference brings together participants from a number of countries including the UK, USA, Australia, New Zealand, Canada, Sri Lanka, Hong Kong, Iran, Italy, Ireland, Norway, India, Brazil, South Korea, Nigeria, Turkey, UAE, South Africa, Iraq, Ghana, Estonia, Saudi Arabia and many more. The conference received over 100 papers and posters covering the following themes:

- Business, Economics and Finance
- Property and Project Management
- ICT, Technology and Engineering
- People, Skills and Education
- Design and Urban Development
- Sustainability and Environmental Systems

Conference will provide a forum for novel discussions into the development and application of new and emerging practices to challenge current design and construction practice in the areas of people, process and technology issues. On behalf of School of the Built Environment, the conference co-chairs and organisers, we wish you an enjoyable and fruitful experience. We hope that you will obtain useful feedback to your research work, gain insight from work of others and forge connections for future.

Dr. Chaminda Pathirage

Conference Chair

Director of Postgraduate Research Studies

School of the Built Environment

University of Salford

United Kingdom

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Takhravanchi



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KEYNOTE SPEAKERS

Professor Chris Harty – University of Reading

Chris Harty is Professor of Technology and Organisation and Head of the School of the Built Environment at the University of Reading. He has been the Director of two EPSRC Centres and since 2010 has been Principal Investigator / Lead Academic on over £3.5 million of research funding. He has authored over 50 refereed papers, is an Editor of Construction Management and Economics and reviewer for over 30 journals in areas of built environment, organisation and technology management. He is currently a visiting professor at Chalmers University of Technology in Sweden, and was previously Visiting Professor at Copenhagen Business School in Denmark. Chris has internationally recognised expertise in understanding cultural and strategic change in organisations, implementation of new technologies and working practices, future scenario development and the connection between physical space and working practices.



Title: The Futures of Construction Management Research

How do academic fields come about, grow and change and, more importantly, how do researchers shape and be shaped by them? Construction management today is a well-established academic area with departments and schools, conferences, journals, a broad community of researchers and PhD students and a diverse range of interests. It also has a history. One might argue that it was established in universities as a professional discipline, and has expanded from education and practice to include multi-disciplinary research, and to encompass researchers from a range of science, engineering and social science traditions. It has also, perhaps, expanded from interests in the operation of construction firms and projects to examine the effect of building and the built environment on societies and economics. However, the landscape of universities are constantly shifting. Current trends in individual and institutional performance measurement, new financial pressures and reprioritisation of research funding are leading to new dynamics for us all to navigate. This keynote will begin by outlining some of those dynamics and the effects they are having, in order to open up a discussion of the future of construction management research. Drawing on future scenario development, four possible futures are outlined - convergence, retrenchment, disappearance and hybridisation. These each speculate on possible futures for the community, on the kinds of research questions we might ask, and the research we produce.

Professor David Boyd – Birmingham City University

David Boyd is Professor of Construction and Director of the Centre for Environment and Society Research, based at the School of Engineering and the Built Environment. He teaches on the MSc Construction Project Management course. David has a background in engineering, but is better known for his management insights of the industry. He has researched and designed solar heating schemes for housing estates, as well as developing a model of projects in the industry as complex adaptive sociotechnical systems. He has completed research on construction clients, which was then published as a book and adopted by the Construction Clients' Group. He has been PI on funded knowledge management and expertise-in-practice projects which explored perceptual knowledge, developing inquiry techniques and inter-disciplinary communications approaches. Currently, he is investigating digital construction focusing on the better use of Building Information Modelling within practice as an engagement tool between disciplines.



Title: Problematisation in Construction in a Post Truth era

This keynote will explore the implication of the way we problematise issues in construction research particularly in our post-truth era. Construction is particularly difficult to research as it operates with uncertainty because of its inherent complexity and with conflicting viewpoints because of its interdependence between multiple organisation and tasks. We, as researchers, have a challenge about what viewpoint to adopt and what narratives to promote. We must ask why some viewpoints are prioritised over others and the implications of this for our results and the industry. Are we as researchers then promoting a deception and if so to whose benefit? Thus, we, as construction researchers, need to understand the implications of our problematisation and its implications for our methodology as part of our work.

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BUSINESS, ECONOMICS AND FINANCE

CRITICAL REVIEW OF THE SUCCESS FACTORS OF STRATEGIC ALLIANCES IN THE UK CONSTRUCTION INDUSTRY

W. Hameed and C. Abbott

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: W.Hameed@edu.salford.ac.uk

Abstract: With an increasingly competitive environment in the world and in the UK particularly, industries that are operating today face many complex technological challenges with regards to both hard and soft systems. Consequently, skills and knowledge are required, that are better accessed by firms through strategic alliances, which allow individual firms to jointly leverage their comparative advantages to gain an edge. This has now become a fundamental business strategy in several industries, where individual firms that are less competitive are forming strategic alliances to compete. In other industries, the resource-based and transaction cost theories show that strategic alliances are insufficient; when assets and capabilities are acquired and where internal contracts and investment are not efficient. Due to the lack of empirical data in this field particularly regarding strategic alliances in the UK, this paper provides a critical literature review that discusses the nature of strategic alliances in general and aims to identify the theoretical factors that influence alliance success in construction. These factors are divided into five categories: trust, commitment, knowledge sharing, communication & IT technology and dependency. This research, therefore, identifies the fundamental success factors of strategic alliances, through a systemic examination of a strategic alliance literature review. It is intended to further test these factors in a range of case studies.

Keywords: Strategic alliances, Construction, Trust, Commitment, Knowledge Sharing.

1. INTRODUCTION

Over the previous two decades, inter-organisational collaborative arrangements have increased as a means of improving a firm's competitive advantage. Companies are focusing on the essential activities of providing good quality products and services through the formation of strategic alliances with suppliers and customers (Sambasivan et al., 2013). Strategic alliances have received attention in previous studies, mainly on how alliances are providing rare and valuable resources, as well as knowledge and skills, that are critical for a firm's survival and growth (Nielsen, 2007). Strategic alliances are considered an important way to quickly develop success strategies and maximise shareholder equity. Thus, research and development strengths could be integrated to obtain external resources and skills, leading to the development and implementation of successful external strategies, which may have a positive or negative effect on a firm's performance (Lin et al., 2011). As a result, the strategic cooperative perspective represents strategic alliances as an alternative mechanism to market strategies, as well as exploring the system of hierarchies amongst firms for tackling specific strategic requirements (Williamson, 1991, Nielsen, 2007).

There are many reasons behind a firm's desire to establish strategic alliances (Gulati, 1998). For instance, cutting edge information and communication technology have created opportunities for cooperative business activities. Also, a challenging competitive environment has led firms to form alliances, because if firms operate alone, they may incur significant costs and generate low value. Hence, through cooperation, firms can increase

effectiveness and speed up innovation processes leading to greater market share and success (Tariq, 2012, Stuart, 2000). Furthermore, the main motivator for establishing strategic alliances is to cooperate and explore the possibility of mixing together compatible assets owned by different firms. In addition, alliances may be created when one company has strengths in different operational stages, such as in the product's value chain or when trying to share competitive risk (Stuart, 2000).

However, many researchers have stated that the percentage of strategic alliances failing has increased by more than 50% around the world (Sambasivan et al., 2013, Dyer et al., 2001, Das and Rahman, 2010, Sivadas and Dwyer, 2000). To overcome this high rate of failure in strategic alliances, a better understanding is required of what the factors are, that are necessary for successful strategic alliances (Sambasivan et al., 2013). In fact, when firms are establishing alliances, they can possibly engage with unqualified partners, which can lead to potential opportunistic behaviour, eventually leading to a loss of specific assets (Gaur et al., 2011).

Noticeably, literature on the strategic alliance of construction industries in the UK has already been somewhat covered. For example, according to (Ingirige and Sexton, 2006), alliances in the construction industry can be used as an instrument to assure a sustainable competitive edge. With studies focusing on the challenge of generalising and preserving the perspective of alliances in the long-term, to improve the environment of projects. Moreover, (Black et al., 2000) have tried to expand the literature on partnerships, by analysing empirical success factors and benefits. Concentrating on how working together to achieve partnership targets within an environment of trust helped realise the project sufficiently, without any opportunistic behaviour or conflict. It also increased end-customer satisfaction for all parties contributing in an alliance that strived to fulfil success (Mohr and Spekman, 1994).

This paper aims to provide a background study regarding the concept of strategic alliances in general as well as the factors for successful strategic alliances. It particularly concentrates on factors that encourage successful strategic alliances within the UK.

2. STRATEGIC ALLIANCES OVERVIEW

The number of strategic alliances has increased dramatically since the late 1970s, specifically in technological industries, where they have been increasingly used as a means to manage the practical risks and improve market performance (Lee et al., 2010). Additionally, alliances could help achieve success in environmental instability through the sharing of crucial information among partners, by identifying reciprocal responsibilities, control partnership implementation, and assessing the outcome of the alliance (Li et al., 2013). To realise the concept of strategic alliances, many researchers in the literature review have defined this concept. For instance, Das and Teng (1998) define strategic alliances as inter-organisational collaborative arrangements, whose purpose is to achieve the strategic targets of partners. In a similar way, Li et al. (2013) state that strategic alliances are facilitating access to partner resources, to absorb sufficient knowledge, as well as maintaining and developing abilities, by combining skills with their partners in order to minimise costs that appear from cooperative risks.

Furthermore, Nielsen and Nielsen (2009) agree with the view that a function of strategic alliances is generating realisation for the managers within the alliance to improve their

capabilities. This can be achieved by providing better products and services with the possibility of obtaining access to partner technology, or effective skills and knowledge portfolios. Also, (Chen et al., 2015, Chan et al., 1997) indicate that strategic alliances can be defined when two or more firms cooperate, involving a partnership through agreement, which identifies sharing resources in production, marketing, and IT technologies. Thereby benefiting from mutual participation for all partners. More specifically, strategic alliances are considered as a type of dynamic capability that supports firms with external resources, which otherwise would have been missed (Ma et al., 2012).

Notably, López-Duarte et al. (2016) point out that strategic alliances identified as a field, are a fundamental area to study, as they explore alliances within both international management and international business research. This study will be aligned with the definition of strategic alliances being generic and relevant to the plan, where (Yasir Yasin and Maqsood Ahmad, 2013) state that strategic alliances are a purposive partnership between two or more independent firms working together and trying to achieve strategic objectives for mutual benefit through sharing, co-development, exchange of resources and capabilities.

In other words, cooperative alliances work as an incentive for partners to increase trust and commitment by providing other members with resources for maintaining the relationship. As well as reducing the competitive level among partners, in turn leading to an enhanced feeling of trust and a higher commitment to work together. Indeed, collaborative firms have found alliances to be a good step towards maintaining lower overall costs, as well as obtaining greater trust internally between workers (Holt et al., 2000). Thus, Furrer et al. (2012) indicate that strategic alliances can be considered as a mixed motivator venture in which partners simultaneously collaborate and compete.

In fact, the researcher is aligned with the discussion mentioned above, that strategic alliances could appear as an instrument in which supporting partners are united together by various advantages such as lower costs, resource distribution, sharing significant knowledge and enhancing the spirit of trust and commitment. In addition, it plays a significant role in growing the needs of competition, to establish the spirit of innovation among workers throughout the alliance. Thereby in this study, strategic alliances will be defined as a horizontal collaborative agreement among two or more firms working at a similar level, aimed at enhancing the joint development of processes, services, operation, and distribution products.

3. STRATEGIC CONSTRUCTION ALLIANCES

When reviewing the literature on construction alliances, there are several principles which have been noted. For instance, (Bennett and Jayes, 1998) demonstrate that partnerships within construction industries have three testified stages, each of which is partially different in concept due to their evolution. While most researchers in construction have taken the principle of “partnering” to represent an alliance within the supply chain, concept of “strategic partnering”, “alliance” and “strategic alliance” are also utilised in describing such relationship. Additionally, many of the researchers and empirical studies demonstrate that strategic alliances in construction can provide a lot of benefits to all stakeholders. Such as those involved in a project, fundamentally due to its ability to change following adversarial behaviour among partners. It has emerged as an essential strategy for avoiding opportunistic

and conflict relations among partners, as well as enabling / or guiding those who are seeking a strategy for long-term relationships and commitments.

However, the application strategy of strategic alliances is different from project partnering. The latest theory of strategic alliances concludes that achievement of alliance targets and project performance are the main goals, while the former model concentrates on opening the scope for a consistent relationship between involved partners. Therefore, the strategy of alliances can be considered as process-oriented, and project partnering as result-oriented. Regarding the rethinking of construction, (Egan, 1998) expresses that alliances and organisational learning are the main mechanism for developing the performance and competitiveness of firms within construction industries. While, knowledge sharing is undoubtedly a way to fulfil competitive advantage. Thereby this component should be incorporated as a core mechanism of strategic alliances.

According to (Kululanga et al., 2001) there are two underlying principles of organisational learning:

- 1- The knowledge which is generated and or imbibed considers results through a learning process produced in both internal and external business environments.
- 2- Application of knowledge is maintained to continuously improve alliance performance.

Aligned with these facts, most of the researchers in construction take the term of alliance as reciprocal relationships within the supply chain. In general, alliances or strategic alliances work to empower the relationships between stakeholders via respect, commitment, trust, teamwork, knowledge sharing, communication and shared goals. These relationships are usually determined through good faith in alliance rules, rather than a formal contract. (Cheng et al., 2004) state that alliances within construction usually create an informal climate rather than formal relations.

The fundamental reason for using a strategic alliance is to fit the targets of engaged partners, which are involved with various incentives and benefits. There is an even more important belief that an alliance should lead to worthwhile jobs for the partners, and quality and time completion for the owner. This might be the essential reason for partners involved to consider utilising it. (Cheng et al., 2004) illustrate that strategic alliances in construction should aid engaged companies to earn actual benefits within the project, and corporate levels. These benefits include decreased risks, developed quality, reduced cost, decreased rework, provided market share, increased profits, improved competitive position, enhanced opportunity of innovation, developed labour productivity and efficiency.

Furthermore, to enhance these incentives and benefits within the alliance, partners should be involved in sharing experiences and skills. While, top management should support these parties by making the execution of an alliance smooth. Ensuring that all partners should be willing to contribute within the alliance as the effort will not be worthwhile without the support of top management. Meanwhile, the main obstacles of alliances are known to be inappropriate technological knowledge, lack of training programmes, conflict, and opportunism (Lu and Yan, 2007).

However, the success of a strategic alliance within construction does not only depend on suitable top management but can also be enhanced via the accomplishment of a current approach such as TQM. (Schultzel and Unruh, 1996) believe that allied organisations should provide a unique contribution to all parties and that construction companies should understand the ability to satisfy the demands of a project which is planned. Thus, the familiarity of knowledge and skills are an essential base for alliance success, with those who have these experiences preferable to those without or lacking when faced with partner selection. Meanwhile, a whole chain of projects can be provided by large developers in order to facilitate long-term collaboration between partners and this can help promote the success of alliance use (Wong and Cheung, 2004).

Moreover, (Egan, 1998) focuses on some major clients of the British Airport Authority and the relationships among objectives of organisations, stating that capabilities are the main incentive for alliance success. While, (Cheng and Li, 2002) provide a framework of management skills and contextual characteristics that can be used to identify critical success factors for a construction alliance. Stressing that alliance can become more successful using proper management mechanisms, which involve alliance tools and individual measures. Thus, to achieve alliance success, the owners of allied organisations should formulate a process of partner forming, which may include the following steps: (1) ensure partners are willing to participate within the alliance, (2) select a facilitator, (3) determine who will participate within alliance workshop, (4) schedule the alliance workshop, (5) choose and provide materials, (6) prepare the agenda and hold the workshop.

4. MOTIVATION FOR FORMATION OF STRATEGIC ALLIANCES

Many firms are using strategic alliances to exchange resources, share risks, respond quickly to environmental changes, accelerate technological advancement, and obtain access to global markets (Yasuda, 2005). Hence, strategic alliances could also be understood to have, in some instances, a sharing arrangement among partners to learn and obtain skills with knowledge that was not available within these firms otherwise (Chen and Chen, 2002). Nonetheless, many scholars have argued regarding the importance of strategic alliances and what the motivation is for firms to form these alliances.

For example, Das and Teng (2000) identify that alliances are usually formed following two theories that are: resource-based and transaction cost. According to the resource-based view, firms engage within alliances rationally with the aim to enhance and maximise their value through pooling and utilising valuable resources and skills as an alternative strategy for firms to gain access to another firm's resources. On the other hand, the transaction-cost theory states that firms target each other to minimise the total of transaction costs, production cost, and the sum of fixed costs via ownership decision centres (Yasuda, 2005).

Das and Teng (1998) argue that there are many reasons behind the formation of alliances. According to the resource-based view, the essential motivation pushing firms to form alliances is to maximise profit in the long-term. While, the fundamental reason leading to instability in alliances is the limitation of resources by partners. On the other hand, the transaction-cost view points out that the main motivation of constituting alliances is that it optimises and economises transaction costs and the primary reason behind the instability in alliances is the opportunistic behaviours of partners.

Meanwhile, (Chen and Chen, 2002) argue that there are three important motivations behind the formation of alliances:

- 1- Huge transaction costs resulting from the small amount of bargaining accrued between partners.
- 2- A strategic attitude that targets the supporting firm's competitive position or market power.
- 3- A search to find organisational knowledge and skills or try to learn and acquire critical knowledge by partners from others.

According to the network theory, the essence of strategic alliances is to make formal relationships among partners to manage and facilitate a continuing exchange of resources. This is because no firm can be considered as self-contained, so that they do not collaborate with other firms in some way or form. Hence, strategic alliances are considered a remarkable solution with a long-term need (Chen and Chen, 2002). Moreover, Vyas et al. (1995) categorise the following points as possible motivation for the formation of strategic alliances:

- Distribution Channels (going around entry barriers).
- Synergy (to pool resources, increase efficiency, share expertise, reduce cost, increase market share and become more competitive).
- Diversification (to reduce/share risk, gain access to new market segments), and
- Sourcing Raw Material.

To summarize the discussion above, the main goal of establishing strategic alliances is to pool resources among partners, to fill gaps in their strategies and achieve their objectives. In addition to sharing tacit and explicit knowledge between partners of the alliance that could improve innovation skills and technologically develop the firm's capabilities to enter new markets.

5. BENEFITS OF FORMING STRATEGIC ALLIANCES

Many researchers have referred to the benefits of alliance formation and the resulting valuable feedback on the firm's performance and attributes. Lee et al. (2010) state that strategic alliances may change the evolution of the firms entirely and enhance their strategic position between other competitors through the sharing of overall costs and risks among partners. As well as improving innovation skills by supporting the spirit of competition among employees, obtaining access to innovative technologies and markets, gathering and learning complementary skills, and accelerating the commercialisation processes.

At the same time, (Chen et al., 2009, Li et al., 2013, Lee, 2007, Nielsen, 2010) argue that strategic alliances offer benefits such as the sharing of vital or critical resources, blocking the appearance of stronger competitors, improving learning and innovativeness, external legitimacy, dealing and managing environmental dynamism. While, (Rai et al., 1996, Chen and Chen, 2002) propose that firms are relying on strategic alliances in order to achieve more profit in which alliances enhance effective means to evolve both economies of scale and scope, through investment in learning and adaptation.

To conclude, strategic alliances play a significant role in identifying policies and decisions, which could be followed to enhance a firm's strategic position within a complex changing business environment. Nevertheless, allied firms should also be prepared for challenges at various stages of the alliance and understand the regulations in selecting partners, managing or leveraging the alliance to achieve the objectives of the cooperation. Moreover, the benefit of alliance formation will not be achieved, if trust, commitment, and the sharing of knowledge are not found in that cooperation.

6. FACTORS SUCCESS STRATEGIC ALLIANCES

6.1 Trust

The concept of trust differs in either an individual's belief or a groups' belief, as it is embedded within the habits and culture of individuals, groups and industries, at a national stage and on an international level. It has been conceptualised as willingness for one party to exchange confidence with another reliably and integrally (De Ruyter et al., 2001, Kumar et al., 1994, Morgan and Hunt, 1994).

In other words, trust in an alliance context is defined as an individual's belief or a common belief among a group of individuals that another individual or group can be relied upon (Yasir Yasin and Maqsood Ahmad, 2013). Within a strategic alliance perspective, a transaction view proposes that the presence of trust is considered a vital factor in the relational governance structure of the partnership because of co-ordination and mutual dependency problems. This suggestion implies that trust has the ability to lower transaction costs via preventing opportunistic behaviour, thus helping partners to extend their view in order to take a long-term perspective to the relationship (Kauser and Shaw, 2004).

In respect of the relationship between trust and alliance performance, many theorists have noted that trust works as a trigger for various structuring, organising, and mobilising mechanisms to enable an alliance to fulfil an extreme performance outcome (Robson et al., 2008). As a result, Chang et al. (2011) propose that the main factor making the actual firm successful is trust, when virtual interaction and interpersonal processes possibly exist, meaning that the outcome will be great. However, disrupting the flow of information between partners could lead to an absence of trust, which could in turn result in conflicts and coordination problems.

6.2 Commitment

Commitment is a main element in the paradigm of a strategic alliance. Several researchers have provided definitions of commitment. For instance, Bianchi and Saleh (2010) define commitment as reciprocal to a partner's beliefs, that helps an ongoing relationship with another, which is so important that it warrants maximum effort to sustain it. Also, commitment is generally defined as an implied promise of relational continuity among exchange partners (Kauser and Shaw, 2004). Thus, if the partners do not sustain the pledges and try to act opportunistically, the value of its commitment will be lost with other firms (Li et al., 2013). However, sharing resources, risks and costs all refer to a partner's commitment, this mean the motivation for firms to make a commitment is the partner's promises of sharing potential outcomes (Li et al., 2013).

With regards to the importance of commitment in establishing long-term relationships, Pesämaa and Hair Jr (2008) identify that inter-organisational commitment is essential for a partnership. This is because it illustrates how success and strength can be accomplished via integration of resources from several firms engaged within the same destination level. For an enduring relationship to evolve, commitment and joint action of the engaged partners is required to encourage the recurring reciprocity. Commitment, therefore, is a significant variable for long-term success, because a partners' alliance is willing to invest valuable resources and sacrifice short-term advantages for long-term success. Furthermore, firms are building and sustaining a long-term relationship, in which if they reciprocate, beneficial gains can result from such a commitment (Chen et al., 2011).

Ultimately, it is suggested that commitment as an element discriminates among relationships that persist and those that have collapsed. So that, the enduring business transaction relationship between partners in a strategic alliance requires commitment to accomplish their common alliance targets. Thereby, commitment is the key for continuing a relationship and the fulfilment of desired outcomes for allied firms, and it has a positive impact on performance (Chen et al., 2011).

6.3 Sharing Knowledge

Sharing and absorbing knowledge can successfully occur by accumulating a range of performance benefits across partnership boundaries, including decreased failure rates and increased productivity (Squire et al., 2009). In turn, transaction values will grow because mobilised partners willingly share sensitive and proprietary knowledge necessary to cooperate and improve their workflow (Katsikeas et al., 2009, McEvily et al., 2003). Inkpen (2000) identifies that the generation of new knowledge is a huge challenge for a firm, so, it is worth doing it because sharing knowledge assures organisational actions and will provide organisational renewal (experimentation, change and innovation, competitive edge) (Lo et al., 2016).

According to the theoretical perspectives on strategic alliances, Inkpen and Tsang (2005) state that learning and knowledge can be obtained by partners engaged within an alliance through their past experiences and their tacit knowledge and experiences. In this sense, trust is considered a fundamental instrument as, if alliance actors are willing to share knowledge at a strategic and operational level, partners will share knowledge with confidence because of the development of trust (Nielsen and Nielsen, 2009). If trust and commitment among the partners are lost, sharing skills and knowledge of technology are commonly inhibited (Yasir Yasin and Maqsood Ahmad, 2013).

6.4 Communication and IT Capabilities

To achieve a successful strategic alliance operation, the partners are required to realise, share, exchange and obtain learning and skills from each other. So to achieve alliance targets, communication should be effectively sufficient to manage pooled resources (Youngtae et al., 2010). Therefore, communication quality can be defined as the level to which the content of communication is received and understood by the other partner in the alliance (Sengupta et al., 2000). The process of communication allows partners who share the information, to improve a relatively informal method. With the quality of information transferred and joint participation by parties in the planning and objective setting, transmitting very important

signals to the trading partners. This means that in virtual teams, a successful alliance depends on effective communication and the sharing of knowledge between partners (Sengupta et al., 2000).

Thus, communication has been realised as an important factor in facilitation and can be effectively used to strengthen the relationship of partners (Mohr and Spekman, 1994). Also, Costa e Silva et al. (2012) propose that communication is an essential asset that assures alliance partners learn skills from each other and co-ordinate their tasks, helping the alliance to enhance and sustain viable bonds. Importantly, achieving a satisfactory partnership can be gained by the development of effective communication skills, which is important for enabling ties of allied partners (Youngtae et al., 2010).

On the other side, information technology plays an effective role as a factor in aggregating essential information, which is responsible for the achievement of alliance targets. Information technology permits allied firms to share efficient and secure information. It is an infrastructure for exchanging information about the levels of demand and patterns, as well as other events that have been created by web based applications and information technology. These events have an important impact on cost reduction and partners' supply chain plans. However, it is clear that information technology alone is not sufficient for firms, who need to exchange critical and proprietary decision making information in order to develop trust and commitment (Chen et al., 2011). When firms have information technology capabilities it can leverage appropriate IT to aggregate a variety of information, which is considered important to fulfil an alliance's goals (information regarding the progress of the alliance duties, specific problems encountered, partner's participations, etc.). Hence, if a firm is engaged in an alliance, the managerial IT abilities become even more vital for achieving a high level of performance (Lioukas et al., 2016).

6.5 Dependency

The concept of dependency is effectively used as a factor to achieve success in a firms' relationship through the exchange of various aspects of (explicit, tacit) resources. According to Lefroy and Tsarenko (2013) dependence refers to the extent that the firm relies on its alliance partners for economic, social and financial resources. Following a resource dependence theory, alliances and maintenance are considered critical resources in the condition of organisational survival, in which firms work widely in an environment of resource uncertainty and thereby rely on cooperate partners to create resources necessary to accomplish the outcomes (Murray and Kotabe, 2005). Bearing this in mind, to deal with the uncertainty of an environment, the amount of information and knowledge that firms need to achieve cooperation and execution of alliance duties relies not only on the amount of activities performed, but on the extent to which actors depend on others to fulfil these activities. This dependence on each other is best captured via the level of dependency in an alliance (Lioukas et al., 2016). Even though, some of the suggestions assert that dominance by one partner might be better for performance, which can efficiently lead to a successful alliance (Liu et al., 2010). It certainly receives more purpose, as it shapes partnership objectives and increases the chances of accomplishing positive profits, by the facilitation of decision-making and empowerment of the action (Chen and Chen, 2002). This aspect can ultimately enable both partners rather than just one that is dominant, by enhancing ability and willingness to pursue target fulfilment, prompting higher satisfaction with the results, and improving new opportunities, as such solving problems through finding new solutions and access to new markets (Chen and Chen, 2002).

7. CONCLUSION

This paper provides a general overview on strategic alliances and strategic construction alliances specifically. In doing so, it presents the motivations and benefits that can be considered as core motivators for adopting the concept. It has revealed that a group of factors can fundamentally enhance the success of alliances. Nowadays, increasingly more clients consider trust and commitment to be essential factors for alliance success. Thus, it is important for clients and partners to have a better understanding regarding these fundamental success factors. Inhibiting knowledge sharing is a challenge for alliance success because it leads to decreased trust between partners. Furthermore, without a proper communication strategy among the clients, partners and project teams, the alliance is likely to underperform and may even fail. Consequently, effective knowledge sharing helps to create innovation, problem-solving, increased performance, and satisfied partners. Additionally, the interdependency between partners helps in reducing the costs of collecting resources, whilst enhancing the trust and commitment to achieve alliance targets. Future research efforts will concentrate on strategic alliances and attempt to illustrate the critical factors that lead to fulfilling alliance success in the construction industry in every single country. Additionally, a suggested conceptual framework will be developed to properly test and validate the research findings.

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ENTERING NEW INTERNATIONAL CONSTRUCTION MARKETS – LESSONS FROM NEW ZEALAND

S. Wilkinson¹, L.S Lim¹ and H.S. Jang²

¹ *Civil and Environmental Engineering, University of Auckland, 20 Symonds Street, New Zealand*

² *School of Architecture, Seoul National University of Science & Technology, South Korea*

Email: s.wilkinson@auckland.ac.nz

Abstract: Construction activities in New Zealand make a vital contribution to the national GDP. As the industry grows and matures, companies increasingly look for international markets. Participation in international markets allows the industry to become more resilient and competitive. This research aims to understand the competitiveness of construction companies in New Zealand, especially those companies focusing on infrastructure projects and wanting to engage, or are currently engaged, in international markets. New Zealand has an international reputation in projects such as international aid programme infrastructure projects, power plant projects, and dairy industry projects. New Zealand companies also have a reputation of being fair and honest in business. New Zealand's construction professional services have strong capabilities, networks, and linkages throughout the international construction market. Using literature, government documents, company reports and national statistics, this research assesses how the construction industry prepares for engagement in the international arena and how it develops collaboration strategies. The research adds new insights into the New Zealand construction industry role in international markets and directs future research on enhancing New Zealand's competitiveness and efficiency in international markets.

Keywords: Construction Industry, International Business, New Zealand, Trade Competitiveness.

1. INTRODUCTION

The construction sector is a significant contributor to New Zealand's economy, contributing to GDP, employment, and business. There is a relationship between construction activity, economic growth, and economic development, including international trade, but New Zealand companies have not taken full advantage of international opportunities because it has traditionally been fragmented and risk averse (MacKenzie, 2000; Gillies, 2014). The encouragement to expand and diversify into international markets is becoming more important for the sector to develop greater economic stability. The Minister for Business Innovation and Enterprise of New Zealand determined that there is a potential construction market boom over the next decade due to population increases and economic transformation of the service industry. In order to meet demands, New Zealand businesses are increasingly seeking international partnerships and overseas opportunities from these partnerships as they become available. As the NZ further matures, there are likely to be international companies bringing newer technology, experiences, and competition to New Zealand, whilst New Zealand companies will seek more integration within the global market. As demand in global construction market increases, larger New Zealand companies are looking to build a sustainable sector which contributes strongly to the New Zealand economy, and an international focus forms part of this strategy. Open markets to international trade and improved international communication and information networks have allowed New Zealand

companies to start to compete and expand. In this paper, an exploration and analysis of the ways in which construction companies access international markets is presented.

2. CONSTRUCTION COMPANIES AND COMPETITIVENESS

New Zealand construction businesses have had some success internationally and have gradually been extending their operations into international markets especially those in developing countries through aid work. However, these companies are competing with other well-established contractors from Japan, Korea, China, the United States, the United Kingdom, Italy and other countries that have been in international markets for decades (Han, 2015). New Zealand companies have recognised the need to upskill by improving innovation and technology use in order to be competitive in the international markets. The variables that affect the performance of construction companies in overseas markets needs to be analysed and ways to increase opportunities, enhance competitiveness and reduce risks considered. In investigating the factors influencing the performance of New Zealand construction firms in international markets, the need to understand shortcomings of previous experiences, and develop optimized solutions which reduce risk and enhance competitiveness become apparent.

The World Competitiveness Annual Report (WCAR, 2015) rates the level of competitiveness of 58 countries. The report uses assets, process, and performance including perspectives of investors, employers, and clients to make a determination. The report gives an overall country focus but it is difficult to determine the competitiveness of the construction industry from the data. What is clear from the data is that internationalized companies generally must possess certain features for competitiveness. Technological capability, firm size, firm reputation, project management and specialist expertise, strong equipment support, access to capital and international experience are important factors influencing construction firms' performance in international markets (Awil and Abdul Aziz, 2012; Ahmad et al., 2008). Strong financial, and managerial, expertise are also important factors to entry (Ahmad et al., 2008). Gunhan and Arditi (2005) state that company strength in international construction markets include track record, specialist expertise, and the capability of delivering project management services are critical. Additionally the network of contacts that can supply critical information about international projects is also important. Ofori (2003), further stresses that managerial expertise, financial resources and expertise, risk management, management of cultural issues and ability to deal with political issues are important for competitiveness and success. Ofori (2006) also showed that international success depends upon access to key inputs, in particular, the skilled labour, competitive and quality building materials, production and engineering knowledge, and access to capital. In general, key features that have been known to improve the competitive advantage for international industries appear to be costs, experience, technology and resources.

3. RISK/CHALLENGES AS PART OF ENHANCED COMPETITIVENESS

Firms need to address the challenges the international construction market poses. The ability to manage risk is part of the competitiveness factor and leads to success. Root (1998) views business activity and operation in foreign market as inherently risky, and argues that firms need to minimize risk when they first enter the international market including political, economic and legal risks. Javernick-Will (2009) concluded that the majority of international project risk arises from international joint venture risks, contractual risks, cultural or social

risks, regulatory risks, and political risks. Instability in the host country increases risk including 1) economic losses for foreign companies; 2) political risks where unstable governments in the host country can harm the operations of foreign companies; 3) operational obstacles of the host countries; 4) taxation systems, business and contract laws of host country that may be disadvantageous to foreign companies, and 5) security risks that can harm the operations (Gunhan and Arditi, 2005). . Risks have costs associated with them which acts as a barrier to doing business for construction companies (Gunhan and Arditi, 2005).

4. CURRENT POSITION OF NEW ZEALAND CONSTRUCTION FIRMS IN INTERNATIONAL MARKET

Construction companies at different stages of maturity in internationalization will have different needs. Figure 1 illustrates the stages of internationalisation from Cavusgil (1980). This is still relevant as a starting point to understand how construction companies enter the international markets and the risks they face.

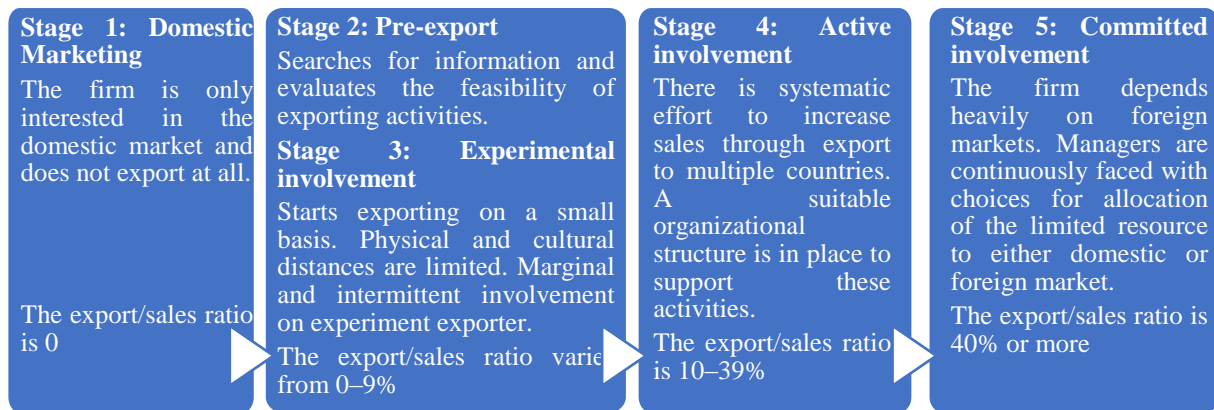


Figure 1: Stages in exporting by Cavusgil (1980)

According to Johanson and Vahlne (1977) there is a series of incremental decisions toward internationalization which increase in complexity as entry progresses. As companies develop international experience, so will the size and the complexity of these operations. In Cavusgil's model the export/sales ratio reflects the operational involvement and companies' increasing dependence on foreign market exports. Awil and AbdulAziz (2002) suggest that the commitment to international activities increases with movement between each stage, as incremental success builds confidence and greater experience in management attitude towards costs, risks, and strategies, leading to more extensive export activity, and to greater internationalization. This stage model of Cavusgil (1980) can be used as a model for evaluation of the progress of New Zealand construction firms. Gankema et al. (2000) found that the time frame of around two years for the transition from one export stage to the next export stage. Reuber and Fischer (1997) stresses that firms with internationally experienced management teams can internationalize much faster than other firms. Culture plays a significant role in overseas activities and motivated by initial test markets to the countries sharing the same culture, language or regulating laws (Fisher and Ranasinghe, 2001).

The New Zealand construction industry is in early exploring stage, Statistic New Zealand, in 2016, reported that there is a small portion of the total construction GDP are overseas income. It is more common for large firms to generate overseas income than small businesses, but it is

recorded that no more than 6% of 56,000 construction firms have ever generated overseas income (Statistic New Zealand, 2016). The level of international engagement is positively associated with firm size. The Small Business Sector Report by Ministry of Business, Innovation and Employment New Zealand (MBIE, 2016) reported that small companies either do not have the capacity or are not interested in exporting services as the risk are high in the international market. New Zealand largest construction company (Fletcher Building) first reportedly ventured overseas in Samoa on 1946 and later expanded into Australia on 1949. The international expansion of Fletcher initially remained predominantly in the same market with a small amount of international revenue ratio from South Pacific but more recent movement has seen the business in newer markets, moving them in the experimental involvement stage. Another one of the largest New Zealand construction companies, (McConnell Dowell), expanded into Singapore initially then Asia, Middle East, and Italy.

5. THE REGION DISTRIBUTION OF AWARDED OVERSEAS PROJECTS

Figure 2 is shows the international projects of Non-residential Building and Heavy & Civil Engineering Construction companies in New Zealand from the year 2005-2016 of the 7 largest contractors in New Zealand.

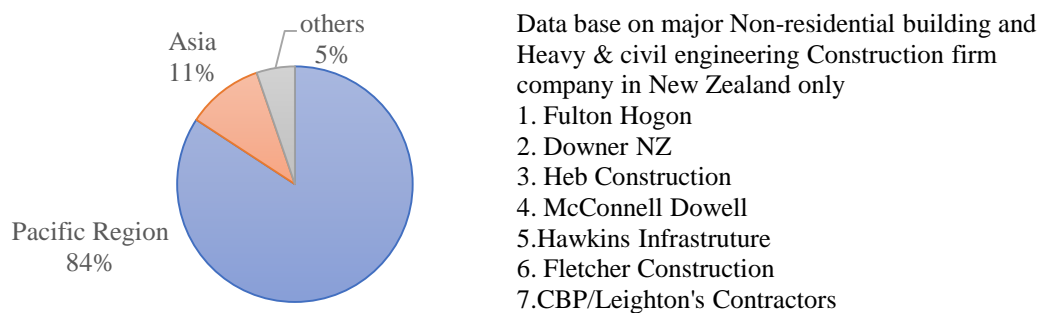


Figure 2: Percentage of total international projects by region, 2005-2016 (Source: authors own figures and analysis)

The majority of international projects developed and managed for the past ten years by NZ construction companies are in South Pacific Islands. This expansion is not unexpected as construction firms are mostly comfortable doing work in neighbouring countries, and there are many Pacifica communities in New Zealand. Investment in a nearby country is common for international construction companies because of familiarity and proximity to the home country, low political risk in the target market, and knowledge of host government regulations, location, cultural understanding and safety. For New Zealand companies, another reason is that most of the projects involve NZ government funding to support developing neighbouring countries and also means that the risk of payment is more secure and there is familiarity with contract standards. Ahmand and Kitchen (2008) pointed out that due to the international knowledge and experience deficits, firms internationalize to market that they most easily understand. The similarity in cultural and legal standard backgrounds in South Pacific Islands and the proximity encourages New Zealand companies to undertake business.

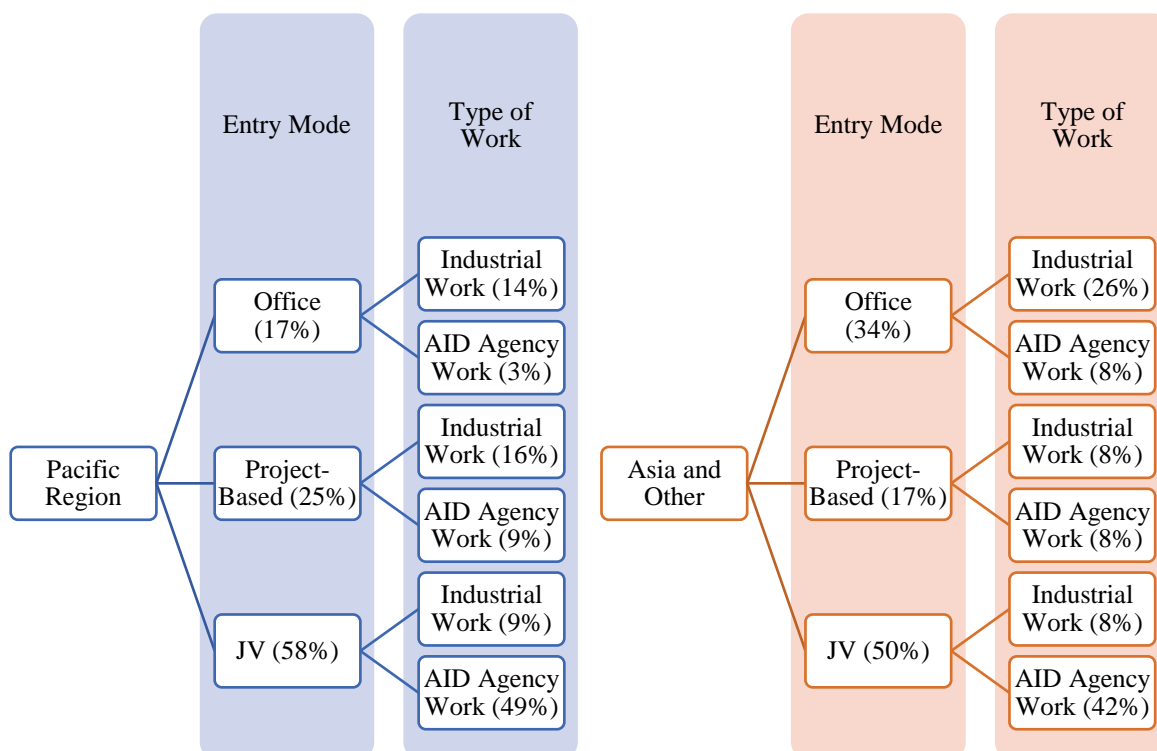
6. PROJECT TYPE

Projects have been classified into two types; Construction or Concession. Construction involves pre-construction and technical advisory, design, construction and project management. Concession (also known as Private Finance Initiative (PFI) or Built Operate Transfer (BOT)) takes the form of an invitation from a local government based on a company's reputation on specialty projects (Mustaffa et.al , 2012). The successful development of BOT/PFI type projects requires strong financial capability and creates more risk for companies.

Most NZ construction firms are keener on construction type projects, but even in concession projects they prefer to participant in scoping activities. New Zealand construction firms appear to have an estimated 1 in 16 projects as concession projects.

7. ENTRY MODE AND TYPE OF WORK AT POINT OF ENTRY

Construction could take the form of acquiring local firms or forging joint ventures with a host company for the purpose of carrying out specific projects in the international market. Crosthwaite (2000) explained that the most common approach to internationalizing operation is to create a joint venture or establish a wholly owned subsidiary. Construction firms can take positions on smaller contracts, or buy into local construction firms which enables them to familiarizing themselves with the major growth markets, securing local supply chains, understanding the local legislation and procurement policies of major clients.



*Office = Representative office, liaison office, branch office

Figure 3: Market Entries Composition for NZ companies (Analysis from sources including Stats NZ, Govt documents and company reports)

International joint ventures are an effective way of getting started in the international market. International joint ventures also have less risk involved and minimizing political and market risks (Root, 1998). Construction organizations have often used this entry strategy (Ahmad and Kicten, 2008). International joint ventures are also used by New Zealand companies as entry modes to new international markets. New Zealand construction firms often prefer to associate with host country local construction firm when undertaking work overseas. As the nature of construction works matures, New Zealand construction firms establish project base representative offices to operate overseas businesses and then local branch offices if there is sufficient local market demand.

Typical type of work at point of entry is industrial work (mostly privately financed projects) and AID agency work. AID agency work is project funded through New Zealand government loans or financial aid to developing countries, loans from the World Bank or Asian Development Bank, or obtained through New Zealand government bilateral trade agreements. The developing countries which are registered selected member countries under foreign funded projects (mainly with an AID agency) are attractive to foreign contractors as they tend to be more payment secure (Mustaffa et.al, 2012). Most of the New Zealand contractors' overseas entry pattern falls into AID agency work, as there are great opportunities to bid for projects in the selected developing member countries by New Zealand Government.

8. AWARDED OVERSEAS PROJECTS BY SCOPE

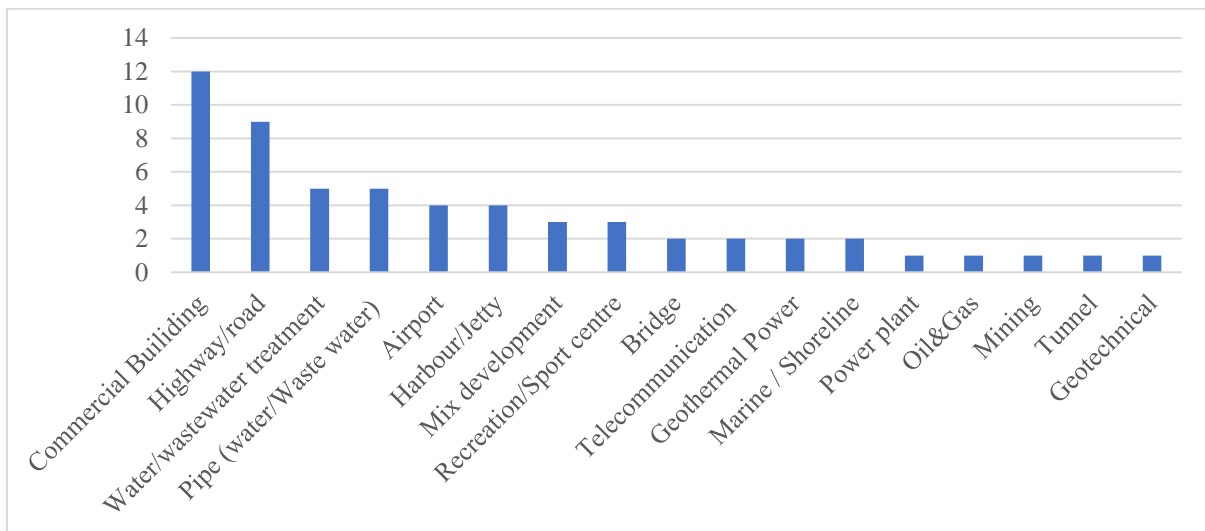


Figure 4: Total international project awarded to New Zealand construction firms by scope, 2005-2016 (Source: Authors from MBIE, Statistics NZ and Company Reports)

The main contracting activities of New Zealand construction firms involved in the international market are shown in Figure 4. Commercial building such as resort, hospital, school and other public buildings are recorded as the highest awarded projects according to scope. The second biggest contracting activities are the construction of highways followed by water/waste water treatment and pipelines. According to Strassman and Wells (1988), there are three distinct types of projects which are graduated by complexity and are the types of progression seen in the New Zealand international marketplace. These are projects which are small and simple; large but conventional, and technologically complex and sophisticated. In general, the majority of New Zealand construction firms have undertaken international work

related to civil engineering projects. Civil engineering projects are more suitable for international contracts, as the scope of the work is large and may need some financing by the foreign construction firms. Construction export in New Zealand remains concentrated in civil engineering projects, more precisely large but conventional projects, mainly because of access to markets and good track record. A contributing reason is the expertise of New Zealand construction firms in large but conventional civil engineering works gained from the same type of work undertaken in New Zealand.

9. STRATEGY

The choice of strategy is considered the most critical decision of international marketing because it determines how the company will position itself and be competitive. Mustaffa et. al.(2012) suggest that firms cannot afford poor decisions in assigning their limited resources to diminishing markets. The strategy to exploit the opportunities to international market expansion is crucial. The three major entry decisions 1) location - to decide which market to enter, 2) timing - to decide when to enter and 3) entry mode to decide how to enter international markets, are major factors in expansion into the international market (Mustaffa et.al., 2012; Isa et.al., 2011,2015; Preece et.al., 2016;).

10. INTERNAL CAPABILITIES OF NEW ZEALAND CONSTRUCTION TO COMPETE

The joint venture entry mode may enable firms to enter earlier, as it increases the firm's resource availability, lowering the risk and increase market power (Isa, 2011; Preece, 2016), but, without internal strengths in the firm, the entry strategy itself is not enough. The combination of strategy with both resource availability and capabilities increases the chance of success. For most international contracts, evaluation of a prefer contractor will integrate price and non-price attributes. New Zealand construction firms do not have a cost advantage as high salaries of New Zealand expertise and location has made New Zealand cost prohibitive. It is difficult to meet the competition in current markets especially when Chinese construction firms have the advantage in labor cost and resources. New Zealand construction firms have developed adaption and technical innovation strategies to enhance internal strengths. Other than pricing strategy, a company needs to strengthen its capabilities such as 1) project management; 2) financial strength; 3) specialist expertise as a competitive advantage in technological frontiers and niches; 4) international networks and connections; 5) track record; 6) capacity of equipment, material, labour support to commit resources (Gunhan and Arditi,2005).

11. TRACK RECORD

Gunhan and Arditi (2005) reported that the most important factor to have a competitive edge in international markets is the track record. Track record demonstrates that the firms have the capabilities in resources and technical knowledge through previous experiences to overcome challenges and issues occur. The track record of New Zealand construction firms in large and conventional projects play an important role in attracting future work. The firms transfer the knowledge and expertise they have built in New Zealand to support developing communities. This achievement is one of the main reasons why New Zealand construction firms are

performing well in South Pacific Islands, especially where there is high demand for core infrastructure services. The firm's track record can be improved with the expanding business into new countries which would help to establish new and more extensive networks.

*Table 1: Type of capabilities accumulative with track record from year 2010-2017
(source: Authors own from various documents)*

| Main Construction Capabilities | | Numbers of firms offering those Capabilities |
|---|------------------------------------|---|
| Transport Services | Road and bridges | 6 |
| | Rail | 2 |
| | Tunnel | 2 |
| | Airports | 4 |
| | Ports | 4 |
| Energy and Industrial Engineering | Oil and gas | 1 |
| | Industrial developments | 3 |
| Utilities | Power Plants/Dams/Renewable Energy | 2 |
| | Gas | 2 |
| | Water and wastewater | 5 |
| Mining | | 1 |
| Technology and communication services | | 2 |
| Parks and open spaces | | 6 |
| Mix Development | | 3 |
| Commercial Building / Government Building | | 3 |
| Earthquake Engineering | | 3 |

As outlined in Table 1, 6 out of the 7 selected firms have capabilities in construct road and bridge and 5 of them have specific competencies in developing and maintaining water and wastewater treatment. In addition to capabilities, firms gain a competitive advantage through their resources and reputation.

12. INTERNATIONAL BUSINESS NETWORKS

Networking is an accompanying factor to be competitive in international markets. A good international network could enhance reputation. Mustaffa et.al (2012) observed that teaming with foreign companies and developing long-term relationships with foreign companies are promising approaches to international business. Some local New Zealand construction firms had previously established international contacts which have facilitated international business. Spence (2003) showed the importance of an international network in reducing the effect of a lack of resources. Firms with well-developed business networks are less likely to be constrained by a lack of resources. Good international networks bring opportunity for alliances, enhance reputation and reduce risk.

13. KEY TECHNOLOGY BREAKTHROUGHS

Key technology and resources possessed by a construction firm are considered to give strategic advantage. The international market expansion for some of New Zealand construction firms come from sophisticated projects. For example, two international geothermal projects awarded to a New Zealand construction firm as the specialist knowledge

and skills that have developed on geothermal projects in New Zealand. According to Quak (1991), distinct knowledge incorporated in structures and equipment that is novel improves competitiveness. Gunhan and Arditi (2005) showed that smaller companies move into the international markets with the specialist technologies and becoming desired consortium partners. Ofori (2006) stated that the industry's products and operations has been influenced by information technology. For New Zealand, sophisticated use of advanced project management tools has helped project operation and management in new markets.

Table 2: Key niche technology and resources offered by NZ companies (source: Authors own from various documents)

| |
|---|
| Key technology and resources |
| Material/Baggage Handling & Airport System Technology |
| Traffic Engineering & Network Modelling |
| Waste/Water Treatment network and system control |
| Energy Generation and Conservation, Design Build and Operation |
| Environmental Sustainable Architecture and urban design including smart city system |
| Earthquake seismic advisory and construction |

New Zealand construction firms experience shows that having a special expertise can be one of the major strengths of a company that looks for opportunities in international markets. The service and technology offered by New Zealand construction companies are well established, especially in area of traffic, waste/water treatment and earthquake engineering.

14. KNOWLEDGE OF THE NEW ENVIRONMENT

New Zealand's multicultural background and migrant history has allowed New Zealand construction firms experience in dealing with people from different countries and working behaviours which are usually the norm in international construction projects. A legal understanding is necessary for international construction projects, particularly the operating laws, host country codes, labour laws, taxation laws, insurance policies, land laws and contractual differences. The amount of labour and equipment required from the local area will be influenced by the host country operating law, so it is crucial to understand the laws to allow estimating on cost, productivity, quality and availability of labour, equipment, and materials within the area. This is a concern for most New Zealand construction firms. Logistics is important to an international project. Companies need to know how they will ship and transport resources, mobilize at the site location, work with currency and banks, ensure safety and security and set up camps for workers.

15. GOVERNMENT SUPPORT

Government support appears influential in competitiveness in international construction. Ofori (2006) shows that support of governments contribute to international firms' competitiveness. To help construction industries to undertake international projects and export their services and generate economic growth, some initiatives have been implemented by several governments in Asia such as Japan, China, Malaysia, Singapore and South Korea. Developing export capability, tied or targeted aid, soft loans for contractors, market information and bidding data assistance, market development grants and tax concessions, and suppliers' credits and insurance support are all mechanisms used. Pooling of resources can

help in exploring more opportunities and reducing the risks. The Malaysia Construction Industry Development Board (CIDB) promotes local construction firms to export construction services and products. The Singapore Enterprise Promotion Department of the Building and Construction Authority (BCA) assists Singaporean based construction and construction-related firms to operate in international markets, providing them with relevant information and new skills, facilitating the preparation of feasibility studies, the formation of value-chain consortia, sourcing of funds, and liaising with host country agencies. The Overseas Construction Association of Japan, (OCAJI) provides support in the development of overseas activities by Japanese construction companies.

In New Zealand, New Zealand Trade and Enterprise (NZTE) provide general support to businesses that want to grow and succeed internationally including refining strategy, improving performance, building global networks and providing in-market support.

16. ENHANCE THE EFFICIENCY OF COMPETITIVENESS

New Zealand construction firms, have gained access to foreign countries using a combination of strategies and have been gradually extending their operations in international markets. The contributors to New Zealand construction firms' success are:

- formation of the joint venture, and alliance to create larger entities;
- international track record of large and conventional projects and early entry in sophisticated projects;
- client management and networking;
- modern project management techniques capabilities; and
- high degree of working within multicultural environments.

The research shows that New Zealand construction firms may have difficulties due to weak financial capacity to ensure solid cash flow, funding support for capital and bonding, and lack of experience in international projects other than South Pacific Region.

17. CONCLUSION

New Zealand construction companies are increasingly seeking international markets. Operation in international markets is different from the domestic market, as the level of risk is higher, and decisions are influenced by factors such as resource availability and internal capabilities. Alliances, joint ventures, and other forms of cooperation help the survival and growth of New Zealand construction firms and success of entering the international markets. The technology coalitions and subcontracting with advanced construction firms have allowed New Zealand construction firms to make inroads into the international markets. The study provides suggestions for future entry, survival and growth of New Zealand companies in international markets. Further work will develop a decision model to guide construction companies in aiding their internationalization strategy.

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MARKET SHARES DISTRIBUTION AND COMPETITIVENESS OF CONSTRUCTION FIRMS IN NIGERIA

I.B. John¹ and W.A. Isola²

¹*Department of Quantity Surveying, University of Lagos, Nigeria*

²*Department of Economics, University of Lagos, Nigeria*

Email: ijohn@unilag.edu.ng

Abstract: Firm level competitiveness results in market sharing. Dominant firms in a market own the largest market shares and maximize profit. Construction firms earn market shares from construction projects contract award. Construction firms' ability to earn market share indicates their level of competitiveness. The market share distribution of construction firms quoted on the Nigerian stock exchange was assessed. The objective of this study is to assess the market shares and competitiveness of Quoted Construction Firms (QCF's) in Nigeria. The population covered construction firms quoted on the Nigerian Stock Exchange. Convenience sampling technique was adopted for this study. Secondary data was collected from the published annual financial reports of construction companies quoted on the Nigerian Stock Exchange for a period of 1978 to 2013. This study showed that there is an uneven distribution of market shares among QCFs which results in low competitiveness levels of the construction sector. Few firms dominates over 80% of QCFs market shares across the period of the study. Market shares dominance leads to increased market power and predatory pricing among dominant construction firms. This explains the high construction prices among dominants construction firms in Nigeria despite measures put in place to reduce construction prices. The study recommends that a more even distribution of market shares among construction firms is required to enhance competitiveness.

Keywords: Competition, Market Power, Market Share, Nigeria, Quoted Construction Firms

1. INTRODUCTION

Poor economic growth in Africa has been attributed to weak policy formation and implementation. This situation has been sustained by the general lack of competitiveness and poor performance of firms in various industries. Government reforms and private sector intervention has not proven effective in revitalising the industrial sectors of the African economy. Nigerian is currently undergoing a period of recession despite its large population and vast investments across sectors. This indicates the need to understudy the dynamics of firm level competitiveness in individual sectors in order to ascertain the current economic state of each sectors.

KPMG (2014) conducted a global construction survey in 2013 and found that among 165 leading construction firms, almost half are planning to compete in the African construction market. Two out of five construction firms with turnover in excess of US\$5 billion are willing to do business in the African construction market (World Bank, 2012). The construction market for basic infrastructural investment and maintenance of infrastructure in Africa is over US\$ 100 billion per year. This huge construction market is the point of attraction for international construction firm's competition. Nigeria has been a point of attraction for international construction firms from the pre-colonial era. International competition within the Nigerian construction industry is also evident in the crop of firms awarded infrastructural projects in Nigeria. There is a need to investigate the structure of the

construction industry, which influences the allocation of market shares and competitiveness of the Nigerian construction industry.

Construction firm's ability to meet clients' demand and operate profitably in the face of intensified global competition and persistent economic dislocation in Nigeria determines firms competitiveness and economic performance. Competitiveness is construction firms' ability to be awarded and selected to design, engineer, construct, finance, deliver, operate, maintain and manage construction works effectively thereby making profit and gaining market shares above rival firms. The nature of construction market, as characterized by its structure underpins the competitiveness that exists in the construction industry. The level of competitiveness within the market plays a significant role, among other fundamentals, in the determination of market shares owned by construction firms in each market segment. The control of market shares arising from the contracts awarded to the largest construction firms indicates the intensity of competition in a market Leon (2014) consequently asserted that market structure studies examine the competitiveness of the firms in an industry. The size structure or market shares of firms in a market is dependents on the market structure in which such firms operate (Tafesse2007). The objective of this study is to investigate how market shares have been distributed among QFCs and its implications on the competitiveness of the Nigerian construction industry.

2. AN OVERVIEW OF THE NIGERIAN CONSTRUCTION INDUSTRY

Economic growth in Nigeria has been stagnated due to inadequate physical infrastructure (AfDB, 2012). Infrastructural development has been the focus of government across various regimes since independence. The Federal Government has been the main client of the construction industry in Nigeria for the construction of physical infrastructures. Various policy and reform agenda have focused on infrastructural development in Nigeria. Much is yet to be accomplished despite government's effort at infrastructural and economic development through the four major developmental policy agenda, plans programmes and projects since independence. The vision 20:2020, which was targeted at positioning Nigeria among the first 20 global economies by the year 2020 has not sufficiently addressed the infrastructural deficit particularly with the current recession in the Nigerian economy. The Federal government is the primary financier and initiator of infrastructural projects in Nigeria through budget allocations. A total of US\$ 350 billion at 2010 constant price will be required to develop the proposed infrastructure within a decade (2011-2020). The huge capital outlay required for funding and maintaining infrastructure in Nigeria is capable of sustaining a competitive construction sector. However, the competitiveness of the construction industry in Nigeria places a demand on the structure of construction industry

The economic performance of the Nigerian construction industry is evident in the competitiveness of all economic entities within the industry. The Nigerian construction industry has performed poorly in terms of its contribution to real Gross Domestic Product in Nigeria (CBN, 2008). The poor contribution of the construction industry to real GDP since independence point in the direction of Bain's (1951) assertion that industry structure variables are the key determinants of economic performance. Although Nigeria is largely an agricultural economy, the low contribution of the construction industry to real GDP is worrisome. The low contribution of the construction industry to GDP also shows that the construction industry is yet to realize its potentials despite the infrastructural deficit and the huge investment in the sector by various government administrations. The low contribution

of the Nigerian construction industry to GDP despite the huge financial investment in the sector requires scrutiny. In 2012, the building and construction industry contributed 2.19 percent of GDP while the agricultural sector retains its leading position with 39.21% contribution to GDP. With the situation worsening over the years, there is need for policy driven intervention to initiate and sustain real growth in the Nigerian construction industry. The physical infrastructures of any economy are products of the construction industry. These physical infrastructures foster economic growth. However, Momaya (1998) argues that in many countries, the construction Industry is neglected. A well-structured and functional construction sector is dependent on the market structure within which market players operate. Economies growth and development in any country is dependent on the economic, social, environmental and physical infrastructure built and sustained by the construction industry.

3. MARKET SHARE: AN OVERVIEW OF RESEARCH DIRECTION

Capitalist economics view markets as central institutions (Beckert, 2009). Market dynamics and interplay are fundamental to growth and development in an economy. Industrial economics paradigms address market structure predominantly. Classical and non-classical traditions characterize market research in industrial economics (IE). Industrial economics is a knowledge area that concerns itself with competition between firms in a market structure of industries, firms, plants, markets, regions in an economy. Industrial economics research focuses on how market structure drives competitiveness within an industry or market (Ma, Weng & Yu, 2015). Industrial economics further concerns itself with the behaviour of firms and markets in order to understand the departures from perfect competition (Einav & Levin, 2010). Firms' departures from perfect competition can be analysed from various viewpoints. These viewpoints include strategic behaviour, transaction costs, information friction and scale economies.

Industrial economics models give substance to traditional neoclassical abstract concept of market types. However, the theoretical base of IE was deepened as a result of criticisms, to the work of Bain (1951) which presented a deterministic structure - conduct - performance (SCP) approach to industrial analysis. Market share is an important indicator of market structure which is capable of influencing the conduct of firms with a market which in turn affects the performance of market players and the market in general. The structure conduct performance paradigm and the relative market power hypothesis are found in the market power paradigm. The relative market power hypothesis posits that only large firms with high market shares enjoy increased profit (Fiona, 2006). This priority placed by large firms in increasing market shares is explainable by the increased profitability of such firms over time. The relative market power hypothesis proposes that large market shares allows large firms to enjoy brand recognition and allows them to influence prices in any market. The benefits that accrue due to increased market share of firms shape the nature of competition within a market. It becomes pertinent to study the market share distribution of large firms within an industry in order to understand the nature of competition that exist and further guide policy interventions within such markets.

The efficiency-structure hypothesis (ESH) proposed by Demestz (1973) and Peltzman (1977) considers market shares dominance as a reflection of firms' efficiency. ESH which has been supported by various studies (Samad, 2008; Fu & Heffernan, 2009; Seelanatha, 2010) deviates from the market power hypothesis which alludes increased profit, brand recognition and predatory pricing to increase in market shares.. Abbasoglu, Ahmet and Gunes (2007)

state that the ESH stipulates that firms with superior efficiency improve their market shares and become more profitable. Scale-efficiency and the X- efficiency hypothesis are approaches within the ESH. The scale-efficiency hypothesis places more emphasis on the economies of scale. The scale-efficiency approach posits that large firms are able to increase profits due to lower unit cost resulting from economies of scale. The lower unit cost may result in higher market share. In contrast, the X-efficiency hypothesis posits that efficient firms are more profitable because of efficient production technology and efficient management (Fiona, 2006). Efficiency in management and production technology allows firms to increase their market shares

There is a dearth of knowledge on the market share distribution of construction firms in Nigeria. This is further deepened by the level of secrecy which shrouds construction firms activities. Studies on the market share distribution of large construction firms in Nigeria could provide some explanation on the increasing prices of construction product and the underperformance of the construction industry in Nigeria. The study could also highlight areas of policy direction necessary to enhancing a competitive construction industry in Nigeria.

4. RESEARCH METHOD

The population covered by the study included construction firms quoted on the Nigerian Stock Exchange. Convenience sampling technique was adopted for this study in order to isolate two quoted construction firms that were delisted within the time frame. Secondary data was collected from the published annual financial reports of construction companies quoted on the Nigerian Stock Exchange for a period of 1978 to 2013

This time frame avails this study of robust data useful for exploring the stability of market shares among QCFs. The time frame also covers various economic policies implemented in Nigeria. This also avails the study the opportunity to assess QCFs gains and loss of market shares across various economic policies. This further provides insights into the impact of such policies on construction firms competitiveness.

Market structure studies can focus on structural or non-structural features of a market. The structural dimensions of a market includes market shares, market concentration, and collusion. However, non-structural features of a market includes entry barriers, product differentiation, advertisement, technology as well as research and development. This study focused on the structural features of QCFs market only. The percentages of QCF market shares were investigated.

4. DISCUSSION OF FINDINGS

4.1. Market Share Distribution of QCF's

The Market share of Arbico Plc. was low throughout the study period. The highest market share attained by Arbico Plc. being less than 4%. The market share of Arbico Plc. was very low from 1978 to 1986 which covered the period of the third national development plan and the fourth national development plan. The period of implementation of the Structural Adjustment Programme (SAP), which was an offshoot of the fourth national development plan. However, the period of the SAP saw slight improvement in Arbico Plc's market shares

from 1992 to 1995. The improvement however began to decline in 1996. The performance of Arbico Plc. in gaining market shares was poor throughout the period considered in the study and thus presents threat to the survival of the firm in the Nigerian construction industry.

Cappa and D'alberto Plc's market share distribution shows some similarities and differences with the market share distribution of Arbico Plc. The trend line for Cappa & D'Albeto Plc. presents a slow growth pattern for market shares. The market share distribution of Cappa and D'alberto Plc. from 1978 to 1986 has been low. However, a significant improvement is noticeable in 1986 which also coincides with the period of the fourth national development plan and introduction of the SAP. Reduction in market shares was however, experienced by Cappa and D'alberto Plc. from 1988 to 1991. This period preceded a short period of increase in market shares for Cappa and D'alberto Plc. There has been a decline in growth of market shares from 2005 to 2013.

In sharp contrast with Arbico Plc. and Cappa and D'albeto Plc, Costain (West Africa) gained market share of over 80% from 1978 to 1986. However, the trend line shows a steady decline in market share from the period of 1986 to 2013. The loss in market share by Costain (West Africa) can explain the gains in market share by the other QCFs during the period of the fourth national development plan and beyond.

G. Cappa Plc. showed a decline in market share ownership from 1976 to 1986. Increase in G. Cappa Plc. market share, which spanned from 1987 to 2004 was followed by a sharp drop in market share in 2005. The period of SAP also presented G. Cappa Plc. a period of increasing market shares as enjoyed by some QCFs. The market share of G. Cappa Plc. has been low and continued to decline throughout the period of the study.

Market share distribution of Julius Berger Nigeria Plc. has been on the rise 1986 to 2013. Although, the period covering the third and fourth national development plan also presents Julius Berger Nigeria Plc. with little market share, the period of implementation of SAP showed an increase in market share by the firm. Julius Berger Nigeria Plc. Preceded by a sharp increase in market shares in 1986, Julius Berger Nig. Plc. Julius Berger Nig. Plc. owns an average of 80% of the QCFs market share starting from 1986 to 2013. The trend line also shows steady increase in Julius Berger Nig. Plc. market shares throughout the period of the study. This presents the possibility of firm survival and business growth in the QCF market.

Roads Nigeria Plc, market share distribution is presented on Figure 1. Low market shares was experienced up until 1986 when the firm began to gain market shares. Market share of Roads Nig. Plc. throughout the study period was less than 10 percent. Roads Nigerian Plc. has never been a market leader throughout the study period. This low market share poses a threat to the survival of Roads Nigeria Plc.

The trend of market share distribution for Dumez Nigeria Plc. showed a decline in market share ownership as presented in Figure 1. Dumez Nigeria Plc. appeared to be one of the QCF market leader from 1978 to 1984. This period covered the second and third national development plans which preceded the Nigerian civil war and these development plans were geared at rebuilding the destroyed infrastructure of Nigeria. Dumez Nig. Plc. maximised the period of the second and third national development plans in gaining market shares. However, beyond the period of the fourth national development plan, Dumez Nigeria Plc. declined in market share ownership and consequently, lost its market leadership position.

The market share distribution shown in Figure 1 shows a comparative presentation of the market share distribution among QCFs in the study. A shift in the market share dominance of construction firms in favour of a single firm which retains the largest market share among QCFs is visible. Dumez Nig. Plc. led QCFs with a market share of 51.58% and 58.29% from 1978 to 1979. However, Costain W.A. clearly dominated the construction industry in 1980, 1985 and 1986 with market share of 84.77%, 87.16% and 83.99% respectively.

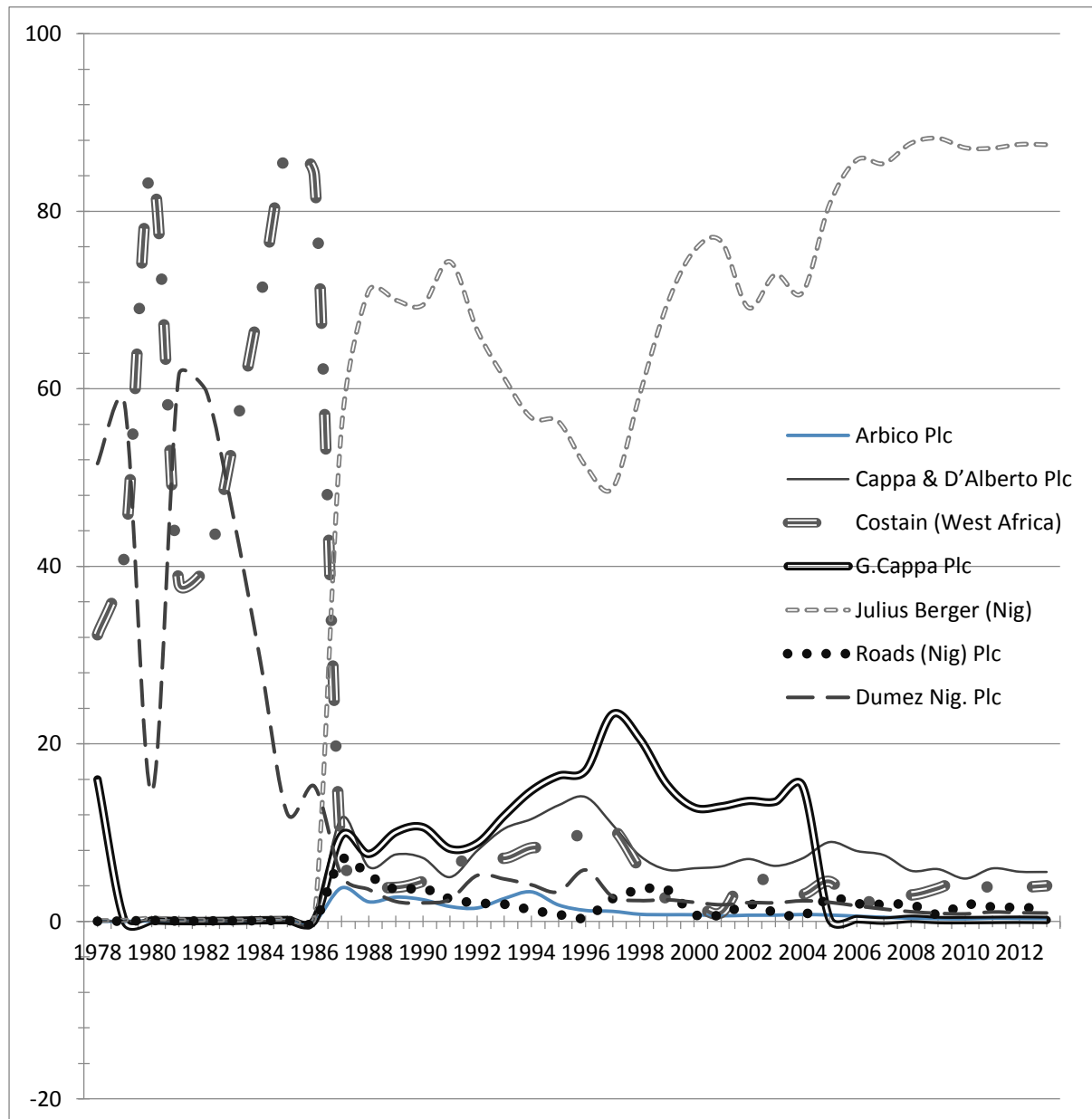


Figure 1: Market shares distribution of QCFs in Nigeria from 1978-2013

Julius Berger Plc. assumed dominance of QCFs in 1987 with a market share of 55.64% and sustained this dominance throughout the study period. However, between 2005 and 2013, Julius Berger Plc. dominates QCFs with over 80% market share. Throughout the study period (1978-2013), it is observed that there is high inequality in market share distribution among the firms. This suggests a relatively low degree of competition.

The size distribution of firms is an important determinant of competition in a market (Beck, Scott & Yelowitz, 2010). However, limited evidence exist on the size distribution of construction firms in Nigeria. This study therefore assessed the market share as a measure of the size distribution of quoted construction firms in Nigeria. Market shares indicate the strength of individual firms within a market. The market share of QCFs from 1978 to 1986 was dominated by two leading construction firms. During this period, the political climate was volatile and characterized by political instability and military rule. The Nigerian Enterprises Promotion decree of 1972 and 1977 aimed at reducing foreign participation in the economy and high repatriation of profit did not appear to influence the market shares distribution of QCFs. The participation of more QCFs or the redistribution of market shares among QCFs was not evident from 1978 – 1986. These two dominant firms jointly held over 83% market share in 1978. Dumez Nig. Plc. which held over 51% of market shares was incorporated on 5th May 1958 while Costain West Africa which held over 32% market shares was incorporated on 16th July 1948. The market share held by house building firms in Britain from 1978 to 1980 presents a sharp contrast with QCFs in Nigeria within that period. Ball (1983) found that 47% of market share were held by 89 large (producing over 250 buildings per annum) house building firms in Britain in 1978.

In 1979, the two dominant QCFs jointly held over 99% market share among QCFs. In 1980, there was a sharp decline in the market shares held by Dumez Nig Plc. to 14% while Costain West Africa held market shares of over 84%. Both firms held over 90% market shares of QCFs till 1986. The market share dominance of these two firms was a reflection of the deteriorating state of the Nigerian economy at that time. The period saw GDP growth rate turn negative and a decline in capacity utilization across sectors of the Nigerian economy.

Bee (2009) opined that average rate of return for business with over 40% market shares is more than double for firms with less than 10% market share. This assertion holds true for QCFs between 1978 and 1986. The dominant firms maintained their market shares while other QCFs were barely surviving. However, a turnaround became evident in 1987 with significant increase in the market shares of all QCFs. except the previous market leaders who experienced a sharp decline in market leadership. This was a year after the government adopted the Structural Adjustment Program (SAP) to re-establish some control over the economy and create a business-enabling atmosphere for economic growth and development. SAP which was in effect until 1990 helped to reverse GDPs' negative growth rate and provided a stable investment climate amidst high inflation rates. Market shares of QCFs during the period of the implementation of SAP were considerably higher than the pre-SAP era. However, Julius Berger (Nig.) assumed market share dominance of QCFs from 1987 to date with an average market share of over 75%.

The market share distribution of the top three leading firms with dominant market shares from 2009 to 2010 was a subject of enquiry for Stefan and Coca (2011). The study showed increases and decreases in market share distribution within the period of the study. The market shares distribution of QCFs in Nigeria has shown increases and decreases within firms but there is clear market share dominance by a single QCF. The uneven distribution of market shares among QCFs shows a low competitiveness in the construction sector. This is further influenced by the market share dominance of either one or two firms throughout the study period.

In the construction industry of Australia (de Valence, 2003), Hong Kong (Chiang et al 2001) and Japan (Woddall 1996), over 70% of the industry turnover was accounted for by the

largest construction firms. FTC/DOJ (2007) reports that over 50% of the northeastern Ohio real estate market was controlled by two firms, while one firm controlled over 50% of the Des Moines real estate market. This is similar with the Nigerian construction industry where two firms held market dominance but thereafter one firm enjoys market dominance. Also the FTC/DOJ (2007) report also showed that a single firm controlled over 75% of the Lincoln NE real estate market. Similarly, studies show that few construction companies (Ibrahim, Githae & Stephen, 2014; Chukwudi & Tobeckukwu, 2014; Aniekwu & Audu, 2010; Olatunji, 2010; Ogbemor, 2002) control over 90% of market share in the Nigerian construction industry. This study also agrees that a single firm dominates over 80% of QCFs market shares. This leads to increased market power of the dominant firm. Increased market power results in predatory pricing for dominant construction firms. This explains the high construction prices among dominants despite measures put in place to reduce c High performance enjoyed by QCFs with high market shares is sustained because such construction firm have opportunity to increase their capacity, purchase modern plants and equipment. This capacity building is required for construction firms to work at different or multiple sites (projects) simultaneously without delaying one project for another. However, the insignificant effect of this result indicate that other factors such as contracts from government, jumbo returns, unhealthy rivalry, collusion and other uncompetitive behaviour characterise the construction industry.

5. CONCLUSION AND RECOMMENDATION

The market shares acquired by construction firms are highly unequal throughout the study eriod. The study period showed uneven and slow growth pattern in market shares among most QFCs. The dominance of market shares by few firms among QCF leads to low competitiveness. It is crucial to provide government intervention in the supply side of the construction industry by way of policy to align the distribution of market shares more effectively among construction firms along desired paths particularly to enhance competitiveness. The mode of acquiring market shares (contract award) in the construction industry is different from the mode of acquiring market shares in other sectors (product sales), this peculiarity can be advantageous to the construction industry. Effective monitoring and regulation of contract awards system particularly for public projects, which the construction industry currently lacks, can help distribute market shares among construction firms more evenly.

Construction firms ability to earn market share shows their level of competitiveness. This study recommends that market shares should be more evenly distributed among QCFs. This is possible among QCFs because government investment in the construction industry in Nigeria remains the highest. Constant monitoring of market shares distribution among QCFs through contract award monitoring must be carried out to provide the possibility of distributing market shares more evenly among construction firms and fostering a highly competitive construction industry. Government can also encourage construction firms increased participation in the industry through its policies.

Market shares is not evenly distributed among quoted construction firms in Nigeria. The uneven distribution of market shares can result in a near monopoly structure capable of sustaining predatory pricing and low competitiveness in the construction industry. There is need for government as the single largest client of the construction industry in Nigerian to facilitate a more rational and even distribution of market shares in the construction industry.

Contract award which is a tool for the distribution of market shares in the construction industry can be better structured to enhance the competitiveness of the construction industry.

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A RESEARCH FRAMEWORK FOR EFFECTIVE RISK MANAGEMENT IN PUBLIC-PRIVATE PARTNERSHIP (PPP) INFRASTRUCTURE PROJECTS IN PAKISTAN

K.M. Mazher¹, A.P.C. Chan¹, H. Zahoor²

¹ *Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, 999077, Hong Kong*

² *Construction Engineering and Management Department, National University of Sciences and Technology, Risalpur Campus, 24080, Pakistan*

Email: mateen.mazher@connect.polyu.hk

Abstract Public-private partnerships (PPPs) are being heralded as a potentially promising alternative to overcome the chronic inefficiencies which characterize the traditional public infrastructure delivery and shortage of development budgets to meet increasing demands for public services. However, such arrangements present their own set of challenges which are primarily attributable to the complex organizational structures and long duration of underlying contractual relationships. In particular, the need for effective risk management becomes all the more important to ensure a successful project and a lapse in this domain is known to deliver disastrous outcomes. Pakistan, a developing country with a large population, abundant natural resources and geopolitical significance, boasts all the drivers to promote and benefit from PPPs. It also harbors elements that expose the stakeholders to significant risks. Therefore, a research framework is developed to identify critical risks, determine risk allocation practices, develop robust models for efficient project risk assessment and allocation, and determine measures to ensure efficient risk management on future PPP projects. Existing literature is reviewed and summarized to determine the significance, drivers, barriers, and risk management characteristics of infrastructure PPPs in the Pakistani context. In addition, results of the preliminary interviews with experts have uncovered multiple lifecycle risks and suggest immature and unsystematic risk management practices, which subsequently inform the development of the research framework.

Keywords: Effective Risk Management, Pakistan, Public-Private Partnerships, Risk Allocation, Risk Assessment.

1. INTRODUCTION

Economic activity and growth of a country and delivery of essential services for domestic and industrial purposes is dependent on investment in economic and social infrastructure (Martini and Lee, 1996; East Asia Analytical Unit, 1998). Traditionally, the provision of infrastructure has been seen as an exclusive responsibility of the government (Grimsey and Lewis, 2007). However, multiple issues have forced the key stakeholders to consider an alternative which relies on an increased participation of the private sector by partnering with the public authorities. The characteristic poor performance of project delivery using traditional procurement strategies, which is marked by time and cost overruns and/or poor quality, and the fiscal constraints of governments constitute some of the key drivers leading to this change (Ahsan and Gunawan, 2010; Beckett et al., 2009; Raisbeck, Duffield and Xu, 2010; Allen & Overy, 2010). Given the existing evidence of better performance of projects delivered through PPPs as opposed to traditional procurement strategies, there is also ample debate against PPPs for not being able to deliver Value for Money (VfM) and that the arrangements prove expensive to taxpayers by providing excessive profits to the private companies (Shaoul, Stafford and Stapleton, 2006; Hodge and Greve, 2007). Moreover, both the public

and private sectors are exposed to additional risks due to the complexity of financing arrangements and uncertainty inherent in the long concession period (Dey and Ogunlana, 2004; Zhang, 2005). Therefore, effective risk management is the key to project success since risks have a direct bearing on the project objectives (Baloi and Price, 2003). A major difference between the traditional and PPP based project delivery methods lies in the way risks are apportioned to each party (FHWA, 2013). Furthermore, the context is very important. Risks and their management are influenced by country, sector, project specific features (Ameyaw and Chan, 2013; Carbonara et al., 2015), and the capabilities of the parties handling such projects (Ng and Loosemore, 2007), in addition to other factors. Zhang (2005) contended that owing to the lack of PPP experience and expertise in many countries and regions, systematic risk identification and management are essential to the success of PPPs.

In terms of gross domestic product (GDP), Pakistan is the second largest economy in South Asia (World Bank, 2015), and ranks 6th as the most populous country in the world, with a total population of 188.924 million as of, 2015 (World Bank, 2016b). The infrastructure situation in Pakistan is relatively poor as it ranks 117 in overall infrastructure out of 140 countries (Schwab, 2015). Poor governance and lack of resources characterize the challenges being faced by Pakistan; thus resulting in a shortage of energy, road networks, passenger and freight train services, mass rapid transit in urban areas, efforts to improve irrigation efficiency, safe water, basic sanitation services (ADB, 2015a), and oil and gas transportation networks (Mubin and Ghaffar, 2008). Pakistan requires investment at a rate of 10% of the GDP to meet infrastructure needs, as opposed to the existing six percent (average), according to the State Bank of Pakistan (Bhatti, 2015), which cannot be met entirely by public resources. PPPs have been suggested as a suitable strategy to partly fill the void between Pakistan's infrastructure needs and available fiscal resources (ADB, 2015b; GoP, 2010). In addition, poor performance of projects delivered through traditional methods of procurement serve as another important driver to promote PPPs (ADB, 2015b; Noor, 2011; Shaukat, Choudhry and Gabriel, 2011). The concept of PPPs is not new to Pakistan since a number of power projects have been developed using private investment (ADB, 2015b), however, the implementation of PPPs in other sectors is lagging such as transportation and water infrastructure sector (Economist Intelligence Unit, 2015). Furthermore, PPP projects in Pakistan are exposed to a myriad of risks that need to be studied systematically. Equally important is the need to explore the current practices towards allocation of specific risks in different sectors and the efficiency and efficacy of such practices. The existing literature has highlighted inadequate risk management efforts on PPP projects, world over, that have led to failures or sub-optimal results, and therefore, there is a need to identify measures to promote effective risk management on PPP infrastructure projects. Such studies will be instrumental in informing future policy design and development of frameworks to assist in decision making and in complementing efforts to ensure successful PPP projects. This paper presents a research framework to study risks and their management in the Pakistani infrastructure (*economic*) PPPs context, and to develop models to assist the key stakeholders in ensuring effective risk management efforts on such projects. A review based on published literature is also presented that attempts to summarize current knowledge on barriers, drivers, risks specific to PPP projects, and the risk management characteristics of the local industry. The results of the semi-structured interviews, conducted with relevant stakeholders from public and private sector, are also included to develop and support the research objectives and to establish the significance of research in the Pakistani context.

2. PPPS IN PAKISTAN - IMPLEMENTATION STATUS

In recognition of the severe infrastructure shortage and its effect in hampering economic growth, the Ministry of Finance established Infrastructure Project Development Facility (IPDF) in 2006 and mandated it to develop PPP policy and oversee its implementation. The revised PPP policy of 2010 provides support for all infrastructure sectors, at the federal and provincial level (Economist Intelligence Unit, 2015). Recently, the government passed the Public Private Partnership Authority Bill 2016, that aims to provide the necessary regulatory and enabling environment for promoting PPPs (The Nation, 2017). With the support and assistance of Asian Development Bank (ADB), the provincial governments of Punjab and Sindh are developing legal and institutional capacity in order to procure infrastructure projects using the PPP modality (ADB, 2015b). Several projects have been executed at the federal and provincial level with the power and transport infrastructure sector being the most active. A huge bulk of investment under the China Pakistan Economic Corridor (CPEC) program is envisaged for the development of energy infrastructure projects (Malik, 2015), where all the energy projects will be implemented under the Independent Power Producer (IPP) mode (Ministry of Planning, Development, and Reform, 2016), that may be based on the Build-Own-Operate (BOO) / Build-Own-Operate-Transfer (BOOT) models, similar to the previously delivered IPP projects. According to The News, some of the projects under CPEC will be financed through the Public Sector Development Program (PSDP) of the government of Pakistan (GoP) using public funds. Realizing the fiscal constraints, the GoP has instituted the Pakistan Development Fund Limited (PDFL) to finance the multi-billion dollar projects on PPP pattern. The company is intended to provide complementary long-term project finance to encourage private sector participation (Haider, 2016). Amid increased attractiveness of Pakistan to foreign investment, as evident from interest of UK, France, Germany, Japan, (APP, 2016; Rana, 2015; The News, 2017; Hussain, 2017; Mirza, 2017), and other countries to partner in CPEC related/infrastructure projects, and the available opportunities, there may be more projects in future that are funded internationally and executed through the PPP mode. As of now, a relatively large number of projects are operational in the power sector, followed by some projects in transport infrastructure sector.

2.1 Power Infrastructure Development Using PPPs

Pakistan initiated work on private investment in power infrastructure development with the assistance of the World Bank in 1987 and established the initial framework of incentives by 1988. The efforts materialized in to success with Hub power project (Hubco), the first private power project in Pakistan, reaching financial close in 1995. It was also a huge undertaking in terms of the sheer size of the project which can generate 1292 MW of electricity and costed USD 1.6 billion at that time. Since it was the first private deal in the power sector and the country, the project faced multiple issues in the political domain. The efforts also led to the development of the first power policy of 1994 (Fraser, 2005). Many projects have been procured since then under various versions of the policy. A total of 59 power generation projects, based on various technologies including Diesel, Waste, Natural Gas, Hydro, Geothermal, Solar, Nuclear, Wind, and Coal are active, as per *Private Participation in Infrastructure Database* (World Bank, 2016a). Many more projects are under development in the renewable and nonrenewable energy sectors.

2.2 Transport infrastructure development using PPPs

Procurement of projects through private investment in the transport infrastructure sector started late. There was one PPP project in, 2010 (Economist Intelligence Unit, 2015). A total of ten projects are currently under construction or in operation phase including the Hyderabad-Mirpurkhas dual carriageway, Sir Agha Khan Jhirk Mulla Katiyar bridge (over river Indus), Karachi-Thatta dual carriageway, Karachi-Hyderabad motorway (M9), Kahna Kachha flyover (Lahore), Lahore ring road (southern loop), Lahore-Sheikhupura-Faisalabad expressway, Lahore-Islamabad Motorway (M2) (Rehabilitation and Modernization), Habibabad flyover (GT Road, Pattoki), and Lakpass tunnel (Mastung) with two projects being procured using the Design-Build-Finance-Operate-Transfer (DBFOT) modality and rest based on BOT modality. The World Bank's PPI database lists only one airport (BOO) and 13 port sector projects that were procured under various modalities of PPP including Rehabilitate-Operate-Transfer (ROT), Build-Rehabilitate-Operate-Transfer (BROT), and BOT. At present, several other projects at federal and provincial level are under the development phase.

3. ISSUES HIGHLIGHTED IN LITERATURE

According to Khan, Jamil and Sattar (2008), in the past, Pakistan had not been successful in exploiting the full potential of BOT form of project procurement as witnessed by very low interest of multinational firms and ventures, operating in Pakistan, to support the proposals initiated by the government. Poor sovereign credit rating (SCR), peculiar to developing countries, leads to difficulty in arranging debt financing for PPP projects (Chowdhury and Charoenngam, 2009) and therefore, securing long-term debt financing in Pakistan is difficult/problematic (Mubin and Ghaffar, 2008, ADB, 2015b). The government has to provide sovereign guarantees to attract private investment. Noor, Khalfan and Maqsood (2012) identified multiple barriers to non-traditional methods (BOT/BOOT/BOO) of procurement in Pakistan which include a lack of understanding of methods, resistance to change, issues related to project revenues, impact of environmental factors, and long gestation period of PPP projects. Financial, economic and security situation of Pakistan is believed to have increased the overall cost of doing business. Poor security situation of Pakistan was reported as the most important impediment to project procurement and implementation in the country. These issues in conjunction with risk of political instability and immaturity of public sector organizations and institutions lead to a lack of investor interest, both domestic and foreign. Significant delays in project initiation due to financial issues have also been reported (Noor, 2011). Other barriers include loopholes in the dispute resolution framework. An outdated Pakistan's Arbitration Act (1940) is in force; the Regulation and Enforcement Act (2011) ensures enforcement of international arbitral awards does not apply to local courts (Economist Intelligence Unit, 2015). A recent review by ADB, of the PPP frameworks in Punjab and Sindh provinces of Pakistan revealed three major barriers, which include 'weak PPP capacity in the government'; 'lack of alignment between various provincial PPP policy, legislative documents, and sector specific regulations (if available)'; and 'lack of off-budget viability gap funding' (ADB, 2015b).

PPP Projects in Pakistan face political, financial, legal and regulatory, and project specific risks (Soomro and Zhang, 2011; Tillmann, Robert and Shouqing, 2007; Economist Intelligence Unit, 2015; Fraser, 2005). Moreover, Pakistan's construction industry lacks risk management maturity (includes all the main stakeholders i.e., clients, consultants and

contractors) (Choudhry and Iqbal, 2012). Public sector organizations tasked with project procurement responsibilities don't have a systematic risk management framework in place and exhibit variation in risk management practices across federal and provincial boundaries (Noor, 2011; Economist Intelligence Unit, 2015; PDD, 2011). According to a study commissioned by the World Bank, optimal allocation of risks, including those that are retained by the government, '*is not well understood and likely to be underestimated*' (World Bank, 2010).

In addition, a review of risk management research in the international PPPs risk management domain emphasizes the need to study measures of effective risk management to determine what influences the quality and success of risk management on PPP projects. Many failed PPP projects have been reported to have suffered the ill fate due to inadequate risk management efforts that occur as a result of low quality feasibility studies, poor contract management, lack of experience and skills of the project company, inflexible contracts, and lack of risk management maturity of project stakeholders, to name a few (Asian Business, 1996; European Commission, 2004; Ke, Wang and Chan, 2009; Lee and Schaufelberger, 2013; Loosemore and Cheung, 2015). Katrin et al. (2010) argued that there is a sheer lack of attention towards the *managerial aspect* of risk management, specific to PPP projects. As inefficiencies may be introduced due to a number of factors, there is a need to identify significant measures that can potentially improve the risk management process outcomes i.e., positively influence risk identification, analysis (qualitative/quantitative), response planning, and control.

Risk identification, analysis, and response planning form the core processes of the risk management activity. Adequate risk analysis and equitable risk allocation on PPP projects are essential for implementing and delivering successful projects (Chan et al., 2011). A number of models exist to assess project risks (Zayed and Chang, 2002; Xu et al., 2010; Ke et al., 2011), however, these models suffer from limitations that impact the accuracy of project risk assessment. A notable limitation lies in treating project risk events/factors as independent of each other, which can introduce errors in project risk assessment and subsequent decision making by relevant stakeholders. Furthermore, the subjectivity inherent in human judgements introduce uncertainty in risk evaluations and hence it must be catered for appropriately. Project risk allocation between the public and private sector, termed as the most critical exercise to ensure project success, is often done inefficiently by disregarding the necessity of allocating risks based on the risk management capability paradigm (Arndt, 2000). Existing models to assist fair risk allocation decisions (Ameyaw and Chan, 2016; Khazaeni, Khanzadi and Afshar, 2012; Lam et al., 2007) accommodate human subjectivity and treat the risk allocation exercise as a multi-attribute decision making (MADM) problem. However, these models are either difficult to understand and apply or limited in application by prescribing allocation of risks either generally or specific to a sector and do not provide a project specific insight.

4. EXPLORATORY INTERVIEWS

In order to develop the objectives of the research and to provide a firm grounding in the context of Pakistan, eight semi-structured interviews were conducted with key public (five) and private sector (three) stakeholders in the Pakistani PPP infrastructure projects industry. Questions asked included inquiries in to the risks impacting projects in each sector (power/transport) over their lifecycle, an exploration of how the respective organizations

were practicing risk allocation on various projects, and issues relevant to the adequacy of risk management efforts on PPP infrastructure projects. It was considered sufficient to limit the interviews to eight PPP experts due to their senior positions and representation of the apex public sector PPP infrastructure project procurement organizations in Pakistan, in both Power and Transport infrastructure sectors. Furthermore, the respondents from the private sector represent private firms that are involved in multiple PPP projects in Pakistan in various states/provinces, thus harboring a broad-spectrum view of peculiarities of operating in Pakistan. Based on the interviews of public and private sector stakeholders, problematic factors were determined through content analysis and classified into ten categories (Table 1). The risks identified are diverse and impact the PPP project across all the phases of the project life-cycle, which according to Liu et al. (2014), includes initiation and planning, procurement, and partnership (construction, operation and maintenance) phase. Several studies geared at identifying and assessing risks on PPP projects have been conducted previously, either focusing on a specific infrastructure sector such as water, transport, or power, or generally identifying risks across multiple sectors. The risk registers employed in these studies share many common risk factors which lie in regulatory, political, financial, partnership, market, technical, and operational domains (Thomas, Kalidindi and Ananthanarayanan, 2003; Wibowo and Mohamed, 2010; Hwang, Zhao and Gay, 2013; Chan, et al., 2014). Thomas, Kalidindi and Ananthanarayanan (2003) contended that risk assessment is based on risk perceptions of individuals with regards to a risk exposure, and that these perceptions are influenced by factors such as profit aspirations or investment in each project, experience, risk communication, and geographical factors. These perceptions not only determine the criticality of risks but may also influence how these risks will be allocated. The difference of risk perception due to the contextual (sector/country) factors is apparent from the review of top ranking/critical risk factors, which vary across the studies mentioned above. Among the risk factors identified from the interviews, political violence, country geopolitical situation, and issues related to capacity and capability of institutions/organizations stand out from other factors in the context of Pakistan, due to the reasons discussed in the literature review. However, the criticality of the various risk factors needs to be further established based on the broader concerns and perspective of all the key stakeholders in Pakistan.

For both the power and transport sectors, interviewees (which represent federal government organizations/authorities) contended that standard contract documents have been prepared that pre-define the risk allocation regime between the public and private sectors. Negotiations that may potentially alter this pre-defined structure of risk allocation are undesirable. This practice ignores the fact that risk profile of project participants varies according to their resources and capabilities (Ng and Loosemore, 2007), and hence a standard risk allocation may not be suitable. Quiggin (2005) argued that standard form of PPP contracts rarely provides prospects of optimum risk allocation in projects. For the transport sector, there is an indication of diverse practices (at federal and provincial level) concerning risk allocation, as evident from the literature, where the provinces seem to allow risk allocation negotiations on a project basis (Economist Intelligence Unit, 2015; PDD, 2011). Which of these practices serve the best interest of the public and private sectors, in the local context, is a question that needs further investigation.

With regards to the factors that significantly influence risk management performance on PPP projects, institutional capacity/maturity (public/private sector) was highlighted as a point of major concern, the lack of which was considered as a significant cause of problems at the pre-financial close stage for projects. One of the interviewees held the opinion that the projects

which bring foreign investment have seen good risk management efforts, principally attributable to foreign experience and expertise of the lenders. Local lenders were also maturing over time, however, the local lenders may be forced to act outside principles, at times, under political influence. The interviewees also held that public sector lacked understanding of risks and exhibited weak contract administration skills in privately financed power projects. Another point

Table 1: Risk factors reported by interviewees

| Risk category | Risk factors |
|-----------------------|--|
| Political | Political risk (Political violence, geopolitical situation, country political stability), corruption, government intervention/interference, price change |
| Legal | Small gaps in legal and regulatory framework |
| Natural | Hydrological risks (hydropower projects), geological risks, flood risk, force majeure, environmental risk (loss of or damage to biodiversity/environment) |
| Social | Public opposition (opposition against high tolls) |
| Development | Development risk (late changes in government project procurement requirements/policies resulting in loss of project development costs), significant delays in financial closure, lack of competition, lack of international participation in bidding, land acquisition, resource assessment (wind/solar resource assessment data) |
| Construction | Technology risk, poor quality (construction), construction equipment risk (breakdown, repair and maintenance), project changes |
| Operation | Operations and maintenance risk, availability/performance risk, power evacuation risks (lack of transmission infrastructure), input/resource risk (supply/cost) |
| Economic | Poor local economy, poor global economy (escape or lack of interest of western investors), inflation, foreign exchange (availability and volatility), financing risk (local investors' credibility/difficulty in attracting foreign investment) |
| Market | Demand risk, competition risk |
| Capacity / Capability | Institutional capacity issues (lack of skilled manpower), turnover of public sector officials (loss of corporate knowledge), high internal resistance to PPPs (within public authorities – lack of ownership / understanding), coordination issues between government departments, long and protracted public decision making process, delays in obtaining permit/licenses |

raised by an interviewee was that sponsor characteristics such as foreign/local, experience, risk attitude, capacity to absorb risks, etc., also matter when it comes to risk management on projects. Proper planning and joint risk management were recommended to be effective in solving issues on projects. For the transport/highway sector, the interviewees expressed dissatisfaction with the pre-tender risk management efforts on projects, on behalf of the public authority. It was argued that the government was particularly weak in understanding risks and in exerting appropriate contract administration efforts. In addition, the interviewee expressed dissatisfaction with the quality of pre-feasibility and feasibility studies conducted by the government for the privately financed transport/highway infrastructure projects. It was also contended that risk mitigation instruments (derivatives) are either not available or too costly to employ. Lack of historical data over which to assess risks for upcoming projects was

also reported to be a barrier to effective risk management. Two of the interviewees expressed that risk management plans are neither made nor managed by the public sector and that risks are only discussed within the framework of contract agreements. One interviewee expressed a great desire to develop detailed and specific risk management plans for PPP projects and asserted that his organization had once procured services of an independent consultant for the development of risk management plan for a previous project but the experience of the interviewee was unsatisfactory.

5. RESEARCH AIM AND OBJECTIVES

In view of the state of research on risk management in PPP projects in Pakistan, the context specific nature of risks, and the identified issues and knowledge gaps, the proposed research seeks to establish a comprehensive understanding of the risks inherent in PPP projects in Pakistan, and to present models to assess and allocate risks appropriately for future projects. The research aims to achieve this goal by delivering the following objectives:

1. To investigate the project delivery trends in infrastructure procurement in the Pakistani construction industry and to evaluate the scope of applicability and issues related to the PPP model for infrastructure procurement
2. To develop and evaluate the measures of effective risk management (ERM) for PPP infrastructure projects to enhance and complement the efficiency of risk management efforts on projects
3. To identify risks, assess the stakeholders' perceptions on identified risks, and to develop a risk assessment model for PPP infrastructure projects
4. To develop a risk allocation model to assist efficient risk allocation on projects

6. RESEARCH METHODOLOGY

The overall research framework to achieve each of the above stated objectives is provided in Figure 1. The project management body of knowledge by project management institute (PMI) defines six processes for project risk management knowledge area (Project Management Institute, 2013). Based on the issues identified from the literature review and the interviews, the objectives set for this research aim to study key processes in the risk management planning domain, including risk identification, analysis, and allocation (which is one of the most critical risk response strategy), and go a step further to identify those attributes that influence the overall effectiveness of the risk management activity. This research adopts a mixed-methods approach involving qualitative and quantitative methods and data to identify and assess relevant risk factors, risk allocation mechanism, and measures of effective risk management, based on the literature review, interviews, case study, and questionnaire survey.

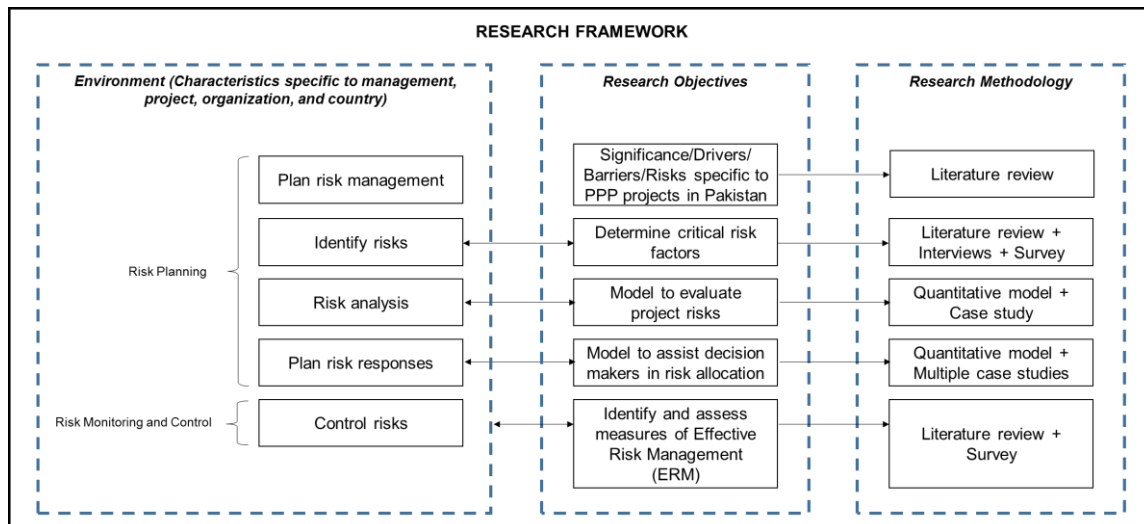


Figure 1: Overall research framework

6.1 Data Collection

Questionnaire surveys and case-studies have been employed widely in construction management research in general, and PPP research in particular as the most popular research methodologies (Zhang et al., 2016). For this research, a questionnaire instrument has been developed that identifies various risk factors and measures of effective risk management, based on a meticulous literature review and semi-structured interviews of public and private sector experts from the local industry. A pilot study was also conducted with the local experts to improve the survey questionnaire. Relevant stakeholders in the public and private sectors have been invited to participate for data collection, including public authorities/public infrastructure procurement departments/PPP units, investors (equity providers/lenders), project companies (consortiums), consultants/transaction advisors etc. In addition, case-studies will be conducted on real projects in each sector (power/transport infrastructure), to assess risks and obtain information on actual risk allocation and risk management capability of public and private sector stakeholders, to assist in development and validation of models for project risk assessment and risk allocation.

6.2 Data Analysis and Model Development

The data collected from questionnaires will be subjected to quantitative analysis to rank the factors (risks and measures of ERM) based on their criticality and importance, as applicable, and to identify principal factors using factor analysis. A framework for promoting ERM on PPP infrastructure projects will also be proposed based on the literature review, interviews, and results of the survey. Keeping in view the above-mentioned limitations in the existing models for project risk assessment and allocation, as a part of this research, quantitative models will be developed to assist the stakeholders in the critical decision making during project evaluation and risk allocation. Fuzzy set theory, proposed by Zadeh (1965), in conjunction with suitable decision making techniques will be employed to overcome the limitations in the existing models.

So far, based on completed literature review and semi-structured interviews, a questionnaire instrument has been developed and piloted with the respondents from the interview panel.

Now, the data is being collected from relevant stakeholders in Pakistan, based on the methodology specified above, and will be analyzed to develop models and to obtain the research outcomes.

7. SIGNIFICANCE AND VALUE OF THE RESEARCH

Given the importance and the role of PPPs in the backdrop of a developing and under-resourced economy of Pakistan and the lack of research in the national context, this research has identified important objectives that will provide useful answers that determine the status of risks being faced by PPP projects and the state of management of such risks along with recommendations to improve the situation, considering the expert opinion and reviewed international best practices. Moreover, the research results will have implications, internationally, as the proposed models potentially provide a superior ability to analyze data, reliably, and will assist the decision makers in project risk assessment and allocation. The proposed framework for effective risk management on PPP projects will be a unique addition to the literature as it views project success from a narrowly focused, risk management process based perspective which varies from the existing broad focused approaches of product or project management success (Liu et al., 2015).

8. CONCLUSIONS

Project delivery using PPPs is gaining momentum in the Pakistani infrastructure industry, however, the risks that plague these projects and their effective management has not been studied systematically. Consequently, backed by an extensive literature review and semi-structured interviews with relevant experts from the local industry, a research effort has been initiated to identify the critical risks in the most active infrastructure sectors for PPP procurement (power and transport), determine existing risk allocation practices, and develop measures of effective risk management in combination with development of quantitative models to assist the decision makers in reliably analyzing and allocating risks on PPP projects. The paper presents the research framework, its significance, and results of the preliminary data collected for this research. The proposed models are intended to be generic so that the methodology can be applied to any project, irrespective of the country and infrastructure sector contexts.

9. ACKNOWLEDGEMENT

Financial support from The Hong Kong Polytechnic University to carry out this research is greatly appreciated.

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TARGET COST CONTRACTS AND THE DEVELOPMENT OF COLLABORATIVE BEHAVIOURS AND VALUE FOR MONEY IN THE UK CONSTRUCTION INDUSTRY

A. Smith and G. Wood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: g.d.wood@salford.ac.uk

Abstract: TCCs are seen to be an effective procurement model through aligning the objectives of the parties to reduce costs and many clients are now turning to them in a bid to obtain value for money. This research paper investigates the extent to which TCCs promote collaborative behaviours and provide value for money within the UK construction industry. More particularly, the research explores the following: which projects TCCs should be used on and how the maturity of the design when agreeing the target cost can affect value for money; how setting both the target cost and the pain/gain mechanism can affect the incentivisation of the contractor to minimise costs; the extent to which TCCs promote collaboration between the contractor, client and supply chain; and what is required to manage a TCC post-contract to ensure that incentivisation is maintained. It is apparent that TCCs are complex procurement models which require extensive consideration and management to ensure parties are incentivised to minimise costs. The research also reveals that although TCCs can promote collaborative behaviours and provide value for money, there is a prerequisite to doing so: developing and managing the TCC correctly to ensure that the objectives of the parties are aligned.

Keywords: Target Cost, Value, Collaboration, Pain:Gain

1. INTRODUCTION

1.1 Background

Incentivisation contracts have long been used in the UK construction industry in order to align the objectives of the parties to a construction contract to achieve better performance. A TCC is a type of incentive contracting commonly used on projects within the UK construction industry. TCCs seek to align the objectives of the parties which helps create a collaborative environment (Bresnen & Marshall, 2000). TCCs were created for use on large infrastructure projects which were complex and high risk due to unknown ground conditions (Heaphy, 2011). Due to their success on these projects their use has grown year on year with standard TCC forms of contract such as the NEC options C and D being established.

TCCs are associated with reimbursable contracts as the contractor is reimbursed the actual defined costs incurred in carrying out the works. However, unlike reimbursable contracts, the financial risks of projects are shared by both the contractor and client through the use of a pain/gain mechanism. A pain/gain mechanism is employed so that any underspend or overspend against the pre-agreed contractual target cost is shared between the parties. If the actual costs are lower than the target, the client and contractor will share the savings based on the pre-agreed share ratio. Conversely, if the actual costs exceed the target, both parties will share any overspend based on the pre-agreed share ratio. The sharing of risk through the pain/gain mechanism should actively encourage parties to collaborate to manage and reduce costs to a minimum (Lewedon, 2017 & RICS, 2014).

During recent years, TCCs have become increasingly popular within the UK construction industry as clients look to obtain value for money through incentivising contractors (RICS, 2017). The UK Government Construction Strategy recognises TCCs as a cost led procurement model capable of producing the 15-20% cost savings required for public sector construction projects by 2015 (Cabinet Office, 2012). TCCs have successfully provided value for money on a variety of recent major projects such as Heathrow Airport Terminal 5, Crossrail Procurement Strategy and the 2012 Olympic and Paralympics Games Infrastructure. However, they have also proved unsuccessful on other projects. Within *AMEC v Secretary of State for Defence* (2013), value for money was not achieved and disputes arose over who was liable to pay cost overruns above the Guaranteed Maximum Price Target Cost (RPC, 2013).

Although it is understood that TCCs in theory should reduce costs through aligning the objectives of the parties, often clients are disillusioned with the financial outcome of TCCs. As the popularity of TCCs has grown in the UK construction industry, clients are questioning whether they really do provide value for money. It seems that it is only in certain circumstances where prerequisites are met, that TCCs promote collaboration and provide value for money. Clients need to be fully aware of the implications of TCCs and the requirements to provide value for money prior to using them.

1.2 Aims and Objectives

The overall research aim is to investigate the extent to which TCCs promote collaborative behaviours and provide value for money in the UK construction industry. The objectives of this research are to:

- explore which projects are suitable for use with a TCC and how the development of design can affect value for money when agreeing the target costs;
- analyse how setting the target cost and pain/gain mechanism can affect the incentivisation of the contractor to reduce costs;
- assess whether TCCs promote collaboration between the client and contractor;
- evaluate what is required to manage a TCC post-contract to maintain incentivisation.

In order to achieve the aim of this research paper, the methodology included a literature review of a large body of existing literature. The pre-existing literature has been examined and analysed to build the argument that TCCs do promote collaboration and provide value for money, but only when parties fully understand the contract process.

2. CRITICAL REVIEW OF LITERATURE

2.1 Introduction

This part of the research paper has been split into four sections. The first section looks at which projects are appropriate for TCCs and how the level of design at the time the target cost is agreed influences value for money. The second section looks at how setting the target cost itself and the pain/gain mechanism can influence value for money through aligning the objectives of the parties. The third section looks at the extent to which TCCs can influence collaboration. The final section explores what is required post-contract award to ensure that collaboration and incentivisation are maintained to achieve value for money.

2.2 Value for Money in Target Cost Contracts

TCCs intend to promote collaboration and provide value for money through incentivising the contractor to control costs. The main constituents of TCCs include the target cost, the fee and the share formula (Perry & Thompson, 1982). The target cost is agreed between both parties normally through a competitive procedure and should reflect a best estimate of likely outturn costs to deliver the scope of work. The fee covers overheads and profit for the contractor and is normally a fixed percentage. The share formula introduces the incentive into the contract by determining how any savings or cost overruns against the target cost will be shared between the parties. Scottish Futures Trust [SFT] (2016, p30), within their review of Scottish public sector procurement, state that “the principle benefit of target cost arrangements is their ability to align the objectives of the parties, which helps to create a partnering environment”. Further, they argue that as objectives are aligned, the parties are encouraged to work together to control costs, sharing the risk through the pre-agreed pain/gain mechanism.

In order to achieve value for money on any project, the most appropriate contract needs to be selected. A study of the use of TCCs was undertaken by Perry & Thompson (1982) within the CIRIA 85 report which is still very influential within the field today. Within this report, they identify that high risk projects where costs are likely to escalate are appropriate for TCCs. This is because TCCs offer more flexibility in terms of change than typical fixed priced contracts. Broome (1999), who has provided influential literature on TCCs, agrees with Perry and Thompson that TCCs are appropriate for projects when a high level of design change is anticipated and thus flexibility is required. It is also suggested by various sources that TCCs are not suitable for low value contracts as they contain the burden of high administrative costs through the use of unfamiliar administrative procedures such as open book accounting (Broome, 1999; Lewedon, n.d.; Hughes & Gruneberg, 2009). Therefore, for smaller projects with minimal to medium levels of risk, clients should look to use alternative contracting models to provide value for money.

Within the literature, there is no general consensus on how defined the scope of works/design needs to be at the point the target cost is calculated. Various sources suggest that TCCs can be useful and may be the most appropriate contract where the extent of work to be carried out has not been fully defined (Broome, 1999; McInnis, 2001; Fenwick Elliot, 2016). The reason behind this argument is that a target cost can be agreed based on an initial specification and can be amended following confirmation of the final specification following contract award. Heaphy (2011) recognises that as work can commence based on an initial design and target cost, earlier starts on site can be achieved when compared with traditional lump-sum contracts. This can provide value for money to the client as the project should in theory finish earlier if a TCC is selected over a lump-sum contract.

Conversely, a different view established within the literature is that value for money will only be secured if the contract is let with a well-defined target cost to enable the contractor to be able to price the works accurately (SFT, 2016; Lewedon, n.d.; International Law Office, 2003). Rawlinson (2007) agrees with this viewpoint that value for money is not achieved on insufficiently defined projects. He suggests that TCCs should be used on well-defined projects with a full set of works information as loosely defined projects provide the contractor with the opportunity to renegotiate the target cost through design amendments. Research undertaken by Tirole (1986) demonstrates that contractors will be less incentivised to minimise costs if there are future opportunities to renegotiate the target cost. Brumm (1992) further develops this viewpoint, suggesting that TCCs in fact incentivise contractors to

propose frequent modifications in order to increase the target instead of reducing actual costs. Where this is the case value for money will be significantly compromised.

Drawing on the research, it needs to be recognised that a sufficient level of design does need to be defined to allow a target cost to be agreed which reflects a best estimate of likely outturn costs. Although Broome (1999) suggests that TCCs are suitable for contracts where the extent of work is not fully designed, he does highlight that the scope of work still needs to be ‘sufficiently’ developed. If the scope of work is insufficiently developed, then the contractor will have numerous opportunities to renegotiate the target cost and may subsequently focus their efforts on increasing the target to maximise gain-share potential rather than creating efficiencies. Moreover, TCCs which involve large amounts of scope change present significant risks to the client in terms of value for money. This is because if the scope and value of contract changes significantly so that changes are assessed retrospectively, then TCCs can easily become fully reimbursable contracts (Broome, 1999). Value for money is not achieved on reimbursable contracts as the contractor is not incentivised to control costs. Therefore, although the design does not need to be complete, clients should ensure that they have an adequate level of design to enable a target cost to be set that, although may need firming up as the design is finalised, will not require drastic changes.

Furthermore, value for money can also be affected on TCCs by reduced quality standards as a consequence of contractors trying to minimise costs to increase gain-share potential. Kwawu & Laryea (2013) argue that with cost often being the biggest element of risk in contracting, incentivisation contracts tend to focus on cost which impacts other areas of the project. Both quality and time become less important than completing under the target cost and subsequently these aspects of TCCs can be neglected. Contractors may look to rush work, reduce quality of materials or use in-experienced and cheaper resources to minimise costs. In the long term this can affect value for money due to higher maintenance and repair costs. To the contrary, Perry & Thompson (1982) and McInnis (2001) argue that quality and time are also principle elements which clients wish to control through the use of TCCs. This is because in order to minimise costs, contractors are incentivised to complete on time and to maintain quality standards through minimising defects. As pre-completion defects form part of the defined cost, but do not constitute an increase to the target cost, the contractor is incentivised to keep defects to a minimum to increase gain-share potential (Fenwick Elliot, 2016). Therefore, although cost is the main focus, both time and quality should not be adversely impacted as a result of using TCCs.

2.3 Setting the Target Cost & Pain/Gain Mechanism

The target cost and pain/gain mechanism are fundamental in aligning the objectives of the parties and driving the right behaviours to reduce costs and obtain value for money. It is therefore vital that clients understand the implications of setting target costs and pain/gain mechanisms.

Target Costs

Within his paper to the Society of Construction Law, Heaphy (2011, p.1) a partner at EC Harris Law firm, defines a target cost as a “genuine pre-estimate of the most likely outturn

cost for the project, as defined in the contract documentation”. Target costs need to reflect the best estimate of probable cost in order to offer a genuine incentive to the contractor (Perry & Thompson, 1982). A realistic target cost plays an essential role in ensuring the opportunity to achieve savings that will benefit both parties (Pinsent Masons, 2016 & Fenwick Elliot, 2016). It is argued that TCCs will only provide value for money when the target cost is set at a level that requires the client and contractor to collaborate to create efficiencies which are beyond those that are normally expected (SFT, 2016 and Heaphy, 2011).

When setting the target cost, there are various issues that clients need to consider. The following figure illustrates three different scenarios that can occur when setting target costs.

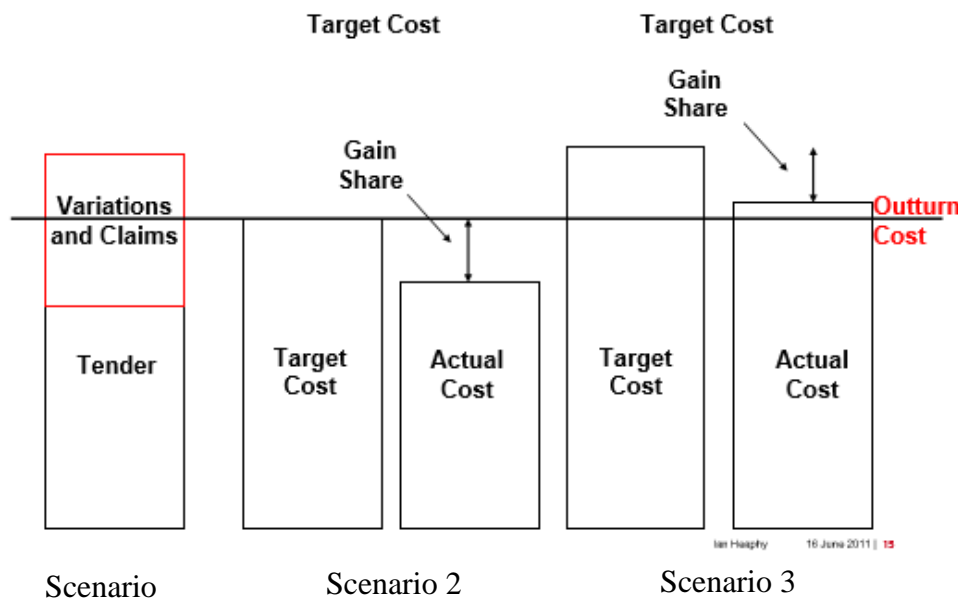


Figure 1: Setting the Target Cost (Heaphy, 2011, p.4)

In scenario 1 in figure 1, in order to win the contract the contractor provides a target cost (tender) which is below a genuine estimate for likely outturn costs (annotated in red). Once the contractor is awarded the contract, they will look to increase the target so that it reflects likely outturn costs (annotated in red) or even above through variations and claims. The high number of variations and claims will cause adversarial relationships between the parties to develop and will distract both parties from focusing on creating efficiencies. The additional administration costs in preparing and assessing variations and claims will increase actual costs and subsequently reduce value for money. Moreover, Rawlinson (2007) suggests that if the target is too low, the contractor may look to seek to recover costs through alternative methods other than raising the target. Rawlinson states that a contractor may look to increase actual costs above the target cost in order to recover costs through additional fee. It also needs to be recognised that some contractors are motivated to secure certainty of yield on TCCs by increasing the value of fee when negotiating the target (Perry & Barnes, 2000). Consequently, clients need to assess both the level of fee and the target cost in order to ensure value for money.

In addition, some clients believe they are gaining value for money by beating down target costs. However, in reality, doing so removes any incentivisation for the contractor to control costs (Fenwick Elliot, 2016). In fact, Perry & Thompson (1982) suggest that beating down the target results in the removal of positive behaviours from the contractor and promotes the

wrong behaviours. Subsequently, instead of aiming to lower the target cost as much as possible which can damage relationships, clients should ensure that the target cost reflects a best estimate of likely outturn costs. Scenario 2 in figure 1 shows a target cost which represents a best estimate of likely outturn cost. With a genuine target that reflects the scope of work, the contractor can focus on creating efficiencies to increase potential gain-share. Value for money is likely to be obtained in scenario 2 as both parties are focusing on creating efficiencies.

Scenario 3 in figure 1 however will not provide value for money to the client. In this scenario, the target cost agreed does not represent a best estimate of likely outturn cost (annotated in red) as it is overinflated. Wamuziri & Seywright (2005) recognise that creating efficiencies on TCCs is not the only way contractors can maximise their payoff. They suggest that seeking an inflated target, illustrated in scenario 3, helps maximise payoff. Clients need to be wary of inflated target costs as they remove any incentive for the contractor to create efficiencies and subsequently impair value for money. Inflated targets may reward the contractor through gain-share for ordinary or poor performance, completing the work at the expected outturn cost or even above (Heaphy, 2011).

Furthermore, in order to achieve value for money on TCCs, clients require sufficient knowledge and experience to be able to accurately estimate the likely outturn costs of the project (Designing Buildings Wiki, 2017). Fisher (1969) in his evaluation of incentive contracting in the defence sector recognises that more accurate methods of determining target costs will increase value for money potential rather than elaborate incentive sharing arrangements. In order to obtain an accurate target cost, clients need “good cost reporting information systems from historical projects, improved costs analysis and estimating capability” (Wamuziri & Seywright, 2005). In addition, in order to ensure the target is robust, clients should seek to use experts to challenge the costs provided by the contractor (Heaphy, 2011).

Pain / Gain Share

Heaphy (2011) and SFT (2016) both recognise that the pain/gain mechanism is the key driver in achieving value for money and contractor efficiency in TCCs. The pain/gain mechanism is tantamount in aligning the objectives of the parties to reduce costs and therefore it is essential that clients understand the implications of setting the pain/gain mechanism (Heaphy, 2011). Within the literature, there is no general consensus on the ideal sharing ratio to achieve value for money. Weitzman (1980) suggests that the optimal sharing ratio depends on the contractor’s ability to reduce costs, risk aversion and project uncertainty.

The most common share ratio adopted is a straight 50/50 split between the contractor and client. A large body of research advocates that clients should avoid setting the contractor’s share at less than 50% as this removes any incentivisation for the contractor to control costs (Weitzman, 1980; Perry & Barnes, 2000; Williams, Williams & Ryall, 2013; Broome, 1999; & Heaphy, 2011). The reason being is that contractors will not be incentivised to create efficiencies if savings are not shared on an equal basis (Pinsent Masons, 2016). If a share percentage less than 50% is allocated to the contractor, they may look to increase the target cost to maximise pay off instead of focusing on creating efficiencies. Heaphy (2011) also argues that the straight 50/50 split is the simplest share method that helps to drive partnering behaviours as the risk is shared equally. If the share formula is weighted in favour of one

party, then the incentive power can be effected as parties are not seen to be working equally (Williams, Williams & Ryall, 2013).

Research undertaken by Wood (2005), within an RICS research paper which involved interviews with 10 national contractors, highlights examples of TCCs where clients had implemented unfair sharing mechanisms which were considered to contradict the spirit of partnering. Within the research, one contractor provided an example of where all underspend against the target cost was allocated to the client. Where this is the case, the contractor will not be incentivised to create efficiencies and consequently both collaboration and value for money will be jeopardised.

When considering a straight 50/50 split, clients need to determine the contractor's potential to reduce costs. Weitzman (1980) argues that where the contractor has great potential to reduce costs through contributing to the development of the design, then they should benefit from a share ratio above 50%. To the contrary, Broome (2002) believes that if there is limited potential for the contractor to provide large costs savings then the split should also be above 50% to motivate contractors. Although clients need to ensure that contractors have the potential to reduce costs, they also need to ensure that the potential is limited in order to motivate the contractor to create efficiencies which are beyond those normally expected. To create efficiencies beyond those normally expected, clients should ensure that value engineering has been undertaken prior to agreeing the target cost and share ratio.

Clients also need be aware of the potential ability of other stakeholders to reduce costs. Perry & Thompson (1982) suggest that the engineer or designer has a considerable influence on the execution of a contract and subsequently can affect the ability of a contractor to meet a target. Subsequently, Perry & Thompson (1982) suggest that engineers are linked into the pain/gain mechanism. However, Williams, Williams & Ryall (2013) argue that linking numerous parties into the pain/gain mechanism contractually can be complex and time consuming which can reduce value for money. It is therefore advisable that clients should only look to include designers and subcontractors into the sharing mechanism if they have a substantial potential to reduce costs, otherwise value for money could be compromised.

Moreover, although most contractors will usually request a share ratio above 50%, this is not always the case. This is because a straight 50/50 split can affect a contractor's profit margin if the actual costs far exceed the target (Perry & Thompson, 1982). Therefore, on high risk projects, contractors may not want to bear the risk associated with a 50% split, especially where the contractor's potential to control costs is limited. Enforcing a 50% split on a high risk project, where the contractor has limited potential to control costs will result in less value for money. This is because the target cost will be inflated with risk due to cost uncertainty. In addition, the contractor will look to renegotiate the target cost through claims and variations in order to further reduce his risk of overspend. Subsequently, when setting the share ratio, client's need to consider the contractors risk aversion as implementing a high ratio could significantly impair value for money depending on the organisation.

Broome (1999), within his previous research has advocated that the contractor's share not be less than 50%. Despite this and contrary to the views of others (Weitzman, 1980; Heaphy, 2011; Perry & Barnes, 2000), Broome (2013) now suggests that this may not always be the case. Developing on his previous research, Broome (2013) now suggests that where the client is larger than the contractor and is better able to carry the risk, then the cost overrun above a certain percentage should entirely lie with the client. Alternatively, if the contractor

is a large organisation, then it may be advisable to cap the over run at 100% to the contractor as they have the financial capacity to bear the risk (Broome, 2013). Where the over spend is fully allocated to the contractor the contract becomes a guaranteed maximum price (GMP) contract. It needs to be recognised that where there is a GMP, once the contractor is perceived to complete the project above the target cost, the client will be substantially less motivated to reduce costs (Broome & Perry, 2002). Where this happens, collaboration and value for money will be impaired as disputes are likely to arise if the contractor feels they are entitled to an increase to the target cost to limit their pain exposure.

Clients also need to consider whether they intend to work with the same contractor in the future on similar projects. Wood (2005) suggests that clients who are going to work with contractors on future schemes tend to be more generous when setting the share ratio because of the potential to replicate any savings on subsequent projects. Increasing the contractor's share will incentivise the contractor to create efficiencies on the first project which will benefit the client in terms of value for money on future schemes.

It can be concluded from the research that setting the share ratio is complex and requires a substantial amount of consideration. Clients need to provide sufficient time to review the impact of different share ratios in order to ensure that the optimum share ratio is employed that aligns the objectives of the parties to provide value for money.

2.4 Collaboration in Target Cost Contracts

Collaboration is a key success factor in ensuring value for money is achieved on projects. There is a strong consensus in the existing literature suggesting that TCCs promote collaboration in projects. Various studies (Perry & Thompson, 1982; Heaphy, 2011; Broome, 1999) highlight that the principle benefit of target cost arrangements is their ability to align the objectives of the parties, which helps create a partnering environment and a resulting identity of interest. Further studies (Hughes, Williams & Zhaomin, 2012; Constructing Excellence, 2011; Bresnen & Marshall, 2000) also suggest that target cost arrangements deliver value for money through creating a collaborative working environment by aligning the objectives of the parties. The contractor is aligned to the client's objective to minimise costs in order to increase their profit margin.

Conversely, research undertaken by Williams, Williams & Ryall (2013), which involved interviews with industry professionals who have experience managing TCCs, disagrees with this general consensus by suggesting that TCCs create a misalignment of objectives between the client, contractor and design team as parties are motivated for different things. This is because the client is motivated by cost, time and quality, the contractor just profit and the design team just quality. In order for collaboration to occur and thus value for money, clients need to ensure that the objectives of all key stakeholders are aligned. Although the research undertaken by Williams, Williams & Ryall (2013) involved personnel experience of interviewees, and therefore does not represent all professional views, the professionals interviewed had years of experience managing TCCs and therefore their direct experience is important to consider. Therefore, in order to align the client's time objective to the contractor, clients should look to use bonus payments or liquidated damages. In order to incentivise the design team and main subcontractors to reduce costs, clients should include the design team and main subcontractors into the contractual pain/gain mechanism.

When the objectives between parties are aligned in TCCs, they should reduce conflict and adversarial relationships associated with other types of contracts. McInnis (2001) argues that TCCs promote teamwork, in replacement of the traditional adversarial relationships and claims conscious attitudes normally associated with traditional procurement methods. Further, numerous studies (Kawau & Laryea, 2013; Eriksson, Atkin & Nilsson, 2009) argue that the sharing of risk and the high level of cooperation associated with TCCs reduces the occurrence and opportunity of conflicts and disputes occurring.

The high level of cooperation present in TCCs stems from the use of open book accounting which enables trust to be built between the parties. Perry & Thompson (1982) argue that the use of open book accounting on TCCs reduces the number of claims greatly and simplifies the resolution of claims that do occur. The openness of information through open book accounting increases confidence and should lead to greater collaboration through the closer alignment of motivation (Perry & Barnes, 2000). In addition, as the client has access to the accounts and records of the contractors actual costs, agreeing variations is easier and less confrontational than with other forms of contract (Heaphy, 2011). Heaphy also suggests that open book accounting will deter contractors from wasting time applying for claims which cannot be justified and will instead focus this time on seeking efficiencies, thus providing value for money. Subsequently, it can be concluded that the use of open book accounting should in theory reduce disputes due to a greater level of collaboration.

Although there is a large body of research recognising TCCs ability to promote collaboration, there are various sources that believe TCCs promote adversarial behaviours. SFT (2016) and Fenwick Elliot (2016) suggest that the use of open book accounting can in fact cause disputes and adversarial behaviours to occur when the client scrutinises the contractor's cost records to ensure they are valid. As the client has access to the contractor's cost records, difficulty can arise when agreeing variations if the contractor submits a quotation inflated with risk to increase the target cost and thus potential gain-share. Broome (1999) recognises that where this is the case, the objectives and motivations of the parties are not aligned.

Similarly, Williams, Williams & Ryall (2013) agree with the aforementioned sources that TCCs can promote adversarial behaviours by suggesting there is a need for the contractor to be claims conscious. This statement can be explained by referring back to scenario 1 in figure 1 where the contractor submits a low target cost to win the work. With a low target, the contractor will try to increase the target cost through overinflated variations and claims. Consequently, it can be argued that TCCs which contain low targets will discourage collaboration and promote adversarial relationships as there will be an increased number of claims and disputes put forward by the contractor. Therefore, as aforementioned, it is imperative that target costs are not set too low as doing so will drive the wrong behaviours which will impair value for money.

It is also needs to be recognised that TCCs require clear definitions of what is payable and disallowable under the contract. If the contract does not define payable and disallowable costs then disputes are likely to arise. Therefore, is it essential that the contract explicitly states what is payable in order to promote collaboration and reduce disputes and claims.

It can be concluded that when the target cost and share ratio are set at a level which encourages the contractor to reduce costs, collaboration will increase due to the alignment of objectives. However, Rose & Manly (2010) recognise that although TCCs are intended to promote collaboration in the whole supply chain, a criticism in the published literature is that they only incentivise the client and contractor only. Other sources (SFC, 2016 and

Rawlinson, 2007) suggest that TCCs incentivise the contractor, subcontractors and suppliers to reduce costs and promote collaboration in the whole supply chain. Although TCCs can incentivise all of the aforementioned parties, SFT and Rawlinson do not state how this can be achieved. Williams, Williams & Ryall (2013) recognise that to deliver a gain under a TCC it requires collaboration not just between the contractor and client but also between the consultants, sub-contractors, design team, supply chain and manufacturers. This is because TCCs do not incentivise other stakeholders to minimise costs if they are not linked into the share ratio. Subsequently, in order to incentivise the key stakeholders, who have a high potential to reduce costs, they need to be linked into the share ratio to benefit from creating efficiencies. This will ensure that all key players who can affect cost performance are motivated to control costs, thus providing value for money.

2.5 Managing Target Cost Contracts Post Contract Award

The previous sections within this paper have predominantly focused on how pre-contract activities affect value for money on TCCs. However, clients need to recognise that post-contract management on TCCs is essential in providing value for money. Without good TCC post-contract management, incentivisation to control costs will be lost and value for money will be jeopardised.

In order to achieve value for money, clients need to recognise that TCCs involve the client carrying a greater amount of risk than they would do with conventional priced contracts (Perry & Barnes, 2000). Often, problems arise where the client does not realise they are carrying a greater amount of risk than compared with a fixed price contract. They then do not manage this additional risk properly. This can result in the target cost not being amended to reflect scope, and subsequently the share mechanism becoming invalid. Where this occurs the contract may revert to an entirely reimbursable basis and value for money will be jeopardised (SFC, 2016). To prevent this from happening, clients need to be aware that TCCs involve clients bearing greater risk than fixed priced contracts and therefore require greater amount of resources to manage post-contract.

Furthermore, as TCCs are a complex contracting mechanism, which are administratively heavy, they require competent project managers as effective project management is a key instrument in ensuring benefits are realised by both parties (Fenwick Elliot, 2016 & Rawlinson, 2007). A common issue that inhibits value for money on TCCs is recognised by Perry & Thompson (1982) who suggest that site personnel who lack proper TCC training may not understand the significance of the target cost and may subsequently treat and manage the contract as if it were reimbursable. Further, the administrative demands of TCCs create a risk that the link between the target cost and actual cost could be lost and the client could be exposed to a significant transfer of risk (Rawlinson, 2007). As a result, in order to maintain incentivisation and value for money potential, it is essential that competent professionals who have experience and training on how to manage TCCs are employed.

Broome and Perry (2002) highlight that the use of open book accounting on TCCs places an extra burden on the client in terms of administration costs as additional time is required to assess subcontractors, types of resources and calculation of productivities. Other studies (Williams, Williams & Ryall, 2013; Lewedon, n.d.; Chan et al, 2011) agree with Broome & Perry, proposing that TCCs are often criticised for the additional time and cost required for administration due to unfamiliar administration procedures such as open book accounting

which impair value for money. They agree that greater client involvement is essential in TCCs and that competent professionals are required. If good purchasing and post-contract management are not present on TCCs then value for money will be impaired as incentivisation will not be maintained.

Although the previous sources referred to suggest that TCCs increase administration costs, Perry & Thompson (1982) believe that TCCs can in fact reduce administration costs in comparison with other procurement models. They suggest that due to the improved facility for evaluating change and the greater collaboration between the parties, the protracted negotiation of claims should be reduced. Therefore, it can be argued that although TCCs are resource intensive, they may actually be less resource intensive when compared with fixed priced contracts where great amounts of change are present. This is because open book accounting should allow for easier agreement of variations and the final account and should therefore reduce the number of disputes as compared with fixed priced contracts whereby the client does not have access to the contractor's records.

The most important factor in maintaining incentivisation post-contract is to ensure that the target cost remains visible to the contractor. To do so, clients need to ensure that the target is adjusted for variations so that it reflects the latest scope of work. Heaphy (2011) highlights that in order to maintain the target cost; changes need to be agreed as soon as they occur. A key factor which is often neglected in managing TCCs is agreeing change as soon as it occurs. Not agreeing change prior to or at the time it occurs means that the increase to the target cost will be based on actual costs incurred. If the target is being increased based on actual costs, the contractor will not be incentivised to create efficiencies and the contract essentially becomes fully reimbursable. Target costs which are unmaintained for long periods and do not reflect actual scope can result in the sharing mechanisms becoming invalid. Where this occurs, the contract will revert to an entirely reimbursable basis and value for money will be impaired.

Moreover, it is fundamental that both parties understand what constitutes a legitimate change to the target cost under the contract to reduce the potential of claims and disputes occurring. The contract needs to identify the risks which the contractor cannot manage and are therefore at the client's risk. These client's risks need to be clearly stipulated in the contract documentation and if any materialise, the contractor shall be entitled to an increase to the target (Broome, 2002). In addition, Perry & Barnes (2000) highlight that the project manager needs to be fair when assessing target cost adjustments as reliable and fair methods of target adjustments are an important component of successful TCCs. They also highlight the importance of precise and clear definitions of actual cost and fee within the contract. Doing so will reduce the administrative costs in time spent preparing and rejecting claims and time spent disallowing costs in payment applications.

3. CONCLUSIONS

In summary, this paper has investigated the extent to which TCCs promote collaborative behaviours and provide value for money in the UK construction industry. The following part of the conclusion revisits the objectives of the paper and summarises the findings.

The literature review has revealed that TCCs are favourable to provide value for money when used on high risk, complex and large projects where change is likely to occur. The flexibility

that TCCs provide will enable change to be administered more efficiently than if a fixed price contract is selected. Value for money will be compromised when using TCCs on simple, low value and low risk projects due to the complexity of the contract and high administrative burdens.

This paper further recognises that TCCs are useful contracting models for projects where the design has not yet been finalised. However, it has become apparent that ensuring an adequate level of design is completed prior to going out to the market will enable a contractor to provide a more accurate target cost. Further, the more developed the design, the fewer opportunities the contractor will have to renegotiate the target cost. Subsequently, they will be more focused on creating efficiencies and providing value for money rather than seeking to increase the target.

The literature review has also revealed that value for money is likely to be achieved on projects where the target cost is set at a level which reflects a genuine pre-estimate of the most likely outturn cost for a project. Doing so incentivises the contractor to focus on creating efficiencies to increase gain-share potential. Target costs that are too low and are over inflated with risk cause the objectives of the parties to become unaligned and thus value for money will be impaired.

It is evident that the pain/gain mechanism is the core driver of aligning the parties' objectives to work collaboratively to achieve value for money. There are a variety of share ratios that can be employed and the optimal share ratio depends on the project conditions. The research has revealed that there is a strong consensus advocating that the share ratio to the contractor not be set any less than 50% as doing so removes incentivisation to reduce costs. Further, it appears that adopting a straight 50/50 split may be the most desirable share ratio due to the simplicity and impartiality of sharing risk equally. However, clients need to recognise that a 50% share ratio may not always be the optimum share ratio to promote collaboration and provide value for money. Clients need to consider the contractor's ability to reduce costs, risk aversion and project uncertainty to ensure that the optimal share ratio is employed.

The research has also identified that in certain projects, it may be necessary to incentivise all key supply chain members including the design team through the pain/gain mechanism if they have a strong potential to reduce costs. However, this paper has not analysed how far down the supply chain the share ratio should be employed. It has become apparent that this is an area for further research and consideration.

In addition, the research suggests that there is a strong consensus that TCCs do promote collaborative behaviours: reducing conflict, disputes and adversarial relationships. The literature suggests that collaboration prospers through the alignment of the objectives of the parties through the pain/gain mechanism and through the use of open book accounting. However, the research also recognises that collaboration can be significantly impaired when the objectives of the parties become unaligned. The research suggests that TCCs promote collaborative behaviours when: the target cost reflects a best estimate of likely outturn costs; the pain/gain mechanism aligns the objectives of the parties; open book accounting is not abused through clients scrutinising cost records; the contract explicitly defines payable and disallowable costs; and the contract explicitly states what constitutes a change to the target cost. It needs to be recognised that although TCCs provide the foundation for collaboration to prosper, collaboration still relies upon the willingness of personnel to co-operate.

Furthermore, this research has highlighted that TCCs often do not promote collaboration throughout the supply chain. Many contracts are let with only the contractor and client linked

into the pain/gain mechanism. It has become apparent that on certain projects other stakeholders have a strong potential to reduce costs. Subsequently, not including these key stakeholders into the share mechanism drives the wrong behaviours and can significantly impair value for money.

Finally, it is evident that good contract management on TCCs is a fundamental requirement in ensuring value for money. Clients need to recognise that they are bearing a greater amount of risk with a TCC than they would be with a fixed priced contract. Thus, competent resources are required to manage the contract and ensure that the target cost is maintained. This involves agreeing change as soon as it occurs to ensure that the target cost reflects the scope of work and the pain/gain mechanism remains valid.

The overall conclusion that can be drawn from the research is that TCCs are a complex procurement model which are capable of promoting collaborative behaviours and providing value for money in the UK construction industry but only when they are developed and managed correctly to ensure that the objectives of the parties are aligned. Further research and consideration is required on this subject in order to establish further how clients can align the objectives of all key parties to achieve value for money.

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5. CASES

AMEC Group Limited v Secretary of State for Defence [2013] EWHC 110

CASE STUDY AS RESEARCH STRATEGY FOR INVESTIGATING BARRIERS TO ACHIEVEMENT OF VALUE FOR MONEY IN NIGERIAN PUBLIC CONSTRUCTION PROCUREMENT

I. D. Obieje and G. Wood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: i.d.obieje@edu.salford.ac.uk

Abstract: A research strategy is an important element of a research design which provide the overall direction for the research to enable it to achieve its objectives. For doctoral research students, selection and justification of a research strategy as appropriate to their research problem is key to successful completion. The implementation of Nigeria's Public Procurement Act (2007) to public construction procurement over the years has achieved little in-terms of its aim for value for money. Existing knowledge on this problem indicate apparent lack of in-depth qualitative understanding based on real-life construction project context. This paper posits that there are prospects for in-depth understanding of the problem through the application of the case study research strategy. The justifications for this position includes: the suitability of the strategy for achieving the research objective of gaining rich understanding of context and process being enacted, the form of research question investigated, suitability of case study strategy compared with alternative research strategies and the successful application of case study strategy in previous similar studies. A rich picture understanding of the barriers limiting the achievement of value for money based on a real-life project context could lead to suggestions on how future improvement can be made.

Keywords: Case Study, Public Construction Procurement, Value for Money.

1. INTRODUCTION

A research design is the conceptual structure within which research is organized and conducted. It essentially comprises of the plans and procedures that span the decisions from broad assumptions to detailed method of data collection and analysis (Walliman, 2006; Creswell, 2009; Easterby-Smith, 2015). A research design provides a framework for the collection and analysis of data and subsequently indicates which research strategy is most appropriate (Walliman, 2006, p. 42; Bryman, 2008). The design of a research would depend on the nature of the problem being investigated; how the research questions will be answered and the goal is to arrive at an operational plan that is most appropriate to the problem being investigated (Yin, 2014).

A research strategy as an element of a research design, provides the overall direction of the research including the route by which the research would be conducted (Wadawatta, et al, 2011). According to Saunders, et al, (2009), choice of strategy is guided by a number of factors, including: the research question and objectives, the extent of existing knowledge, the amount of time and other resources available to the researcher and the philosophical assumptions guiding the study. Common research strategies include (Saunders, et al, 2009): Experiment, Survey, Case Study, Action research, Grounded theory, Ethnography and Archival research. No research strategy is innately superior or inferior to any other, the goal in selecting a strategy is to arrive at one that is most appropriate to the problem being investigated.

This paper presents the rationale for selecting case study strategy as an appropriate strategy for investigating the barriers to achievement of value for money in public construction procurement in Nigeria under the regulatory framework of the Nigeria public procurement Act of 2007. This is part of an on-going doctoral research aimed at developing a framework for the implementation of the Nigerian Public Procurement Act (2007) that will improve the opportunity for achievement of value for money on public construction projects.

Terminologies such as “research method”, “research strategy”, “research approach”, found in Research methodology literatures for example, Yin (2014); Creswell (2009), Saunders, et al, (2009), Naoum, 2013, Easterby-Smith (2015), etc., are often used to mean different things by different authors and this can sometimes be very confusing, especially for a doctoral researcher. To provide clarity and consistency, this paper adopted mainly the terms and general meaning of the terminologies as defined in the Research “onion” model proposed by Saunders, et al (2009).

2. BACKGROUND TO THE RESEARCH PROBLEM

In 2007, the Nigerian legislative arm of government enacted an Act of Parliament known as the Public Procurement Act (PPA 2007) to govern the public-sector procurements. The PPA (2007) amongst other objectives, aim to achieve value for money in government procurement. Value for money is a phrase in common use, but for practical purposes, attaching a precise meaning to it has been described as inconsistent and problematic (MacDonald, et al, 2012; Glendinning, 1988). According to MacDonald, et al, (2012) there is lack of consistency in the definition of value for money resulting from aspects of it which can be interpreted differently: the dimensions of value and timeframe of evaluation. This notwithstanding, a common feature from most definitions is the multi-dimension understanding of value from a broad perspective, encompassing not just the intuitive economic aspect of cost savings but also the criteria for efficiency and effectiveness (Glendinning, 1988; HM Treasury, 2006; Barnett, et al, 2010; DFID, 2011; Eze, 2012; National Office Audit, 2013).

The reality for public construction projects in Nigeria would suggest that there is a limited scope of achievement of the PPA (2007) aim for value for money. Symptoms indicating that there are problems with public construction procurements in-terms of achievement of value for money evident in literature includes: high cost of construction works, construction cost over-runs, construction time over-runs, poor quality of works, increasing cases of re-work, use of in-efficient procurement strategies, and abandonment of projects (Bima, et al, 2015; Ajayi & Oyeyipo, 2015; Adegboye, 2014; Ekung, et al, 2013; Ade-ojo & Babalola, 2013; Shittu, et al 2013; Shwarka & Anigbogu, 2012; Onyema, 2011; Ibrahim & Musa-Haddary, 2010; Ayangade, et al, 2009; Olatunji, 2008). What is not evident in literature is what is causing the problem.

Literature search also reveal that the implementation of the PPA (2007) is faced with many challenges which mitigate its effective implementation. Familoye, et al, (2015) collated sixteen (16) of these challenges and assessed them to determine the most significant through quantitative survey of public procurement practitioners’ opinion. It concluded that procurement practitioners ranked ‘Size and Complexity of procurement’, ‘Political interference’ and ‘Shortage of public procurement practitioners’ as the top three (3)

significant challenges facing the effective implementation of PPA (2007). It did not however, provide evidence towards what can be concluded in terms of the ability of the PPA (2007) achieving its stated aims on account of these implementation challenges.

Furthermore, examination of literature sources reveal that evidence in support of the implementation challenges mainly relied on secondary data sources and a few from practitioners' collective reflections and experiences across a number projects over some period of time based on a quantitative survey. There appears a knowledge gap mainly due to lack of evidence based on in-depth qualitative rich picture understanding of the implementation of PPA (2007) on construction project. Likewise, the scope of these implementations challenges on a real-life construction project and their implication on achievement of value for money objective of the PPA (2007) is largely unknown because literature sources lacked evidence based on a real-life project context. For a more complete understanding of the problems that affect construction performance, Love, et al, (2002) & Dainty (2008) both advocated the need for a robust investigation that consider all philosophical viewpoints.

This paper therefore contends that for a better understanding of the problems with public construction procurement in Nigeria in-terms of achievement of value for money, there is need for in-depth qualitative investigation of the implementation of PPA (2007) on a real-life public construction project to obtain a richer picture and more profound understanding of experiences on a project by project basis. This could help explain why the PPA (2007) is underachieving and lead to suggestions on how future improvements can be made. The case study strategy provides the opportunity for gaining rich understanding of context and process being enacted and has its niche where a "how" and "why" question is being asked about a contemporary set of events (Saunders, et al, 2009; Yin, 2014). According to Proverbs & Gameson (2008), the case study strategy is highly relevant to a project driven industry like construction but have low level application among construction management researchers.

3. CASE STUDY RESEARCH STRATEGY

Yin (2014) provides a comprehensive definition of case study as an empirical inquiry that:

- Investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.
- Copes with technically distinctive situation in which there will be many more variables of interest than data points, and as on result
- Relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and as another result
- Benefits from prior development of theoretical propositions to guide data collection and analysis.

The data for case studies come from variety of sources including observations, interviews, questionnaires, reports and archival records and this gives the researcher the advantage of arriving at a consensus of findings that could be considered robust (Fellows & Liu, 2008; Proverbs and Gameson, 2008).

There are positivists criticisms of case study strategy for lack of scientific rigor, that they rarely allow generalizations to be made from specific cases to the general population and they produce large amount of data, which allow researchers to make any interpretations they want (Easterby-Smith, et al, 2015). However, a contrasting position, more relevant to the position of this paper, is the constructionist view point of case study strategy, which is more less concerned with issues of validity, but more concerned with providing a rich picture of life and behavior in organizations or groups by investigating cases because of their unique features, which may or may not be generalizable to other contexts. (Easterby-Smith, et al, 2015).

Yin (2014) identified five important components of research design for a case study:

1. Study's Question
2. Its Propositions or Purpose (if any)
3. The Units of analyses
4. The logic linking the data to the proposition; and
5. The criteria for interpreting the findings.

In response to the positivist criticism, it is suggested that making clear decision on this these components prior to data collection would to some degree demonstrate rigor and improve validity (Easterby-Smith, et al, 2015).

4. THE UNIT OF ANALYSES

The Unit of analyses component of Case study design is related to the fundamental problem of defining what the case is (Yin, 2014). According to Proverbs and Gameson (2008), the unit of analyses is a key issue in identifying and selecting case(s), and in the context of the built environment, unit of analyses maybe a construction project, a company or organization, or an individual or group of individuals such as project managers, architects, etc.

The unit of analyses suggested by this paper for investigating the barriers to achievement of value for money is the construction project. This is on ground that the judgement for achievement of value for money is determined by the value or benefits derived from the project outcome. To understand why PPA (2007) is having limited scope of achievement in terms of value for money and how this may be improved, data collected from the selected construction projects will be used to assess how value for money has been achieved (or not achieved), the enablers and barriers to achievement of value for money, the effects the implementation challenges of PPA (2007) have on the capability of the regulations to support achievement of value for money, what has gone well or not gone well on the project, and why. Relying on multiple sources of information for answers, as typical with the case study strategy, could result to a robust understanding of the problem and lead to suggestions on how future improvements may be made.

5. CASE STUDY DESIGNS AND TYPE PROPOSED

Yin (2014) categorized Case study designs into four basic types based on two distinguishing factors; whether they are single or multiple case and whether they are holistic or embedded:

- Type 1 – Single-case (holistic) designs
- Type 2 – Single-case (embedded) designs
- Type 3 – Multiple-case (holistic) designs
- Type 4 – Multiple-case (embedded) designs

The primary distinction in designing case studies is between single-case dealing with only one case or multiple-case dealing with more than one case (Yin, 2014). Embedded case, distinguished from holistic case, occurs when in the same single-case (or multiple-case) attention is given to a subunit or subunits of analyses.

According to Yin (2014), there are five rationales for assessing when the single-case is an appropriate design. These are when the case represents a critical case, an unusual case, a common case, a revelatory case or a longitudinal case. On the other hand, Saunders, et al, (2009) suggested that the rationale for using multiple cases focuses upon the need to establish whether the findings of the first case occur in other cases and, therefore the need to generalize from these findings. According to Proverbs & Gameson (2008), results from investigations based on a single-case will to some extent be treated with some degree of circumspection because no one can be sure how the results apply to other cases. In contrast, evidence from multiple cases are often considered more compelling and the overall study is regarded as being more robust (Yin, 2014).

Therefore, this paper favors the choice of the multiple-case (holistic) design over a single-case design. Consideration for this was for a more compelling evidence that could lead to some level of generalizability of the research outcome and for a better data saturation. For a start, three public sector construction projects were selected, one each from Nigeria's main three geo-political regions of North, South-East and South-west. The construction project is the unit of analyses and each project represent a 'common case' public construction procurement. Using a replication logic, the paper proposes to establish whether the findings from one case occur in the other cases. Again, Proverbs & Gameson, (2008) suggests that when results from multiple-cases support each other, the evidence will always be more compelling. The study proposes to continue adding cases as necessary to achieve data saturation.

6. RATIONALE FOR CHOOSING CASE STUDY STRATEGY

The case study strategy has been considered as a more appropriate strategy over other alternative strategies for the research problem at hand due to a number of reasons. Firstly, the strategy is more advantageous for the achievement of the research objectives as it provides the opportunity for rich in-depth investigation on a real-life project context. Review of existing knowledge on the research problem generally indicate lack of evidence based on in-depth qualitative investigation on a real-life project context. Case Study strategy provides a good prospect for contributions towards filling this knowledge gap.

Secondly, the Case Study strategy has also been considered over other strategies because of the form of the research question. The form of research question, according to Yin (2014), is one of three factors to consider while deciding upon an appropriate strategy and recommends case study to be more appropriate for answering the "how" and "why" research questions.

Table 1 shows the consideration that has been made relating to three conditions to satisfy while deciding upon case study strategy.

Table 1- Consideration of Situations Relevant for Different Research Strategies (Adapted from Yin, 2014)

| Method [Strategy] | Form of research question | Requires control of behavioral events | Focuses on contemporary events? | Consideration for this Research |
|--------------------------|---------------------------------------|--|--|--|
| Experiment | How, Why? | yes | yes | Not selected because behavioral control is not practical for the research subject |
| Survey | Who, What, Where, How many, How much? | no | yes | Not selected because the suggested form of research question is not consistent with the research question being investigated |
| Archival analyses | Who, What, Where, How many, How much | No | Yes/no | Not selected because the suggested form of research question is not consistent with the research question being investigated |
| History | How, Why? | no | no | Not selected because the research need to focus on contemporary events |
| Case Study | How, why? | no | yes | Selected because of the research focus on contemporary events which requires no behavioral control. The suggested form of research question is also consistent with the research question investigated |

Thirdly, the suitability of Case Study strategy compared with strategies for the study at hand was considered, and case study strategy remained the most suitable. While Action research provides an alternative strategy for achieving the research objective for in-depth understanding based on a real-life context, it has not been selected mainly due to practical reasons. Action research, is a research in action to bring about a change, where the researcher is often part of the change process (Saunders, et al, 2009; Easterby-Smith, 2015). There are concerns with the length of time of typical public construction procurement from start to finish required for the often-iterative procedure to cause and evaluate a change compared with the period for a full-time PhD study. Also, the researcher is not an employee of a public-sector organization and therefore unrestricted access was a genuine concern. Perhaps, Action

research can be considered next best alternative as it is also compactible with the research aim of making suggestions that will bringing about a change.

Similarly, Grounded theory and Ethnography strategies, although presents opportunity for in-depth qualitative data in-line with the research objectives, were also not considered suitable. Grounded theory involves the development of theory from primary data (Easterby-Smith, et al, 2015). In contrast, the proposed study does not aim to develop theory, but to understand a phenomenon in a real-life context; why the PPA (2007) is having limited achievement in-terms of value for money and how achievement of value for money may be improved, partly relying on existing theory. Ethnography on the other hand, requires the researcher to be immersed in the setting of the social world being studied as completely as possible in a way to describe and explain the phenomenon being studied just as the subjects of the research would (Saunders, et al, 2009). This is time and resource consuming beyond what is available to the researcher, therefore the Ethnography strategy was also not selected.

Also, as described in Table 1, Experiment, Surveys and Archival research strategies have not been selected because, they are not suitable for answering the research question and generally not consistent with the Relativist/Constructionist philosophical view point assumed by the study.

Finally, the case study strategy has been used successfully in similar previous studies. For example, Nisar (2007) used case study strategy to investigate value for money drivers in public private partnership projects in the United Kingdom. Also, National Audit Office (2004) used real-life project contexts to illustrate how design quality impacts value for money in public sector construction projects.

7. SAFEGUARDING RELIABILITY AND VALIDITY

Reliability and Validity are the logical tests used to assess the quality of a piece of research. Therefore, it was essential while proposing the case study strategy as appropriate for investigating the barriers to achievement of value for money in public construction procurement in Nigeria, to ensure that the research measure up with the criteria for a good quality. Reliability and validity are concerned with the credibility of the finding or conclusions drawn from a piece of research.

According to Bryman (2008), Reliability is concerned with the question whether the results of a study are repeatable. The extent to which data collection technique or analyses procedure will yield consistent findings (Saunders, et al, 2015). On the other hand, Validity is concerned with the integrity of the conclusions that are generated from a piece of research (Bryman, 2008). Whether the findings are really what they appear to be about (Saunders, et al, 2015). Yin (2014), suggests four tests commonly used to establish the quality of a case study research strategy as indeed used for assessing any empirical social research, and identified tactics for dealing with the tests. These are reproduced in Table 2 below alongside tactics proposed by this paper for use while investigating the research problem.

Table 2 - Tests for assessing the quality of research and tactics employed (adapted from Yin, 2014)

| TEST | Purpose | Case Study Tactic | Tactic proposed |
|------|---------|-------------------|-----------------|
|------|---------|-------------------|-----------------|

| | | | |
|--------------------|--|--|---|
| Construct validity | Identifying correct operational measures for concepts being studied | <ul style="list-style-type: none"> • Use of multiple sources of evidence • Establish chain of evidence • Have key informants review draft case study report | <ul style="list-style-type: none"> • Use of interviews and Documents as multiple sources of evidence • Review of draft report by key informants |
| Internal validity | Seeking to establish a causal relationship as distinguished from spurious relationship | <ul style="list-style-type: none"> • Do pattern matching • Do explanation building • Address rival explanations • Use logic models | <ul style="list-style-type: none"> • Explanation building • Use of logic models |
| External validity | Defining the domain to which the study finding can be generalized | <ul style="list-style-type: none"> • Use theory in single-case studies • Use replication logic in multiple-case studies | <ul style="list-style-type: none"> • Use of replication logic in the multiple-case projects selected |
| Reliability | Demonstrating that the operations of the study can be repeated with the same result | <ul style="list-style-type: none"> • Use of case study protocol • Develop case study database | <ul style="list-style-type: none"> • Use of case study protocol • Development of case study database |

8. CONCLUSION

This paper has presented the need to deepen the understanding of the problem with public construction procurement in Nigeria, in-terms of achievement of value for money, through a research design that employ the case study strategy. The implementation of Nigeria's Public Procurement Act (2007) to public construction procurement over the years has achieved little in-terms of its aim for achievement of value for money. Existing knowledge of this problem have mainly relied on evidence from literature review and quantitative survey of experiences across a number of projects over some period of time. There is currently lack of in-depth qualitative understanding of why the implementation of the PPA (2007) to construction procurement is achieving limited success in terms of achievement of value for money and how it may be improved. This paper posits that there are prospects for deeper understanding of this problem by investigating through the case study research strategy. The rationale for this position comes from the advantage the case study strategy offer for gaining rich understanding of context and process on contemporary set of events. A profound rich picture understanding of the barriers limiting the achievement of value for money based on a real-life project context is necessary and could lead to suggestions on how future improvement can be made. And that is the niche of the case study strategy.

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SCALING UP HOUSING MICROFINANCE FOR INCREMENTAL BUILDING A CASE STUDY OF MICROFINANCE BANKS IN NIGERIA

O. Aturamu and G. Wood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: O.B.Aturamu1@edu.salford.ac.uk

Abstract: Providing financing options for low income earners is one of the most complex challenges faced by financial institutions worldwide. Low income earners require financing options to meet their basic needs such as housing however, accessing finance for housing purposes remains a critical issue and many households struggle with obtaining access to housing finance. Nigeria is no exception and has over the years grappled with huge housing deficit with a rapidly growing population and requires a minimum of an additional one million housing units per annum to avert a housing crisis in the country. The inability of low income earners to access formal forms of finance and the extortionary terms of informal finance for the low income earners have provided a strong need for innovative approaches such as housing microfinance. However, with a few exceptions, most Nigerian Microfinance banks don't offer housing finance mainly because they are small in size, region specific (concentrated in the south) and with a limited collective outreach and there remains a need to scale up their operations. Adopting a qualitative research methodology, this paper finds three major variables which deter the scaling up of housing microfinance with the housing policy being the fixed variable on which the other variables depend. For there to be a scaling up of housing microfinance, there has to be an overall growth of the microfinance industry with the Government integrating housing microfinance into the current housing policy while microfinance institutions form partnerships with the formal financial institutions to mobilise deposits and reach out to a wider pool of borrowers.

Keywords: Housing Finance, Housing Microfinance, Housing Finance Policy.

1. INTRODUCTION

With over 186 million inhabitants, Nigeria is Africa's most populous country and over the past decade has achieved a stable and strong economic growth making it Africa's largest economy with its GDP accounting for 35% of Sub-Saharan Africa (STATISTICS 2014). Despite this, Nigeria trails its peers in Sub-Saharan Africa in essential infrastructures such as housing and has a very high rate of poverty and income inequality with about 65% of its population being classed as low- income earners (International Business Times 2015). With over 65% of Nigeria's population being classed as low income earners and being excluded from financial services for basic needs such as housing, (CBN, 2012) it is obvious that the housing sector needs urgent intervention to ensure that it functions efficiently. (Okupe 2000) and (Olayiwola, Adeleye et al. 2005) have identified one way of achieving this through the introduction of inventive products such as housing microfinance, which have been effectively adopted by other countries with similar macroeconomic indices. However, despite the vast potential of housing microfinance being used as an avenue for facilitating housing in other developing countries, it still exists on a very small scale and therefore has very little positive effect on housing supply in Nigeria and how to scale it up remains an on-going challenge within the microfinance sector. As at 2014, the number of MFI'S in Nigeria stands at 986

(CBN NIGERIA 2014) but despite this large number of microfinance banks focusing on low-income earners and their ability to access finance for various purposes, only the largest 7 of these banks offer housing finance as one of their core products (Mix Market, 2014). The market for Housing microfinance in Nigeria can potentially be much larger than the current portfolio suggests as it is estimated that between 10% and 33% of all microfinance loans given is applied to housing in some way whether directly or indirectly (Habitat for Humanity, 2013). This goes to show the existence of the market and its potential to facilitate new housing delivery on an incremental basis. For housing microfinance to fulfil its full potential as a strategy to meet Nigeria's housing shortfall, the constraints that actively and passively deter the growth and expansion of Housing Microfinance as a key component for housing finance must be overcome and the critical success factors which help in scaling up housing microfinance in other nations need to be identified and implemented. More importantly, there has to be an acceptance and support of housing microfinance as an effective route by which low-income earners can meet their housing needs. Drawing on interviews with management staff and loan officers of three selected microfinance institutions in Nigeria, the research will investigate and examine their views on factors which deter and affect the achievement of scale. This research adopts a qualitative approach using multiple case studies to explore the perspectives of identified stakeholders in microfinance banks and also combines an extensive review of literature on the challenges microfinance banks face both in the form of policy, processing and the public perception in providing housing finance to the low income earners in the society. The research focuses on some identified stakeholders in microfinance banks and uses a qualitative (interview) method to gain an in-depth understanding of their perceptions, opinions and experiences in the research area.

2. LITERATURE

Housing is a very crucial factor necessary for the development of any nation and many issues have been raised on this subject. (Onibokun 1985, Olotuah 2002) observed that housing not only acts as a physical construction of dwelling units but also performs three important functions such as material functions in terms of shelter provision, symbolic functions in terms of status or social class and the external functions which refers to the strategic location of housing in geographical space. In developed economies such as the United States, housing is financed mainly through mortgage financing and represents one of the largest components of the capital markets however in developing countries such as Nigeria, contrary to what can be obtained in developed economies, mortgage financing is an option that is largely under-utilized and the opportunities in the mortgage sector remains unexploited. Housing in Nigeria is characterized by various inadequacies which can be classified into qualitative and quantitative inadequacies (Oladapo 2006). The quantitative housing problem refers to the inadequate number of existing stock while the qualitative inadequacies refers to the condition and state of the housing stock and this can be equally enormous and complex. Several researchers have identified various reasons for the shortage of housing in Nigeria. (Akinmoladun and Oluwoye 2007) identified limited land supply and acquisition obstacles as major factors affecting housing supply in Nigeria while (Merrill and Mesarina 2006) identified finance as a major obstacle because low income earners (who make up majority of the population) don't get access to credit facilities for housing purposes. More recently, (Onu and Onu 2012) supported the view that even when there is available supply of land, access to the land is still very difficult because of poor access to credit facilities and finance. In Nigeria, housing is financed either through formal or informal sources of finance, (Adedeji and Olotuah 2012). Formal housing finance however does not reach majority of

those classed as low income earners due to various reasons such as complex procedures, insufficient financial resources, the inadequacy and sparse coverage of the banking network and the inadequacy of housing standards prescribed by banks for eligibility for lending. Most importantly, the formal financial institutions consider the low income earners as high-risk borrowers (Ferguson 1999). This risk is shown in the high interest rates charged which are often times not affordable by the low income earners. To therefore overcome the limitations brought about by the lack of financing options, housing microfinance has been identified as one of the options available to low income earners to access finance for housing purposes however, the potential role which it can play for housing needs has not been fully recognized and enough effort has not yet been put into studying how it can be scaled up to increase its outreach. (Otero 1999) defined microfinance as the provision of financial services such as savings, credits and other financial services (insurance and payment services) to low income earners while (Ferguson and Haider 2000) defined housing microfinance as small loans given to low/moderate income households typically for self-help home improvement, expansion and new construction of basic core units. (Daphnis and Ferguson 2004) also defined it as a discrete practice that intersects housing finance and microfinance as shown in Figure 1 below. It is said to be an intersection between microenterprise finance and mortgage finance because it shares the same characteristics with both microenterprise finance and mortgage finance.

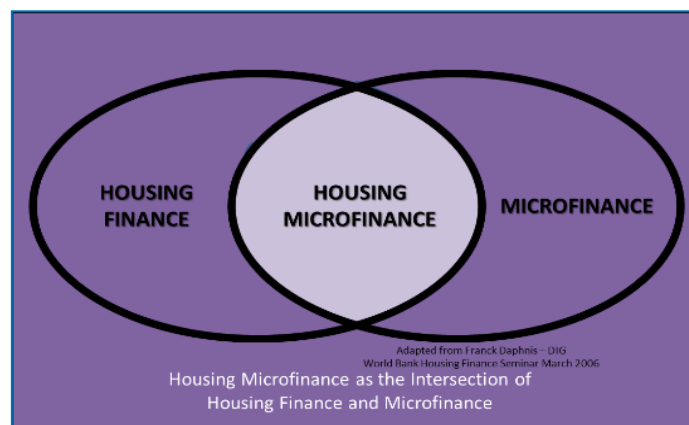


Figure 1: Link between Housing and Microfinance
Source: (Daphnis and Ferguson 2004)

Housing microfinance fits in perfectly with incremental housing whereby the lender provides funding for housing related issues in small loans sufficient to cover a specific housing phase. It is primarily the provision of unsecured microcredit, to meet the demand of low-income earners to either repair or improve their existing homes or build their own homes incrementally one loan at a time. It intersects both housing finance and microfinance while attempting to fill the existing gap that exists between government subsidy programmes and the traditional sector by adapting the principles of microenterprise finance. (Daphnis and Ferguson 2004) envisaged that the idea behind housing microfinance is to adopt the principles of microfinance to provide financial services that allow the poor and low income earners finance their housing needs. These principles are listed in Table 1 below:

Table 1: Principles of Microfinance
Source: (Daphnis and Ferguson 2004)

| |
|--|
| <ul style="list-style-type: none"> • Loans are relatively small amounts and are based on clients' capacity to repay |
| <ul style="list-style-type: none"> • Repayment periods are short (especially in comparison to mortgage lending) and |

| |
|--|
| are on par with mid- to high-end microfinance individual loans |
| <ul style="list-style-type: none"> • Loan pricing is expected to cover the long run operational costs of providing the service |
| <ul style="list-style-type: none"> • Loans are not heavily collateralized, if at all, collateral substitutes are often used. |
| <ul style="list-style-type: none"> • Loans tend to finance habitat needs in an incremental manner, with short repayment periods and relatively low monthly payments |

Incremental building accounts for 70% of all housing investments in Africa (AUHF, 2015). Building incrementally allows a household to put together its shelter needs, step by step as the finance becomes available. Housing microfinance fits perfectly with incremental building. It fills a real finance gap and adds value to the housing process of low income households and small home improvement or home construction loans can easily be applied to various incremental building activities, such as roofing, finishing units, extending and other tasks. Incremental housing facilitates access to housing options through a phased process whereby borrowers complete the construction of their homes through a series of small loans (Hasan 2010). However, for housing microfinance to be effective, it must be able to achieve a level of scale that allows it to be implemented sustainably. This can only be feasible in an environment where there is a vibrant informal housing sector with people already building incrementally such as Nigeria.

3. CHALLENGES FACING HOUSING MICROFINANCE

Several issues have been identified as deterring microfinance institutions from scaling up the provision of housing microfinance. Firstly, it has been observed that most microfinance institutions that provide housing microfinance operate on a small scale and only focus on housing improvements because they need a larger credit base for the land acquisition component. This is evident in a country like Nigeria that has 986 microfinance banks licensed by the CBN to operate within the country (Mix Market, 2011) with only 7 of them having the capacity to offer specific finance options tailored towards housing. Most Nigerian MFBs are small in size, region specific and have limited collective outreach. In addition to the relatively small scale of their operations, Nigerian MFBs also tend to have a narrow scope, offering only a limited range of financial services beyond credit. For housing microfinance to work, it has to respond to the needs of those in the informal economy and for a microfinance bank to operate successfully, it must be sustainable. (Ehigiamusoe 2005) opined that for a microfinance institution to attain sustainability, it must first of all operate efficiently. He argues that only efficient institutions can reach large numbers of people to make any impact on their standard of living. More recently, (Martin 2008) hinged the factors that limit the expansion of housing microfinance globally to be mainly risk related. He envisaged the factors to include: “the perceived risk of the market, the perceived risk of the product methodology and the bank’s operations. Long-term loans contribute to credit risk, because the longer the term of the loan, the higher the probability of defaulting borrowers. If the MFIs bear the cost of the risk, it will impose substantial cost on the institution such that it might not be sustainable in the long run and if passes this cost over to the borrowers it will increase the default risk as they may not be able to pay for this service. Also, financing long-term assets like housing, can lead to term mismatch especially when MFIs rely on deposits as their source of funding. This is especially true in developing countries like Nigeria which experience macro-economic instability, such that within a long loan term, inflation can rise and therefore may call for increase in interest rates to offset effect. Loan diversion is another risk which arises when customer use part or all their loans for purposes other than the intended purpose. How a client uses his or her loan

will affect the outcomes or impact that it can have. Understanding the clients' needs is also important so that services can be tailored, risks managed and impact maximised (Nelson and Nelson 2010). While loan diversion may be a serious risk to the microfinance bank, with regards to housing microfinance, it will distort the incremental building process hence lead to default of loans because housing does not produce income in the short term. (Mesarina and Stickney 2007) also discovered that the most important argument managers made to explain their reluctance to expanding their housing microfinance portfolio is because they believe the product not being explicitly part of their business or social mission. The institution's core business and mission is defined around the concept of financial services for microenterprises whereas housing microfinance is defined not as a loan for productive microenterprise purposes, but as a consumer loan. Having identified the challenges that microfinance banks face when offering housing microfinance options, it becomes critical to identify how these factors deter them from scaling up their housing finance options and develop a framework that can be used by various stakeholders to overcome this challenges and scale up housing microfinance.

4. METHODOLOGY

For a problem to be adequately investigated and a suitable solution proffered, the investigator needs to adopt a methodology that will help achieve its aim. This study adopts a case study research approach. (Yin 2009) defines a case study as “an empirical inquiry that investigates a contemporary phenomenon in-depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”. Case studies are useful where there is a need to understand a particular problem in great-depth with identification of case study areas rich in information (Noor 2008). It can either be a single or multiple case study which can include quantitative evidence, rely on multiple sources of evidence and benefit from the prior development of theoretical propositions (Bryman 2012). This research will base its approach on case study approach on a constructivist paradigm. The case study approach provided an opportunity to explore the problem statement within a local context and a multiple case study design was chosen to promote the richness, depth and complexity that will be drawn from multiple events which help in understanding the phenomenon of interest that is shared among the diverse cases. However, (Stoecker 1991) was of the opinion that a multiple case study risks reducing complex cases to a few comparable variables, resulting in the loss of the peculiarity of individual cases therefore to mitigate this risk, the study focuses on the three largest microfinance banks in Nigeria offering housing loans in line with (Creswell 1998) who suggests that no more than four cases be examined to allow individual cases to be adequately explored. Lagos state has the most number of microfinance banks in Nigeria (Mix Market, 2015), and over 93% of these microfinance banks have their head office in Lagos state mainly because Lagos state is arguably the most economically important state in Nigeria and the nation's largest urban area hence why it has the largest concentration of microfinance institutions. It is also the second most populated state in Nigeria and the most economically viable state in Nigeria. The three microfinance banks selected make up over 60% of the total customer base of all 7 microfinance banks that provide housing loans as a core product. The primary data obtained from these three microfinance banks is a representative sample of microfinance banks that provide housing loans and the selection of these banks was based on two different criteria namely the customer base and outreach. Figure 2 below shows the spread of microfinance banks in Nigeria

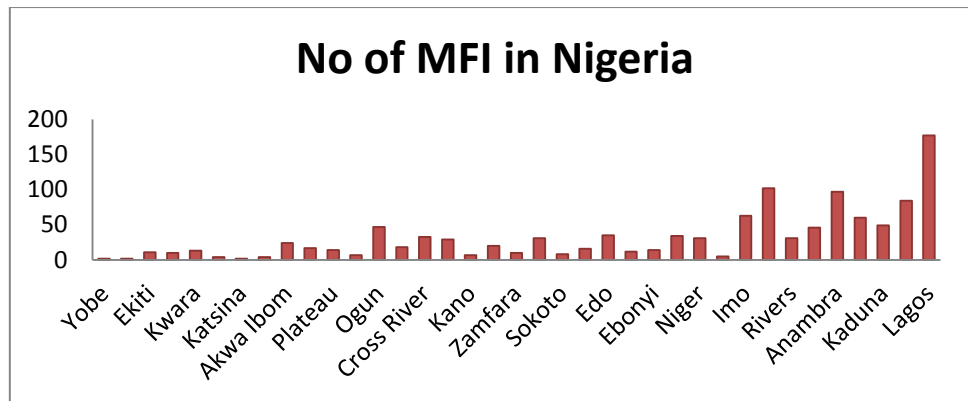


Figure 2: Spread of Microfinance banks in Nigeria
Source: CBN (2015)

Using face to face semi structured interviews, the selected staffs of the banks were interviewed in order to gain information that helps to determine issues limiting the scaling up of housing microfinance and this was deduced based on the perception and experiences of the management staff and loan officers of the microfinance banks. The information generated enabled the researcher to determine the challenges and barriers that deter the microfinance banks from providing housing loans directly or indirectly to low-income earners thereby limiting the provision and expansion of housing microfinance. The scope of this research is limited to 3 of the 7 microfinance banks which provide housing loans and have the largest customer base thereby providing a wider database on the lending and demand pattern of funds of these banks. Information for this selection was obtained from the Mix market. The Mix Market (www.mixmarket.org) is a data hub where microfinance institutions (MFIs) and supporting organizations share institutional data to broaden transparency and market insight. All the semi structured interviews were tape recorded and transcribed before the commencement of the data analysis. Conceptual content analysis was used for the data analysing process. All the transcripts were scrutinized carefully with the aim of identifying concepts related to the research questions. While going through the transcripts, they were broken down into meaningful content categories which related to a particular concept. A code was then assigned for each concept identified from the transcripts. When a concept is identified, a code is assigned from the provisional list of codes developed through theory or assigned a new code. This process was carried out in repetitive cycles until no new concept is identified. This process permitted the researcher to be more familiar with the interview transcripts and to generate new concepts from the text. The coding was done using descriptive key words where the key words were chosen from the original words and phrases used in the transcripts.

5. RESULTS AND DISCUSSION

From the interviews transcribed and analysed the following results were deduced. For all three microfinance banks, housing microfinance is not a core product which the bank offers rather it is a product which is added to the bank's portfolio mainly for customer retention. Figure 3 below reflects the reasons why the banks offer housing microfinance loans to its customers, the sources of funds and the target group of the banks.

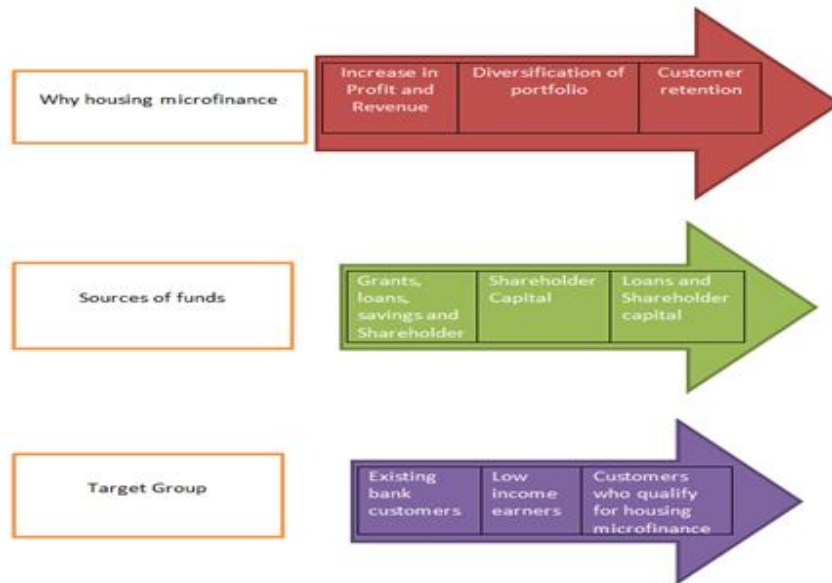


Figure 3: Sources of funds and Target Group of Banks
 Source: Field Surveys

Bank management staffs interviewed are of the opinion that the demand for housing microfinance is on the increase both in the rural and urban areas. They reasons they have given for this increase borders on increase in population , an increase in awareness on the part of the customers and an increase in general public awareness, the level of education of their customers and the corresponding knowledge about the lending system. Bank customers are becoming more aware of the option of housing microfinance and because these customers can neither want nor afford a large long-term traditional mortgage to purchase their houses, they are turning more to the option available to them which is housing microfinance. Also, more people are becoming aware of the importance of having a bank account and therefore come in contact with the bank officials who make them aware of the options available to them through the bank. From figure 8 below we can see there has been a reduction in the exclusion rate over the years from 53.0% in 2008 to 39.7% in 2012 so this confirms the views of the management staff showing that more people are becoming more aware of the importance of having a bank account hence the demand for housing microfinance is increasing because more and more people are also becoming aware of the option of housing microfinance.

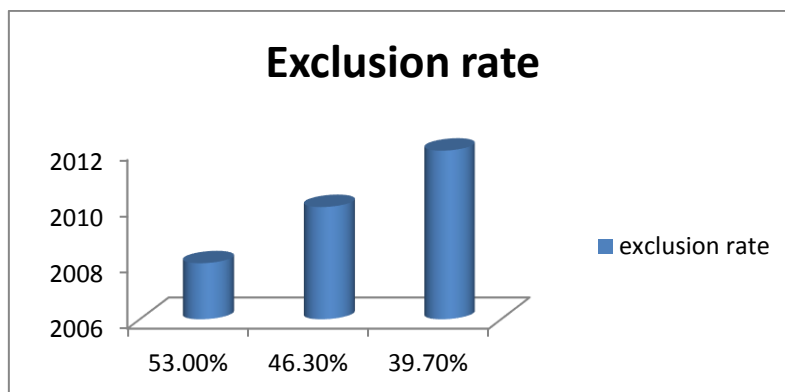


Figure 4: Exclusion rate in Nigeria
 Source: CBN (2015)

6. PRODUCT DIFFERENTIATION AND PRICING

From the interviews conducted with the management staff of the selected microfinance banks, it was discovered that there is no clear differentiation between housing loans and other types of loans as housing loans are still sometimes been classified as enterprises loan. The banks tend to have targets set out for them monthly and because housing loans can sometimes be difficult to process and approve, the bank staff tend to process enterprise loans as housing loans and the management staff have no issues against this as long as each branch meets its target for the month. In this case therefore, it is difficult to determine the current supply and determine if the supply is meeting the demand from the customers. From data gathered it was discovered that bank management refer to these loans as housing loans not because they are interested in providing housing loans to improve housing supply but rather to increase revenue for the bank and also retain the loyalty of their existing customers. So providing this housing loan deters customers from going to other microfinance banks that might be offering the service. Of the three banks selected, Bank A and C offer home improvement/construction loans while Bank B provides personal and business loans to its customers however what the customers use the loan for was entirely their own decision. Interest rate for home loans at the three selected banks was seen to be higher than that of all other loans. The managers interviewed indicated that housing loans tend to be less profitable than other loans such as business loans or enterprise loans because business loans have a higher turnover than housing loans. This goes to show that housing loans have not been identified as a core business objective of any of the banks. While the banks are looking for short term investment with profit maximisation, the customers are looking for long term loans with low interest rate to finance their housing needs. The managers are of the opinion that if the government can include housing microfinance in the policy, prioritise housing related issues and provide subsidies to microfinance banks (like what is presently applicable with agricultural intervention fund which is accessible through commercial banks in Nigeria) this could help reduce any potential loss of capital by the microfinance bank (arising from the risk of default loans) thereby making the banks more willing to give out more housing loans to its customers. Also it will enable the banks reduce the interest rate being charged on housing loans and if the interest rate is low, it will encourage customers to borrow more for home improvement and construction and will boost effective demand for home loans

7. PROCESSING OF LOANS/LENDING METHODOLOGIES

The average time identified by the management staff to process a housing loan is 25 days. The method by which the housing loans are processed and disbursed was found to be a bit cumbersome and time consuming. Loan processing and disbursement is handled by the operations department with the loan officers acting as front liners. As long as the customers fulfil all the eligibility criteria of the bank and fill out the application forms, the maximum processing time identified so far is 60 days. However, before the bank can even start to process any loans the customer has to produce documents such as the building permit etc. This can be very cumbersome and time consuming. Figure 9 shows the average time taken by the loan officers to process a housing loan. With all three banks, for a customer to qualify for a loan, he has to open an account with the bank and operate same for a minimum of 3 months. When the customer fulfils all the eligibility criteria, he/she then fills an application form where he/she attaches documents of the land or house he intends to build or improve. Completed loan applications forms are then submitted to a Loan Committee which then reviews the application based on the amount requested vis-a-vis repayment capacity of the

client. This is done using software where the net monthly income of the applicant is inputted and the monthly repayment is automatically generated. In instances where the client's monthly income cannot support the monthly repayment, the loan amount is reduced to an amount which is affordable by the customer. With all three banks, there was a consensus that the monthly repayment must not be more than 40% of the net income of the customer.

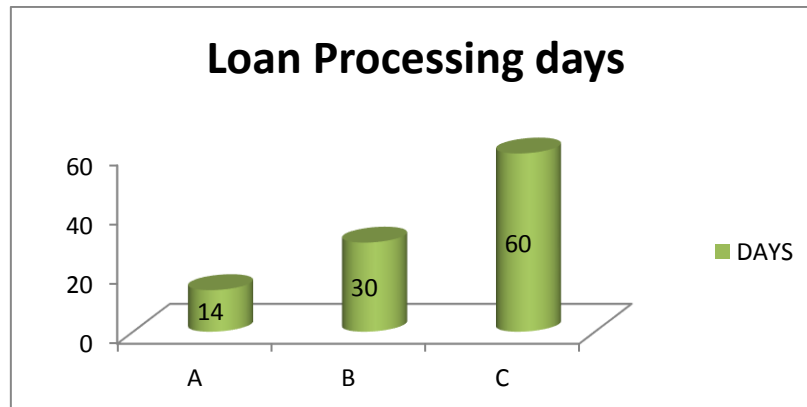


Figure 5: Loan Processing days
Source: CBN (2015)

When the loan officers were asked how long it took the bank to process the housing loans, the first respondent said it took 14 days, another said it took approximately 30 days and the other said it took nothing more than 60 days. The main reason for the time difference in the processing times can be attributed to the time frame it took to produce the required documentation and the time it took to verify the information provided by the customers due to lack of appropriate database and technology. The lending method adopted by all three microfinance banks is the individual lending methodology where loans are extended to individuals rather than a group. According to the management staff of all three banks, there was a general consensus that housing loans are extended to customers who are eligible for them and whose credit history has been determined based on the premise that these customers have previously been offered microenterprise loans and have been customers of the bank for over 3 months so a history and relationship has already been determined. Their views on this is that if a customer is eligible for an individual microenterprise loan and has the capacity to repay it, then it stands to reason that the same customer will be able to pay for the home loan as well. It is jointly believed that because all customers operate in different socio-cultural and economic conditions, it can be tedious getting people with different backgrounds and social setting to come together to form a group. Also because housing microfinance loans are for larger amounts compared to microenterprise loans and have longer repayment periods, using group lending methodology will not be a viable option because it will involve using peer pressure and group guarantee systems which imply holding the group collectively liable for repayment over a long time. This results into higher default risks as repayment fatigue can set in overtime. This supports the work of (Klinkhamer 2000) who opined that it is good practice to use individual lending methodology for housing microfinance rather than the group lending methodology due to the risks associated with the group guarantee system especially as loan sizes become bigger.

8. ELIGIBILITY, LOAN TERMS AND SIZES

From the interviews conducted, it was discovered that the criteria to be eligible for a housing loan depends on the customers current financial profile and therefore not very rigid. The eligibility criteria only acts as a guideline to ensure that the customers will be able to meet the loan repayment so as to avoid default risk. The eligibility criteria as stated by the management staff at all three banks tend to be similar. Information gathered from all three banks, it is shown that all potential customers must have been operating a savings account with the bank for a minimum of 3 months and be able to demonstrate the 5 c's of credit (capacity, collateral, capital, character and condition) Customers must be able to provide land documents (C of O) showing the ownership of the land where the proposed house will be built and provide a letter from a guarantor who will stand as surety for the loan when approved. This is to reduce the risk of default loans. This however limits the number of customers who are eligible for housing loans because majority of the customers cannot meet the criteria. One of the principles of microfinance is providing Loans that are not heavily collateralized, and if at all, collateral substitutes can be used. This isn't applicable though showing that banks are not operating as purely microfinance banks and hence missing their expected targets (low income earners).The repayment terms vary from all three banks. For bank A, three types of repayment are available daily, weekly and monthly repayments and the customer can select which ever option works best for him while at bank B repayment was fixed at a specific date each month and at Bank C repayment was monthly at any time during the month convenient for the customer however, one fixed issue amongst all three banks was that the repayment terms must not exceed the maximum duration periods agreed by the customer with the bank

9. LOAN SECURITY/UNDERWRITING

The strategies mainly used to secure loans for home construction by the three microfinance banks is grouped into two namely– savings and co-signers. These three banks provide home construction loans to two main categories of customers: Those self-employed and the salary earners who work either in the public or private sector but are classed as low income earners based on the level of their incomes. The guarantee required for self-employed customers is the savings they have in their savings account. As part of the eligibility criteria, savings is mandatory for this category of clients and as such a pre-condition for the disbursement of the loan. Potential clients must save at least an agreed percentage of the loan amount they intend to take and have to continue saving even when they have taken the loan. On the other hand, for salaried workers, the monthly repayment should not exceed 35% of the net monthly income and they are required to provide either co-signers or personal guarantors. Based on the views of the management staff at the three banks, providing guarantors for the loans helps to locate the customer should in case the customer defaults and decides to either relocate or abscond and the guarantor services the loan by repaying the loan he/she guaranteed should in case the customer absconds

10. STAFF TRAINING/TARGET BENEFICIARIES

An interview with the management staff revealed that credit officers were not employed based on any background relating to housing issues rather they tend to be trained on the job (learn on the job). Management staff observed that loan officers employed reported that

construction technical assistance should be made a condition attached to the housing loan. In their perspective, this will help in the monitoring of customers housing projects and help keep the customer in check. Monitoring of customers was found to be quite difficult because the bank staff saw it as extra work load which they had to do without any extra incentive. So rather than go from house to house checking up on the progress which the customers had made on their houses, they simply fabricated up results. They believe that if construction assistance was made compulsory, there will be an expert on ground to give advice and monitor what the customer is building and the progress being made. However, the management staffs see construction assistance as an unnecessary expenditure that will simply increase the cost of the loan which will then be transferred to the customer thereby making the housing loans even more expensive for the customer and could result into loss of profit for the bank. This cost can also deter customers from applying for housing loans as well. Data collected from the management staff of the microfinance banks indicates that the banks tend to target more of salaried staffs who are classified as low income levels based on the amount they earn. This goes to show that the microfinance banks are still not targeting the right set of customers. They believe the risk of targeting the self-employed will be too high. However, the essence of microfinance is to provide financing options for the low income earners.

11. LACK OF HOUSING SUPPORT FROM GOVERNMENT

There was general agreement among all participants that the Nigerian government does not identify housing as one of the core needs of the people. When asked about the government’s role in housing matters, the replies given by the respondents are listed below:

*Table 2: Responses from respondents
Source: Field Survey*

| | |
|--------|--|
| Bank A | Government is ineffective in providing support to microfinance banks who provide housing finance for low income earners |
| Bank B | The government is not interested in providing support for housing because it doesn’t see housing as a major issue in Nigeria. The government concentrates all its efforts on issues relating to oil and gas and agriculture |
| Bank C | Housing is not a major concern for the government. The government is not interested in long term projects because the govt. is so unstable. Housing needs time. The govt. has no time because the government can change at any time. This also deters investors who want to invest in Nigeria. |

Participants interviewed were of the opinion that until the government actually sees housing issues as a major cause of concern, the financing of housing through housing loans will never be recognised as a core product of any bank. An example of the importance the government places on agriculture was given .Based on the fact that Nigeria is a major food exporter the federal government provides commercial banks with Special credit intervention fund to fast track the development of the agricultural sector. Likewise it also provides Special intervention fund to provide low cost, long tenured funds to MSMEs to enhance their capacity for employment generation, economic development and inclusive growth. However, because the government doesn’t see housing as a major issue, there hasn’t been any provision of any intervention fund .Also, with regards to what they think should be done by the federal government to improve the process of incremental housing and microfinance, all the staff

interviewed were of the opinion that there should be new governmental housing programs incorporating the existing housing stock while two of the participants recommended the provision of services and utilities and advocated for an interest-free banking system and some flexibility in government policies.

12. RECOMMENDATIONS/CONCLUSION

From this study, it has been observed that though there is a great demand for housing loans, microfinance Banks are failing to meet this demand mainly due to lack of loanable funds and an aversion to risk taking. As a way forward, it is recommended that the government through partnerships with the private sector integrate Microfinance banks into the broader financial system so as to address the financial needs of the low income people. Similarly, it is also recommended that more microfinance banks diversify their loan products to include housing loans to tap into the lucrative market by extending the housing microfinance loans to more of their client's thereby increasing outreach. Scaling up will require increasing the scope (number of individuals reached), impact (effect on the well-being of borrowers), and depth (ability to reach the poorest of the poor) of microfinance banks. The emerging consensus from interviews conducted shows that to achieve a positive result in the scaling up housing microfinance will require deposit mobilization which can be facilitated through the commercialization of microfinance banks i.e. more MFBs transforming themselves into formal financial institutions, and commercial banks offering microfinance products. As housing microfinance expands, the level of government intervention and commitment must also increase. The government can obtain double benefit from supporting incremental housing. First it will increase the capacity of low income earners to find solutions to their housing need and secondly, it will lead to an improvement in the existing housing supply with minimum government intervention. The government should develop new schemes and finance options such as the introduction of an intervention fund which will help reduce risk arising from default loans to microfinance banks and will enable the microfinance banks increase their allocation for housing loans to construct houses for low-income earners. Government should consider low income earners when issuing loans and should introduce more lending organizations. All participants interviewed suggested the provision of services and utilities and advocated for an interest-free banking system while suggesting that some level of flexibility in government policies will be helpful. Low income earners tend to build their houses incrementally over time. However in Nigeria, the building codes are designed for the construction of complete homes, thus making incremental building difficult however, having a more comprehensive housing government policy could better support incremental housing expansion. It is also recommended that the federal government provide a national loan guarantee scheme which can be managed by microfinance banks .This has been done previously by the Federal Government through the provision of the of the agricultural Credit Guarantee Scheme Fund (ACGSF) which was established in 1977 in Nigeria (CBN NIGERIA 2014) for agricultural purposes. The Fund guarantees credit facilities extended to farmers by banks by up to 75% of the amount in default net of any security realized. If this can be implemented for housing microfinance, it will make it easier for low income earners to borrow money from the microfinance banks because the government is willing to underwrite the loans. This will then make the microfinance banks more willing to lend to the low income earners because they have less risk of losing the money. Scaling up housing microfinance will provide an option for the majority of the population who are classed as low income earners with options on how to build and finance their housing needs incrementally over time. It is submitted that if the Nigerian housing policy is modified to include housing microfinance and

the government provides an option to microfinance banks on how to reduce the risks involved in offering housing finance, housing microfinance can be used as an option of achieving the millennium development goal which is to provide adequate housing for all by the year 2050.

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FACTORS LEADING TO THE RENEGOTIATION OF PRIVATE FINANCE INITIATIVE (PFI) DESIGN-BUILD-FINANCE-OPERATE (DBFO) ROAD PROJECTS IN THE UK

A. Fatokun¹, C. Liyanage¹ and A. Akintoye²

¹ School of Engineering, University of Central Lancashire, UK

² School of Built Environment and Engineering, Leeds Beckett University, UK

Email: aofatokun@uclan.ac.uk

Abstract The renegotiation of Public Private Partnership infrastructure projects has not received public sector recognition because of the outcomes recorded over years. The stakeholders involved in the renegotiation of the PPP road projects have adduced numerous reasons. In some instances, the reason can also be the factor leading to the renegotiation of PFI (DBFO) road projects. Thus, a number of factors inform the decision of the primary stakeholders to renegotiate the contract. This paper, therefore, evaluates and assesses the factors leading to the renegotiation of PFI (DBFO) road projects in the UK. Qualitative interviews involving both public and private stakeholders were extensively adopted on five PFI (DBFO) case study road projects in order to address the aim of this study. This serves to complement the findings of the literature with respect to the factors leading to the renegotiation of PPP road projects. The findings of this research reveal the respective factors leading to the renegotiations of PFI (DBFO) road projects in the UK. However, the prominent factors are a change in scope of the works necessitating works removal and an addition of assets, change in standards and obsolete specification occasioned by the long duration of the PFI road project concession among others.

Keywords: Renegotiation, Factors, Private Finance Initiative (PFI), Design-Build-Finance-Operate and Road Projects.

1. INTRODUCTION

Governments of countries both developed and developing countries have been known to adopt PPP as a procurement method for the delivery of infrastructure projects including roads. This is due to the perceived merits of PPP over other modes of delivery of infrastructure projects. However, despite the many merits of PPP, several challenges have been found to militate against the benefits obtainable from the adoption of this procurement method among which are issues surrounding the renegotiation of contracts in PPP concessions, especially in the road sector. Hence, this paper critically reviews renegotiation of PPP in the road sector by identifying and assessing the factors leading to the renegotiation of PFI (DBFO) road projects in the UK from the experiences of five case study projects.

2. RESEARCH METHODOLOGY

This research adopts both secondary and primary sources of data collection as methodology adopted for the research. Related renegotiation literature was reviewed and serves as an extension to the initial study of Fatokun et al., (2016), which identifies and categorise the factors influencing the renegotiation of PPP road projects in their respective order of

literature prominence. Few kinds of literature attest to renegotiation experiences in the context of the UK (Makovsek et al., 2014). This paper, therefore, evaluates and assess through an extensive review of the literature and an empirical study of 5 PFI (DBFO) road projects the respective factors leading to the renegotiation of UK PFI (DBFO) road projects. Nine respondents provide answers to the well-designed interview questions targeted at eliciting information on the reasons and factors leading to PFI road projects renegotiation.

Therefore, the interviews questions are administered on both private and public sector stakeholders involved in the PFI (DBFO) road projects. The reason for this is the preliminary studies conducted, which reveal that both private and public sector are privy to the renegotiation information and are parties to the PFI road projects renegotiation process. The findings based on the Nvivo analysis of the renegotiation reasons are listed in accordance with the decreasing order of significance and prominence as shown in the succeeding sections of this paper.

3. LITERATURE REVIEW

3.1 Criticisms of Private Finance Initiative in Infrastructure Projects Delivery

The PFI has been criticised because of its inability to deliver VfM for the public sector. This criticism has led the UK government to introduce a refined and advanced form of private financing known as PF2. Ballati & Douglass (2013) and HM Treasury (2012) identify the numerous weaknesses of the projects delivered through PFI procurements, which led to the introduction of PF2 as follows:

- The implementation process of projects is slow with the consequential impact of huge financial costs to the public sector evidenced in reduced value for the taxpayer and for example a high payment for the government in the case of shadow toll roads.
- Lack of transparency of the process particularly in the estimation future liabilities and investor returns.
- Inflexibilities of the PFI contracts, though it has its attendant merits and difficulties in making contract alterations during the operational period.
- Requirements for the payment of higher risk premium by the public sector due to the high level of risk transferred to the private sector.
- High worry by public sector stakeholders on nature and true value for money on the projects based on the high perception of the gain attributable to the equity investors and concessionaire over the life cycle of the projects.

Based on all the enumerated points coupled with the impact of the renegotiation as identified by numerous literature, the use of PFI in the delivery of infrastructure projects has witnessed unsuitability of its application in the delivery of the objectives of the government in infrastructure projects procurements including roads (HM Treasury 2012). Value for money has been identified as a procurement issue in various policy documents and literature. Indeed, several other kinds of literature have identified other issues limiting the prosperity and advancement of the PFI. These issues are related to incomplete contracting, project abandonment, cost and time overrun, and renegotiation (Guasch et al., 2014; Nikolaidis, & Roumboutsos, 2013).

One of these factors is the renegotiation of PPP contracts. Renegotiation is considered important and major because of the high incidences witnessed over years especially in the

road sector of Latin American countries, Spain and Portugal etc. These high incidences have had enormous implication VfM at the respective implementation point of infrastructure projects particularly water and road sectors (Guasch et al., 2014). However, in the context of the UK, there will be a level of significant implication on the transport sector since the sector attracts 26.40% share of UK total infrastructure projects (IFSL, 2009). Hence, the motive of the renegotiation in the context of DBFO road projects, which constitute larger percentages of financial outlay in the UK PFI allocation and delivery (Akintoye, 2009).

3.2 Concept of Contract Renegotiation in PPP Road Projects

A greater percentage of literature bordering on renegotiation in PPP infrastructure projects identifies various definitions of renegotiations. Notable among these definitions of PPP contract renegotiations are those provided by recent PPP renegotiation studies (Guasch et al., 2014; Sarmiento, 2014). A change in the original contractual terms and conditions between the public partner and private party under a mechanism defined in the contract can be referred to as renegotiation (Guasch et al., 2014). A renegotiation could also be agreed in a concession contract when there is a significant and major change or amendment of the original contract. (Nikolaidis & Roumboutsos, 2013). These infer that renegotiation of PPP road projects is usually premised on certain changes some of which usually leads to the amendments of the terms of the original contracts.

Contract renegotiation in PPP infrastructure projects is requested at the instance of one or both of the main parties to the DBFO road projects i.e. the public client and the concessionaire or SPV. However, the literature confirms that most PPP renegotiations especially in the water and transport sector are mostly initiated by the private enterprise and are particularly premised on certain cogent reasons and factors (Xiong and Zhang, 2014). The factors necessitating renegotiations are best known to the private sector of PPP road projects and include among other things the followings discussed in the succeeding sections.

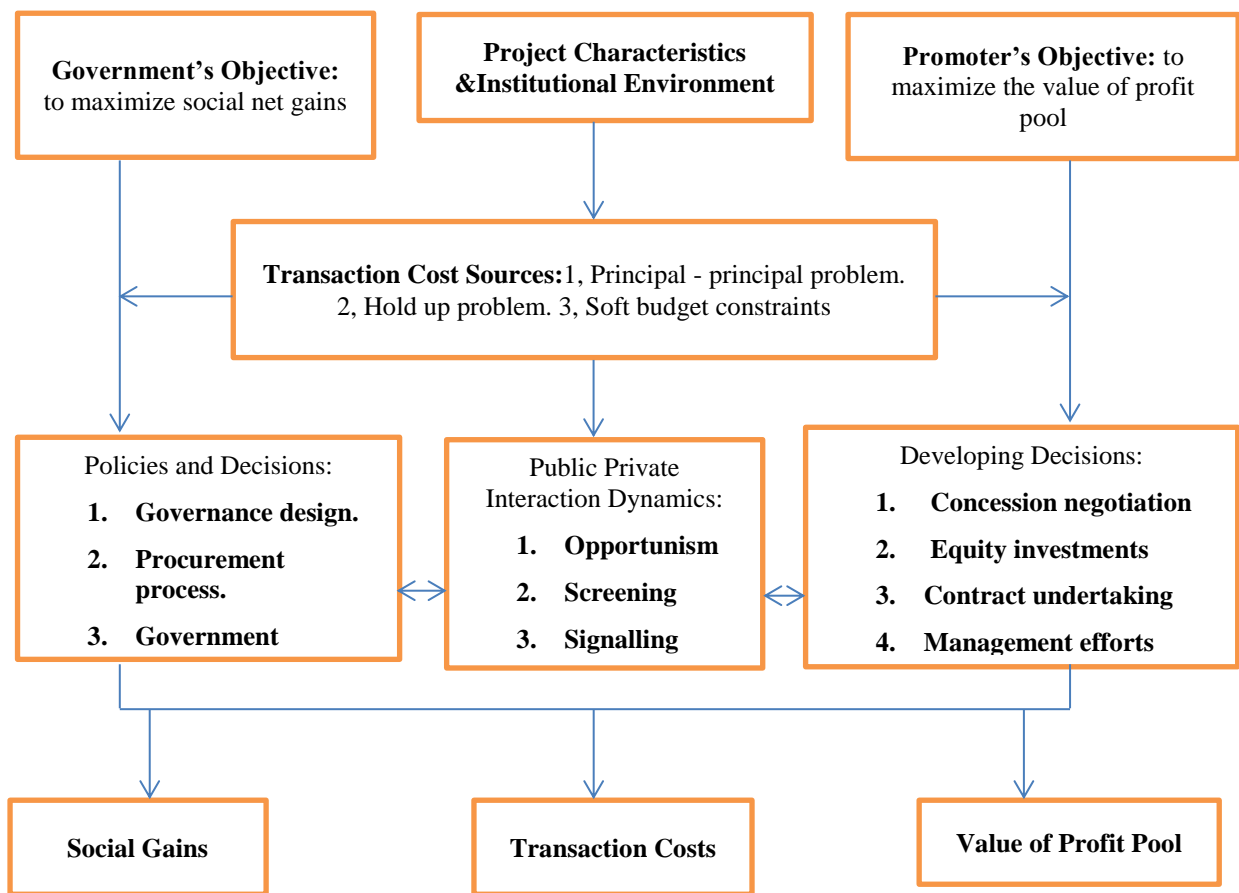
3.3 Theoretical Perspectives of the Reasons for the Renegotiation of PPP Road Projects

Therefore, there are several motives or reasons for the renegotiation of PPP projects (particularly roads) as identified by notable academic literature. Though certain factors drive renegotiation, there are, however, reasons why stakeholders may want to renegotiate a concession contract. Nikolaidis & Roumboutsos (2013) state that there are cases of transport PPPs contract incompleteness, which arises as a result of misallocation of traffic revenue, contractual risks over the period of concession with the resultant effects of PPP contract renegotiations. Thus, misallocation of traffic revenue and contractual risks, which may not be foreseen at the time of forming the contract are reasons for PPP contract renegotiations.

Furthermore, certain reasons are identified from recent studies among which are: traffic overestimation; the inflexibility of the contract, which have the tendency of constraining the ability of the private sector to manage project risks: construction preference of the private sector rather than operation responsibilities and the dislike of voters with regards to toll charges (Acerete et al. 2010). The private sector intent and motive in initiating infrastructure projects with the sole aim of gaining maximum profit has been identified as one of the reasons for contract incompleteness as well as the failure or bankruptcy of the project (Bi & Wang, 2011). This shows that poor estimation of traffic (over or under traffic estimation),

poor contract design, construction risks, inadequate or poor project planning, inordinate contract preference and profit maximisation motive by the private sector, project bankruptcy and dislike of toll charges by users are factors leading to the renegotiation of PPP infrastructure contracts.

Further studies conducted also reveal that traffic and revenue risks are a source of PPP contract renegotiations (Nikolaidis & Roumboutsos, 2013) while Ho (2006) aggressive bidding may be encouraged by the government when there is the willingness to renegotiate the PPP contract. Fig 1 support's this discuss and shows a clear picture of the process framework of PPP interaction dynamics between the public and private sectors as well as its effects on the outcomes of a PPP project, namely, social gains, transaction costs, and returns from the profit pool of the investment. The interaction dynamics logically shows the connection between the respective objectives of both partners in the PPP with the outcomes of the renegotiation.



*Fig 1: The Process Framework of PPP Interaction Dynamics
Source: Ho & Tsui (2009)*

The summary of fig 1 is that the respective transaction costs sources can impact the respective objectives of the partners through any of the PPP interaction dynamics. As indicated in the factors leading to renegotiation of PPP road project, transaction cost ranked highest, which can either have consequential effect on social gains by the public sector or the value of the profit pool by the private sector. However, in most renegotiation cases, the public sector benefits have been found to be negatively impacted.

Trebilcock & Rosenstock (2015) also classified the reasons for renegotiation into four categories: the tendency of the private party to lower tender cost during the bidding stage of competitive tendering, opportunistic behaviour, and lower demand on the road network and unexpected changes on the project. The changes in the project environment could be related to economic, environmental, political etc., which could have an effect on the outcome of the projects social gains (Fatokun et al, 2016). Because of these changes amongst others, the private sector players have generally argued that the behaviours of the private party within the project environment have resulted in making PPP road projects commercially unviable. Further reasons for the renegotiations of the DBFO roads are the defective design of the contract, government failure in honouring contractual clauses and ineffective regulations.

Conclusively, opportunistic behaviour by private players, increase in tariffs, loss of sanctity of contracts, undermining of competitive bidding principles and reduction in the general welfare of the people due to increase in costs of goods and services are some of the major concerns of PPP renegotiations Trebilcock and Rosenstock (2015). Governments also use bilateral renegotiation processes as a means to grant unfair benefits to private players at the cost of the welfare of the public or for political gains. Therefore, both the private operator and the government can use renegotiations as a means to gain unappropriated or unfair means. Thus, government opportunistic behaviour can manifest in terms of increase in infrastructure spending on the ground of paying adequate attention to public welfare, which according to (Engel et al., 2006) increases the government's popularity among the electorate and by extension, its chances for a re-election.

In addition, governments also use renegotiations overspend and exceed the provisions of the budget. However, this action has been contested based on the non-achievement of value for money for the public organisation, (Guasch et al., 2014; Adair et al., 2011, Engel et al., 2006). Thus, from the foregoing arguments, it could be revealed that renegotiations could also be as a result of government's opportunism in contrast with previous submissions that private parties' opportunism drives renegotiation of PPP road projects. Table 1 shows the literature evidence of the reasons for PPP road projects renegotiation.

Table 1: Literature Perspectives on the Factors Leading to the Renegotiation of PPP Road Projects

| S/N | Reasons for the Renegotiation of PPP Road Projects | Ho (2006) | Guasch et al. (2014) | Xiong and Zhang (2014) | Gifford et al., 2014 | Cruz & Marques | Menezes and Ryan (2013) | Bi and Wang, (2011) | Montecino & Saavedra(2011) | Baeza & Vassallo (2010) | Chan and Levitt (2009) | Beckers et al. (2010) | Engel et al. (2009) | Zhang (2001) | Ho and Liu (2004) | Sarmiento (2014) | Number of Citations | Ranking of Citations |
|-----|---|-----------|----------------------|------------------------|----------------------|----------------|-------------------------|---------------------|----------------------------|-------------------------|------------------------|-----------------------|---------------------|--------------|-------------------|------------------|---------------------|----------------------|
| 1 | High transaction costs | v | | v | | | | | v | | | | | v | | | 5 | 1 |
| 2 | Significant and unfavourable change in conditions e.g. project cost and market demand | v | | | v | v | | | | | | | v | | | | 4 | 2 |
| 3 | Consideration of high service charge to the users | | v | | | | | | | v | | | | | | v | 3 | 3 |
| 4 | Opportunistic bidding | | v | | | | | | | | v | | | | v | | 3 | 3 |
| 4 | Incomplete contracts & obsolescing bargain | | | | v | | | | | | v | | | | v | | 3 | 3 |
| 5 | Departure of contract from expected outcomes | v | | | | | v | | | | | | | | | v | 3 | 3 |

| | | | | | | | | | | | | | | | | | | |
|----|--|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|----|
| 6 | Inordinate profit maximisation by the SPV | | | | | | | v | | | | | | | v | | 2 | 7 |
| 7 | Problem of information asymmetry or inadequate awareness of project scope | | | | | | | | v | | | | | | v | | 2 | 7 |
| 8 | Corrective motive in consideration of business reputation | | | | | v | | | | | | | v | | | | 2 | 7 |
| 9 | Bankruptcy of Special Purpose Vehicle | | | | | | | | | | | | | | v | | 1 | 10 |
| 10 | Time overrun as a result of delays | | | | | | | | | v | | | | | | | 1 | 10 |
| 11 | Cost overrun e.g. (construction cost) | | | | | | | | | | | | | | v | | 1 | 10 |
| 12 | Lack or inadequate compliance with agreed terms | | | | | | v | | | | | | | | | | 1 | 10 |
| 13 | Departure from contract terms due to the existence of transaction costs etc. | | | | | | v | | | | | | | | | | 1 | 10 |
| 14 | Operational and major cause (e.g. force majeure) | | | | | | | | | | | | | | v | | 1 | 10 |
| | Total Number of Citations | 3 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 7 | 33 | |

As shown in Table 1, several reasons motivate the primary and main stakeholders to request for renegotiation of PPP road projects. Ho (2006) substantiates these by stating as follows *"In PPP, financial renegotiation may happen when project cost, market demand, or other market conditions become significantly unfavourable"*. Hence, contract incompleteness could necessitate renegotiation because of strategic and non-strategic factors (Gifford et al., 2014). These factors considered strategic and non-strategic fall in the respective categories: design and planning, technical, economic, regulatory, environmental, tendering and bidding, administrative and managerial etc. The categorisation is, therefore, based on the renegotiation experiences of Latin America, Greece, Portugal and Spain amongst few others (Fatokun et al., 2016). However, in the context of the UK, the profound factors leading to PFI (DBFO) road projects renegotiation fall under the technical and additional works categories, where strategic actions become necessary during the implementation of the road projects. Hence, these technical factors and others necessitating the renegotiation of UK PFI (DBFO) road projects are fully discussed in the next section.

4. EMPIRICAL FINDINGS

4.1 Factors Leading to the Renegotiation of PFI (DBFO) Road Projects in the UK

Several factors have been identified as leading to the renegotiation of UK PFI (DBFO) road projects. The findings of the study reveal that the renegotiation of PFI DBFO road projects is based on a change in standards, changes in specification and additional works in their respective decreasing order of significance. The additional works entail the removal and the addition of roads infrastructure assets, which according to respondents XY1 is stated as follows: *"in order to comply with the contract; they will be renewing old technology that didn't suit our needs. So, we decided to take it out"* Hence, certain assets have to be removed on this project thereby necessitating renegotiation.

Further findings reveal that renegotiations experienced on the case study projects are based on the changes in standards of works, changes in specifications, additional works, which entails the removal, and the addition of roads infrastructure assets and change in scope of works. Therefore, the renegotiation is due to changes in the standards and specification of works and assets. The essence is to keep up with the current and best standards occasioned by the obsolescence of the specified standards because of the long duration of the concession contract. Hence, renegotiation should provide VfM benefits to all the stakeholders especially the public who have been found to be on the losing end in most renegotiation experience. respondents XY2 substantiate these by stating that all changes on the PFI road project should

be "A VfM change on the network". The renegotiations also seek to address the shortcomings inherent in the written contract as indicated by XY1.

All these reasons are premise on the VfM benefits for the members of the public through the provision of a safer road, journey time reliability amongst other benefits. The respondent's identity and case study projects are coded as shown in Table 2 to maintain the anonymity and confidentiality as indicated at the time of data collection. In addition, the respective verbatim transcriptions as analysed in the NVivo version 11 software shows the references of each of the nine respondents from the five case studies as presented in the extract of the NVivo analysis sheet in Table 2.

Table 2: Extract of the NVivo Analysis Sheet

| Code | Reasons Adduced for Renegotiation |
|------------|---|
| XY1 | <p><Internals\Interviews\CS1 XY1> - § 2 references coded [3.51% Coverage]</p> <p>Reference 1 - 1.76% Coverage</p> <p>XY1: Because the way the contract was written, a 1998 specification when it was set in tune. CCTV since 1998 has changed a lot since then. In order to comply with the contract, they will be renewing old technology that did not suit our needs</p> <p>Reference 2 - 1.75% Coverage</p> <p>XY1: Take it out rather than figure a contract change, which would have been more expensive. Me: Which means the initial specification did not fit the present needs?</p> |
| XY2 | <p><Internals\Interviews\CS2 XY2> - § 4 references coded [3.41% Coverage]</p> <p>Reference 1 - 1.33% Coverage</p> <p>XY2: Yes, so, there was always going to have to be a negotiation there. It was always put in as an option in the contract but it was never or not in a detail, there has not to be a renegotiation of the contract. The fact that the scope of work change from what was originally intended makes that renegotiation slightly more complicated when drawn out than what was originally anticipated.</p> <p>Reference 2 - 0.82% Coverage</p> <p>XY2: From my perspectives, in that case, the major construction works, let's start with them, there is obviously a time and value element to that as well as various other factors such as safety, quality, environmental etc.</p> <p>Reference 3 - 0.52% Coverage</p> <p>XY2: No. Because we are looking at it from the cost neutral perspective. Each change obviously has a reason. There is a reason for each change to take place.</p> <p>Reference 4 - 0.74% Coverage</p> <p>XY2: In every case, there will be a benefit. A VfM change on the network. So in terms of actual change coming about. There will be VfM criteria set and achieved. Then the actual renegotiation will always be cost neutral.</p> |
| XY4 | <p><Internals\Interviews\CS2 XY4> - § 2 references coded [2.68% Coverage]</p> <p>Reference 1 - 1.65% Coverage</p> <p>XY4: For the latter upgraded sections, we change the DBFO; we added assets that were not part of the original contract. There is a need to renegotiate the main contract. We also changed the way in which the road operate. In some sections, we removed the hard shoulder, which essentially in changing the way the SPV provide services in the respective locations.</p> <p>Reference 2 - 1.03% Coverage</p> <p>XY4: Ehm, the latter upgraded sections were envisaged at the inception and in principle and stated in the major contract that this is how you will price them. So, that was only the large change that was specifically referenced in the contract.</p> |
| XY3 | <p><Internals\Interviews\CS3 XY3> - §Reference 1 - 1.07% Coverage</p> <p>XY3: It is based on standards and the current practice. It is to try to keep up with current standards and best practice.</p> <p><Internals\Interviews\CS3 XY3> - §Reference 2 - 1.50% Coverage</p> <p>XY3: It is to try & keep up with current standards and best practice. Some of the DBFO's that were signed prior to that in the 90's,</p> <p>Reference 3 - 0.45% Coverage</p> <p>Some of the standards are merged into the 1996.</p> |
| XY5 | <p><Internals\Interviews\CS3 XY5> - § 1 reference coded [1.35% Coverage] Reference 1 - 1.35% Coverage</p> <p>XY5: It was due to the experience they have had on other PFI projects where the standards were frozen and the projects basically has 30 years' duration date.</p> |
| CS4 XY6 | <p><Internals\Interviews\CS4 XY6> - § 4 references coded [2.20% Coverage]</p> <p>Reference 1 - 0.34% Coverage</p> <p>XY6: Yes, changes in standards and also, we introduced those changes in 2009 and we negotiated it with Highways England to modify the contract to introduce the change in standards.</p> <p>Reference 2 - 0.15% Coverage</p> <p>XY6: Why we did it. Again, as I say it is because standards change.</p> <p>Reference 3 - 0.73% Coverage</p> <p>XY6: So in terms of change in standards. In 2010, when we included the enhanced service from 1997 to 2010 there have been 400 changes of standards.</p> <p>XY6: In the design manual, the Highways England have said lot of things about that. They have spoken about the standards that superseded the previous standard because of the change.</p> <p>Reference 4 - 0.98% Coverage</p> <p>XY6: the standards to us is been reviewed and new technology ahh and basically when they review the standards they look at the new technology introduced and have a look whether they provide VfM. In addition, the Highways England do that on behalf of the Secretary of State or Department of Transport. They will review those standards, ascertain whether introducing those standards will produce a safer road for the travelling public, and provide some sorts of VfM for the taxpayers. That is what is done.</p> |
| XY7 | <p><Internals\Interviews\CS4 XY6> -</p> <p>XY7: As the standards have changed, then we become aware of the difference and if the PFI contract requires certain sections and</p> |

| | |
|-----|---|
| | <p>element needs to be maintained. Then that will be when we will try to take the opportunity to look at the idea of funding the difference. Therefore, it is within the maintenance regime.</p> <p>XY7: Because the new standards are trying to make the road more consistent with the standards that are operating on the rest of the strategic road network.</p> |
| XY8 | <p><Internals\Interviews\CS5 XY8> - § 1 reference coded [0.40% Coverage]</p> <p>Reference 1 - 0.40% Coverage</p> <p>XY8: The contract is under code and agreement with Transport Scotland and that affected the scope of the works and obligation.</p> |
| XY9 | <p><Internals\Interviews\CS5 XY9> - § 2 references coded [0.70% Coverage]</p> <p>Reference 1 - 0.14% Coverage</p> <p>XY9: I will say that they are nearly always political.</p> <p>Reference 2 - 0.56% Coverage</p> <p>XY9: Occasionally, we see a need to vary a specification or introduce a change in material and we the request as a company variation but it still has to be signed off by the Scottish minister. They still have to accept it.</p> |

Hint on Case Study Respondents:

- XY1:** Respondent one on Case study one (CS1)
- XY2:** Respondent two on Case study two (CS2)
- XY3:** Respondent three on Case study three (CS3)
- XY4:** Respondent four on Case study two (CS2)
- XY5:** Respondent five on Case study three (CS3)
- XY6:** Respondent six on Case study four (CS4)
- XY7:** Respondent seven on Case study four (CS4)
- XY8:** Respondent eight on Case study five (CS5)
- XY9:** Respondent nine on Case study five (CS5)

Summarily, the factors leading to the renegotiation of the PFI (DBFO) road projects in their decreasing order of significance are:

- Changes in standards of works.
- Changes in specifications.
- The addition of road assets.
- Change in scope of works.
- Response to provisions of the original contract.
- Need to ensure a safer road for travelling public.
- Changes in technology.
- Change in pricing and service.
- To provide VfM benefits for the public.
- Changes to the legislation and regulation.
- Adverse weather season e.g. winter months.
- Political reason to meet constituency demands.
- Poorly written contracts.
- Previous experience of other DBFO road projects.

4.2 Cross Analysis of the UK Findings and Cross Countries Literature Findings Factors Leading to the Renegotiation of PPP Road Projects

The identification of the respective perspectives of the literature on the factors leading to the renegotiation of PPP road projects based on the experience of other countries provides a basis for a cross comparison with the findings of the empirical study conducted in the UK. As enumerated in the preceding section, the detail and main factors identified by the nine

respondents from the five case studies at their respective significant level are shown in comparison with the findings of the literature in Table 3.

Table 3: Comparative perspectives of the Leading Renegotiation Factors

| Literature Perspective | | | | Empirical Study Perspective | | |
|------------------------|---|-----|------|---|-----|------|
| S/N | Reasons for the Renegotiation of PPP Road Projects | No. | Rank | Reasons Leading to the Renegotiation of UK PFI (DBFO) Road Projects | No. | Rank |
| 1 | High transaction costs | 5 | 1 | Changes in standards of works | 7 | 1 |
| 2 | Significant and unfavourable change in conditions e.g. project cost and market demand | 4 | 2 | Changes in specifications | 4 | 2 |
| 3 | Consideration of high service charge to the users | 3 | 3 | Addition of road assets | 4 | 2 |
| 4 | Opportunistic bidding | 3 | 3 | Change in scope of works | 3 | 4 |
| 5 | Incomplete contracts & obsolescing bargain | 3 | 3 | Response to provisions of the original contract | 3 | 4 |
| 6 | Departure of contract from expected outcomes | 2 | 6 | Need to ensure a safer road for travelling public | 2 | 6 |
| 7 | Inordinate profit maximisation by the SPV | 2 | 6 | Changes in technology | 2 | 6 |
| 8 | Problem of information asymmetry or inadequate awareness of project scope | 2 | 6 | Change in pricing and service | 2 | 6 |
| 9 | Corrective motive in consideration of business reputation | 2 | 6 | To provide VfM benefits for the public | 2 | 6 |
| 10 | Bankruptcy of Special Purpose Vehicle | 1 | 10 | Changes to the legislation and regulation | 1 | 10 |
| 11 | Time overrun as a result of delays | 1 | 10 | Adverse weather season e.g. winter months | 1 | 10 |
| 12 | Cost overrun e.g. (construction cost) | 1 | 10 | Political reason to meet constituency demands | 1 | 10 |
| 13 | Lack or inadequate compliance with agreed terms | 1 | 10 | Poorly written contracts | 1 | 10 |
| 14 | Departure from contract terms due to the existence of transaction costs etc. | 1 | 10 | Previous experience of other DBFO road projects | 1 | 10 |
| 15 | Operational and major cause (e.g. force majeure) | 1 | 10 | | | |

The findings of Table 2 shows that there is the comparable difference between the perspective of the literature and the findings of the empirical study. There is evidence of high transaction costs and significant changes in project costs leading to increasing user charges and high payment by the public client in the case of shadow and toll roads respectively. Other paramount reasons from the literature necessitating the renegotiation of PPP road projects are opportunistic bidding on the part of the concessionaire, contract incompleteness, departure from the expected contract outcomes, which may be due to the high transaction cost ranked highest etc.

These findings, which is based on other countries, differ considerably from the findings of the UK as most of the renegotiations experienced on the case study projects witnessed considerable changes, which borders on standards, the scope of works, specification, technology etc. Additional works at the construction and operational stages of the PFI (DBFO) road projects are also renegotiation-leading factors amongst others. Other reasons, which are considered main and positive that informs the decision of the public and private stakeholders to renegotiate the contract are the response to the provisions of the original contract, need to ensure a safer road for travelling public and to provide VfM benefits for the public etc.

5. CONCLUSION AND RECOMMENDATIONS

Certain issues have plagued the PFI as a method of procurement in the UK, which have necessitated government to make a paradigm shift to private finance 2 (PF2). One of the

issues is the non-achievement of VfM for the public sector as a result of renegotiation of infrastructure projects e.g. PFI road project. Though, the credibility of PPP renegotiation has been questioned across Latin American countries versed in the adoption of PPP for the delivery of road projects, Portugal, Spain and others. However, in the context of the UK, the reverse is the case as most of the responses reveal the achievement of VfM in PFI (DBFO) road project. Based on this finding, the emerging challenge, therefore, is to provide an answer to why some PPP road project renegotiations are not achieving VfM for the public sector. The results of the literature and empirical study on factors leading to the renegotiation of UK PFI (DBFO) road projects renegotiations reveals that there are different reasons why the respective contracts experienced renegotiations.

From the literature perspectives, renegotiations are premised on design and planning errors, defective regulation, opportunistic behaviours of the contracting parties, poor administration and management skills e.g. error in tender evaluation and management of the implementation process amongst others. However, the empirical perspective based on the findings of the study of the DBFO road projects in the UK reveal contrasting position premised on the fact that few of this reasons necessitate the renegotiation experienced on the case study projects. Thus, one can conclude that the factors leading to the renegotiation of PPP road projects or in other words, the reasons why the main stakeholders renegotiate the contract have an impact on the outcome achieved in terms of VfM criteria established for the contract. Based on this conclusion, the following recommendations become necessary:

- There should be a definition at the start of the contract the factors, which should lead to renegotiation and the factors, which should not lead to renegotiation of PPP road projects
- Renegotiation should only be requested when it is highly reasonable that that value for money will be achieved.
- There should be justifiable reasons, which is proved and tested beyond the reasonable doubt and agrees with the contract provisions.
- The changes proposed to the contract must be agreed by both parties to be value for money change at the point of the renegotiation and must benefit all stakeholders especially the road users and the public sector.

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DESIGN AND URBAN DEVELOPMENT

SAUDI HOUSING POLICIES AND PROGRAMS: A REVIEW OF THE PAST AND PRESENT IN LIGHT OF THE 2030 VISION

M. Alhajri, C. Trillo and D. Baldry

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: M.Al-hajri@edu.salford.ac.uk

Abstract: Saudi Arabia has experienced a high population growth with a high urbanization rate that has reached 80% resulting in an upsurge in the demand for housing and sharp increases in land prices and construction costs, particularly in urban areas. Saudi Arabia has introduced policies and programs to meet housing needs. This paper aims to discuss housing policies and program in Saudi Arabia as presented in the literature and published government reports before and within Five Year Development Plan until the present to have a comprehensive understanding of the housing sector in Saudi Arabia. Additionally, the paper will draw some conclusions and make some recommendations to meet the Saudi Vision 2030 concerning the needs in the housing sector.

Keywords: Housing Policies and Programs, Kingdom of Saudi Arabia, Saudi Vision 2030.

1. INTRODUCTION

Saudi Arabia consists of thirteen regions with a total area of 2,250,000 square kilometres. In the late 1940s the process of urbanization in Saudi Arabia started with the commercial production of oil (Al-Hathloul & Edadan, 1991). One of the major results of the oil discovery has been a massive increase in population especially in urban areas, which is reflected by the combined effect of a natural increase, a larger foreign work force, and migration from rural to urban areas in search of employment opportunities and improved living standards (Huang, 1985). Population growth is one of the essential factors affecting the housing need. Saudi Arabia has one of the highest birth rates in the region and its population has massively increased, rising from 7.01 million in 1974 to 22.67 million in 2004. In 2009, the population was 25.37 million, and in 2016 it was 31,742,308 people (Central Department of Statistics and Demographics, 2016). The population growth and size has implications on policy making to strengthen the public utility and service provision (Abdul Salam, Elsegaey, Khraif, & Al-Mutairi, 2014). Since the foundation of the Kingdom of Saudi Arabia in 1932, the government has implemented several housing programs and policies to ensure housing delivery. The main goal of the Government Housing Policy is to provide citizens with safe, and suitable accommodations (Al-Otaibi, 2006). This paper aims to discuss housing policies and programs in Saudi Arabia as presented in the literature and published government reports before and within Five Year Development Plan until the present in order to have a comprehensive understanding of the housing sector in Saudi Arabia. Additionally, the paper will draw some conclusions and make some recommendations to meet the Saudi Vision 2030 concerning the needs in the housing sector.

2. BEFORE THE FIVE-YEAR DEVELOPMENT PLANS 1932-1970

In 1932, King Abdulaziz unified the country as a new state. This new nation had no infrastructure or technology and its industrial base was non-existent. It also had no modern social, medical or educational institutions. There were shanty settlements in the central and eastern regions of the country and the economic base was different from one region to another depending on their location. The discovery of oil and the resulting production operations led to a change in the basis of the nation's economy. Many activities and services related to oil production were imported to the country through the east and west coasts: this was a new challenge and led to economic development, with an economic change from agriculture and nomads to an oil-based industrial nation. The first oil community was built in Dhahran in 1938, and subsequently Ras-Tanura became an oil industrial operation city. The urbanization rate had reached 10%. Like the trading route before oil production in the Arabian Peninsula, the construction of the 1200km TAPLINE (Transit –Arabian Pipeline) from Qaysomah in the eastern province of Saudi Arabia to the Sidon Port in Lebanon was the reason for new settlements in the country along this pipeline and near the oil pumping stations, and each of these settlements was self-sufficient (Al-Mubarak, 1999).

2.1 Housing Ownership Programs

The first housing program was introduced by Aramco (Saudi Oil Company) with the cooperation of the Saudi government in order to obtain and develop urban settlements and provide accommodation for Saudi employees working for the oil industry in 1953. The government granted lands and the company provided the Saudis with interest-free loans. The program granted a five-year rent plan for contractors, which aimed to encourage local contractors to build housing units in order to increase the supply of housing in the region. The requirement for these loans was to be an employee in the company for a minimum of four years and to continue working for Aramco until the loan was paid back. The candidate received the loan at different stages of the construction period (Tunclap and Al-Ibrahim, 1990). This was the first housing program in the country.

2.2 Al-Malaz and Al-Nassaryia Projects

Al-Malaz Project, was the first housing project by the Saudi government housing covered 500 acres, with 750 villas and three apartment buildings with 180 flats, as well as all required facilities and services, including public gardens, a race track, a football field, a public library and a public zoo, all of which were introduced to the city for the first time. Al-Malaz Project introduced new types of housing to the central region for the first time. Also, Al-Nassaryia Project developed a royal residential complex containing villas and residential buildings (Al-Hathloul, 1981). In addition, the government hired foreign expatriates to design this housing project and the villas and apartments were sold to the government employees on a long-term basis (Al-Mayouf and Al-Khayyal, 2011).

2.3 Land Grants

The founder of Saudi Arabia, King Abdulaziz, took settlement policies to the Bedouin and Nomads by settling them to control the country. They settled on land granted by the

government in small villages in rural areas. In 1954, the Ministry of Municipalities and Rural Affairs took the responsibility for developing land and authorized local municipalities in urban areas to grant free land to Saudi citizens. This policy granted a free residential land plot for every eligible citizen in his area of residence in a planned neighbourhood, whether a city or town municipality (Al-Mayouf & Alkayyal, 2011).

3. FIVE-YEAR DEVELOPMENT PLANS

A Five-Year Development Plan is a short-term comprehensive plan applied, and monitored by the Ministry of Planning and Economy to achieve the development in all parts of the country. It aimed to transform rural areas into urban and industrial societies by developing both the human resources and the physical environment (Al-But'He and Saleh, 2002). In addition, one aspect of the government concentration on the housing sector over the past decades was giving housing provision the utmost importance in five-year Development Plans. According to Al-Otaibi (2006), "It is useful to consider the implementation performance of the housing program through the Saudi Five-year development plan" (p5). Figure 1 represent key event that have influenced housing development in Saudi Arabia.

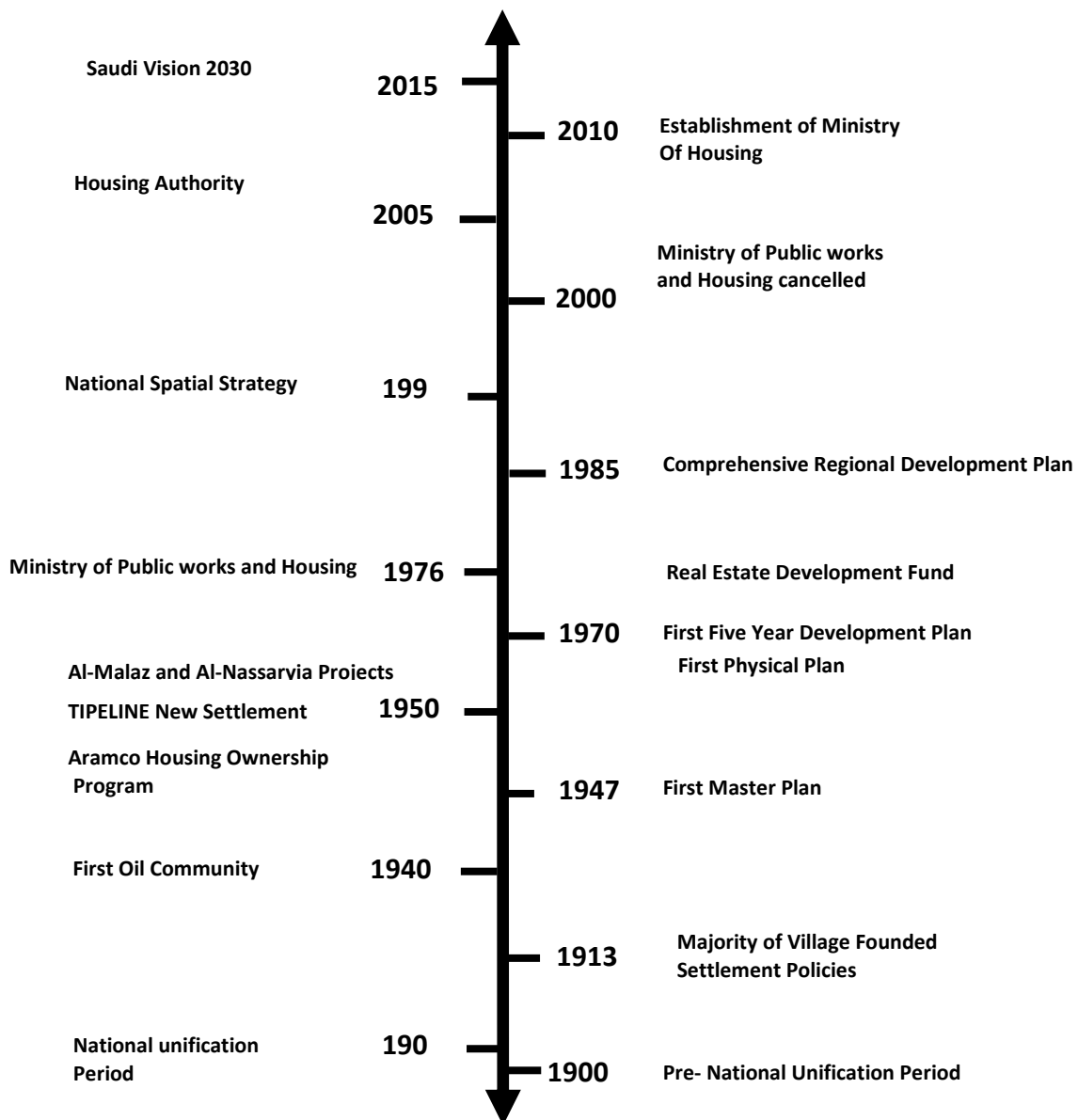


Figure 1: Key Events that Have Influenced Housing Development in Saudi Arabia

3.1 First Five Year Development Plan (1970-1975)

Urban development in Saudi Arabia began with the start of the five-year development plan in 1970. The Ministry of Municipal and Rural Affairs (MOMRA) carried out regional studies in five different regions to establish a physical plan. This was the first major effort at a national level to address local planning. In addition, for the housing sector, the aim was to upgrade the housing conditions of all urban and rural settlements in the kingdom by conduct a comprehensive housing inventory. This inventory helped establish an agency to fund housing, to obtain a model design for residential neighbourhoods, and to create a comprehensive housing program. During this period, 75,000 housing units were built, but the actual need - according to the first development plan - was 154,000 housing units. (Bahammam, 2002). Furthermore, at the end of the first development plan, the government established the Real Estate Development Fund (REDF), created to contribute to the establishment of modern housing and housing complexes in different parts of the country

(REDF, 2017). This was the first step to encourage individual citizens by providing funds, and it led to the construction sector being activated. On the other hand, when the Government Staff Housing Program started, many government agencies provided accommodation for some or all of their employees by developing their own local housing communities, which provided all necessary services and infrastructure for their residents (Bahammam, 2002).

3.2 The Second Five Year Development Plan (1975-1980)

The government also established housing programs in order to design and build housing for middle and low-income people, to identify eligible citizens, to collect payments from the beneficiaries over the long term (25 years), and to perform maintenance. In addition, there was a rush housing project by the public sector in Eastern and Western regions of the country. In the same year, MOMRA conducted seven master-plan projects in different parts of the country, which included the following cities: Jeddah, Riyadh, Dammam, Madinah, Abha, Jizan, and Taif (Al-Hathloul & Edadan, 1991). Furthermore, the main goals of the housing sector were to provide families with comfortable housing units that were appropriate for their income, to increase the supply of housing, to develop housing with regular urban forms, and to develop different financial legislative agencies to support housing development. There was a need for 329,000 units in different regions of the country during this period, where the public sector achieved 102% of the goal. The target of the second development plan was to build 52,500 units and the achievement was 53,600 units, while the private sector achieved 123% of its target. 122,100 units were needed and 150,000 were built (Second Five Year Development Plan, 1975). Therefore, the successful provision of the target number of new housing units can be attributed to three factors: the starter fund from the REDF in 1976 to provide public housing by the government, the provision of staff housing and the construction boom in the country during this period.

3.3 The Third Five Year Development Plan (1980-1985)

The housing need for this period was 730,000 housing units, including homes for new families and replacement housing for families who lived in poor housing conditions, or demolished and burned housing units. More than a quarter of families obtained modern housing units during this period. Also, housing projects from the Second Five Year Development Plan were continued, providing 15,853 housing units. New housing projects provided citizens with 10,000 units, as well as providing 14,800 land lots with connected infrastructure in fifteen different locations across the country (Bahammam, 2002). In addition, the Ministry of Housing and Public Work established three housing projects in the three major cities: Riyadh, Jeddah, and Dammam. In total, the three projects provided homes for more than 27,799 people. Furthermore, during this period a 1984 decree - issued by the council of ministers -encompassed the urban growth boundary of Saudi towns and cities for the next 20 years (Al-Hathloul & Mughal, 2004).

3.4 The Fourth Five Year Development Plan (1985-1990)

The government reviewed the housing policies and funding regulation from the REDF. By the end of this period, there were 871,700 housing units. 172,607 were built during the fourth development plan. The target was 285,000 housing units. This period came before the budget

deficit caused by the Gulf War in 1990, which led to a slowdown in development during the 1990s (Al-Mayouf & Al-Khayyal, 2011).

3.5 The Fifth Five Year Development Plan (1990-1995)

The following policies were established during the fifth development plan. Firstly, to review policies in the different government agencies related to the housing sector. Secondly, to limit the construction of housing from different government agencies. Thirdly, to develop applicable tools to enhance the housing conditions for low income people. Fourthly, to review the REDF regulations. Fifthly, to establish a national building code. Sixthly, to encourage the private sector to fund housing projects with cooperation from the REDF. Seventhly, to conduct an inventory of poor-condition housing.

Furthermore, the government established the National Spatial Strategy to achieve equality of development, based on the needs of the population of each region. At the end of the fifth development plan, there were 2,850,000 housing units. The private sector built 2,604,430 units, accounting for 91% of the existing units, and 20.9% of these units were funded by the REDF (Fifth Five Year Development plan, 1990).

3.6 The Sixth Five Year Development Plan (1995-2000)

The estimated housing demand during the sixth development plan was for the private sector to provide between 500,000 and 600,000 housing units, in cooperation with the REDF. The aim was to increase the level of home-ownership with the encouragement of the private sector. A total of 283,300 housing units were provided during this period. The total number of housing units at the end of this plan was 3,120,000, 92% of which were built by the private sector and 573,000 funded by the REDF. The public sector only built 8% of the total housing units constructed in the country during this period. There was a clear gap between the number of housing units and the population growth rate, which reflected the housing need (Al-Mayouf & Al-Khayyal, 2011).

3.7 The Seventh Five Year Development Plan (2000-2005)

The total housing demand during this five-year period was 800,000 housing units, and the goals of the housing plan were to have a national long-term housing strategy, to increase the supply of residential land lots with necessary infrastructures and services, and to reduce spending on planning, construction, and maintenance. In addition, it aimed to provide tools for the private sector to provide funds and to establish comprehensive sustainable housing projects. The total number of housing units built in the seventh development plan period was 300,000. Home ownership fell from 60% during the seventh development plan to 55%. In addition, there was a shortfall of 270,000 houses behind the target of the housing sector in the seventh development plan (Seventh Five Year Development Plan, 2000). During this period, the Ministry of Public Works and Housing was closed in 2003. This had built more than 25,000 housing units in the main cities, and it had been responsible for housing construction for Saudi citizens since its establishment in 1975, and aimed to fulfil housing demand (Sidawi, 2009).

3.8 The Eighth Five Year Development Plan (2005-2010)

The total number of housing units needed during this period was 1,000,000. It was also necessary to develop 280,000,000 square metres of land in different parts of the country as residential land lots. During the eighth development period, the goals were to provide housing units for every family that did not have one, and to increase the housing ownership rate. In order to achieve these goals, the following policies were established: to increase housing for low income people, to have different types of housing funds, to reduce the cost of construction and maintenance, to ensure that housing programs cover all parts of the country especially small towns, to enhance residential land management, to encourage the intervention of the private sector, to review housing codes and expand housing charity projects, to develop national housing strategies, to develop and implement a Saudi housing code, to prepare housing studies, and to conduct research and inventories, in addition to setting up a housing database. In 2008 the government established the General Housing Authority (GHA), which took over responsibility for all housing affairs from different government agencies (Al-Mayouf and Al-Khayyal, 2011).

3.9 The Ninth Five Year Development Plan (2010-2015)

The goals of the ninth development plan was to complete and start to implement a comprehensive housing strategy, to reduce and eliminate the widening gap between demand and supply of housing, to achieve intensive development and improvement of the housing sector, to develop and organize funding and lump sums, to develop regulations for renting rights for owners and renters, and to set up regulations to encourage private sector intervention in housing projects and programs. In addition, the plan for this period was to provide 1,000,000 housing units in different parts of the country and the aim was to enable the housing sector to provide comfortable residential units for the different classes of society in all regions (Ninth Five Year Development Plan, 2010).

3.10 The Tenth Five Year Development Plan (2015-2020)

This period aims to implement Housing National Strategy which aim to diversify the financial resources of REDF, to enhance housing fund and mortgage, to implement regulation which guarantor the rights of tenants and landlord, and to increase private sector participation. Furthermore, the plan for this period is to build 1,250,000 housing units (Tenth Five Year Development Plan, 2010).

In 2016, to meet housing needs and challenges that the housing sector faced, The Ministry of Housing applied several programmes as following (Ministry of Housing, 2016):

- **The Alaradi Albida Program** aims to increase the supply of developed land, to provide residential land with suitable prices, and to bring equality in the residential market.
- **The Wafi** program aims to encourage private developers by selling housing units at an earlier stage after the design or during construction, and the Ministry of Housing will be the guarantor.

- **The Masarat Tamalk** is a comprehensive program to study the beneficiaries' housing needs to provide them with suitable housing based on his/her social and financial situation.
- **The Etihad Almolak Program** aims to regulate the relationship between owners and occupants in the joint ownership of housing units.
- **The Eajjar Program** aims to develop the real estate market though providing a solution that is integrated between the landowner, the tenant, and the real estate agent with unified rental contracts and to provide electronic services via the Ministry of Housing system.
- **Etman** is a centre that provides all the services related to private developers. It provides all the data and requirements needed by private real estate developers in order to speed up the process that they are required to follow to conform to government requirements.

4. SAUDI VISION 2030

In 2016, The Saudi Arabian Government announced the new Saudi Arabia's Vision 2030, which is going to be implemented as a roadmap for economic and developmental action in the country. In its aim to grant the Kingdom a leading position in all fields, Saudi Arabia's Vision 2030 seeks to identify the general directions, policies, goals, and objectives of the Kingdom. Some ministries, institutions, and government entities underwent a restructuring process to align themselves to the requirements of this phase. In order to enhance the level and quality of services provided to beneficiaries; and achieve a prosperous future and sustainable development (Saudi Vision 2030, 2016). Saudi Government will seek to increase private sector contribution by encouraging investments, both local and international, in healthcare, municipal services, housing, finance, energy and so forth. According to the Saudi Vision 2030, even though 47% of Saudi families already own their homes, the aim will be to increase this rate by five percentage points by 2020. This would be a substantial achievement given the high increase in the number of new entrants to the housing market. The government plan to meet this target by introducing a number of laws and regulations; encouraging the private sector to build houses; and providing funding, mortgage solutions and ownership schemes that meet the needs of Saudi citizens (28). For the housing sector, the new vision is to establish and develop programs to encourage partnership between the private and public sectors in organizing, planning and monitoring housing for the different levels of the society with a reasonable quality and price (Ministry of Housing, 2016). Therefore, the new strategy is to transfer to public private partnership (PPP) in housing delivery

5. PUBLIC PRIVATE PARTNERSHIP (PPP)

The idea of Public Private Partnerships PPPs has been around since the seventies. There is no simple agreed-upon definition of the term PPP, which covers several models of operation including DBFO - design, build, finance and operate; BOOT - build, own, operate and transfer; and BOT - build, operate and transfer. Public private partnership (PPP) has been defined as "a partnership for construction, operation and maintenance, and service delivery of public projects by the private sector" (Chowdhury, Chen, & Tiong, 2011). PPP are now written into legislation in many countries like UK, USA, France, Italy, and The Netherlands (Bovaird, 2004). The change in the regulation of providing and maintaining public

infrastructure and facilities is now known as the New Public Governance (NPG) (Caperchione, Demirag, & Grossi, 2017). There are two key drivers in most countries for public private partnership: the activation of private sector funding for public service and the utilization of the expertise from the private company and their capital for massive investment. Because of the success it has had, public private partnership is celebrated as a viable alternative and strategy for creating and delivering public services to cities in the developing world (Miraftab, 2004). In addition, “governments around the world are turning to PPPs as one possible financing option for large scale investments in the provision of affordable housing and other basic infrastructure assets.” (UN-HABITAT, 2011).

In Saudi Arabia, the concept of partnerships with the private sector stated in official Saudi government documents from the late 1970s but there were no regulations or policies developed to until 2002 which was comprehensive framework to regulate the involvement of the private sector in the provision of water and electricity. Furthermore, study by Biygautane 2017 shows that there are seven major PPPs infrastructure projects in Saudi Arabia two of them were to build airports and other projects where in power and water planets. For example, in 2009 Prince Mohammad bin Abdulaziz International Airport, in Medinah was built under a PPP agreement. Therefore, in Saudi Arabia from the two pilgrim airports and, several independent water and power plants, PPPs have not been used in other high-profile infrastructure projects. Unlike Western countries, where PPP have been used occurs across a wide range of projects (Biygautane, 2017).

In 2016 the Ministry of Housing defined PPP as a long contract relationship between the public and private sectors to get the benefit of experience resources. The assets of both sectors will provide a service, and the risk is shared based on the partnership contract. In addition, the aim of obtaining PPP in the housing sector is to increase the supply of the affordable housing, reduce the cost, and motivate the private sector to develop new housing within a shorter time.

6. CONCLUSIONS

The series of five-year development plans was the government’s main instrument to steer the development of housing in Saudi Arabia. Housing units were provided by both the government and the private sector, with the support of the REDF. It is clear that at the end of the second development plan the number of housing units built met the target. This was also true of the third development plan. After the fourth development plan, the number of housing units lagged behind the target of planned housing delivery, and the present tenth development plan aims to achieve 85,6% of the total housing demand. Therefore, there has been a rapid increase in housing demand, reaching 154% since the first development plan, and the rapid growth in population did not coincide with the production of an adequate number of housing units.

The REDF is the main source of funding for housing in Saudi Arabia, and is considered the backbone of the country’s housing and real estate financial allocation. Furthermore, 1,026,083 housing units have been founded by the REDF. In addition, there has been a rapid increase in the number of applicants and the waiting list has now reached a wait of more than 15 years.

The intervention of the Saudi government in the housing sector has gone through various stages and formed different government policies. Different government ministries and

agencies, several of which have been cancelled or replaced by others, have applied these policies. At the beginning of this development, during the 1970s, the responsibility was held by the Ministry of Finance, and later by the Ministry of Housing and Public Works, as well as the Ministry of Social Affairs for housing for low-income households. In 2003, the Ministry of Housing and Public Works was closed. Later, in 2008, the government established the General Authority for Housing, which became the Ministry of Housing in 2010.

The government commitment to delivering housing units has been clear since the first development plan between 1970-1975, where the Saudi Government played the role of the founder, developer, and contractor in delivering housing. Since 1990, the number of housing units needed has sharply increased with every government's five-year development plan. The Ministry of Housing (2016) announced that in 2020 the total number of 1,250,000 housing would need to be built, to meet the housing demand. Therefore, to meet this demand the new government strategy is to shift from the role of provider to enabler and give the role of housing delivery to the private sector. It has become clear that the government alone cannot provide adequate housing and meet the housing need due to a lack of investment and a decrease in the housing budget (Salama & Alshuwaikhat, 2006). The government's new strategies to meet the housing need gives the private sector a greater role though PPP. However, the legal and regulatory framework for PPP is absent in Saudi Arabia (Biygautane, Hodge, & Gerber, 2016). In conclusion, to meet housing need with the new Saudi vision 2030, the government needs to create a supportive legal framework of PPP.

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CRITERIA FOR PUBLIC SCHOOL CONSTRUCTION IN POLLUTED ENVIRONMENT: A CASE OF THE NIGER DELTA AREA OF NIGERIA

U. J. Ogbonda and Y. Ji

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: U.J.Ogbonda@edu.salford.ac.uk

Abstract: The inhalation of poor indoor air due to infiltration of polluted outdoor air and its correlation to the health of schoolchildren and their academic performance has led to different guidelines and specifications considered as means to provide clean indoor air into the classroom for schoolchildren who spend 80% of their active times in schools. Yet this has not in any way been considered in the Niger Delta (ND) area of Nigeria where open air burning of gas emitting more than 200 anthropogenic substances into the environment is an everyday occurrence. The aim of this paper is to attempt to address environmental issues through the design of a performance specification that can be used to achieve clean indoor air based on developed standards and experts views centred on immediate environmental considerations for schools in polluted areas of Nigeria. Adopting a design science methodology and using open-ended self-administered questionnaire technique, this paper finds that immediate environment specific condition is significant for clean indoor air. Analysis showed that rather than rely on the Nigerian Building Code or the internationally acclaimed air limits recommended globally, the immediate environment should be considered in the selection criteria of some chemical substances due to activities carried out in the Niger Delta. Environment specific criteria that will enhance the choice of material, design and construction method used for school construction were therefore recommended.

Keywords: Air Pollution, Environment Specific Criteria, Niger Delta, School Building and Schoolchildren.

1. INTRODUCTION/ BACKGROUND

Most developed countries have regulations and guidelines for schools to follow in achieving clean air quality in schools. For instance, in the USA, the Clean Air Act (EPA, 2013) prescribes a management framework for indoor air that helps schools achieve good indoor air quality for the comfort of students and staff. The European Union (EU) has also implemented different indoor quality strategies to help in reducing health risk and provide comfort for the school environment (EFA, 2001). The London Sustainable Exchange (LSX, 2013) made specific provisions in their school curriculum where citizen science is taught in schools and out of school lessons are held in other to educate students, teachers, support staff and maintenance teams on the need for a clean environment. Recommended ventilation systems including both naturally by open window ventilation systems and mechanically by any device that will allow clean air into buildings with minimal energy have been stated (Bakó-Biró, Clements-Croome, Kochhar, Awbi, & Williams, 2012; Gao, Wargocki, & Wang, 2014). ASHRAE (2007) recommended an acceptable ventilation rate of 6.7 to 7.4 l/s – person. Other national guidelines specify other ventilation rates for classrooms. For example, the Portuguese Standard prescribes a rate of 8.3 l/s (Conceição & Lúcio, 2006), while Kim et al. (2005) reported that Swedish standards require 8 l/s per person.

In spite of the foregoing, the Nigerian Building Codes do not provide any standard or guidelines on indoor air quality (IAQ) for schools as section 6:2:4:1 of the Code provides that a minimum openable area shall be 4% of the floor area ventilated. This is complicated by section 6:2:5:1 which provides that it should conform to the specification as prescribed in the schedule by the manufacturers (FGN, 2006). Similarly, environmental guidelines as promulgated by the Nigerian Government Departments such as Federal the Ministry of Environment, Federal Environmental Protection Agency and others did not include any indoor air quality standards (FEPA, 1999; NESREA, 2010). As opined by Ladan (2013); Weli and Adekunle (2014), indoor air pollution is not yet a priority for the Nigerian Government. This is in spite of the preponderance of air pollution related illnesses ravaging the areas where gases are flared constantly in the ND. Similarly, ESCAP (2012) observed that developing nations are yet to embrace the updating of building codes as used in developed nations, by integrating environmental sustainability and specification details.

Therefore, proposing a performance specification as a reference document requires a methodological process that will provide the opportunity for systematic interaction of built environment professionals to aid the design of specification for the ND.

2. LITERATURE

The Oxford Dictionary (2008) defines air quality as the degree to which the air in a particular place is pollution-free. Air quality deteriorates mostly due to industrialisation; population increase, traffic and energy use as stated by Zhao *et al.* (2012), while EPA (2011) sums it up as the decrease in air quality because of pollution. According to the Tenth Report of the Royal Commission on Environmental Pollution, *"Air pollution is the introduction by man into the environment of substances or energy liable to cause a hazard to human health, harm to living resources and ecological systems, damage to structure or amenity or interference with legitimate use of the environment."* (P3 RCEP, 1984, p. 3). World Health Organisation (WHO, 2014) defined air pollution as the contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

Outdoor and indoor pollution cause respiratory and other diseases, which can be fatal (WHO, 2014). A chemical, physical or biological agent that modifies atmospheric composition resulting in air pollution could either be natural or man-made (anthropogenic) (Jacobson, 2002). Although several definitions have been outlined above, Daly and Zannetti (2007) opined *"One could claim that air pollution started when humans began burning fuels. In other words, all man-made (anthropogenic) emissions into the air can be called air pollution, because they alter the chemical composition of the natural atmosphere"* Daly and Zannetti (2007, p. 2). Based on the description above, possible deterioration effect of air quality would be said to result from the impact of gas flare causing air pollution.

Nigeria has thirty six states, with Abuja as the capital, of which nine constitute the ND situated at the zenith of the Gulf of Guinea on the west coast of Africa and on the Nigerian South – South geopolitical zone (NDDC, 2006) as designated on the map in different colours (figure 1). These 9 states namely; Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers as designated, spread across 185 local government areas.



*Figure 1: Map of Nigeria showing the ND in coloured patches
Source: NDDC (2006)*

Figure 1 represents the map of Nigeria with the 9 states in the ND denoted in other multiple colours. It is densely populated poor area representing 12% of Nigeria’s total surface area of 112,110 square kilometres with an average population density of 265 inhabitants per square kilometre.

There are over 18 multinational oil companies which are involved in oil and gas exploration and production in the ND (Poindexter, 2008). Nigeria has a gas reserve of over 110 trillion standard cubic feet (ft³), about ten times its crude oil reserves. In 1989, 617 billion ft³ of associated gas was flared, releasing 30 million tons of CO, at the end of 1999. Cumulative gas production in Nigeria amounted to ca. 27,795.22 barrels per standard cubic feet (Bscf) of which ca. 23,005.35 Bscf was flared representing 82.8% of the net gas produced (Malumfashi, 2007; Nwanya, 2011). These flared gases are mostly carbon black coloured as represented in figure 2. Accordingly, Nwanya (2011) affirmed that in ND about 2.5 billion cubic feet of gases are flared per day and has an estimated 106 trillion m³ of proven natural gas. However, the amount of flared gases could be higher than what is been estimated as observed by the Nigerian National Petroleum Cooperation (NNPC) in their 2014 reports (NNPC, 2014). This is because a significant number of oil companies exploring oil and flaring gases do not provide figures for the amount of flares thereby reducing the total amount of flares in the ND



*Figure 2: A Typical Gas Flaring Effect
Source: limits (2013)*

Figure 2 shows a carbon content of a typical flaring in the ND. The chemical composition of the exhaust of gas flares which impacts on air quality and subsequent health impact includes Volatile organic compounds (VOCs) and hydrocarbons (containing methane, ethane, propane and butane, ethylene, butylenes) (Kindzierski, 1999). Due to the adverse health impact of air pollution, the Department of Environment Food and Rural Affairs (Defra) in 2013 listed different pollutants harmful to the health of people as shown in table 1;

*Table: 1: Gas Flare and Health Effect Implications
Source: Defra (2013)*

| Pollutant | Health effects at very high levels |
|--|---|
| Nitrogen Dioxide, Sulphur Dioxide, Ozone | These gases irritate the airways of the lungs, increasing the symptoms of those suffering from lung diseases. |
| Particles | Fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of heart and lung diseases |
| Carbon Monoxide | This gas prevents the uptake of oxygen by the blood. This can lead to a significant reduction in the supply of oxygen to the heart, particularly in people suffering from heart disease |

The health impact of these pollutants as summarised in table 1 cannot be over emphasised yet they are the major chemical substances emitted from gas flaring in the Nigeria Delta where building is within 3 to 10km away from the flare site. Although research has shown that the intensity of these chemicals is between 0 – 3.5km from the flare sites, its effect goes beyond the estimated distance (Sonibare & Ede, 2009). The adverse health effect of these gases as emitted from flaring sites have also been affirmed by Ovuakporaye, Aloamaka, Ojieh, Ejebe, and Mordi (2012) in their research, provided empirical evidence showing that there are differences in matched values of ($p < 0.05$) significance. Their findings showed that residents in the gas flaring areas had reduced peak expiratory flow as the rate compared to children from the non-gas environment. Therefore, if this summation is true, what are the likely health implications of poor indoor air quality?

3. METHODOLOGY

In order to investigate a problem and proffer a solution, the investigator needs to adopt a methodology that will help achieve its aim. Therefore interacting with professionals practising through a methodical process in the study area is crucial where there is no documented evidence. According to Hevner (2007), design science (DS) is the process of organising, defining and solving problems systematically reaching that goal. It is the scientific study and creation of artefacts as they are developed and used by people with the goal of solving practical problems (Johannesson and Perjons, 2012). This method proffers solution for a recognised problem and represents its solution in a practical environment.

DS provides answers to design questions with the aim of designing to sustainability standards through a multidisciplinary integration and methods used for actualisation (Cross, 2006; Reich, 2013). Again, providing solutions to environmental issues and as opined by Ilstedt and Wangel (2013), there is good potential for using design science to explore and propose *changes* at larger scales, for developing prototypes on the basis of lifestyles rather than basing the speculation on technologies only. Accordingly, Simon (1996) noted that DS is

about how things have to be in order to fit certain design standards for efficiency. It is like envisioning the world where though the environment might be polluted adaptable measure could provide livable conditions. Adequate facilities are put in place so that the adverse effects do not have any economic, financial and environmental effects on people.

However, it is not another research strategy but a method, which uses a holistic approach to problem-solving in order to achieve a specific goal by means of a creation of an artefact (Johannesson and Perjons, 2012). Moreover, its uniqueness is its ability to create and implement a solution that is able to influence or modify a particular occurrence. Furthermore, (Van Aken, 2005), submitted that the core mission of DS is to develop knowledge that can be used by professionals. Also, Ogbonda and Bichard (2017) noted that the adoption of DS provides rigours and systematic process of valid information in a study where documented evidence is scarcely evident.

Therefore, due to the complex nature of the built environment and the over-dependence of the construction industry in Nigeria on the importation of building materials, geographically based specification will help with material selection, design and constructions. Using this method, this study recommends criteria that form specification requirements significant to building in the ND.

To ascertain the level of impact of gas flare on pupils, it is pertinent to get professional opinions of experts in the built environment, practising in the area using an open-ended questionnaire technique, which was carried out in an iterative system. This iterative system was conducted in different periods first in 2014 between the months of April to July and in 2015 between the months of January to February. One hundred and Twenty (120) open-ended questionnaires were sent out to the built environment professionals out of which, one hundred and three (103) questionnaires were returned. Professionals were asked to indicate on a Likert Scale, the impact of gas flare on air quality, the performance of children, and impact of Nigerian Building Code when designing schools.

4. RESULTS AND DISCUSSION

Table 2 shows the various responses, confirming that air around Gas Flare areas in the ND adversely impacts on health, and performance of pupils. Likewise, the Nigerian Building Code supposedly the tool guide for construction has a very low impact as responses showed its low impact on school design.

*Table 2: Impact of Gas Flare
Source: Field Survey*

| | 1 Very low Impact | 2 Low Impact | 3 Moderate Impact | 4 High Impact | 5 Very High Impact |
|---|--------------------------|---------------------|--------------------------|----------------------|---------------------------|
| Gas Flare Impact on Air Quality | 2% | 5% | 20% | 49% | 24% |
| Impact of Gas Flare on Pupils' Performance | 6% | 11% | 28% | 35% | 20% |
| Health Impact Associated with Gas Flare | 5% | 6% | 21% | 45% | 23% |
| Impact of Nigerian Building Code on school Design | 48% | 25% | 20% | 7% | 0% |

From table 2, the responses show that GF has a significant impact on the factors posed in the question. Based on the analysis, 2% showed very low impact, 5% low impact while 20% indicated moderate impact with 49% showing high impact and 24% very high impact. This is almost the same with the impact of GF on the performance of schoolchildren and health impact as respondents indicated that GF has significant impacts on the factors. However, this was different with the impact of the NBC on school design. Here respondents noted that the NBC does not play any significant role in the design of school buildings as 48% indicated a very low impact, 25% low impact, 20% moderate impact, 7% high impact and 0% very high impact. Therefore, from the analysis, it is pertinent that the activities carried out in the ND area cause pollution which affects the health of the children. Thus, the prescriptive specification system of the NBC provides professionals with justification due to the limitations and rigidity. This makes it a necessity for environment specific requirements that will allow professionals achieve clean indoor air in school buildings.

Further to the statistical analysis conducted, respondents were also asked to elaborate on their options ticked due to the open-ended nature of the designed questionnaire. Figure 3 summarises comments made by respondents confirming the results of the analysis carried out above.

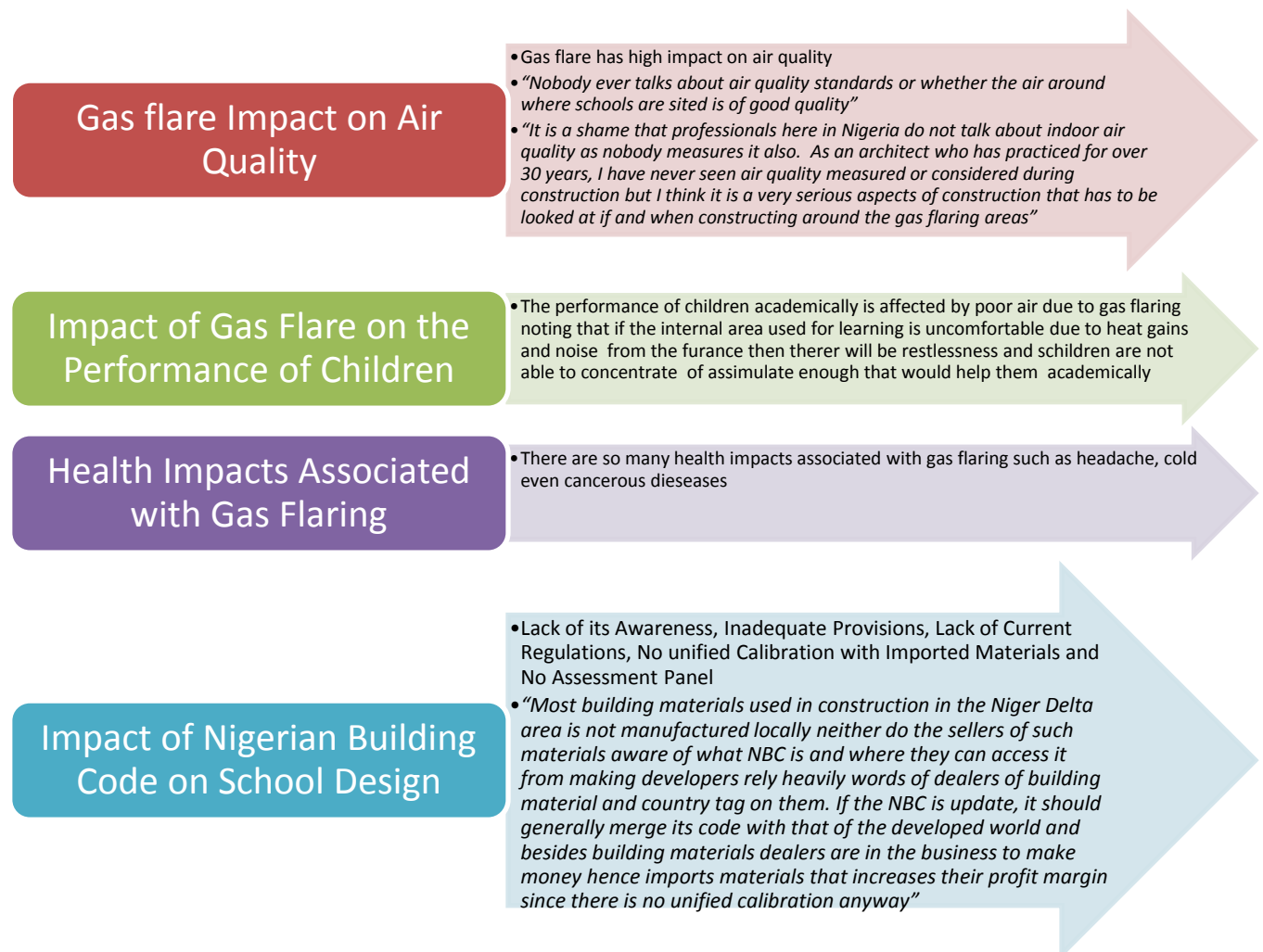


Figure 3: Gas Flare and Its Impact
Source: Field Survey

Despite the awareness that gas flare leads to health implications as confirmed by the field survey and the promulgation of different laws and regulations that should help in the total eradication of open air flaring and adoption of gas harnessing and rejection technologies. Nigerian has failed to tap into these advanced technologies, as affirmed by Oluduro (2012), Nigeria prefers to collect fines and levies from flaring companies. This shows that the country will continue to engage in this act as such other remedial actions which need to be explored as a measure to help reduce health hazards is a mirage. Thus the quest for performance base criteria for air quality limits as adopted internationally is proposed.

5. SOLUTION

The continued flaring of gases in the ND area endangers the life and health of children known to the most vulnerable. Therefore, to address environmental issues, the design of a performance specification that could be used as a guide during design; selection of materials and construction of schools is adopted. This is because most developed and developing countries have explored strategies of providing clean indoor air quality for the vulnerable through the use of performance specification to meet their different environmental needs. Thus the need to allow professionals in the ND provides requirements criteria for school building construction in the immediate environment based on climatic differences.

*Table 3: Iterative process for Air Quality
Source: Field survey*

| Performance requirements for IAQ Limits | 1 Strongly Agree | 2 Agree | 3 Partially Agree | 4 Disagree | 5 Strongly Disagree | 6 Not Known |
|--|-------------------------|----------------|--------------------------|-------------------|----------------------------|--------------------|
| Carbon Monoxide (CO) -15 mins – 100 mg/m ³ ; -1 hour – 35 mg/ m ³ ; -8 hours – 10 mg/ m ³ ; -24 hours – 7 mg/m ³ | 44.4% | 40.0% | 6.7% | 6.7% | 2.2% | - |
| Particulate Matter PM _{2.5} : 10µg/m ³ annual mean; 25µg/m ³ 24-hour mean and PM ₁₀ : 20µg/m ³ annual mean; 50µg/m ³ 24-hour mean | 31.1.0% | 44.4% | 20.0% | 2.2% | 2.2% | - |
| Ozone Limits O ₃ : 100µg/m ³ 8-hour mean | 11.1% | 46.7% | 31.1% | 2.2% | 2.2% | 6.7% |
| Nitrogen Oxide NO _x : 40µg/m ³ annual mean; 200µg/m ³ 1-hour mean | 2.2% | 4.4% | 6.7% | 37.8% | 46.7% | 2.2% |
| Sulphur Oxide SO ₂ : 20µg/m ³ 24-hour mean; 500µg/m ³ 10-minute mean | 31.1% | 44.4% | 11.1% | 4.4% | 6.7% | 2.2% |

| | | | | | | |
|---|-------|-------|------|------|------|---|
| Benzene 1µg/m ³ and 1 ng/m ³ (one Nanogram per millilitre) | 51.1% | 40.0% | 4.4% | 2.2% | 2.2% | - |
| Polycyclic Aromatic Hydrocarbon (PAHs) | 53.3% | 37.8% | 4.4% | 4.4% | - | - |

Table 3 shows analysis from an iteration process of chemical substances and limits adopted during the study. Centred on the analysis, responses showed significant positive responses from the limits provided in the table. Here the percentage of responses for CO showed minimum responses of 0% for not known and maximum response of 44.4% for strongly agrees. Similarly, PM had a minimum response of 0% for *not known*, a maximum of 31.1% of *strongly agree* and 44.4% of *agree*. O₃ had a minimum percentage of 6.7% of *not known* and 2.2% *strongly disagree* with a maximum of 11.1% *strongly agree* and 46.7% *agree*. Contrarily, NO_x had a maximum percentage of 46.7% of *strongly disagree* and 2.2% *not known*. However, SO₂ showed from analysis a minimum of 6.7% *strongly disagree*, 2.2% *not known* with a maximum percentage of 31.1% *strongly agree*, and 44.4% *agree*. Similarly, Benzene's minimum response showed 2.2% *strongly agree* and 0% *not known*. PAHs indicated the lowest minimum responses for *not known* and *strongly disagree* as it showed 0% respectively and had 53.3% *strongly agree* and 37.8% *agree*.

Therefore, having analysed information as provided by respondents, it was clear that although most developed and developing world adopts all limits provided. Professionals in the ND disagreed with nitrogen oxides and requested that leads as chemical substances should be added to the requirements provide based on the discussions below;

5.1 NITROGEN OXIDES NOX

Constituting part of the substances that are emitted from GF, NO_x impact negatively on air quality and are detrimental to the environment where ever they can be found. It is the sum of Nitrogen oxide (NO), Nitrogen dioxide (NO₂), and the reaction between nitrogen, oxygen and hydrocarbons result in the formulation of NO_x. Its impact on the immediate surroundings of the GF sites of the ND was investigated in this study details of which were captured earlier.

Assessing its effects on the environment, the majority of the respondents noted that the annual mean should be less than that specified in the designed PS and should reflect limits provided by the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN). According to them, serious deliberations have been ongoing on the limits as provided in the FEPA standards. These standards are known to lack improvements and hence fail to be representative of the ongoing trend in the developed world as a means of reducing GF effects. As described in table 1 and figure 3 the symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_x.

Furthermore, they are known to cause eye, nose and throat irritation, shortness of breath, and increased risks of respiratory infections. Its health implications can be enormous with as little as 30 minutes' exposure, hence implying a rather horrific impact on inhabitants of these GF vicinities. Thus the limits were refined to meet the EGASPIN guideline of NO_x: 40µg/m³ annual mean; 75-113µg/m³ 1-hour mean as compared to NO_x: 40µg/m³ annual mean; 200µg/m³ 1-hour mean.

5.2 Lead (Pb)

During the demonstration exercise, respondents noted that the designed PS was void of lead (Pb), which has greatly influenced the quality of air around Nigeria's Delta region. The experts, in reference to works done by (Ekpo et al. 2013; Ede and Edokpa 2015) noted that industries, together with regular petroleum exploration and exploitation, release trace metals into the atmosphere. This, therefore, steered the addition of Pb into the designed specification. However, there was a disparity in the choice of the limit to adopt. While some of the professionals had a choice of the WHO annual limit of $0.5\mu\text{g}/\text{m}^3$, others settled for a $0.25\mu\text{g}/\text{m}^3$ based on UK limits. Their decision was based on information such as the inhalation of lead (Pb) resulting in health risks like cognitive deficits, negative behavioural patterns (hyper activity/restlessness) and flu-like symptoms that include anorexia, vomiting and lethargy mostly in children. These health issues impact on their academic performance and number of out of school cases (Quillen (1993). According to WHO (2016), it is a cumulative toxicant that affects multiple body systems, including the neurologic, hematologic, gastrointestinal, cardiovascular, and renal systems. Children are particularly vulnerable to the neurotoxic effects of lead, and even relatively low levels of exposure can cause serious health issues and in some cases irreversible neurological damage.

Based on the advantages permitted by open-ended questionnaire, suggestions and comments made by respondents lead to the refinement and re-administration of the questionnaire as clearly allowed by the adopted DS method. This provides its effectiveness and validity for research purposes. Based on their comments information requested was added in the new requirement and analysis from table 4 shows the opinions of respondents.

Table 4 Analysis for the final Iteration on IAQ
Source: Field Survey

| Performance Requirements | 1 Strongly Agree | 2 Agree | 3 Partially Agree | 4 Disagree | 5 Strongly Disagree | 6 Not Known |
|--|-----------------------------|--------------------|------------------------------|-----------------------|--------------------------------|------------------------|
| NO _x : $40\mu\text{g}/\text{m}^3$ annual mean; $200\mu\text{g}/\text{m}^3$ 1-hour mean | 2.2% | 4.4% | 6.7% | 37.8% | 46.7% | 2.2% |
| NO _x : $40\mu\text{g}/\text{m}^3$ annual mean; $75-113\mu\text{g}/\text{m}^3$ 1-hour mean | 28.9% | 44.4% | 22.2% | 2.2% | 2.2% | - |
| Lead (PB) Annual limit $0.5\mu\text{g}/\text{m}^3$ (WHO) | 31.1% | 53.3% | 6.7% | 2.2% | 6.7% | - |
| Lead (Pb) Annual limit $0.25\mu\text{g}/\text{m}^3$ (UK) | 35.6% | 55.6% | 6.7% | 2.2% | - | - |

From table 4, the study only re-administered questions relating to requirements that did not meet respondent's criteria in satisfying clean air achievability in the ND. Therefore, it is evident that respondents were aware of these limits as indicated in the analysis and comments provided.

Following analysis of responses for NO_x, the result showed that respondents *strongly agreed* at 28.9%, *agreed* at 44.4%, *partially agreed* at 22.2%, *disagree* and *strongly disagree* having 2.2% each, and 0% *not known*. This is clearly different from responses in the iteration as illustrated in table 3 Wherefore NO_x analysis showed 37.8% of the responses *disagree* and 46.7% *strongly disagree*.

Similarly, Lead (Pb) which was added during the second stage of the iterative process was returned to respondents to provide their opinion on a Likert scale just as in the case of the other substances. However, respondents indicated two different air limits from WHO and UK guidelines. These limits were represented in the open-ended questionnaire and analysis from the responses showed the ensuing results: For the WHO guideline, 31.1%, 53.3% and 6.7% represented *strongly agree*, *agree* and *partially agree* respectively while on the contrary, 2.2%, 6.7% and 0% opted for the *strongly disagree*, *disagree* and *not known* options to 0.5µg/m³ respectively. On the other hand, the UK guideline and limit for Pb showed that 35.6% *strongly agreed*, 55.6% *agreed* and 6.7% *partially agreed*, while 2.2% *disagreed* with none *neither strongly disagreeing* nor indicating *not known* to the annual limit of 0.25µg/m³ as specified. Subsequently, the designed PS was adjusted to include Pb with an annual limit of 0.25µg/m³.

Therefore, these responses form a valid and complete adjustment to the criteria significant for clean indoor air in the ND area of Nigeria. Thus, confirming respondents' comments that show reasons for disagreeing with the PR as discussed in the solution section. No additional information was provided requiring refinement and adjustments for immediate environmental criteria forming a complete process for the IAQ.

6. CONCLUSIONS

This paper has argued that design of specification is presumably the idea guiding the design and construction of schools in the polluted areas of Nigeria. The continued reliance on outdated building codes and regulation as obtained in Nigeria will leave a lasting impact on the health of pupils seen as the future leaders of tomorrow. The continued inhalation of poor ambient air will lead to adverse health conditions that will hamper the health and academic performance of schoolchildren. The study has shown that performance specification will provide a geographically relevant and suitable strategy and climate-fit blueprint for construction in an area prone to environmental hazards. Thus, it is important that designing with performance specification rather than the National Building Code will provide the needed requirement to satisfy local criteria. It is submitted that if design and construction of schools are part of the responsibility of the government and a way of meeting the millennium development goal then the quality of air inhaled by children who spend most of their time in schools should be paramount in the design of schools in the ND.

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STRATEGY OF DEVELOPING A DIGITAL TOOL FOR COLLABORATIVE CONCEPT DESIGN

T. Jaraskumjonkul and M. Shelbourn

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: T.Jaraskumjonkul@edu.salford.ac.uk

Abstract: A digital tool for collaborative concept design is in process of development and implemented with design science research which is adjusted by using prototyping model for developing a digital prototype in a part of design and development. Prototyping model is the appropriate methodology due to small-scale development approach but lacks a phase for developing ideas for user interface and interaction. This gap can be filled by integrating a concept design phase supporting design in terms of user interface and interaction enhanced by creative and critical thinking before system design phase. The approach needs to elucidate and propose how to implement design of the prototype for achieving evaluation and usage of users in context. Design is discussed including constituent components so that designers or developers will understand and apply in problem solving aspect of concept design. In addition, it can be supported by tools of creative and critical thinking to generate appropriate solutions either. Thus, this paper aims to propose framing strategy of design and development for designer or developer to develop the digital prototype with the prototyping software development by understanding and analysing definition of design, concept design, and creative thinking, then, integrating these into the modified model.

Keywords: prototyping, concept design, design, creative and critical thinking

1. INTRODUCTION

Concept design stage is significant with original problems which can be solved and provide an opportunity for collaborative working in real time. A digital tool for collaborative concept design is in the process of development through the methodology of design science research. The research methodology consists of explicating the problem, defining requirements, designing, development, demonstration, and evaluation of an artifact which will need to be adjusted as part of design and development of a digital prototype. In software development, there are many types of approaches and an appropriate model will be selected and integrated into the research methodology. The selected approach identified is the prototyping model which will be considered, modified and applied for use in this research. Because it is suitable for developing a small scale of a digital prototype and only one or few developers in the development process. Therefore, the model will be modified by adding the concept design phase before the design phase for supporting the development of abstract ideas to concrete ideas for the design in terms of user interface and interaction.

2. GAP OF KNOWLEDGE

This paper identifies the knowledge gap as follows:

1. How to modify the prototyping model approach for developing a digital prototype for collaborative concept design?

2. What is concept design and what elements are concerned in design thinking?
3. How can concept design be supported by creative and critical thinking?

3. PROTOTYPING MODEL OF SOFTWARE DEVELOPMENT

Software Development Life Cycle (SDLC) follows important phases that are vital for developers such as planning, analysis, design, implementation and testing. Models of software development have been developed since 1970 such as waterfall, incremental, spiral, V-model, agile, and rapid prototyping (Balaji and Murugaiyan, 2012). These methodologies include complex phases “...based on iterative and incremental development...” and involved developers emphasizing management of documents and collaborative process within the team or across teams using such as waterfall, incremental, spiral, and V-model with the exception of prototyping. The prototyping model is more appropriate for developing a digital prototype due to the small-scale approach, which allows breaking the project into many segments, more ease-of-change including iterative modification during the process (Davis, 1992, and Centers for Medicare and Medicaid Services, 2008). As shown in Figure 1, the prototyping process starts with requirement, followed by system design, code and unit test, integration test, and software system test with each of these phases providing iterative loops. After software system testing of the final product, the prototype will be released to users and then problems or requirements can be reported to the developer. Some researchers have advised that prototyping can build the basis which can be converted into the final product in an entire software design process (McPhee, 1996).

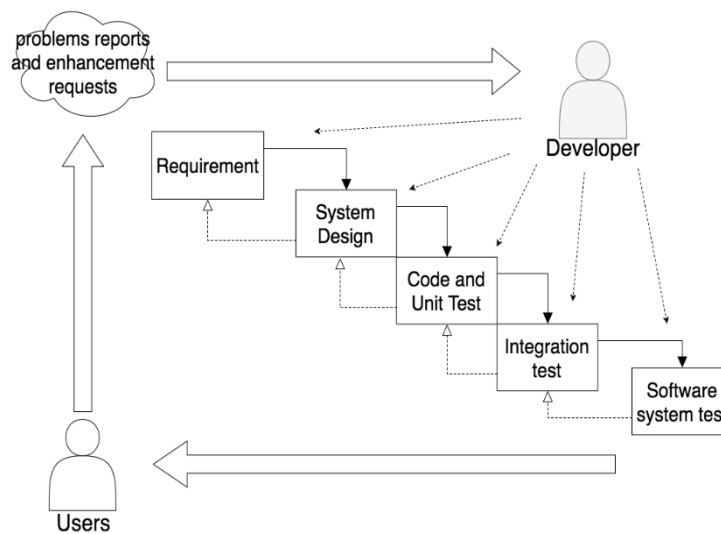


Figure 1: Prototyping model development (modified)
(Source: Davis, 1992)

Regarding with the prototyping model (see Figure 1), the requirement phase is the conclusion of user needs including identification of explicit problems, system specification and other requirements which the information of requirements is analysed to break into segments of a complex project, define interface, or build data schema in phases of system design. When segments of project are delivered within other phases, each segment can be built code and unit tested and, then, these segments will be checked for errors at integration test. After these segments are checked in the integration test, a final product, which is united with these

segments, will be tested in the final phase of software system test. At each phase it is possible to move backwards to the previous phase to improve problems that appear at a particular phase allowing any problem/s to be solved at the source.

User interface and interactive design are as significant as efficiency of the system design is. User interface and interaction will affect with users in terms of use and may present problems for users after releasing into the user's context. Lawson (2009) and many researchers pointed out the existing problem of digital tools in the United Kingdom (UK) Architecture Engineering and Construction (AEC) project in terms of complex user interface and interaction. Although the part of software design specifies "design", it is also a way for analysis and solving problems in the system (Waldo, 2006) and it is more scientific. Thus, this is reason that a concept design phase should be integrated into the prototyping model (Figure 1) to enhance the creative part of the approach in terms of integrating user interface design into the process to enable balance between design of the system and usage of user.

4. MODIFYING THE PROTOTYPING MODEL APPROACH FOR DEVELOPING A DIGITAL PROTOTYPE

Concept design can assist to develop ideas of user interface and interaction from understanding and analysing definition of design and concept design and including creative and critical thinking. The user interface and interaction design can be encouraged through creative and critical thinking in concept design. This leads to the proposal to develop a strategy for modifying the prototyping model (Figure 1) for developing a digital prototype for collaborative design.

4.1 Understanding design and concept design

A clear understanding of design and concept design is explored to appreciate components of design and function of concept design and justifying integrating concept design phase in the prototyping model approach.

"Design" was analysed and developed by Ralph and Wand (2009) from interdisciplinary fields of engineering, architecture, design, and science of design between 1964 and 2007 due to a lack of an exact definition. They proposed a conceptual model of "Design" with five components being critical such as goals, environment or context, requirement or needs, primitive or sub-ideas, and constraints which can become design problems in the design process.

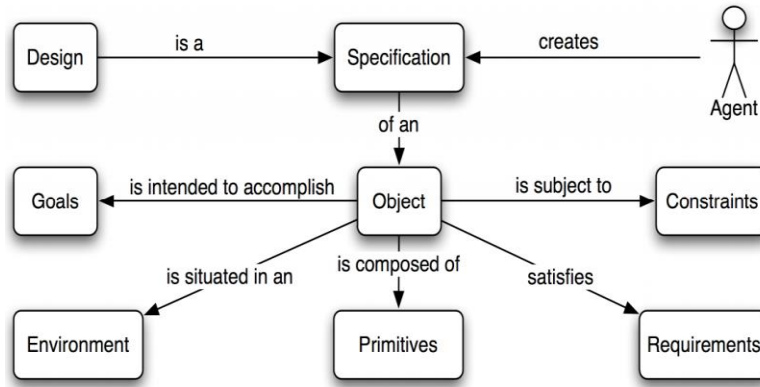


Figure 2: Meaning of Design
 (Source: Paul Ralph and Yair Wand (2009), p.108-109)

Silk, Daly, Jablokow, Yilmaz, and Berg(2014) and Laseau(2000) also found that well-formed design problems include at least three components which are goals, environment, and requirement summarised as follows:

- a. a brief **context or environment** about for whom and for what purpose a solution is needed
- b. a statement of the **need** that specifies the functional requirements and constraints on acceptable solutions
- c. a description of the **goal**, including the general instructions and criteria to use in evaluating ideas

Activity in the design process is described as negotiation between problem and solution from reflecting on each through analysis, synthesis, and evaluation (Lawson, 2006). Thus, “Design” has been defined as consisting of a goal or including sub ideas, requirements, and environment under constraints, is the creation of a design which problem and solution reflected by each other are intensively driven by analysis, synthesis, and evaluation.

According to the definition of “Concept” by Margolis and Stephen (2011), “Concept” is an abstraction or abstract object being referent of something whether it is an existing object in the real world or an idea. The concept is beneficial to solve problems from ignoring the details and incidentals assisting to avoid fixation on gathering ideas leading to ‘the crux task’ (Chuang-Nainby, 2010). Asimow (1962) supports the idea of “design” as process and its characteristic which is defined as the abstract-to-concrete progress of the creative concept (Asimow, 1962 cited by Chuang-Nainby, 2010). An abstraction process is initiated by perception of need, intentions, and ideas relevant with a thinking process distanced from ideas of the object and whereby concrete details are left vague or undefined to use in a simplified way. Thus, “Concept design”, can be defined as a process of developing design ideas from abstract to concrete idea by ignoring concrete details.

Thus, elements of user interface and interaction can be designed by transforming ideas from abstract to concrete ideas assisting designers to gradually develop abstract ideas rather than trying to design from concrete elements. In addition, five components are goals, environment or context, requirement or needs, primitive or sub-ideas, and constraints or at least three main component; context, needs, goal are important for design thinking in concept design.

However, there are other tools for assisting in dealing with design problems which are creative and critical thinking.

4.2 Creative and Critical thinking

Creative and critical thinking are significant in design and especially plays a role in concept design and design thinking. Creativity masters a process of making or producing for idea generation and criticality is a process of assessing or rational decision making (Paul & Elder, 2004). Critical and creative thinking are actions of mind which need knowledge as natural source and skill to deal with process in mind. These actions involved with solving problem which are intensively driven by analysis, synthesis, and evaluation (Lawson, 2006) (See Figure 3). Creative and critical thinking will be analysed and explained to propose ways it can assist concept design and design thinking.

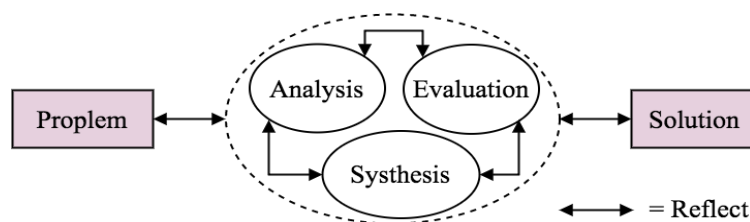


Figure 3: Lawson's solving problem (Modified)
(Source: Lawson, 2006)

Enhancing design with the critical thinking

Critical thinking directly relates to logic, analysis, and judgment for evaluating information involving background, experience and knowledge (Oxman-Michelli, 1992). It is a linear dimension in mind activity (F. Sofo, Colapinto, M. Sofo, & Ammirato, 2013) which starts with analysing information and, then, the analysed information is evaluated from reasoning and deciding (Paul & Elder, 2004). An external representation or diagram can assist to deal with analysis and evaluation. The diagram/s are generally made of symbols and are abstract, they do not have a scale and do not relate to pictorial representations (Parthenios, 2005).

In terms of user interface and interaction with a prototype, the system and user requirements should be analysed to produce logical activities and involve data types which will interact between user's activities and the system. All logical activities and data types can be arranged and gathered in the same groups of the problem or task and, then, externalized into vague diagrams and texts to leave the designer's mind free to produce ideas or solutions of the user interface and interaction. Significantly, each vague diagram will become the explicit idea which is a crucial resource for building several creative ideas. The advantage of a diagram is it can encourage creative thinking for design exploration.

Generating ideas with creative thinking

Creative thinking is regarded as thinking that is imaginative and spontaneous, original and intuitive as when you think creatively, you produce something novel (Oxman-Michelli, 1992). It is an activity of the mind which explores resource or knowledge to generate and

select appropriate solutions for problems (Okpara, 2007). In addition, it is non-linear dimension and more complex for exploring and building or synthesising novel ideas. Ellis Paul Torrance proposed four components for assisting design exploration and solution generation (Alvino,1990 Cited by Cotton, 1991) that are:

- 1) FLUENCY - generating many ideas.
- 2) FLEXIBILITY - shifting perspective easily.
- 3) ORIGINALITY - conceiving of something new.
- 4) ELABORATION - building, modifying, or detailing on other ideas.

According to Ellis Paul Torrance’s components, solutions or novel ideas can be generated from applying the four components. The two components; fluency and elaboration, become the main components to generate design ideas concerning the design components; goals, needs, and context and these ideas can be also modified for generating other new ideas. Originality is the criteria for consideration in terms of creativity of new design ideas which must be novel, feasible, and appropriate. Finally, flexibility is design exploration which can enhance the generation of new design ideas.

Problem tasks gathered from logical activity and data types can be supported from creative thinking in terms of diagrams. These diagrams will be continuously developed to be used at concept design parts of user interface and interaction and which can be enhanced using Ellis Paul Torrance’s components. Abstract design ideas of user interface and interaction can also be developed by these diagrams. Background knowledge of programming skills becomes important to assist a developer or designer to evaluate the feasibility of these creative design ideas. A novel digital prototype can be created and accepted if it is a new design idea that can be developed on the system.

Thus, creative and critical thinking can be used to create design ideas in the concept design or design process. Design problems can use creative and critical thinking to assist in solving these problems by developing a diagram incorporating and using Ellis Paul Torrance’s components (See Figure 4).

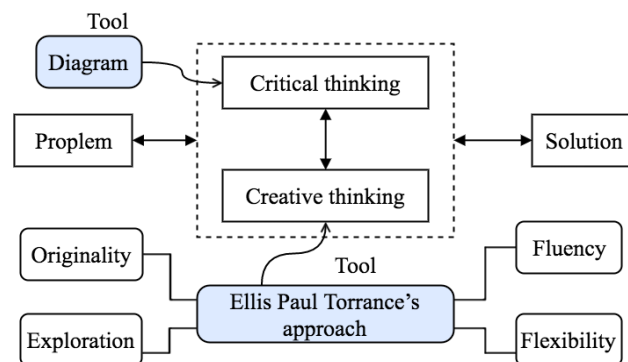


Figure 4: Creative and critical thinking in solving problem of design
(Source: Jaraskumjonkuk, 2017)

In addition, the diagram will be used for analysis and evaluation of critical thinking to construct ideas or solutions and a tool for solving problem in design and create alternative designs (see Figure 5).

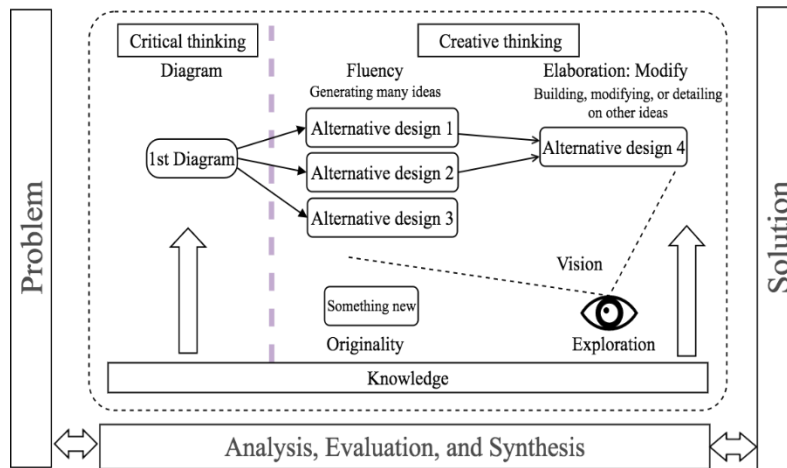


Figure 5: Tool for solving problem in design
(Source: Jaraskumjonkul, 2017)

4.3 Strategy for modifying the prototyping model (modified) for a digital prototype

Regarding the prototyping model development (modified) approach illustrated in Figure 1, it can be modified to allow the integration of the concept design phase between requirement and system design phases shown in Figure 6 below. It is argued that the phase of concept design and creative and critical thinking can assist the transformation of abstract ideas to concrete idea. All phases are connected with the knowledge part which is important to enable retrieval of knowledge and experience or learn new technology and/or some issues to solve problems in the process.

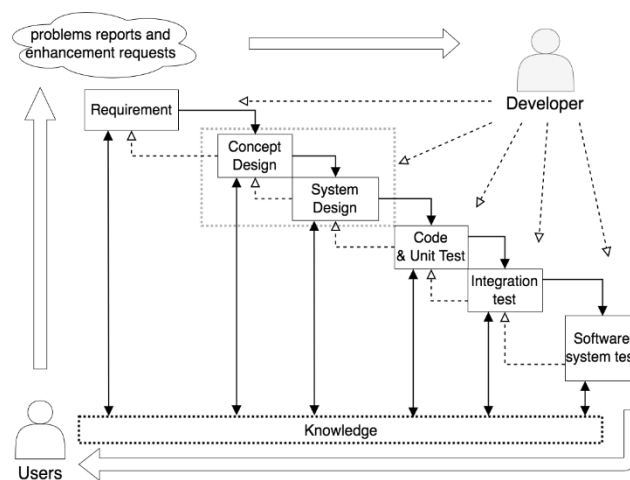


Figure 6: Modifying of Prototyping Approach
(Source: Jaraskumjonkul, 2017, Adapted from Davis)

The Modified Model of Prototyping Approach above includes the following phases:

- 1) Requirement phase is state of gathering information which identifies explicit problems, needs of user and system, environment of system.
- 2) Concept design phase provides opportunity of developing user interface and interaction in which the intuition of user will be crucial criteria. In addition, abstract

idea of the system will be designed along with design ideas from user interface and interaction.

- 3) System design is the phase of solving problems in terms of the system. This will involve object oriented design, algorithm design, database or data persistence design. The abstract ideas from the early phase will be developed into concrete ideas and applied into the system design.
- 4) Code and Unit test phase is a stage of code programming practice and test. Each object and algorithm part will be written and tested to identify errors and solve these problems.
- 5) Integration test phase is prepared to test when parts of the project system are united. All variables and procedures are involved and communication between these parts tested and checked for errors.
- 6) Software system test is the phase of testing the entire system process.

5. CONCLUSION

This paper presents the prototyping model approach which is integrated the tool for design thinking. It can be summarized that:

- The meaning of design comprises five components consisting of goals, requirements, context, constraints, and sub ideas. At least three components; goals, requirement, and context, are crucial for designing.
- The prototyping approach is modified for developing a digital prototype by inserting the concept design between the requirement and software design phases.
- The concept design phase is an initial process of developing concrete ideas from abstract ideas by ignoring concrete details. User interface and interaction should be designed by considering goals, needs, environment, sub ideas, and constraints and including user criteria in terms of limitations and activities in the concept design phase so that both of them can be delivered to system design.
- Solving problems in the design process can also be supported by creative and critical thinking using both diagrams (See Figure 4, 5, and 6) and Ellis Paul Torrance's approach.

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MICRO TO MACRO; UTILIZATION OF THE ARCHITECTURAL DRESS FOR THE FLOW OF URBAN SPACES

P. Liyanage and S. Hettiarachchi

Department of Integrated Design, University of Moratuwa, Moratuwa, Sri Lanka

Email: pitigalap@gmail.com

Abstract: The progression of the relationship between body and objects of our daily life, including the dress, can be identified in four stages. The naked body, dressing on the body, attachments to the body and extensions to the body. The dress can be recognized as an attachment. Four methods of attaching the dress to the body can be identified and three of them progresses from the interior; the body, to the exterior; the surroundings, in accordance with the process of experiencing a dress. Currently spaces in urban areas are a result of in between spaces that are a resultant of individually architected structures. While the climate of the equatorial region and the socio-economic arena of developing countries, by nature brings people, especially of the lower income classes, to the outer urban spaces that occurs incidentally without proper designing due to current practices of architecture and urban planning. Inspired by the aged relationship between the dress and architecture, the research considers the possibility of developing a theoretical framework by converting the relationship between body and dress-as-attachment to design better flowing, human centred urban spaces. The research was funded by the Senate Research Committee of the University of Moratuwa under the grant no SRC/ST/2016/26.

Keywords: Architectural Dress, Body and Dress, Inductive Approach, Spaces-in-between, Urban Spaces.

1. INTRODUCTION

The comparison of the relationship between dressing and architecture has been existent for centuries, dating back to the time of Vitruvius (1st cent. BC) (Quinn, 2003). Mainly this has been in the perspectives of understanding shelter on the body as dress and architecture as extended shelter. Especially when historically considering, period fashion depicts a high degree of inspiration taken from architecture (Quinn, 2003). And in recent years the resemblance of garment construction techniques in architecture is very significant. Methods of architecting such as folding, draping, pleating, pinning and darting are instances of direct inspiration of methods of construction of the dress in architecting. Through the traditional dressing methods of South Asia and Far-East Asia and later fashion revolutions of visionaries such as Issey Miyake, Rei Kawakubo, etc. the dress has been developed in such a manner that it is constructed in accordance with the way the wearer experience the dress; from the interior to the exterior. And in this method the spaces in between are also designed as opposed to being a mere resultant when creating the exterior. While the dressing and architecture have been sharing their methods of visual construction the research problem was found in the gap of questioning whether the conceptual approaches of dressing can be burrowed for architecture. Therefore, the research investigates the problem of, how and in what ways can methods of dressing can fund the better flow of urban spaces? Liyanage & Hettiarachchi (2016) identifies four methods of attaching a dress to the body. Section 5. Structure of the dress explores these ideas the hypothesis was created to investigate possibilities that when urban spaces follow the methods of attaching the dress to the body it can better suit the

behavioural patterns and needs especially of people requiring better designed, better functioning urban spaces. This takes into consideration the climatic conditions of the urban area, the socio-economic structure and so on.

2. KEY TERMS IN USAGE

The Dress – For the past few centuries the dress has been recognized as sociological parameter than an isolated object depicting material details of the period. Since then the dress has been considered as “...a subject that is simultaneously economic, aesthetic, social and psychological” (Haye & Wilson, 1999). While the need of the dress has been questioned widely, whether it is in the aspect of shelter/protection, adornment/ornamentation or modesty, what must ultimately be considered is that under any circumstance the dress has been covering or providing means to the body so that the individual may express and align oneself with “... an organized, formal, normative system that is recognized by the society” (Barthes, 2013). The research recognizes the term dress as an embodiment of an individual’s identity which has been materialized through contemporary social, cultural, political and economic traits.

Spaces in between – The research recognizes two types of spaces in between; in architecture/built environment and in dressing. Spaces in between in a built environment or largely, in a city, are its roads, alleyways and left-over spaces from one building to another. This concept is further discussed in section 4.2 Understanding spaces in between. In dressing, the term can be recognized between the bare minimum of upon-the-body to a maximum of infinitely extended boundary.

Urban fabric – The urban fabric in the holistic city itself. “The city is after all, so much more than a material artefact. It is economic processes, social relations, psychological states, cultural milieu and so on” (Hillier, 1989). The urban fabric also allows its users to create a “place-identity”, associating attributes of place to personal identity (Hull, et al., 1994). Therefore, the research uses the term urban fabric to discuss the city with its materials such as buildings, roads, alleyways and its contemporary social, political, cultural and economic phenomenon that is embodied in the weave of the city.

3. METHODS AND METHODOLOGY

In a quest to solve the above-mentioned research problem data of both dressing and architecture in urban spaces was required. The initial stage of the research was to solidify the recognizable relationship between dressing and architecture. This required to find patterns in dressing and architecture in isolation and finding connections between the two areas to be considered as a singular entity suitable for study. Finally, a modular framework was realized in which previously categorized modes of the recognizing a connection between body and dress was converted as problem solving methods for urban spaces. Figure 1 summarises the methodology.

Thomas (2006) explains the suitability of the inductive approach to guide a research of this nature. He claims that shown by Corbin & Strauss (1998) the inductive method is suitable for the condensation of an expansive collection of raw data into a summary. Furthermore, the inductive approach encourages clear links allowing transparent and understandable

representation of processed data and the allowance of justifiability of the findings in par with the research objectives. It also allows the development of a model or theory that is based on an underlying structure of experience-processes that are evident in the text data (Thomas, 2006).

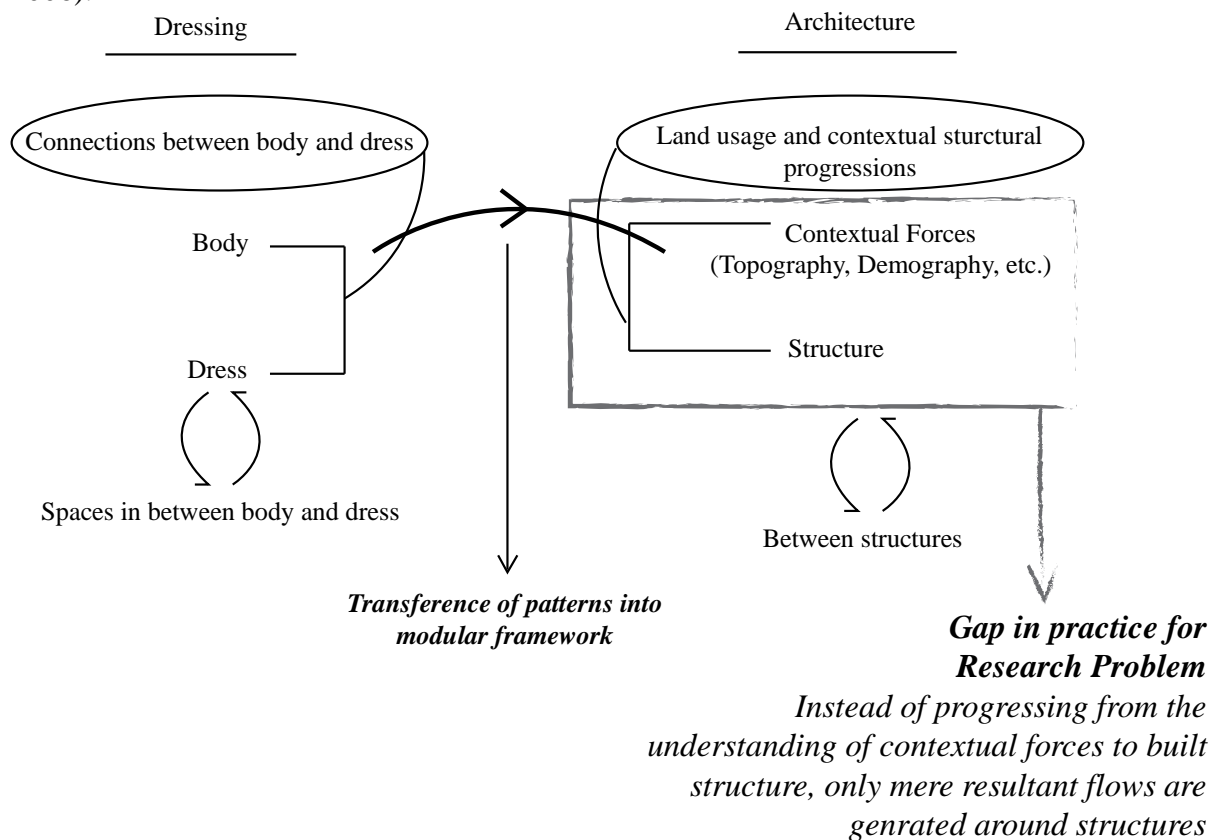


Figure 1: Summary of research methodology identification

Secondary to the identification of the appropriateness of the inductive approach the suitability of the grounded method for research progression was understood as shown in Table 1.

Table 3: Grounded method as evident in the research

| Characteristic (Corbin & Strauss, 1990) | As expressed in the research |
|--|---|
| <i>Concepts are the basic units of analysis</i> | <i>While the data itself was conceptual representations of occurrences, data was categorised according to the methods of conversion from concept to product both in dress and architecture.</i> |
| <i>Categories must be developed and related</i> | <i>The refining of categories helped to understand the distinction between visual/ conceptual similarities and differences.</i> |
| <i>Sampling in grounded theory proceeds on theoretical grounds</i> | <i>The research was designed upon the hypothesis that approaches in dressing can allow a more holistic urban fabric as opposed to isolated buildings in a city. Therefore, ideas of construct in architecture and dress was developed separately.</i> |
| <i>Analysis makes use of constant comparisons</i> | <i>The separately gathered data was continuously cross examined so that the developed ideas are further</i> |

| | |
|--|---|
| | <i>constructed in a manner allowing the necessary conjunction of dress and architecture in the conclusion.</i> |
| <i>Process must be built into the theory</i> | <i>The theories that were built had the flexibility of adapting in accordance with novel findings. Therefore, the structure was created upon the findings while adjusting as required by interpretation of gathered data.</i> |

The research conducted through the inductive approach and the grounded method to solve the prior mentioned research problem concluded the following.

Identified types of spaces between and *lost space* in an urban environment can be subjected to a better flow prior to construction as well as post construction, as existing areas which requires development of spaces between. Unplanned settlement progression can be recovered through design solutions which considers unprecedented chronological development and solves it by the means of layering in dress. Ad-hoc rear space encroachment can be guided towards a sensible progression through addition of elements. *Lost spaces* in cities such as the immediate ground next to high rise buildings or car parks later subjected to abandonment can be utilized positively by existing structures adding the volume of *lost space* unto them. The following sections will systematically realize these findings.

4. THE FABRIC OF URBANITY AND THE SPACES IN BETWEEN

In the search for a definition of urbanity, what primarily becomes evident is the almost incomprehensible amount of definitions. In the field of urban design, it be an environment that provides a high density of variety, accessibility, legibility, robustness, identity, cleanliness, biotic support and aesthetic richness. Furthermore, it also considers about public spaces, although due to the minimal extent of the sample it cannot be considered holistic (Grounlund, 2007). Coming on to cities of the third world countries of the East, sometimes these definitions found in the West, the developed countries becomes irrelevant. This section will explore the notions of city and urbanity and aim to realize a fabric, an idea about urbanity which is cohesive and woven. Following the ‘spaces’ of this fabric is understood, in aspects of the inception of spaces, its uses and its utility value when compared with the previously understood definition of urbanity.

4.1 Definitions of City

To understand the nature of urban spaces it is important to understand what a city is. The attempt to define a city is complex in nature. This is due to the complexities that arises when trying to encapsulate intertwined bonds between the economics, culture, and politics of a city.

In a developing country such as Sri Lanka, in which the governmental understanding of development is defined through mega-structures the social structure undergoes a segregation even of a physical nature. While the upper-income level is entertained the lower-income level is pushed into a chaotic disruption. Deciphering of a more poetic expression of the city by Ralph Waldo Emerson (as depicted by (Clapp, 2014)) explains this phenomenon, where the people of the city become unaware of each other levels, mostly upper levels of the lower levels due defined structures of segregated welcomes. “Cities force growth and make men talkative and entertaining but they make men artificial”.

According to the identification by Alexander (1964) (as said by (Broadbent, 1990)) the physical growth of the city has two manners. To grow with time, without a plan according to the desires, choices made by individuals of localities. “Sri Lanka’s economic geography is characterized by concentration of economic production: its “urban footprint” is low in density, with sprawl and ribbon development along the main roads and coastal belt.” (UN Habitat; The World Bank, 2012). The other method discusses the planning of a city according to a planner’s sense of space and order. The failure of present urban design occurs at this level. The usual process treats buildings as isolated objects on landscape and not as a part of a larger fabric. Decisions about growth patterns are made from two-dimensional land-use plans, without considering the three-dimensional relationships between buildings and spaces and without a real understand of human behaviour. The urban landscape cannot be analysed entirely by means of rationality. It is ever transforming and overlapping, creating new layers and new dimension ever so frequently. Contextual forces of this nature require more complex ways of understanding and reinforcing its physical structure.

As an example, Colombo; the capital of Sri Lanka, a colonial settlement has now been inundated by waves of distressed migration and Kandy; a city in the central hills of the Island, a structured traditional city is flooded by unchecked urban growth and incoherent built form. Figure 2 and 3 of Colombo and Kandy expresses this situation. This has produced strange and yet familiar images which have been slowly weaving themselves into the existing urban fabric and producing fragmented, random illegible urban structures. Further in these contexts, architecture is not considered by planners as an instrument in structuring the urban landscape, resulting in our cities being visually and perceptually chaotic.



Figure 2: Colombo, from highly dense nodes to spreading as ribbon settlements

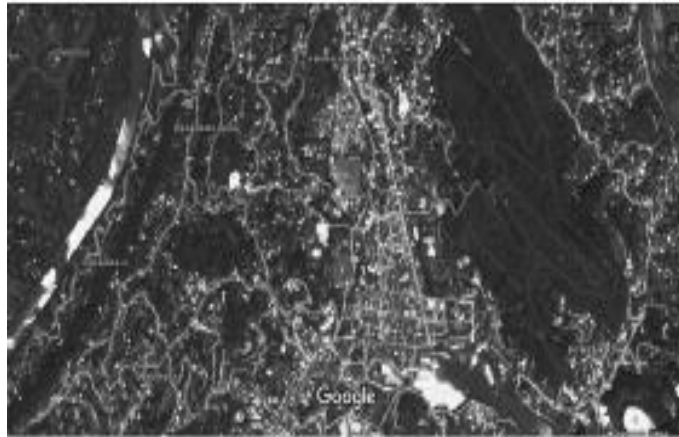


Figure 3: Kandy, from planned inner city to unplanned ribbon settlements

4.2 Understanding Spaces in Between

The research recognizes the space externally and geometrically bounded by a variety of elevations of built structures that form an edge can be called the space between buildings. This external space is unobstructed space for movement in the open air with public, semi-public and private zones.

- Squares – A non-linear, centralised and discontinuous open space. These forms the nodal points of the city.
- Streets – A linear, open-to-sky, continuous linking element bounded either on one side or both sides by continuous facades or by a series of buildings which may be having gaps in between. The layout of streets is a merely a framework, the character of the streets is generated by the people's contribution towards it.
- Sidewalks and pavements – Space between the road and the building edge or the fence which is for the pedestrians is considered as sidewalks and pavements. In third world cities are mostly dominated by poor urban dwellers, who share and use it as a multipurpose space predominantly for living and trade.
- Courtyard – A centralised and discontinued open space in a building complex or a group of buildings arranged around it. The scale makes the courtyard (; smaller in size) differ from the square.
- Rear space – Space in between the rear edge of the building and the rear boundary is called as rear space.

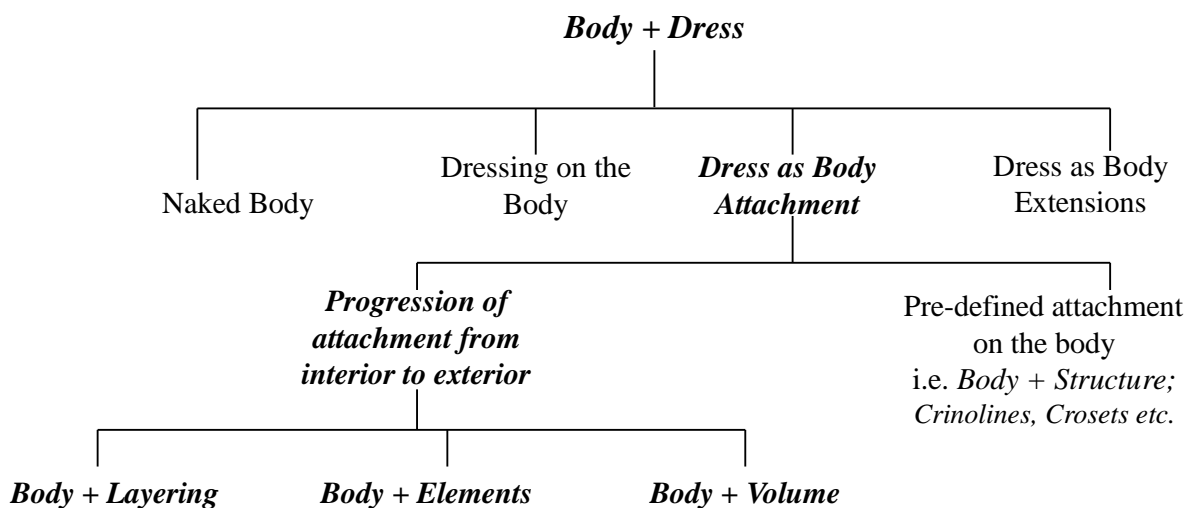
Spaces in between which can facilitate public interaction in a city when not used becomes a “lost space”, an anti-space. Lost space can be defined as the left over unstructured space between buildings or the undesirable urban areas that are making no positive contribution to the surrounding of the users (Trancik, 1986).

The importance of outer spaces becomes integral to the lifestyle of countries of the equatorial region due to prevailing weather conditions throughout the year. Rain is seasonal and other days are mostly sunny. In this the gathering in outer urban areas, especially by the lower-income class is very high. Existing practices of urban planning ignores these behavioral patterns and forces this population into high rise buildings which entirely disrupts the lifestyles which are heavily dependent on above said types of spaces.

5. THE STRUCTURE OF THE DRESS

We first shaped our societies and allowed our cultures to grow and now our societies shape us (How Art Made the World; More Human Than Human, 2005). Our societies are our creation through millennia. While geographically the nature of societal and cultural values varies, a common norm to all is ‘dressing’ (Entswitle, 2000). Dressing in this isn’t merely limited to clothing, but includes tattooing, body painting and even physical body modifications. All form of dressing brings meaning to the naked human body. While covering the body for protection; as shelter and covering the body for modesty; to cover our nakedness are prominent factors of dressing, expressing identity, social standing expressed by dressing is also an important implication of the dress which is common to all societies and cultures.

Figure 4 shows the understanding of the relationship between body and dress within the research scope. Dressing on the body, such as previously mentioned tattooing or body painting, dress as body attachment, such as our day to day wearable clothes and dress as a body extension, such as products we use to help us achieve our daily tasks. The connection between the dress and the body is mostly observable in the second category of dress as attachment. Therefore, the research uses previously gathered analysis and synthesis to which resulted in four different methods of connection for body and dress as attachment.



Layers



Elements



Volume

Figure 4: Categorization and segmentation of the relationship between body & dress, based on (Liyange & Hettiarachchi, 2016)

Body + Layers – Layers of material can be constructed from the interior to the exterior. The traditional South Asian Sari creates freedom of movement, a variety of draping methods from the same sized fabric and adheres even to drastic body size changes of the wearer. (Figure 4: Layers, Source: Banrjee & Miller, 2004 edited)

Body + Elements – An individual element can be repeated to create a continuous *fabric* of its own or to bring attention to special details i.e. using the boundary of a hollow element to bring attention to what is in middle of it. (Figure 4: Elements, Source: Student design project, Dept. Of Integrated Design, University of Moratuwa)

Body + Volume – While the original form is disfigured, more space can be acquired through the materialistic means. (Figure 4: Volume, Source: 1997 Collection, Rei Kawakubo, <http://www.vogue.com/fashion-shows/spring-1997-ready-to-wear/comme-des-garcons/>)

6. CONCLUSION

Layering, addition of repetitive unit elements, engulfed space as volume to structures of the urban space can be considered as means that connect the people of the city through activity to the urban fabric. Spaces in between and lost spaces of the city can be utilized to give meaning to dispersed and chaotic urban activity.

Formal and informal activities of cities can be funded by the means of adding structural elements, on or above the ground level, solving unnecessary chaos especially created by activities such as pavement hawking. These additions should be considerate of the income level of the user groups and prevent alienation. If not, micro-economies will be disrupted creating unprecedented chaos through attempts of development.

Public activity that is already occurring can benefit from the addition of subtle layers of physical construction that will not hinder existing practices. Addition as layers is important for forced physical elements without considering adaptation time of the users may disrupt the rhythm of social patterns.

Lost spaces of the city can be better utilized through the means of being consumed by existing structures or any other recognizable nodes, resulting to deform the structure in a positive manner.

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TOWARDS SOCIO-CULTURAL SUSTAINABILITY IN DESERT DWELLING DESIGN IN SOUTHWEST LIBYA

A. Elhassi and H. Elkadi

School of Built Environment, University of Salford, Salford, M5 4WT, UK

Email: A.El-Hassi@edu.salford.ac.uk

Abstract: Southwest Libya is one of the most important desert regions in Libya, with its significant historical oases and towns. This region is characterised by its unique design of vernacular dwellings, with a rich architectural heritage and a remarkable convergence of cultures. The nature of these dwellings is founded on a harmonious blend between architecture and people, which has formed its architectural identity over centuries (Eltrapolsi, 2016). However, in recent decades, the vernacular architecture of desert dwellings is no longer able to keep up with contemporary lifestyles of different generations (Bilghit, 2007). The vernacular architecture of desert dwellings and the architectural landscape in southwest Libya face several serious challenges. These challenges include rapid changes in the way contemporary dwellings are built, and incorporating modern trends for desert dwellings. Such trends have led to transformative patterns in socio-cultural life that have distorted the architectural landscape of the region (Shawesh, 1996; Almansuri, 2008). The region has experienced problems with dwelling design in terms of a lack of compatibility of those dwellings with the socio-cultural needs of locals, including a lack of harmony with the architectural identity and patterns of contemporary life and the distortion of the architectural landscape of historical towns. This condition is worsened by the fact that the current desert dwellings are, nevertheless, still designed and implemented by the same trends, causing problems in meeting the requirements of the socio-cultural sustainability needs of locals (Bilghit, 2007; Azlitni, 2009). This paper highlights the absence of socio-cultural sustainability considerations by examining the levels of satisfaction with both vernacular and contemporary desert dwelling design in southwest Libya in three selected historical towns: Ghadames, Sabha, and Ghat. The aim is to increase residents' satisfaction, among different generations, with the design of their dwellings regarding the fulfilment of their social and cultural needs. A particular focus is on the views of the new generations on architectural identity and the contemporary lifestyle. From the findings, this paper synthesises a set of guidelines for sustainable dwelling design based on an integration of the lessons learned, the features of vernacular architecture, and the advantages of contemporary desert dwellings in terms of socio-cultural sustainability.

Keywords: Southwest Libya, Socio-Cultural Sustainability, Satisfaction level.

1. INTRODUCTION

Nowadays, the design of sustainable dwellings is one of the most important issues in many developing societies, such as Arab countries, especially in light of the political and economic volatility in these countries. The theme of sustainable dwelling design has come to the attention of architectural researchers in order to meet the future needs of the population in a sustainable manner (Hoseini et al., 2011).

The surrounding environment, in forms such as natural, climatic, economic, and socio-cultural, affects several important aspects of dwelling design and urban environment for the population (Mohamed et al., 2012). However, it is influenced by changes in contemporary developments and by both modern technology and economic growth. In this context, sustainable dwelling design employs modern technology along with compatibility with the

environment in order to produce a design that both ensures comfort and improves the quality of life and well-being of its users (Hoseini et al., 2013).

According to Ahmed (2011), improving the quality and safety of human life is linked to interaction with the natural environment, the economy, and socio-cultural features. However, socio-cultural features are particularly important for dwelling design, especially features such as social values and cultural heritage that are inherited by different generations (Grant, 2006); socio-cultural features are perhaps the least explored within the prevailing development literature (Al-Jamea, 2014).

The various human societies often carry different traditions and customs without any logical explanation, and ultimately constitute the cultural heritage values of that society (Malkawi et al., 2003; Altman et al., 1980). The adoption of sustainability rules and strategies has become vital in housing design and residential environments (Almansuri, et al., 2009).

Rapoport (1969) has drawn attention to the fact that the three foundations of sustainable architecture are social, economic, and environmental aspects. Sustainable dwellings are devoted to the principles of environmental protection and enhance the quality of life (Faulconbridge, 2013). Socio-cultural feature experiments are often associated with measuring the level of satisfaction of a population (Makinde, 2015).

As Rapoport (1969) has indicated, a society considers a dwelling as not just a place to live, but also a place for social and cultural interactions. Rapoport (1980) also points out that uneven socio-cultural features should be equally important to dwelling design. The success of a sustainable dwelling needs to balance the environmental, economic, and socio-cultural aspects of building sustainable dwellings (Alwaer et al., 2010). According to Connelly (2007), economic development, social justice, and environmental protection are among the most important priorities of sustainable housing projects. Meanwhile, in some of the literature and previous studies in the context of dwellings, the importance of socio-cultural features, such religious, emotional, and heritage values, has been ignored (Kaklauskas, 2015).

Sustainable dwellings are devoted to the principles of protecting the residential environment and enhancing the quality of life of the population, since these aspects are often linked to residents' satisfaction with the design of their dwelling (Makinde, 2015). The current situation in many historic towns in southwest Libya, which inherited centuries-old values and experiences that are threatened by new actors changing their built environment, is that the rapid entry of the contemporary trends of design by government institutions, designers, and the impact of contemporary international architecture trends that came with foreign companies have contributed significantly to changes in the architectural environment. That has led to a disconnect in the relationship between the people and their vernacular built environment. This is in addition to the question of whether these contemporary trends in dwelling design can meet the cultural needs of the desert society.

Most of the previous research on towns in the region focused on environmental and climatic aspects and ignored the aspects of socio-cultural sustainability, despite its importance and need, especially as the problem continues to worsen. Nevertheless, Abufayed, et al. (2005) highlighted some aspects of environmental sustainability in the vernacular architecture of Ghadames, and Aburounia (2007) dealt with some of the trends in environmental and social sustainability in specific housing projects in Tripoli. Therefore, there is a deep lack of socio-cultural sustainability in the literature in this area. The need arises for a new design that

creates a balance between the contemporary needs of the population, especially the new generations, and the protection of heritage and cultural identity. The current contemporary desert dwelling designs that have failed to meet the socio-cultural needs of the population and that have contributed greatly to the distortion the architectural landscape of these historical towns should be reconsidered.

In light of this, it should be taken into account that the essence of a sustainable dwelling is to be appreciated in the context of human housing, and sustainable dwellings contribute to raising the standard of quality of life, preserve the residential environment, and enhance socio-cultural features. This should be achieved through an appropriate dwelling design that should not be based solely on emotional discourse but on a real relationship between dwellings and socio-cultural features. In this sense, the purpose of this paper is firstly to formulate a set of guidelines for the integration of the socio-cultural architectural features of vernacular and contemporary desert dwellings for sustainable desert dwelling design in southwest Libya. It also aims to highlight the absence of socio-cultural sustainability considerations in the design of current contemporary desert dwellings in southwest Libya in three selected historical towns (Ghadames, Sabha, and Ghat) by measuring the satisfaction levels of different generations of the population regarding both vernacular and contemporary desert dwelling design. Particular scrutiny will be given to the views of the new generations on the architectural identity and contemporary lifestyle. Secondly, the paper aims to formulate a set of guidelines for sustainable desert dwelling design based on the integration of the lessons learned from the features of vernacular architecture and the advantages of contemporary desert dwellings in terms of socio-cultural sustainability that could help increase the satisfaction of the population, achieve more socially and culturally sustainable design, and help to create balance in these historic towns.

2. SUSTAINABLE ARCHITECTURE AND SOCIO-CULTURAL SUSTAINABILITY

2.1 Sustainable Architecture

The WHO describes dwellings as a private environmental domain that gives the residents the physical structure of a dwelling with different facilities, services, and supplies, and all that is necessary to ensure their health, comfort, and mental wellbeing and their social prosperity. Sustainable development of cities considers dwellings to be very important (Shehab et al., 2016). Environmental efficiency at present requires further improvements and investments to develop sustainable dwellings to make access to sustainable dwelling available for all strata of society according to their social, cultural values, and economic potential (Varol et al., 2011).

Although the built environment meets a basic need for human beings and is a cornerstone of development and sustenance, it is also part of the impediment to sustainable development at present because of its current unsustainable activities (Brandon and Lombardi, 2011). The continued application of traditional concepts of sustainable development leads to fragmentation of the natural and social environment that is the basis of the welfare of societies (Akotia, 2014).

The emergence of sustainable architecture coincided almost perfectly with the development and spread of sustainable development concepts (Cofaigh et al., 1996; Almansuri, 2008). According to the definition of McDonough (2000), sustainable building design is a concept that reflects the sense of the environment and is compatible with the evolving environmental

system. Roaf et al. (2005) point out that environmental dwellings are strongly related to the locations in which they are built and environmental conditions, such as climatic, natural, and social. Therefore, sustainable architecture is architecture that meets the needs of the population and is largely compatible with its surroundings and limits the negative effects on the environment. It also adopts a consensual approach to resource consumption (Almansuri, 2008).

Sustainability deals in the long term with the relationship between humans and the natural environment (Almansuri, 2008). The essence of architectural sustainability is defined as an integrated approach to dealing with the environmental, economic, social, and cultural aspects of the design and construction of housing and buildings. The sustainable environment of any residential area is understood by looking at the diverse local features of that region as environmental and economic factors and understanding its socio-cultural features (Ghaffarian et al., 2011). Therefore, the fundamental implicit criterion for sustainable architecture is to understand the local features of the surrounding environment (Guedes et al., 2009).

Sustainable architecture aims to achieve a responsive architecture that is compatible with the environment and represents an ethical, social, and even political commitment. It is, therefore, an integrated system that seeks to produce biological stability at the global level (Portcous, 2002). The work of Pourjafar et al. (2011) indicates that the efforts to achieve this compatibility and sustainability of responsive architecture have intensified in the last decades of the last century through a variety of different interpretations, most of which are based on environmental awareness and concepts of environmental sustainability. In fact, there was no comprehensive context for the concept of environmental awareness. However, there were various efforts to improve the built environment. An example of this is the appearance of the term "green architecture", which was used in the context of eco-friendly architecture, that is, architecture that is suitable for the natural aspects of the environment and that has sufficient facilities to achieve good efficiency and provide the necessary conditions that ensure the comfort and well-being of users, such as the appropriate internal environment, by different relationships with nature (Pourjafar et al., 2011). Therefore, the concept of sustainable architecture is linked to the protection of the environment, especially from the adverse environmental impacts of industrial waste from construction and architecture. This coincides with the aggravation of the impact of environmental problems on the health and lives of people. Sustainable architecture also focuses on the role of architecture in reducing the problems of environmental pollution (Izadpanahi and Elkadi, 2013). The development of sustainable architecture leads to a reduction in energy consumption, rational use of natural resources, harmony between the environment and people, and helps to improve the quality of life (John et al., 2005).

Sustainability is as old a principle as architecture. However, environmental and ethical constructs are the foundation of modern sustainable architecture. Through working a sustainable and stable society, a sustainable society is an important continuum for sustainability. Stability can be achieved through seamless coordination of the chain of sustainability. In order to achieve stable architecture, objectivity and authenticity must be followed, because sustainability is biased towards the moral realm as part of the local culture and values. However, change in lifestyle and attention to the local environment has become important, and has been created on the basis of knowledge, science, and techniques that achieve specific environmental objectives (Pourjafar et al., 2011).

There is a scientific basis for sustainable architectural design that derives its strength from conscience and morals. The principle of sustainable design is based on three pillars: human design, resource abundance, and a determination to preserve the rights of future generations. It is implemented in a manner that includes the design, implementation, operation, and maintenance, and on the basis of recycling and the use of available architectural resources. Therefore, specialists, professionals, and architects should take steps to implement this framework rather than any other solution (Pourjafar, et al., 2011).

According to Varol et al. (2011), the primary purpose of housing is to meet the initial needs of the population. In the context of sustainable development, it is not enough to ensure that all needs are met; the environmental aspects must be considered comprehensively to cover all aspects. Sustainable housing development can thus be defined as housing development that meets the needs of housing and the demands of the current generation without compromising the ability of future generations to meet their needs and demands.

In other words, a sustainable dwelling is not solely intended to meet the needs of the present population. It seeks to ensure that future generations will be able to meet their needs. Nevertheless, sustainable dwellings are defined environmentally. Some studies have focused on the socio-cultural aspects of dwellings, and most of them emphasized its importance for the design and planning of dwellings (Al-Jamea, 2014, Connelly, 2007). Hence, dwellings not only involve the requirements of the population, but also include the development of critical socio-cultural features, and thus sustainable dwellings seek to integrate social, cultural, and environmental features together to achieve sustainable design (Varol et al., 2011).

2.2 Socio-Cultural Sustainability

Dwellings play an important role in various aspects of sustainable development as one of the most important constituents of the built environment (Amato, 2006). According to Reffat (2004), sustainable dwellings include interrelated environmental, economic, and socio-cultural aspects. Sustainable development is an integrated vision to create a balance between ecological needs and people's needs to provide a prosperous and equitable quality of life (Al-Jamea, 2014). Furthermore, Reffat stressed that dwelling sustainability is a multi-faceted issue not only concerned with housing, but with the environmental characteristics of the location, including climatic conditions, geographical location, economic potential, and human and socio-cultural values (Reffat, 2004; Al-Jamea, 2014).

Local social considerations are often shaped by cultural characteristics such as customs, beliefs, attitudes, and philosophies that are inherited via different generations (Chiu, 2002, Shehab et al., 2016). These traditions can be considered as motivations that drive community members as part of their culture and patterns of social behaviour. Thus, traditions can be described as informal rules. Physical products, such as components of technology, and other non-material products, such as customs, traditions, and others, are all born of human culture. It is therefore important to understand the interactive relationship between social aspects, culture, and population (Chiu, 2002; Shehab et al., 2016).

Socio-cultural features are important factors in shaping an environment. Altman (1980) mentioned that there are four different characteristics that connect man, environment, and culture. It is classified according to Altman as first, the cultural background of beliefs,

customs, traditions, and social behaviour; second, knowledge and its association with the behaviour of the group; third, how these beliefs are inherited among the different generations; and finally, the current culture of the society reflecting its features in the architecture of dwellings or other buildings (Shehab et al., 2016).

In the same context, Rapoport (1980) similarly describes the different aspects of the relationship between man, the environment, and culture, where he first described culture on the basis that it represents a lifestyle for a group of people. Secondly, he argued that culture is in fact symbolic meanings and a system of cognitive framework; and thirdly, he pointed out that culture is a manifestation of the adaptation of a society to the resources available in the environment. Furthermore, culture is also classified as a set of expressions of behaviour, a process that moves from abstract to concrete (Shehab et al., 2016).

As a result of continuous changes and the evolution of the concept of culture, it has not yet been defined accurately (Elkadi, 2008). Eliot has described it as a group of activities carried out by people, and although this description is reasonable to some extent (Howells 2003), it has encountered criticism in terms of the principles of the definition of the people, and also, this definition does not refer to the dimensions of morality, religion, and politics (Elkadi, 2008).

The sustainability of socio-cultural architecture is linked to the preservation of the cultural heritage of the population. The adaptation of people to the nature of their place of residence and modern technological developments reflect the physical framework of a dwelling. The physical framework is therefore part of cultural expression. The interior design of the spaces in the dwelling is the outcome of the interactions of the socio-cultural features of customs and traditions, and so forth. In contrast, the exterior design of the house is a result of the availability of certain types of building material, the climatic conditions surrounding the dwelling, the individual capabilities of the owners of the dwelling, and the aesthetic style prevailing in the community at the time (Chiu, 2004).

In the same context, Chiu points out that meeting people's needs is the primary concern of the sustainable development of housing, and not only to preserve the resources of the surrounding environment. However, the main concern for sustainable housing should not be to meet basic needs, but rather to improve the internal and external conditions of the living environment (Chiu, 2004). As Ahmed (2013) indicated, most of the needs of the population are changeable and can be developed; thus, the design of a dwelling should be adaptable. It is therefore important to envisage adaptation as one of the essential elements of socio-cultural compatibility.

In addition, Chiu also indicated that there are wide overlaps between cultural and social sustainability, where many elements and attributes are linked and are sometimes difficult to separate. Furthermore, cultural and social sustainability can be different at a given time, and there are features that are difficult to measure, such as social considerations and inter-social relations that vary from place to place. On the other hand, cultural dimensions such as art, music, literature, and even religion are perhaps more tangible. (Chiu, 2004).

In general, the concept of dwelling design in terms of socio-cultural sustainability is a dwelling design that meets the social and cultural needs of the population and also preserves the right of future generations to use the environment. However, these needs vary from one society to another and cannot be uniform at a global level. Therefore, the best way to achieve

the aim of socio-cultural sustainability is to investigate the needs of society and find appropriate solutions for dwelling design in that society (Chiu, 2004; Al-Jamea, 2014).

There is a limited amount of literature regarding the socio-cultural sustainability of dwellings, especially desert dwellings, according to literary reviews and similar earlier studies in some desert areas, such as the Arabian Gulf region (Mahgoub, 1997; Asfour, et al., 1998; Ahmed, K.G, 2011; Al-Jamea, 2014; Shehab et al., 2016). This is partly due to the specificity of the Saharan community in southwest Libya; there are some limited studies that have touched on the Ghadames Oasis that refer to some social and cultural factors (Bilghit, 2007). This study proposed four basic features: privacy, safety and security, shape and design, and social and religious considerations, each of which generates a set of sub-items with which to measure the levels of satisfaction of different generations of the population regarding both vernacular and contemporary desert dwelling design. It added three main features: architectural identity, cultural heritage, and contemporary lifestyle, with another set of sub-items. The socio-cultural dimension of sustainability is primarily related to people and their quality of their lifestyle that protects the "cultural identity" of the community, which provides stability and meets the moral and material needs of the population. A sustainable society seeks to motivate the members of the society to enjoy safety and equity for all persons (Al-Zubaidi, 2007; Rogers et al., 2012). These two features are reserved for the youth, because older age groups perhaps are more in touch with their cultural and architectural identity. This highlights the problem of changing the identity of young people, and also shows that young people face rapid changes and developments in their contemporary lifestyle, which contributes significantly to the disintegration of cultural identity and weakens the sense of national identity, which is an important basis for people's civilization and their history (Al-Eid, 2014). These last couple of features have a greater correlation with this younger age groups in creating a balance between the requirements of the modern lifestyle and the cultural identity of young people and preserving the cultural heritage and architectural identity of the historic towns of southwest Libya.

3. RELATED LITERATURE REVIEW

There is a clear lack of studies on architecture and the design of dwellings related to socio-cultural sustainability in Libya, especially in desert areas. However, most of the relevant studies in Arab countries are about similar desert areas in the Arabian Gulf region. One of the earliest studies on social and cultural sustainability in the region was a study presented by Yasser Mahgoub (1997) called "Sustainable Architecture in the United Arab Emirates", which concluded that there are many lessons to be learnt from vernacular architecture. The study included three aspects of sustainability; environmental, economic, and socio-cultural sustainability. The main features of socio-cultural sustainability according to this study were summarized as privacy, desires, identity, religion, family, and community lifestyle. Another study, "Sustainability crisis in the Arab world" (Asfour, et al., 1998), pointed out that one of the most important factors in the crisis is the international architecture trends that have affected the environment and local culture and have led to a loss of self-identity. Al-Zubaidi, in her study on "The sustainability potential of traditional architecture in the UAE" (2007), presented criteria for design guidelines for housing sustainability adaptation in UAE and stressed the preservation of the environment and traditional architecture in UAE. In his study "Evaluation of social and cultural sustainability in typical public house models in Al Ain, UAE" (2011), Ahmed examined in particular the Sheikh Zayed Housing Program in Al Ain and concluded with the proposal of eight guidelines for housing design aimed at achieving

cultural and social sustainability in that region. May Al-Jamea in 2014 conducted a study on social and cultural sustainability of contemporary housing design in Saudi Arabia, a desert region that is somewhat similar to the desert in southwest Libya. The study discussed the absence of social and cultural sustainability in housing design and established guidelines to address this issue. Finally, the research of Shehab et al., "The influences of socio-cultural values on sustainable housing design: evidences among Arab countries" (2016) analysed the impact of socio-cultural values in the design of sustainable housing, and was conducted on Arab students in Malaysia. It explained the importance of social and cultural values in the development of sustainable housing design.

4. A BRIEF BACKGROUND ON SOUTHWEST LIBYA

The desert in southwest Libya is part of the Sahara Desert in Northern Africa. The vast Sahara Desert stretches from the west bank of the river Nile and extends to the outskirts of the coastal cities in the south of Morocco and Mauritania. It represents large parts of the territory of the Maghreb (Figure 1).

The Sahara Desert has an exceptionally dry nature and has the typical natural features and topography of a desert, including the specific characteristics of the desert in the south of Libya, as presented below. The study area under investigation, as shown in Figure 1.2, is located between 9° and 19° East, 23° and 31.5° North (Atlas of Libya, 1978).

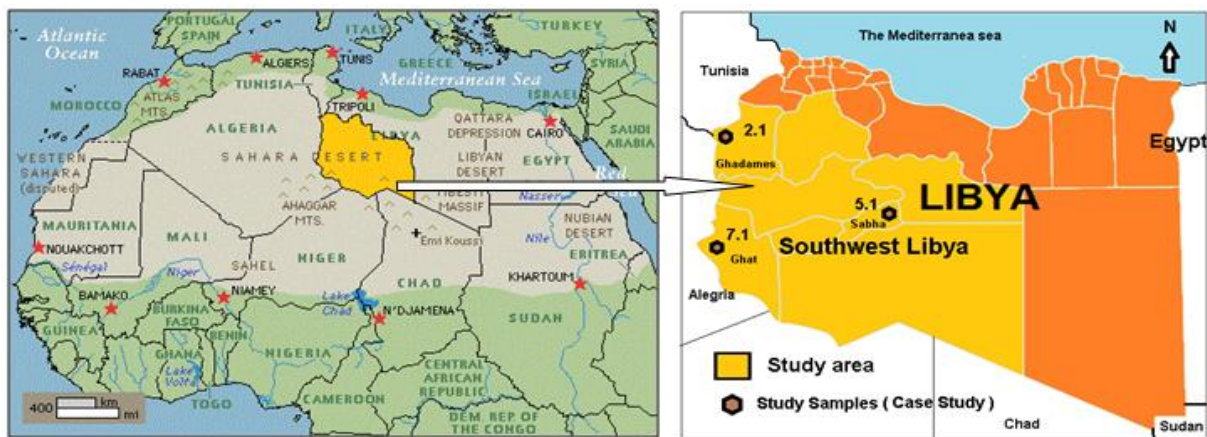


Figure 1: The location of the Sahara Desert Figure 2: The study area, southwest Libya
Source: Adapted from Atlas of Libya

Figure 2 illustrates the study area, which is shown in yellow, and the three historical desert towns (Ghadames, Sabha, and Ghat), which were selected on the basis of specific criteria as samples for this study, in order to generalise the results to each region in southwest Libya. According to the geographical location, the desert in south Libya is considered a dividing barrier between the areas of middle Africa and its coastal areas in the North. The southern parts of Libya have directly been influenced by the region's historical events in ancient times, which have been important for trade, particularly for sub-Saharan countries in Africa (El-Tantawi, 2005). This represent the emergence of urban settlements in the desert. In addition to these, the south of Libya has a strategic location, forming a link between the east and western parts of the Arab world. It represents the convergence of Arabic, local, Islamic, and African cultures. These cultures and civilizations meet and blend in this region (Al-Maazi, 2003).

5. RESEARCH METHODOLOGY

The research uses triangulation or mixed-method approaches, using both quantitative and qualitative data collection and analysis. The questionnaires used in a quantitative method, and the sample survey involves 311 respondents from different generations, most of them young, from the population of the three selected historical towns in southwest Libya. These questionnaires gave an understanding of the respondents' perception of the socio-cultural sustainability of both the vernacular and contemporary desert dwellings and their levels of satisfaction about these two types of dwelling, and their desires and opinions in relation to sustainable dwelling design in the future. Quantitative data was analysed using the SPSS program (using the Wilcoxon test) and descriptive statistics such as frequencies and percentages. The qualitative method contained semi-structured interviews involving 20 professionals that were analysed using content analysis. Additionally, data was obtained from photographs, the maps of some vernacular dwellings, and documents such as government reports, historical documents. The findings of the research were based on a summary of the mixed analysis from the quantitative and qualitative methods.

6. SOCIO-CULTURAL FEATURES OF THE DESIGN OF VERNACULAR DESERT DWELLINGS IN SOUTHWEST LIBYA

According to Salama (2002), sustainable design is can reuse some of the features and values of vernacular architecture. Many experts agreed that the architecture of vernacular dwellings is more efficient in terms of sustainability than contemporary dwellings (Susilawati & Al-Surf, 2011).

The evolution of features of vernacular architecture in southwest Libya is evident in vernacular societies in their principles and way of life. Where the surrounding environment was the source of living, the local population used the principle of sustainability in their everyday life. They lived, cultivated, ate, and built sustainably. Interaction with the local environment and utilizing natural resources were part of their survival on Earth. As Fethy (1973) has indicated, architecture is a natural product of the everyday life of the society that produced it.

The vernacular architecture of desert dwellings is a natural product of the interaction between environmental factors (site, geography, topography, and climate) and socio-cultural features (religion, traditions, norms, and cultural background). The socio-cultural features of the vernacular desert dwellings in southwest Libya as a man-made product is not only about the installation of dwellings; it is a view of life from locals, builders, and professionals. It expresses the society and culture of the previous generations (Al-Maazi, 2003). Therefore, it represents the experience of multiple generations over the years, uniting the concepts of existence and life. According to data analysis and the discussion with specialists, there were several points that have been derived from vernacular desert dwellings, through the exploration of views about socio-cultural sustainability of vernacular architecture for the design of desert dwellings, that can support the integration of sustainable socio-cultural features into guidelines for new desert dwelling design. Most of these points are summarised here.

The first point regards the design of the main entrances of desert dwellings. They do not directly reveal the inside the dwelling (living space is often on the first floor, or the entrance

opens on the storage away from the living space) for enhanced separation of public and private space within the dwellings and to conserve and respect the local customs, traditions, and cultural heritage of the population in southwest Libya (see Figure 3).

The second point is related to the distribution of desert dwellings in vernacular oases and towns in southwest Libya. They have followed certain techniques to maintain privacy, such as using roofs as a sleeping place for the family in the summertime, and the morphology of vernacular desert dwellings, particularly dwellings that face each other, have been developed to maintain the privacy of family space. There is usually an inner courtyard and roof with walls of differing height, and the majority of the living space is on the upper floors, build around the courtyard. The existence of a central space in desert dwellings, such as an inner courtyard, provides an area that encourages social interaction between family members, and it can also be a gathering place for women at events involving neighbours and relatives (Al-Maazi, 2003).

The existence of an outdoor central space can provide a sitting area, which are called "mastaba", encouraging social contact with the members of the community, such as those in Ghadames.

The morphology of vernacular desert dwellings and the compact urban fabric provide a private indoor environment that reinforces security and safety, especially for the children in each neighbourhood. In addition to this, there are other examples that enhance the security and safety through the compact architectural compositions of vernacular architecture, such as the presence of gates and narrow entrances in residential neighbourhoods. Furthermore, people prefer their dwellings to be near their relatives in the same neighbourhood (see Figure 4).

Other points are that the similarities of the shapes, sizes, and colours of vernacular desert dwellings, as well as the suitability of those dwellings with human scale and compatibility with the surrounding environment at oases, conferred a sense of place, identity, comfort, and tranquillity for locals.

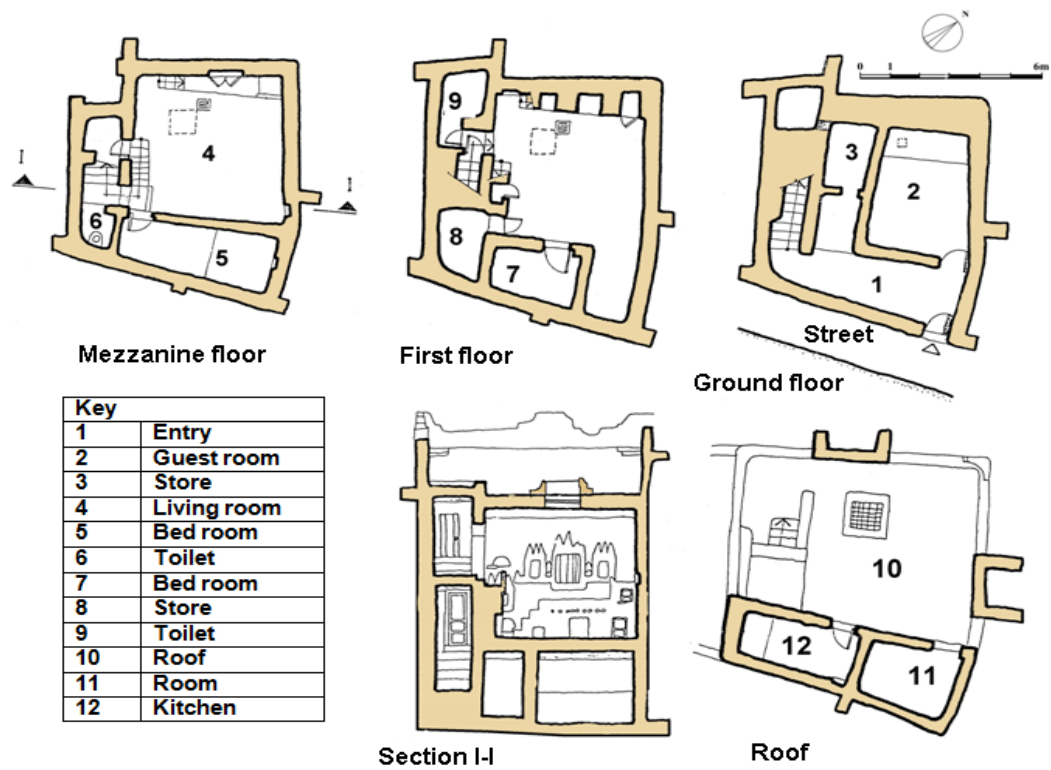


Figure 3: Plans of vernacular desert dwellings without an inner courtyard, Ghadames



Figure 4: The morphology of vernacular dwellings



Figure 5: Corridors for women



Figure 6: Interior decoration

Source: The researcher, field work, 2015

It is useful to look at techniques of vernacular architecture that promote socio-cultural sustainability. For example, the existence of upper corridors for women on the roofs of dwellings in the traditional town of Ghadames provides privacy and supports social contact among neighbours away from prying eyes (see Figure 5). Building materials of vernacular dwellings are obtained from the same environment, thus, the materials used were sustainable, renewable, and compatible with the nature of the place and man. Furthermore, interior design, decoration, colours, and the distribution of spaces in vernacular dwellings came from cultural heritage and values, customs, and traditions of locals, which have led to boosting the cultural and architectural identity of vernacular dwellings in southwest Libya. All the previous vernacular designs and techniques support achieving a socio-cultural sustainability in external and internal desert dwelling design (see Figure 6).

In summary, most of arguments supported efficiency to create a sustainable framework between vernacular architecture and new desert dwellings design in terms of socio-cultural sustainability. However, it is important to take the lessons of the past and evolve a new design of dwellings that will be more humanised, and more with environmentally friendly.

7. THE IMPACT OF THE CONTEMPORARY ARCHITECTURAL TRENDS OF FOREIGN COMPANIES ON THE ARCHITECTURAL ENVIRONMENT IN SOUTHWEST LIBYA

During the transition period of the 1970s and 1980s, Libya went through rapid economic, social, and political change. These changes had broad repercussions, which came and went at great speed. The discovery of oil in Libya greatly influenced housing designs, as a result of the economic growth. At the same time, there was a need to fill the large housing shortage in some desert towns and remote oases. For economic and political reasons, the state at that time implemented a set of contracts that allowed the entry of some foreign companies, which used modern methods and trends in the design of housing that were previously unknown in the region and ignored the socio-cultural features and architectural identity of those towns. This led to profound changes in the desert society, as well as changes in the general shape of the urban fabric of historic towns. Therefore, architects from foreign lands such as the UK, Finland, Japan, Korea, and India designed most of the structures in the Libyan desert. The contributions of local Libyan architects remained unnoticed. Thus, local architecture did not

have any opportunity for development. This resulted in a lack of architectural identity in Libya in comparison with other states, especially in Arab areas (Shawesh, 1996; Amer, 2007; Almansori, 2008).

These changes affected different aspects of local life, which is reflected in the cultural transformation of the Libyan desert society. An expression of the changes can, for instance, be seen in the emerging model of life, and this in turn triggers the inflow of fundamental changes into the existing residential environment. The trends usually follow the international style or echo it in the particular way it is perceived. This is the case for both individual houses and larger urban complexes.

The proportion of the total Libyan population in urban cities has increased from 25% in 1951 to 69% in 2003, registering a rise of 88% (NCID, 2003). The level of urbanization in Libya at that time was one of the highest in Arabic countries (Abubrig, 2013).

Southwest Libya has witnessed an increased demand for new buildings and infrastructure projects. This demand is elevated in the central towns such as Sabha, Hoon, and Ghadames due to the impact of the intensive urbanization process. This process was rampant in the mid-1990s and the beginning of the 2000s, up to 2005 (Bilghit, 2007). Also, necessary changes have occurred in construction housing projects and the physical built environment, which still use the same international design methods without regard for the cultural and social background of the region, which has exacerbated the problem. In conclusion, the urbanisation of international design methods has become one of the most significant driving forces of the change in social housing design in the Libyan desert, which has influenced housing design in terms of socio-cultural sustainability and has distorted the architectural landscape of historic towns.

8. A SUMMARY OF THE SET OF GUIDELINES FOR SOCIO-CULTURAL SUSTAINABILITY THAT SHOULD BE IMPLEMENTED IN THE DESIGN OF CONTEMPORARY DESERT DWELLINGS IN SOUTHWEST LIBYA

According to the research findings, a set of guidelines was formulated to implement a sustainable desert dwelling design in southwest Libya. The following is a summary of these guidelines and recommendations.

The design should adhere to the visual privacy of the various spaces in the dwelling (common public space, private public space, private space such as bedrooms, etc.). Audio privacy should be provided through the distribution of spaces and the use of building materials to assist in acoustic insulation. The appropriate number and size of openings that conforms with the principle of maintaining visual privacy with neighbours and the street should be taken into account when designing the dwelling. This can be done by carefully placing windows and using the appropriate type of material. Social customs and traditions should be taken into account when designing the organization of interior spaces, such as the size of rooms and the locations of bathrooms and kitchens. Also, the design should maintain the privacy of insulation in bedrooms, especially for children, and provide appropriate places for them to sleep and conduct their activities in their rooms.

The aspects of security and safety should be considered in dwelling design, such as ensuring the quality of the materials used to make doors and windows, the types of locks used in the buildings, and the use of modern technologies such as electronic doors and magnetic locks.

The height of the walls surrounding the dwelling or residential neighbourhood should also be considered. Dwellings should be distributed in an appropriate manner to protect the entrances to and exits from the neighbourhood to ensure the safety of the population, especially children. Clear foundations for safety should be established in the design of dwellings to ensure the safety of the population, such as emergency exits in cases of fire and accidents, and the installation of early warning systems for family safety. The necessary measures should be taken to protect against crime and theft by concentrating on the entrances and exits of the dwelling, as well as using the method of social distribution of housing according to the practice of families and tribes in southwest Libya to alleviate problems of tribal or family origin.

Dwellings should be a suitable size for the average number of family members in southwest Libya so that there is no need for expansion, which could affect the facades of dwellings and therefore affect the general architectural landscape of the town.

The dwelling should be located near to public service buildings such schools, clinics, and markets for easy mobility, especially for women, the elderly, and children. And rely on pedestrian and sub-traffic as far as possible away from the main roads to promote social sustainability.

The doors and windows of the dwellings should be almost the same design and size and manufactured from high-quality materials to ensure a clean and safe internal environment, devoid of environmental pollution and unwanted air currents.

The external facades of the dwellings should be made from high-quality materials to ensure resistance to the harsh external factors in the desert in order to reduce the need for continuous maintenance, as well as to reflect the forms, colours, and local character of the architectural identity of the historic towns.

The design of the dwellings should promote family relations and social and cultural activity by providing suitable spaces for family gatherings that create a warm atmosphere. Additionally, space should be provided for children to play in and experience their childhood. Each dwelling should contain appropriate facilities and services that satisfy each member of family. Furthermore, the dwellings should be designed and distributed in a manner that creates spaces and internal gardens to provide suitable places for different social activities to strengthen social ties among the population, in addition to facilitating access to religious places, especially for the elderly.

The interior and exterior design of the dwelling should reflect the cultural identity of the desert society in southwest Libya through the reuse of some vernacular architectural elements in the facades in a contemporary manner, with modern techniques and careful replication. Therefore, the exteriors of dwellings will appear to be similar in terms of form, which will enhance the sense of identity for population of the built environment.

It is important that sustainable design is in line with the architectural style of the historic towns in southwest Libya in order to preserve this architectural heritage, but in a contemporary fashion so it conforms to contemporary lifestyles and does not conflict with the wishes of new generations. This can be achieved through a number of measures, including the education and training of young people, such as new generations of architects and planners, and showing them the importance of preserving the architectural and cultural

heritage of the region, which is part of their cultural heritage and identity. The new design should achieve a reasonable balance between the preservation of cultural heritage, customs, traditions, and the right of new generations to keep up with the contemporary lifestyle in a manner that does not remove their cultural identity, and enhances their sense of identity and self-expression.

The dwelling design should provide a healthy internal environment, provide good ventilation and lighting, and be well protected from harsh desert conditions. It should also consume energy sustainably through economical technologies. Its spaces should be flexible enough to keep up with contemporary socio-cultural developments and to be able to adapt to any changes that may be needed by the population in the future, such as expanding or narrowing some spaces and keeping up with modern technology during daily activities.

To produce a sustainable design that succeeds in meeting the population's needs and achieves a good level of satisfaction, it is important to involve the population, especially young people, throughout the design process in order to take advantage of their ideas and share their views.

9. CONCLUSIONS

According to the review of the literature on socio-cultural needs, this paper attempts to highlight the absence of the implementation of socio-cultural sustainability in desert dwellings in southwest Libya. However, the conclusion of this paper is to formulate and summarise a set of guidelines for sustainable socio-cultural features for desert dwelling design that can help increase residents' satisfaction with the design of dwellings that fulfil their socio-cultural needs throughout different generations. The paper will contribute to filling the gap in sustainability development in the dwellings sector in the Libyan desert in general and in socio-cultural sustainability specifically.

The principles that must be implemented in the design of contemporary desert dwellings to move towards socio-cultural sustainability are privacy, safety and security, shape and design, and social and religious considerations. This paper develops these measures by addressing cultural heritage and architectural identity, and contemporary lifestyle, as two separate features according to the findings of recent research that focuses on young people's opinions. These important concepts should aid in the production of a desert dwelling design in southwest Libya that can serve all the socio-cultural needs of the people.

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CHANGES IN ARCHITECTURAL DESIGN PROCESS IN THE DIGITAL AGE: RECENT PHENOMENA AND FUTURE POTENTIAL OF COMPUTATIONAL DESIGN

A. Haidar, J. Underwood and P. Coates

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: A.Haidar@edu.salford.ac.uk

Abstract: The rapid evolution of digital technologies applied in the current architectural practice is resulting in radical changes in the way designers create, communicate and interact. Design processes are becoming more complex, which is resulting in the emergence of new roles in design teams, and a growing need for more collaborative and interdisciplinary environments. Furthermore, new modelling techniques are evolving that are shifting the focus from the modelling of the building form to the modelling of its behaviour and structural and environmental performance. The adaptability of those modelling techniques is enabling the creation of a digital narrative fit for purpose in which a design team can adapt tools and processes to fit the specific needs of the project at hand. In general, a wide range of novel design approaches and methodologies are currently being developed in the architectural practice. Those approaches are growing in a radical manner whereby no mature theory has yet been provided, despite intensive publication. Through a case study research methodology, the paper explores some of these cutting-edge design methodologies in order to link them to the existing theory. Two semi-structured interviews were conducted with practitioners from the architectural and software development practice. The analysis of the data was linked to the existing computational design theory, and based on this link, the paper explores the real impact of digital technologies on the architectural design process, together with how such digital technologies can be utilised to develop innovative strategies in architectural practice.

Keywords: Architectural Design Process, Collaboration, Computational/Digital Design, Design Theory, Interdisciplinarity.

1. INTRODUCTION

The impact of digital technologies on architectural practice started to crystallise in the 1980's as CAD (Computer-Aided Design) was adopted by a wide range of practices over the world (Penttilä, 2006). At that time, CAD proved its efficiency in project delivery due to its ability in speeding up replications within the design process (Holzer, 2015). In the 1990's, CAD started to be an inevitable design tool in the majority of architectural practices, where the focus was on using CAD to produce digital documentation for design instead of the traditional paper-based drawings (Penttilä, 2006). Within the same decade, CAD applications continued to evolve, and hence, started to enable high quality visualisation, which dominated the propagation of computational skills within the practice (Bernal, Haymaker, & Eastman, 2015). Later, CAD and 3D modelling programs, together with the rapid prototyping and physical modelling tools, started to grow and evolve very quickly; thus, these digital tools have started to influence the core of the design process in its early stages. As a result, it could be argued that the design first concept can be born from the nature of the digital resource. In such a situation, it is important to identify the true potential of digital technologies and their implicit impact on the creation and production of design artefacts. To achieve this identification, the paper classifies the recent computational design phenomena in the current

architectural practice, and then later explores how those new digital design methodologies can make sense within the real practice.

2. RECENT PHENOMENA IN ARCHITECTURAL DESIGN PROCESS

2.1 Complexity

Digitally-driven design processes are characterised mainly by a high level of complexity (Mitchell, 2005). This complexity is reflected in the relationships between designers, tools, knowledge, information and other actors in a project team (Kocaturk, 2013; Oxman, 2006; Thomsen, Tamke, Gengnagel, Faircloth, & Scheurer, 2015). As a result, the focus in the design process has shifted to some extent towards managing this complexity (Whitehead, de Kestelier, Gallou, & Kocatürk, 2011), and has provoked an indispensable need for standardisation to reduce this complexity Mueller (2011). In this regard, Oxman (2006, p. 240) states that an intensive nomenclature is emerging to help in identifying names for the “sub-tasks” and “sub-phases” within a design process, which, in turn, helps in crystallising the increasingly complex processes of design. Thus, the traditional representation of design as a “staged, linear/cyclical process” is being replaced by another one, which is more “particularised taxonomically” (Oxman, 2006). Therefore, it could be argued that this complexity in digital design is resulting in changing the structure of the design process, through changing the sequence of its stages and by adding more sub-stages.

2.2 Emergence of New Roles

In order to tackle the increasing complexity in computational design, new roles within architectural teams are emerging, such as software developers, parametric designers, geometry specialists, sustainability specialists, and data scientists (Ceccato, 2010; De Kestelier, 2013; Hesselgren & Medjdoub, 2010; Katz, 2010; Whitehead et al., 2011). Furthermore, many architectural practices have already started to adopt BIM (Building Information Modelling) technology where the radical increase in the information content is challenging the capacity of a project architect who needs to deal with this enormous flow of information (Holzer, 2015). Such a situation has redefined the role of a project architect, and has resulted in a growing need for specialists in information management, data integration, and interdisciplinary coordination in order to enhance efficiency in BIM workflows (Holzer, 2015). This wide variety of roles and areas of specialisation within the architectural practice has, in some cases, exceeded the field of the built environment. For instance, most of the design teams at Zaha Hadid Architects (ZHA) are provided with software developers (Ceccato, 2010), while Foster + Partners have their in-house research group, in addition to artists, mathematicians and an aerospace engineer that work within their design teams (De Kestelier, 2013; Foster+Partners, 2013).

2.3 Collaboration and Interdisciplinarity

Four decades ago, Jones (1969) was urging designers to enhance transparency in the design process in order to allow contributions beyond designer’s own expertise and knowledge. Currently, the nature of digital tools applied in design practice is resulting in increasing transparency in design processes by shifting some aspects of the design process “from implicit to explicit” (Oxman, 2006). In this regard, Thomsen et al. (2015) argue that these

interdisciplinary environments help architects to learn from neighbouring fields, and to inspire ideas and technologies rather than reinventing the wheel. Kolarevic (2004) claims that digital technologies are enabling a “seamless collaborative process” by integrating design, constructional, analytical, and other processes, which results in “a digital continuum from design to production”. For her part, Kocaturk (2013) describes collaboration within socio-technical environments as the main engine for innovation in architectural practice. In general, it could be argued that enhancing collaboration and interdisciplinarity is becoming inevitable in the current architectural practice in order to tackle increasing complexity and the multiplicity of roles by sharing information, ideas, and techniques throughout the different stages of the design process.

2.4 Adaptability

Traditionally, architectural designers used to develop design solutions by using specific tools. The new digital technologies applied in the design practice are enabling designers to adapt the tools they are using to be ‘fit for purpose’. From a practical perspective, Whitehead et al. (2011) claim that the technologies used in the design process should be customisable based on the specific needs of each individual project, and should be developed by the design team in parallel with the development of the design itself. From a theoretical perspective, Oxman (2006) states that these digital tools and techniques applied in current practice are resulting in “a paradigm shift in the design process from form to formation”; as they enable designers to interact with the very process by providing the capability of adapting and reforming the tools within the design process. Mueller (2011) describes this phenomenon as a new level added to the design process, in which a designer needs to design the building one level, and on a different level, design the tools that will be utilised to design the building.

2.5 New Dimensions in Design Modelling

A variety of modelling techniques are enabled by different digital tools, which can be utilised to create different sorts of models; such as physical model, BIM model, parametric model, script, and sketch (Kocaturk & Kiviniemi, 2013). While each of these models represents a specific degree of abstraction, each model is being produced for a specific purpose such as analytical, geometrical, visual, contextual or environmental models (Kocaturk & Kiviniemi, 2013; Whitehead et al., 2011). The function of modelling in the design process, according to Whitehead et al. (2011, p. 240), is to manage “change propagation” in the design process, which can be captured in a model-driven process by creating a “federation of models”, and then exploring mechanisms to link these models and allowing them to work together in an integrated way. In this light, Thomsen et al. (2015) argue that the current digital technologies allow not only modelling the building form, but also modelling the behaviour of a building in order that a model can show how the building will look like and also how it will perform. This multiplicity of models can result in more mature decisions as it facilitates referencing and data exchange between different modelling processes and provide feedback for designers (Whitehead et al., 2011, p. 240). In this regard, Kocaturk and Kiviniemi (2013) argue that these various modelling techniques have the potential of shifting the focus in the design process from providing drawings to providing ‘intelligent models’ from which different drawings can be extracted. From a different perspective, Thomsen et al. (2015) state that this phenomenon is starting to challenge the traditional hierarchical organisation of design fields by enabling new design-based information modelling, which is starting to focus on

investigating inter-scalar interdependencies within the design process. Hence, all the information from different scales and levels; from Micro level to meso level through to macro level, are integrated into one single platform and are represented in one single model (DeLanda, 2016). Thus, it could be argued that the advances in digital technologies are resulting in adding new dimensions to design modelling, and are enabling a variety of approaches in a design process, such as relying on ‘federated models’ or integrating processes into ‘one single model’. Therefore, those rapidly evolving modelling techniques are gradually becoming an integral part of the design process.

2.6 Increasing Role of Research within Architectural Practice

Due to the rapid growth of tools and methods currently applied in the design process, some design practices are provided with research teams that help in developing tools, methods and experiences. For instance, ‘Foster + Partners’ is provided with the SMG (Specialist Modelling Group) that carry out project-driven research and development (Whitehead et al., 2011). According to Hugh Whitehead (the head of SMG), the tools developed within the design process of a specific project are being re-customised and re-used for other projects. Likewise, ZHA (Zaha Hadid Architects) provides its design teams with a variety of in-house online media and data-bases to capture constructional and architectural knowledge such as “descriptive techniques and parametric scripts”. This knowledge is recorded using different digital repositories to help in developing a sustainable and growing knowledge base that can be used to transfer experiences from one project to another (Ceccato, 2010). On its part, SOM (Skidmore, Owings & Merrill) relied on intensive research in developing its own software in order to enable the modelling, analysis and documentation of large and complex projects (Katz, 2010). On the other hand, Lars Hesselgren (Director of PLP Group), who also has a similar research group, argues that the role of this group may differ based on the nature of each individual project, and the stage in which the research group engages; however, he states that such an engagement may slow down the design process due to the different criteria used to drive the practice and the research (Hesselgren & Medjdoub, 2010). Such examples represent highly innovative strategies in the architectural design process in which tools and processes are being digitally documented to inform future design projects. It is essential to rearticulate those strategies within an efficient theoretical context in order to identify their potential in developing novel design methods.

2.7 Increasing Role of Information

In response to the growing need for more collaborative environments and more means for coordinating different design and construction platforms, new technologies are widely available to facilitate and automate the flow of information within the design process. This increasing need for information has resulted in the emergence of BIM, which relates to “the concept of relating data to geometrical objects that form a digital representation of building component assemblies” (Holzer, 2015, p. 67). BIM can enable higher building quality and an effective and high level of collaboration between participants from different disciplines as it allows the creation of an accurate 3D model that contains both geometrical and non-geometrical information, as a result, an automated and direct extraction of 2D drawings at any time can be achieved, together with automatic corrections when a part is modified, synchronisation of design and constructional information, earlier cost estimations with acceptable accuracy, earlier determination of potential errors and energy analysis and

evaluation (Eastman, Eastman, Teicholz, & Sacks, 2011; Eynon, 2016; Garber, 2014). From a theoretical perspective, Oxman (2006) describes information in computational design as a “new material” for designer, while Kolarevic (2004) states that this seamless flow of information in computational design is blurring lines between design and construction processes and is resulting in digital continuum from design to production. Thomsen et al. (2015) state that BIM is shifting the focus from a 3-dimensional geometric extension to an n-dimensional field of divergent, heterogeneous and conflicting information, which in turn, can trigger significant changes in the way architects work, particularly, where the parsing, analysis and calculation of information become an integral part of the design representation.

2.8 Influence of Disciplines Beyond the Building Industry: Topology and Non-Euclidean Geometry

New terms from industrial design, informatics, topology, film making, and biology have started to invade the discourse of contemporary architecture, such as; algorithms, NURBS, curvilinearity, hyper-surfaces, kinematics, bio-morphic, and genetics. According to Kolarevic (2004), design and production of curvilinear forms was broadly used in other industries some time before they were adopted into architectural practice. For instance, Frank Gehry produced the doubly-curved skin of the Walt Disney Concert Hall in which he utilised CATIA (Computer Aided Three-dimensional Interactive Application), which had been used in aeronautical design for 20 years (Glymph, 2003; Kolarevic, 2004; Lawson, 2011). Similarly, in shipbuilding and automotive design, the reliance on drawings was abandoned in favour of centralised 3D-models some time before similar methods were adopted in architecture. In addition, architects have started to adopt CAD/CAM systems which were developed for product industry, and some software applications from film industry (Kolarevic, 2004).

One of the main consequences of this phenomenon in computational design is the emergence of topological, non-Euclidean geometry, whereby architects tend to provide habitats similar to those of nature (Bhooshan, 2016). For this purpose, some architects have started to “manifest norms of beauty” by migrating from Euclidean spaces and Cartesian grids towards double-curved, complex and interactive geometry (Kolarevic, 2004). Many historical attempts of embedding such geometry into architectural forms failed due to the lack of representational technologies of their times (Moneo, 2001). Currently, those attempts are effectively enabled due to the availability of affordable constructional technologies together with highly-advanced software applications (Oxman, 2006). The results of this phenomenon are vast; theoretically, Kolarevic (2004) argues that these “blobby”, “formless” and “fluid” shapes are shifting the focus from “spatial distinctions” to “spatial relations”, while Oxman (2006, p. 252) claims that topological design is “characterising the first formal statement in new design philosophy” by providing a new kind of formal complexity, and departing from the “topological determinism” of traditional design. Practically, despite the lack of aesthetic theory to support curvilinearity in architecture as Kolarevic (2004) complains, this phenomenon can be exemplified by many existing buildings such as ‘Kustaus Graz’ by Peter Cook (CRAB, 2003), ‘Web-of-North-Holland’ by Sander Boer and Kas Oosterhuis (Kocatürk, 2006; Oosterhuis & Boer, 2004) or ‘BMW’s exhibition pavilion at the IAA ’99 by Bernhard Franken and ABB Architekten (Franken, 2003).

In relation to the research topic, this phenomenon has an impact on the architectural design process, as designing such forms requires incorporating highly-advanced mathematics into the design process in order to analyse and generate highly-complex and doubly-curved

surfaces. In other words, this kind of design requires new sorts of knowledge and experiences that were not highly related to conventional design processes. This is reflected in the current practice, as some practices have started to integrate aerospace engineers, mathematicians, and specialist from other disciplines within their design teams.

2.9 Changes in design thinking and culture

The new digital tools and methods currently applied in design have influenced the core of the design process. Some authors describe this influence as a shift in the culture of designing and design thinking (Kolarevic, 2004; Oxman, 2006), while others tend not to exaggerate in describing this influence (Lawson, 2011; Whitehead et al., 2011). According to (Oxman, 2006), this cultural shift is reflected in the centrality of digital tools, and the adaptability and “non-determinism” of the design process. Kolarevic (2004) argues that the new digital processes are ignoring traditional styles in design and concentrating more on processes driven by automated and responsive form generation. A potential evidence of this cultural shift can be traced in Hesselgren’s description of the role of computational and parametric group in his practice as “extending computational design beyond the sphere of geometry” (Hesselgren & Medjdoub, 2010, p. 247). In general, the computational approaches applied in the current architectural practice are re-addressing the entire cycle of the design process including the generation, evaluation and optimisation of design alternatives as stated by (Bernal et al., 2015) who recognise three levels of the impact of computational methods on each design stage. Those levels range from assisting, to automating, to finally augmenting the actions undertaken within the design process. Fürnkranz J and Hüllermeier E. (2010) in Holzer (2015) argue that these computational methods are not only optional methods awaiting effective inclusion within the design process, but that they are silently being the norm.

3. RESEARCH METHODOLOGY

The epistemological position of this research leans towards interpretivism; the research tends to identify the impact of digital technologies on the architectural design process and the way in which different digital tools, techniques and methods, applied in the current design practice, are reshaping the designer’s thinking process. Thus, the research is seeking knowledge that is going to be interpreted from people’s subjective perspectives and opinions (architectural design practitioners), in addition to the social context of this knowledge within the current architectural practice. Besides, the ontological assumptions that will lead this research lean towards subjectivism in that the research is not looking for a single reality. In fact, this reality (the true potential) seems subjective and can be different from one design practice to another, as each practice has its own methods, techniques and approaches in employing digital technologies in their work. Furthermore, within the same practice, the potential of digital technologies can be different from one architectural project to another. In fact, in the realm of architectural design, each project has its own nature, and may require different kind of information, and perhaps, unique methods and approaches.

The purpose of this research is mainly explanatory as it focuses on determining the relationship between two main variables; the digital technologies and the architectural design process. This relationship is caused by the rapid evolution of digital technologies, which is resulting in a radical change in the methods and techniques applied in the current architectural practice. In addition, the architectural design process is a variable that contains

two ‘sub-variables’ that are the current design practice and the computational design theory. In this regard, the research investigates how the adoption of digital technologies in the current practice is rising the need to revise the design theory.

The previous section investigates the impact of digital technologies in architectural design process by classifying the recent phenomena in digitally-driven design processes. Within this section, the paper explores those phenomena within the real practice in order to identify the theoretical context of these phenomena, and how this identification can lead to the development of innovative strategies in computational design; hence, a case study research strategy was adopted where the two cases represent two firms from totally different nature, however, both of the firms have proved efficiency and success in utilising and developing computational design methods within real projects. A semi-structured interview was conducted for each case. Both participants are architects.

3.1 Case Study 1: Computational Design in a Large-Scale Architectural Firm

This case study relates to one of the leading architectural firms in the UK whose work relies on a highly collaborative environment and interdisciplinary teams. They are currently in charge of a variety of design and construction projects in the UK and worldwide. The participant is an architectural assistant that is currently working at the practice.

Teams, Technologies and Tools: The firm is divided into teams and sub-teams which have specialists from a wide range of disciplines. This includes architects, structural engineers, artists, geometry specialists, aerospace engineers, environmental engineers, programmers, and model makers. The participant states that this interdisciplinary environment has a significant impact on their work as a designer. In their previous work experience, they used to spend most of the time struggling with different tasks to the extent that they barely found time for design. In their current work, they have different specialists that can help in the multiplicity and the complexity of the design tools and processes, which enables them to focus more on their creative work. The firm has almost all the relevant software applications to match the different needs, specialisations and cultures within the teams. The teams are also supported by open source for training and skill development. In addition, the 3D printer is essential and it is used in the various stages of the design process for several purposes.

Processes and workflows: During the ideation and conceptualisation stages of the design process, the software applications are not used to generate and communicate design ideas. Instead, they rely on freehand sketches and rough models. Besides, the BIM specialists and parametric modellers do not intervene until the concept design is achieved. At the end of the conceptual design stage, the design team provides a model to be approved, and this is when the BIM specialists start to develop their own model, based on the conceptual model, and then, they start to integrate into the design team in order to guide the team throughout the rest of the design process. The BIM team normally provide a Revit model as, in most of the projects, the Revit model is part of the agreement with the client which might rely on this BIM model for the facility management during the operational phase of the building lifecycle. According to the participant, relying on methods developed from previous projects does not seem to be part of the culture of the firm. Instead, they believe that designers should be creative in every single project and to rethink the design solutions from scratch for every problem, rather than having something ready to use. They state that it is just the experience

and knowledge that an architect gains from a project that could be taken forward and fed into subsequent projects.

Adaptation of Tools: The company is provided with a whole team of software developers, programmers and scripting specialists which support the different teams including the design team in developing software applications to match the specific requirements of each project. When it comes to complex and large scale projects, the software developers work with the design team side-by-side throughout the design process to manage the tools, in order to reduce complexity by making applications more efficient, and fit for the project purposes. According to the participant, the development of tools normally takes place within the project context. Moreover, due to the wide range of software applications and other digital technologies used in the firm, the software development team are in charge of continuously enhancing the interoperability between different technologies used in order to provide the seamless flow of data and other information across different applications. In this regard, the participant insures that they did not experience any interoperability issue throughout their two-year experience in the firm.

Collaboration: The way in which the design team collaborate with other project stakeholders, and the type of shared material may differ based on the design stage and based on the other participants involved in the project. For instance, at the early stages of design, they collaborate mainly through meetings and discussions, while during the later stages, the design team start sharing drawings and models with other disciplines, such as the structural engineering team. In some projects, the design team interact with external teams specialised in providing intelligent models. In this case, the design team sends the design model to the external team, who updates the model and provides feedback. The design team respond to the feedback and send the modified model again, and the loop continues until the model is approved by all parts.

3.2 Case Study 2: Collaboration and Interoperability in Practice

This case study relates to a software development firm located in USA. The participant is an architect holding the position of the head of the application engineering team. The firm is an interdisciplinary firm which consists mainly of a mix of experienced software developers and building professionals. They are in charge of developing an online platform, which is a data-rich, collaborative platform for teams of architects and engineers working together in building projects. The platform contains a wide range of simple and lightweight software applications dedicated to enhancing interoperability between popular software applications used in the current architectural practice and building industry.

Teams, Technologies and Tools: The firm is divided into departments and teams, such as the design department, the business development team, and the product development team. In addition, there are teams for geometry, infrastructure, and data management. The firm develops its software mainly on top of popular software applications, such as Revit, Grasshopper, Excel, AutoCAD, and 3DS Max. For instance, the platform contains plug-ins that are dedicated for interoperability. These applications enable direct and real-time data transfer between MS Excel and Rhino-Grasshopper, between Revit and Grasshopper, and from Revit to Excel. The platform also includes a wide range of bespoke applications; some of them contain just few commands, or even one single command so that the data can be generalised into a simple, light-weight format that could seamlessly be transferred across

different project platforms. The online platform does not have a central database as they do not aggregate data. Rather, they link their users to existing databases. For instance, the platform has an application that enables designers to access project site maps to then select a region that contains the building site and its surrounding. The application automatically generates a 3D model of the surrounding buildings with their real heights. To do this, the platform does not contain any maps or information about the height of each building, but rather, it links users to OpenStreetMap website that contains this sort of information. This same application can also automatically achieve the topographical survey of the site by linking users to the NASA website that contains the contour lines of most parts of the USA.

Processes and Workflows: The application engineering team interfaces with professionals from the AEC industry in order to identify potential opportunities where the firm can assist. In addition, the team leader interacts with their teammates as well as with other teams and departments within the firm in order to expose the information that their team generates, and expose it to the necessary members. This working process allows the firm to maintain continuous improvement and development of its tools in order to respond to the rapidly evolving industry. From the user perspective, the online platform allows users to export any sort of data or shape into a cloud-based environment that contains the main files so that multiple users can exchange data and geometry by a click of button. They normalise data into simple and lightweight elements, send it over to the platform and then other participants in the project team can recall the necessary data from the platform without the need to upload, send and then download the whole blocks of data as described in the previous case. This novel strategy of data sharing increases effectivity and efficiency in working processes as it can significantly minimise the waste of time by enabling users to get only the necessary data in the desired way and time. It also allows participants to minimise both the large file storage and complexity in working processes, which are resulted from the saving of different versions of the same file on different platforms.

Collaboration and Interdisciplinarity: The firm is a highly collaborative and interdisciplinary work environment. In fact, collaboration is an essential part of their culture, and enhancing collaboration in the AEC industry is in the core of their role. The different members at the firm interact intensively with one another. In addition, they support interdisciplinary teams in the building industry with developing new collaboration methods in their practice. This collaboration is supported on different levels. At the enterprise level, they provide a cloud-based system and tools that allow different participants in a building project to share data and transfer different sorts of information seamlessly. At a wider level, they make their design tools available online for the users themselves to develop their own tools collaboratively on top of the existing applications, which appears to be collaboration on a global level. Furthermore, the firm tends to be highly collaborative with other software developers. For instance, they have an open line of communication with large software vendors, such as Autodesk and McNeels, whereby they continually talk about opportunities where they can collaborate.

Future and Ambitions: Flux believes that their teams are not just providing intelligent tools for practitioners to utilise, but rather, are changing the way buildings and cities are being designed and constructed. In this regard, Carlile (2014) (a software developer at the firm) provides a series of inspirations for the development of architectural design methods. She argues that architects should learn from the way ‘mother nature’ generates trees from a seed. Hence, they should start thinking of developing building seeds, rather than repeating the same process again and again for every single project. She also urges architects and builders to

learn from the software industry, where the applications are shared for different participants to build their tools on top of the existing applications, rather than starting to develop a separate application from scratch.

4. DISCUSSION

Based on links between analyses of the computational design theory and the computational design methodologies applied in the current practice, this section will link the theory and practice to identify the potential impact of computational design, and how this link can help in developing innovative and more effective digitally-based strategies in architectural practice.

4.1 Enhancing Collaboration on Different Levels

Collaboration is inevitable when highly-advanced digital technologies are utilised due to the increasing complexity of these technologies and the need for various areas of specialisation to manage this complexity. According to the practitioners, collaboration in architectural design process has proved a high level of efficiency in tackling design problems, and in coordinating different experiences involved in the design process. The case studies reveal several levels of collaboration. At the enterprise level, different members and different teams rely on digital tools to share ideas and information from the earliest stages of the design process, and continuously throughout the whole project within interdisciplinary teams. In addition, the case studies reveal potential collaboration at a global level, where some practices make their tools and processes available online for users to benefit from, and to build on top of the existing tools, and hence contribute to the evolution of those tools and processes. In between those two levels, there could be collaboration at the organisational level whereby organisations, such as RIBA (Royal Institute of British Architects) or AIA (American Institute of Architects), provide updated standards and regulations, and create database and digital libraries of data for all practices to benefit from. Hence, developing strategies for collaboration at all its levels should be one of the main priorities on any practice that focuses on technology and development.

4.2 Paradigm Shift in Design Processes

Belshaw (2012) provides an interesting comparison between the rendering of images in the past and in the present, in order to explain how processes are approached in the recent digital age. Traditionally, a rendering program produces the image in a linear sequence by starting from the upper line of pixels at the top of the image down to the bottom. In this case, the designer might spend significant time watching the top part of the image which is often just a sky. In such a situation, any mistake that might be found in the rendered scene will only be explored very late when the rendering is almost finished. This can be cumbersome and extremely time consuming. However, in the recent versions of the same programs, the render starts by showing the whole image from the beginning, but in a low resolution and with fewer pixels, and as the render progresses, the image starts to get clearer by gradually increasing pixels. This has a great potential as it allows designers to capture any mistake very early within the render time, as this scenario enables designer to view the end result from the first stage. It is this comparison that can perfectly illustrate the paradigm shift in computational

design processes. In the conventional design process, the end results of the design are seen very late in the process, as designer used to communicate with structural engineers and other participants in a project very late in the design process when the design is well developed and close to completion. In this case, any problems found or any changes required might be very expensive and time consuming (Mueller, 2011; Turrin et al., 2011). The new modelling techniques are allowing the integration of several kinds of performative criteria into the conceptual design stage, so that any problem can be tackled much earlier in the process.

4.3 Complexity vs Simplicity (Simplicity)

The concept of complexity within computational design processes is tricky to a certain level. Many authors argue that digital technologies are resulting in increasing complexity in design (Kocaturk, 2013; Kolarevic, 2004; Oxman, 2006; Whitehead et al., 2011). In fact, the opposite can be true in certain situations. For instance, parametric design allows exploring a variety of design possibilities simply by manipulating parameters or moving sliders. It can also provide automated structural analysis and optimisation. Similarly, BIM allows a seamless flow of information and automatic update for associated items. These examples show how some activities within the design process can be simplified when technology is adopted. However, there are still some aspects in the design process that seem to become more complicated such as the coordination of different design and engineering platforms. In general, as the participant in the second case argues, complexity is a matter of understanding; things remain complex until we understand them and when we understand them, they become simple. Therefore, a design practice should develop strategies in order to explore different aspects of complexity and increasing the level understanding for the new methods and tools. This will allow the evaluation of the missing skillsets for training, which is similar to the strategy that the architectural firm in the first case is adopting. Furthermore, as complexity is about understanding, there should be a change in the architectural programs at universities in order to improve the understanding of the different features of computational design. Thus, enhancing collaboration with academic organisations is a highly effective strategy to reduce complexity in design processes.

4.4 Inspiring Processes from Nature

The new digital technologies have enabled architects to go beyond Cartesian grids and Euclidian spaces (Kolarevic, 2004) by developing habitats similar to those of nature (Bhooshan, 2016). However, the processes undertaken in designing such habitats have no relation to nature. Later in time, new ideas started to emerge that discuss the possibility of developing design processes that are similar to the natural processes of generating and growing forms. In other words, the focus is shifting from simulating natural forms, to simulating the natural formation processes. In this regard, the term ‘building seed’ is suggested where designers tend to develop building seeds that can be planted to grow different buildings, rather than repeating the same design process for every single building (Carlile, 2014; Mueller, 2011). Hence, the ‘building seed’ concept proffers a great potential in architectural design as it can enhance sustainability in design process, and it is quite useful for any architectural practice to orientate their research to allow the development of ‘building seeds’ so that in an architectural practice, there could be a library of seeds which can be developed either by independent research based on design experiments and software development, or through the accumulation of experiences and knowledge acquired from

different projects. The seed itself can continue to be developed over time so that, at the end, we might end up having a super seed that can grow into any sort of building. In general, observing nature, and learning from the way it generates forms and systems is a great potential in developing new forms and new processes in design, especially when we already have a variety of tools at hand that can support such kind of tendency, such as parametric modelling and scripting.

4.5 Research and Development

Due to the increasing complexity and rapid evolution of digital technologies applied in design, the design process should be accompanied with research and knowledge acquisition strategies. Case 1 reveals how some architectural firms rely on research in developing their designs tools, and methods, and how research can be conducted either independently or within a design project. On the other hand, in case 2, the concept of designing building seeds rather than single building was discussed, and the idea of creating a library of seeds to be used in different projects was suggested. This idea can make more sense if the library is shared online and open to the public. Therefore, instead of developing the library based on a handful of members in the internal teams, a much wider range of participants from all over the world would continuously contribute to the development of the building seeds; hence, they might come up with smarter and more efficient seeds. Such an innovative strategy is not new, as similar strategies can be found in the web industry, especially after the emergence of web 2.0, which allows users themselves to upload their material and create the content of the website themselves (Barnes & Tynan, 2007; Thomson, nd). This sort of interactivity on an extremely wide range of communities has resulted in a radical grow of different websites, such as Wikipedia, YouTube, and Twitter. Similar strategies can be seen in the current software industry, as most of the design-related software providers make their tools available for other programmers and software developers, such as the firm in Case 2, to develop their tools, applications and plug-ins based on existing applications. This is resulting, as discussed in Case 2, in developing highly effective collaborative design methods that can save time and effort allowing designers to focus on their creative work, rather than managing complexity in the design process. In this context, architectural practitioners should consider adopting a similar strategy if they wish to have similar results. They need to inspire ideas, processes and developmental strategies from other disciplines, and try to adapt them to their profession.

5. CONCLUSION

The paper has shown the impact and potential of digital technologies in developing innovative strategies in architectural practice, such as enhancing collaboration and interdisciplinarity on several levels, observing nature and learn from its processes, focussing on research, and inspiring developmental ideas from the web and software industry. However, the aspects discussed in this paper do not seem to be representing clear cultural shifts in architectural design process. In fact, the rapid evolution of digital technologies applied in architectural practice have enabled the development of novel design approaches that take full advantage from those digital technologies, such as the processes driven by parametrics, genetics, algorithms and scripting. These approaches are beyond the scope of this research, and they need to be discussed in further research if we are to identify the cultural shifts in the design process. This paper has set the foundation for such research, which can rely on the outcomes of this paper in identifying how those novel design

approaches can enhance collaboration, interdisciplinarity and automation in architectural design process, and hence, resulting in paradigm shifts in the architectural design process and new models in design thinking.

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MANAGING CHALLENGES TO LOCAL CULTURE IN CONSTRUCTION: PRESERVING ARCHITECTURAL IDENTITY IN THE CITY OF BASRA

H. Samir¹, C. Trillo¹ and A. Toriello²

¹*School of the Built Environment, University of Salford, Salford, M5 4WT, UK*

²*Ministry of Cultural Heritage and Activities, Italy "La Sapienza" University of Rome, Italy*

Email: h.h.samir@edu.salford.ac.uk

Abstract: Preserving Cultural Heritage as a tangible expression of the collective memory of society is paramount to ensure the continuity of local culture in the field of construction and more in generally to preserve its identity. Unfortunately, over the past decades, the Iraqi-built environment, and especially the traditional architectural heritage, has been deeply affected by three wars, which challenged the cultural memory of the people and of the younger generations in particular. This research considers Basra as a pilot case study to investigate the features of the Iraqi architecture. Drawing from the selected case study, the findings from the paper are that Basra is losing its local architectural identity due to a variety of factors. As such, the aim of this research is to develop a guideline framework to steer the preservation of the city's identity, complementing this conservationist approach with a more constructivist-oriented perspective by assessing how the local population currently value its tangible cultural heritage and by recommending how a framework may be operationalised within the socio-cultural context.

Keywords: Cultural Heritage, Basra, Iraqi Traditional Architecture, Guideline Framework.

1. INTRODUCTION

One of the main cultural instruments to understand the progress from the past to the future is architecture, which is regarded as an educational instrument apt to improve the knowledge of people in regard to the heritage within their environment (Abel, 2000). There is no doubt that cultural heritage can be considered as the richest source for identity. According to one of its definitions, heritage represents all the styles and traditions transmitted over time from the old to the young generations and hence reflecting their collective identity. Losing the historical monuments will result in a disconnection between the future generations and their history because the lack of knowledge of their cultural heritage would lead to a weakening of their identity. Since identity is a phenomenon, architecture is part of this phenomenon, therefore any transformation undergone by buildings and places will undoubtedly have an impact on the local identity (Abel, 2000).

Iraq can be regarded as one of the main centres in the world for archaeology: it has around 7000 archaeological sites according to the 'Guide to Archaeological Sites' issued by the Iraqi government in 1970 (Fethi, 1977). It has a long history that extends back to Antiquity, therefore it owns an extremely rich cultural heritage. It was the cradle of many civilisations of ancient Mesopotamia such as the Sumerian, the Assyrian, the Babylonian, the Akkadian and the Abbasid. Accordingly, the monuments of these ancient civilisations can still clearly be seen all over Iraq. Some of these sites and monuments are within the urban areas, thus facing serious dangers concerning the development processes of these areas along with other threats such as wars and neglect (Fethi, 2007). Moreover, the use of bricks made of clay rather than

stone, due to the rarity of the latter in the Mesopotamian area, is another threat to the preservation of its architectural heritage, given the more perishable nature of such material.

The historic cities regard as the most prominent monuments which still extant and reflect the traditional heritage, in particular, the traditional neighbourhoods, which are the cores of the present cities. However, rapid development poses a serious threat to these cores because of the growth of the commercial areas within them, occurring to the detriment of the residential areas. Many of these heritage areas and neighbourhoods still represent the core of the main cities of Iraq such as Baghdad, Mosul, Kirkuk, Najaf, Arbil, Karbala, Samarra and Basra as well, to the extent that many people still live within these historical areas (PolSERVICE, 1972).

2. HISTORICAL BACKGROUND OF BASRA

The city of Basra has a long history that can be traced back to the time of the illustrious Babylonian king Nebuchadnezzar (605 – 562 B.C.), as ruins were found of a city named “Tridon”, located to the south of the town of Al Zubair - in the present metropolitan area of Basra - and dating back to his rule. (Al-Muzaffar, 1988). More than a thousand years later, in 635 A.D., the Muslims founded Basra, which was, therefore, the first Islamic city established by Muslim Arabs outside the Arabian Peninsula. The city has gone through several stages since its foundation (Bazi, 1989).

In the first stage, Basra was an outpost where soldiers would spend the winter or retreat after the fighting, hence a military encampment made of tents rather than a city with proper buildings. In the second stage, a mosque, a principality house, a prison and houses for the soldiers were built by using the reeds available in the area. Later on, a large fire swept through the settlement and destroyed it. In the third stage, starting from circa 635 – 637 A.D., the structures of the religious, administrative and civic buildings began to change thanks to the adoption of materials such as wood, clay and mud. The mosque and the principality house were entirely rebuilt with them (Al-Ali, 1988).

The next important stage is the Ottoman occupation, that started in 1534 A.D., and can be subdivided into two periods: the first, which lasted until 1859 A.D. and was characterised by disorders, excessively centralised control of the land and its use and by the incompetence of the rulers; the second, coinciding with the office of the Wali of Baghdad, Midhat Pasha, which was, on the contrary, devoid of conflicts and instability. In this period, plots of the land of the emirate of Basra were made available to the population for the purpose of construction, so that the city was brought to a new life. Due to organisational purposes, a municipality office was established in addition to the security office, which encouraged people to immigrate to Basra. During the British occupation, the Wilayah of Basra divided it in three “Liwas” (that is “banners”, a type of administrative division): Al Mintifig, Al Amar, and Al Basra (Darraji, 1989). Basra is the only maritime port in Iraq. It is also regarded as an important industrial centre of nationwide relevance, and it is of no less importance in agriculture, due to the presence of many palm trees in its area. It is also rich in minerals, as its subsoil contains the largest deposits and wells of oil in Iraqi (Alwan, 1999). In fact, its reserves of oil and natural gas are the largest in the world.

2.1 The Architectural Identity of the City of Basra

The city of Basra has a long history rich in culture and an identity clearly distinct from that of the other Iraqi cities so that it has often been defined the most beautiful city of Iraq (Al-Samarrai, 2002). Basra used to be the jewel of the Arab Gulf, where trade brought wealth and wellbeing. It was a city of poets and intellectuals, who mingled with foreigners and traders. It had many beautiful buildings and was traversed by many canals, a very specific feature of Basra, to the extent that it was dubbed the “Venice of the East” (Alwan, 1999), Figure (1).

Many factors have influenced the architectural identity of the city of Basra such as history, topography, climate and traditions. The characteristics of the Arabic Islamic city have obviously played a key role in the formation of the city’s identity. Basra owned a unique feature that distinguished it from the other Iraqi cities due to its strategic location on the Arabian Gulf, which gave it the opportunity to cross-pollinate with other civilizations by means of the contacts allowed by trade (Al-Ali, 1988).

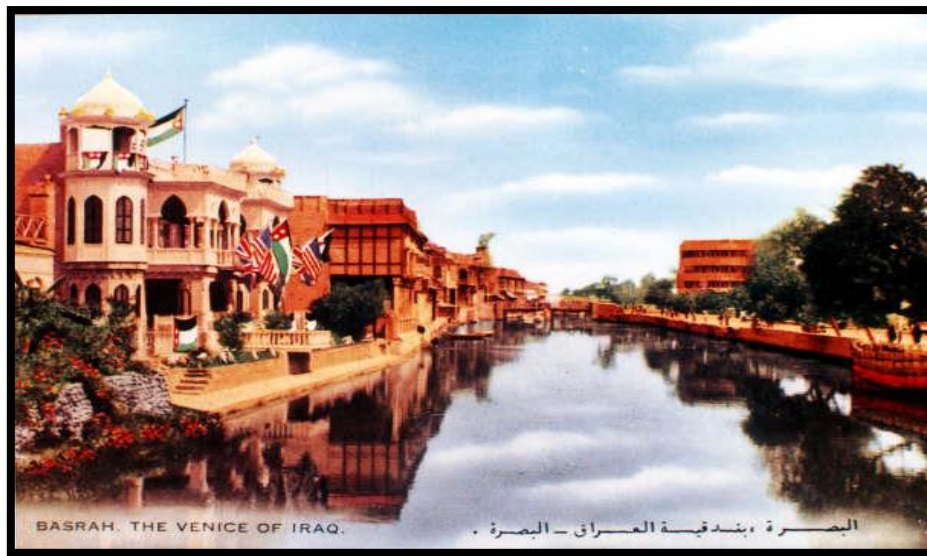


Figure 1 The city of Basra “Venice of the East”

The city was characterised by its natural sources and its unique topography, represented by a grid of canals and, in its environs, a wide marsh in the north, the desert in the east, date palm forests, covering large areas in the south, and the river, the “Shatt al Arab”, to the west (Musabeh, 1990). This topographical diversity had a huge impact on the formation of the city’s architectural identity.

Basra had a unique traditional urban fabric, which consisted of clusters of adjacent houses oriented towards their interior courtyards, resulting in an organic layout of winding, narrow alleys which formed according to the location of the houses and the relationships between them, aimed at providing solutions for the climate and other social requirements of the local society (Jaber, 1996). This fabric was characterized by marvellous architectural elements, which constituted the city’s unique and valuable heritage (Al-Ali, 1988). The cultural aspects of Basra’s community have played a significant role in the formulation of the characteristics of the city, and this was clearly reflected on its productions, including the city’s architecture and planning (Bazi, 1989). The formation process of the city has been determined by many factors such as the building materials, Islamic philosophy, and the Arabic lifestyle, which

entails specific habits, traditions and ethics. The varied demographic composition of Basra and the connections with other civilisations due to its nature of trading port led the city to develop a uniqueness, albeit now lost, still largely present in the memory of its residents (Al-Muzaffar, 1988).

The planning of the city of Basra was the first experience of urban planning in the Early Islamic Age. The location of the mosque was in the centre of the city with the house of the governor and the treasury house, then the market was built around the mosque, and in direction of the mosque all the streets and alleys were oriented (Al-Ali, 1988). Basra's city centre consisted of two areas until 1935: the Ashar area, which was characterised by the linear central pattern and grid plan fabric, and the area of old Basra, whose organic urban fabric was characterised by the radial central pattern (Al-Samurai, 2002). The urban fabric of Basra's city centre, between 1935 and 1962, extended eastwards, in the direction of the Shatt al Arab, northwards in the direction of the al Maaqal area, southwards in the direction of the Abu al Khasib, and westwards in the direction of the old city of Basra. A second expansion took place between 1962 and 1987, and was interrupted to the north by the Garmat Ali River, to the south by al Sarraji River and the palm forests in Abu al Khasib, to the east by the strip along the Shatt al-Arab, and to the west by the Shatt al-Basra (Alwan, 1999).

2.2 The Crisis of Basra's Identity

Iraqi cities, in general, and the city of Basra, in particular, have not received enough attention in the studies that discuss identity and architecture. However, Basra and many Iraqi cities have undergone a significant social, economic, political and cultural change, which caused a dramatic urban transformation within the local urban built environment (Al-Ali, 1988). The modernisation that affected the city has not taken into account the local conditions such as traditions, habits, the climate and the characteristics of the place: the history of the city has been ignored. Furthermore, the wars that took place in Iraq in 1980 - 1988, 1991 and 2003, can be seen as the definitive historical moments that changed the city of Basra from a cultural, social and also architectural point of view. All the aforementioned factors have led to the loss of the identity of the city (Samir, 2015). Basra was under the attack of the bombs and the grenades for much of the 1980-1988 war and then again in 1991 and in 2003. Its unique architecture has disappeared slowly since, as the old buildings have deteriorated due to the lack of the necessary maintenance, as in Figure (2). The absence of awareness from the local population has contributed to a transformation of the local identity, which took place unconsciously within the society and resulted in an extensive modification of the local built environment of the city of Basra.



Figure 2 The destruction of Basra's heritage.

Many external and internal factors have threatened the identity of Basra on many occasions during the twentieth century, transforming, distorting or obliterating it. The external factors are those pertaining the Ottoman occupation and the ensuing British colonisation, the modernity movement and finally the globalisation. The internal factors are mainly the policies of the previous governments and the three great wars of the last decades which affected negatively the society of the city and its demography. Most of the architectural landmarks of the city have disappeared as a result of the destructions occurred during the wars or due to the neglect and lack of maintenance that the city suffered during the time of the UN sanctions against Iraq, from 1990 to 2003.

The worst happened after 2003, with the arrival to Basra of foreign investment companies that implemented several kinds of projects in several fields. As to architecture, the designs of the project of these companies were foreign and alien, because they were carried out according to their cultural background. They, thus, ignored the history and the identity of the city, nor did they take into account the culture, traditions and values of Basra's society. They were far from the city soul, and represent a significant risk which could threaten both the architectural and, more in general, the cultural identity of the city (Samir, 2015).

3. MODERNITY IN IRAQ

Modernity is the period of the new. It is what gives the present the specific quality that makes it different from the past and points the way toward the future (Berman 1994). Modernity could be described as a break with the traditions and a refusal of the legacy of the past. It looks like a selection process of foreign elements and concepts imported from different environments. According to Habermas, Modernity is a phenomenon that entails different forms with multiple meanings which aim at discovering a new world (Afaya, 1998).

In relation to architecture, the term "modernism" refers to a "new" work which distorts the relations and rules that connected to traditional knowledge (Stern, 2009). According to Berman (1994), modernity is a discontinuation or modification of the past, a mode of power

through new forms of self-consciousness of the human. For Ibeling (1998), the aim of the new modernity is to use programmes to construct buildings without any consideration for the context, either the time or the place, and to create a comfortable environment by only using technology, refusing any aspect of the cultural background. The ideology of modernity deems as no longer effective the concept of neighbourhood as a coherent relationship between residents and between families, since the hierarchy of the spaces within the neighbourhood was broken as soon as the pattern of rigid boundaries, inherent in the gridline plan, was adopted in the contemporary design of the neighbourhood (Abd-Elmonem, 2011).

According to Al-Wardi (1988), the impact of modernity in Iraq can clearly be seen in the change of the society's structure, as the social interaction between neighbours and friends have decreased, most of the extended families have become nuclear families and, more in general, the family size has reduced. The social interaction between people has dramatically changed, the relationships between people have become limited because of the disappearance of the social spaces that served for this purpose (AL-Mullah, 1988).

The modernisation of Iraq took place starting from the early twentieth century with a large expansion of the cities, mainly the three major ones: Baghdad, Mosul and Basra. In parallel with this expansion, these cities were affected by formal transformation as well. Al-(Sultany,1982). Consequently, there were three different architectural styles for each city: the traditional style, in the old centre of the city; the colonial style, in the area surrounding it; a modern style, in the more recently built areas (Al-Rahmani, 1986). All the development processes of Iraqi cities have been implemented by foreign architects, despite the presence of many qualified Iraqi architects (Bernhardsson, 2005).

The main features of the traditional style are the narrow and winding paths, the courtyard houses, the ornamented façades, and the common use of the local materials and the volumetric homogeneity of the clusters of buildings, which have only one or two floors. On the contrary, the colonial style introduced during the British invasion of Iraq at the end of the First World War is characterised by straight and relatively wide roads, external columns on the façades, construction of a roof cover over existing internal courtyards, houses with a front garden, and other buildings with several storeys. The impact of western culture is very clear in the modern style, which is characterised by detached or semi-detached houses, wide streets, and disappearance of the courtyards, use of unfamiliar materials and a general lack of volumetric homogeneity due to the different heights of the buildings (Al-Sultany, 1985).

4. THE METHODOLOGY

Since the paper focuses on the identity of traditional architecture in Iraq, in general, and in Basra, in particular, the research methodology of the paper adopted a case study, Basra, selected as a pilot study. A mix-method approach was followed in this study in order to identify the main features of the city's identity and understand the threats posed to its continuity. The research strategies include a semi-structured interview which has been conducted with professionals, in addition to a questionnaire survey with householders within three neighbourhoods.

The three neighbourhoods chosen are; old Basra, Ashar and Al-Jazair. The selection of these neighbourhoods was carried out according to an architectural pattern for each of them. Each neighbourhood has an own architectural style which distinguishes it from the others because

it is related to the specific period. The neighbourhood of Old Basra is related to the Ottoman period, while the Ashar neighbourhood was established at the time of the British colonisation. The third neighbourhood, Al-Jazair, follows the modern style since it was built only four decades ago.

The semi-structured interview conducted with 12 experts who have long time experience in fields concerning with identity. On the other hand, since the evaluation of the residents is considered a significant issue that should be taken into account in order to reveal the failure and success of the physical environment, therefore, 119 residents, who live in the three neighbourhoods, participated in the questionnaire survey phase of the study. The table (1) presents the number of the residents who participated in the survey according to each neighbourhood.

| Case area | Old Basra | Ashar | Jazair | Total |
|-------------|-----------|-------|--------|-------|
| Respondents | 39 | 33 | 47 | 119 |
| Percentage | 33% | 28% | 39% | 100% |

Table 1: The responses of the questionnaire survey

5. A FRAMEWORK TO MAINTAIN THE ARCHITECTURAL IDENTITY OF BASRA

The conceptual framework highlights the main issues to be studied. According to Miles and Huberman (1994), a conceptual framework “lays out the key factors, constructs, or variables, and presumes relationships among them”. The conceptual framework developed for this research is presented in Figure (4), and highlights the process of maintaining the architectural identity of the city of Basra. This conceptual framework has been created on the basis of the literature review on architectural identity and it has been developed according to the finding of the field study which included interview, questionnaire and observation.

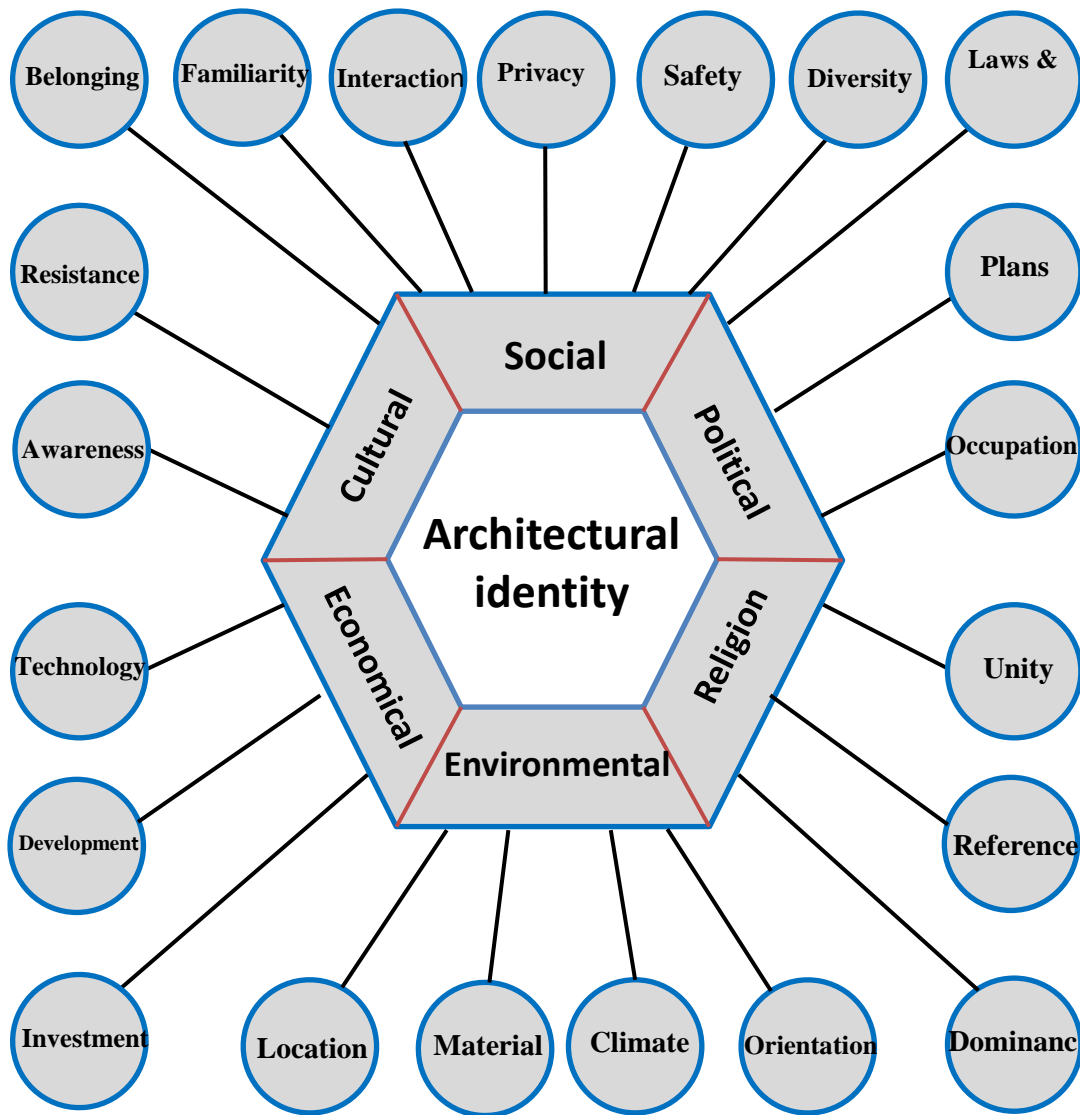


Figure (3) The main dimensions and factors that influenced the Basra City Identity

5.1 The First Stage

The first stage was developed through the review of the literature and involves the identification of the main dimensions that had an influence on the formation process of the architectural identity of the city of Basra, as well as its impacts on the transformation process of the identity which has occurred and is still occurring in the city's architecture. The six dimensions identified are; social, environmental, economic, political, cultural and religious. Each of these dimensions involves several factors, as clarified in Figure (3).

Simulation

Simulating the traditional architecture through imitating the heritage and historical elements and forms via copying or metaphorisation, in order to root these components and their meanings into the collective memory of the local society.

Abstraction

It could be achieved by abstracting historical and heritage elements or concepts and transforming them into modern forms, by focusing on these components' outline, as they are able to express traditional meanings in order to link the society with its past and authenticity.

Generation

It could be achieved by considering the heritage as the main source of the architectural identity, thus generating new elements and forms from it. Therefore, this will result in a harmony between the modern and the traditional buildings.

In regard to modernisation, there is a necessity of adopting appropriate instruments to guide architects and urban planners to create a modern architecture style. The research suggests three instruments, such as; Filtration, Adaptability, and Interpretation.

5.2 The Second Stage

The second stage is based on the responses from the interviewees and the householders: to achieve the aim of the study, the conceptual framework focuses on two main issues: firstly, on how traditional identity can enable modernisation, secondly, on how to deal with modernisation considering the preservation of the traditional identity.

Regarding traditional architecture, in order to maintain the local identity, which is reflected via the traditional architecture, a set of instruments should be taken into consideration by the architects when they design new buildings, as follows.

Filtration

It can be achieved through the process of filtration of the global architectural products by classifying them and choosing appropriate architectural elements, forms, relations and materials on the basis of their suitability for the local environment, according to the social culture and the climate of Basra.

Adaptability

It can be achieved by adopting but also modifying the appropriate elements of global architecture so as to render them closer to concepts that are already familiar with the local environment, as they already exist in the collective memory of the residents.

Interpretation

It can be achieved by reinterpreting a number of modern architectural forms and elements by giving to them new meanings tied to those rooted in the collective memory in order to render them familiar to the local people.

5.3 The Third Stage

This stage is related to the results expected from the conceptual framework. The adoption of instruments relating to modernisation will lead to the creation of a new architectural product within a traditional form, which could preserve the local identity in the memory of the residents. On the other hand, the adoption of instruments that derived from heritage and history will lead to revive the traditional architectural product, although in a modern form so as to enable modernisation.

On the basis of the approach outlined above, the expected final result of this conceptual framework will be a modern local identity, harmonious with the new era but still rooted in the past, as clarified in Figure (4).

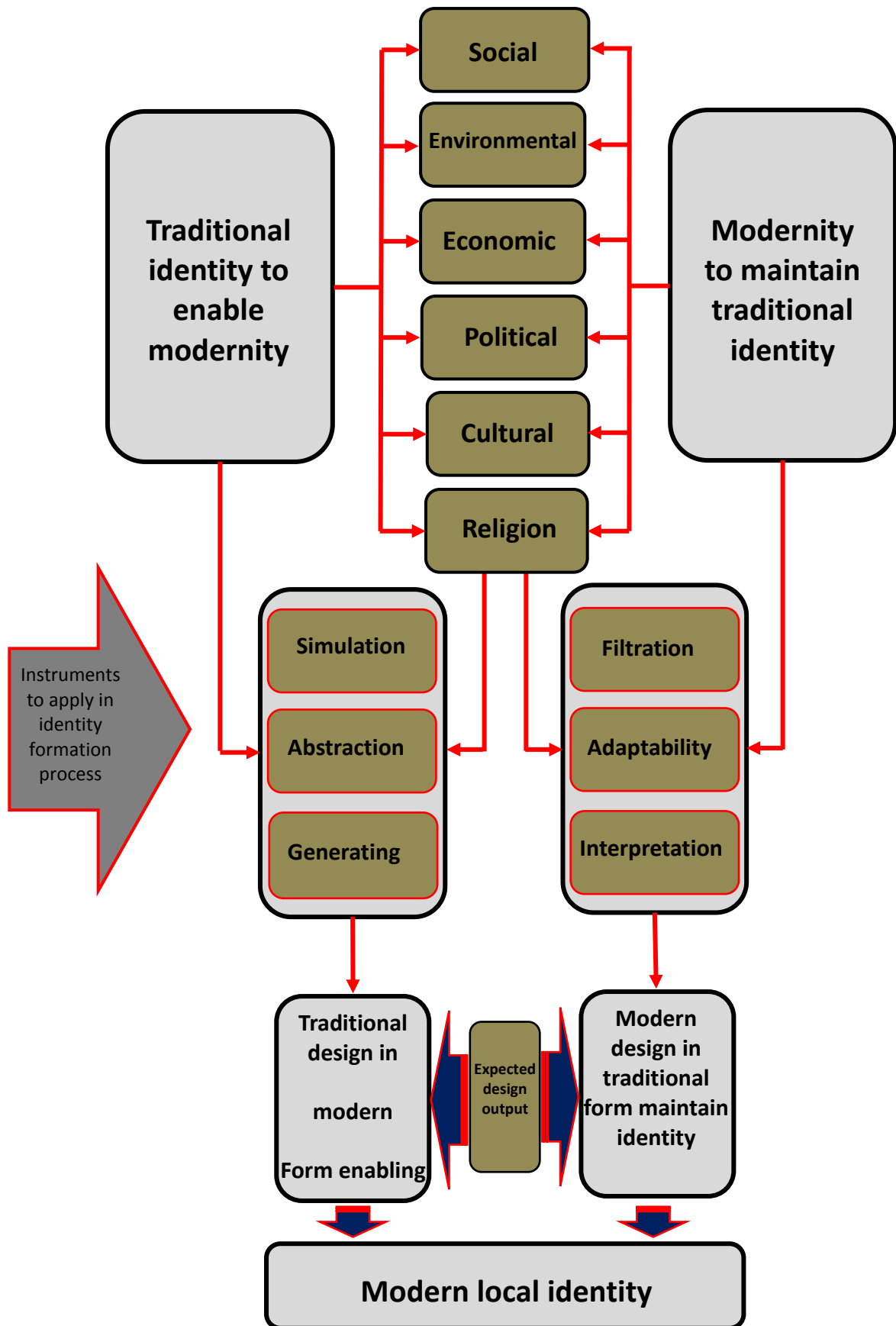


Figure 4. The conceptual framework

6. CONCLUSION

The paper has offered a critical evaluation of the impact of modern and global architecture on the architectural identity of the city of Basra. Undoubtedly, cultural heritage can be regarded as one of the main sources for identity and its continuity. Iraq has a large number of archaeological sites, which have led it to qualify as a centre of worldwide importance. However, this heritage has suffered from decay and losses due to several factors such as wars and neglect. In fact, the rapidity of the development and modernisation processes of the city of Basra, especially after the three wars, posed a significant threat to the traditional areas of the city and led to the loss of Basra's identity.

The paper showed the significantly negative effect of the three wars of the past four decades on the identity of the city of Basra, both architecturally and demographically. The investigation of the three neighbourhoods that have been selected as case studies, was dedicated to the impact of the modern and western architectural style on the Basra society. The results finding indicates that there is a need to develop a framework to guide the professionals to deal with both the traditional and the modern architectural styles, which currently conflict within the urban landscape of the city.

The framework proposed in this study focused on the main factors that influenced the identity formation process. Thus, it determined six main factors which are: society, environment, politics, culture, economics and religion. In addition, it suggested a number of mechanisms that can be used by professionals to lead traditional and modern architectural styles to approach each other.

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ICT, TECHNOLOGY AND ENGINEERING

EFFICIENT RE-DESIGN OF CONTINUOUS CONCRETE-STEEL COMPOSITE BEAMS

M. Al-Shuwaili, A. Palmeri and M. Lombardo

School of Civil and Building Engineering, Loughborough University, Leicestershire, LE11 3TU, UK

Email: m.a.al-shuwaili@lboro.ac.uk

Abstract: Continuous steel-concrete composite beams are widely used in the construction industry. The concrete slab is typically attached to an I steel girder by means of welded headed studs, which however are susceptible to several problems and need special considerations at hogging bending regions. In this paper, an efficient re-design for the steel I-shaped girders is proposed. The width of the upper flange is reduced while the depth of the web is increased which maintaining the same area of steel. The elongated web has perforations along its length and penetrates the slab in such a way that allows the concrete to form concrete dowels and thus achieve the required bond. A numerical study based on the plastic analysis of the composite section is used to quantify the change in the bending capacity due to the proposed type of connection, considering both cases of sagging and hogging moments. The results of a comparative analysis between the proposed re-design and examples of designs taken from the literature are also presented. The study demonstrates an increased moment capacity in both sagging and hogging regions for the composite beams, with the possibility of fabricating more efficient cross sections based on the actual bending moment diagram.

Keywords: composite beams, continuous beams, hogging moment, plastic design, sagging moment.

1. INTRODUCTION

The combination of steel girders and concrete slab works very well in simply supported composite beams (sagging moment) because concrete is efficient in compression and steel in tension. Both concrete compressive strength and steel tensile strength, along with the geometry of the composite cross section, determine the ultimate sagging moment capacity of the beams. Compared to simply supported beams, continuous composite beams have been used widely in multi-storey buildings and long-span bridges, owing to several advantages such as reduced deflections and higher span to depth ratio (Liang, 2015). At internal supports of continuous composite beams, however, the steel girders are under compression while the concrete slab is under tension, causing a cracked section which does not contribute to the ultimate hogging moment capacity. In addition, shear connectors embedded in cracked concrete are susceptible to larger deformations due to the reduced strength and stiffness of materials. For these reasons, the efficient design of continuous composite beams is more challenging and different considerations in design are required (Vasdravellis et al., 2012).

1.1 Shortcomings of headed studs

The majority of composite beams use headed studs to achieve the bond needed for the composite action between steel and concrete. However, researchers have identified several issues associated with the use of headed studs (Rodrigues & Laím, 2014), such as the relative vertical movement (slip). The latter increases the deflection, makes beams more vulnerable

against fatigue problems and reduces the composite action. Furthermore, in the design of composite continuous beams in hogging regions, codes permit only complete bond between steel and concrete (Liang, 2015). The connection through the web is sufficient to provide the complete composite action between concrete and steel (Klaiber et al., 2000).

1.2 The Role of the Upper Flange

The area of upper flange is a considerable percentage of the total area of the steel girder cross section. Many researchers have discussed the function of the upper flange and its negligible contribution to the beam moment capacity (Knowles, 1973, Oehlers & Bradford, 1995 and Klaiber et al., 2000). According to Oehlers & Bradford (1995), an efficient design should remove the upper flange. Moreover, the upper flange typically does not reach the steel yield point and this might affect the plastic moment calculation that assumes the entire section is under yield. In this respect, the inverted T section is more efficient as the yielded area actually about the whole cross section, which matches the design assumption (Rauscher & Hegger, 2008). **Error! Reference source not found.** shows the difference in yield strain between the two cross sections.

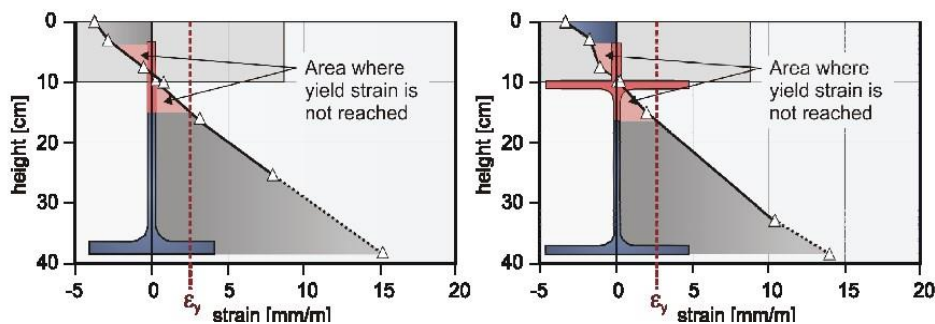


Figure 5: The difference in yield strain distribution (Rauscher & Hegger, 2008)

1.3 Connection through the web

Knowles (1973) - among others - indicated that it is possible to use the web as an efficient shear connector instead the upper flange. Numerous connection methods have exploited this concept to achieve the bond between steel and concrete. Roberts & Heywood (1994), Klaiber et al. (2000), Jurkiewicz & Hottier (2005), Li & Li (2009), Lorenc, et al.,(2010), Seidl et al. (2013) and Remennikov & Roche (2014) presented various developments utilising the web for connection, all enjoying insignificant slip between steel and concrete (see **Error! eference source not found.**).

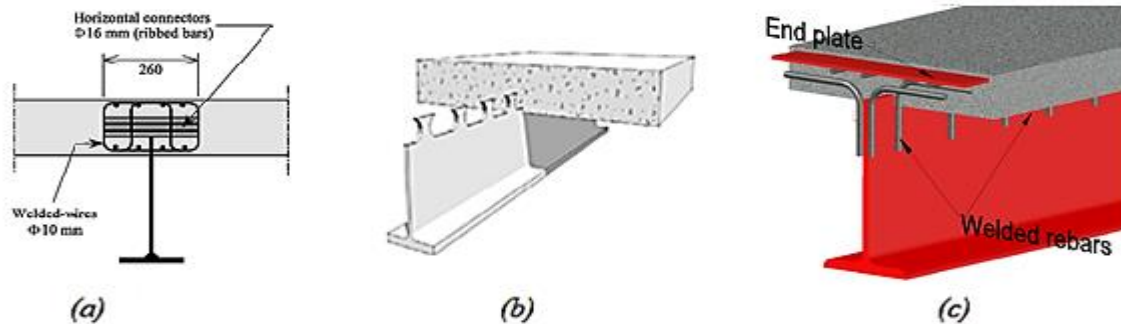


Figure 2: Connection through the web presented by (a) Jurkiewicz & Hottier (2005), (b) Lorenc, et al., (2010) and (c) Remennikov & Roche (2014)

To the best of the authors' knowledge, detailed studies are not available to highlight the relationship between the bending moment type (sagging or hogging), neutral axis position and depth of encasement in these connectors. Furthermore, design rules to fabricate continuous beams according to the bending moment diagram are also not available. This research presents a detailed re-design to the traditional I steel section based on analytical investigations that allows achieving the bond by encasing part of the steel girder into the concrete slab. Eliminating the welded connection devices is attractive, as it can reduce the fabrications cost and accelerate the pace of construction.

2. PLASTIC ANALYSIS OF COMPOSITE BEAM

2.1 Assumptions

The plastic analysis of steel-concrete composite sections assumes that the stresses are rectangular blocks. These stresses reach a constant value, i.e. the material strength, in both tension and compression at the ultimate moment capacity. The plastic neutral axis (PNA) divides the composite section into equal parts, experiencing equivalent forces (in tension and compression). These forces, which are located at centroid of each stress block, represent the product of the relevant area and the material strength. The moment capacity is calculated directly from the summation of the moments of these forces about any reference point (Mohd Yassin & Nethercot, 2007). **Error! Reference source not found.** shows the stress blocks and their equivalent forces for a composite beam where the PNA crosses either the slab or the web, while C_c and T_s , for instance, represent the steel and concrete equivalent forces, respectively, when the composite beam is subjected to a sagging moment and the PNA crosses the concrete slab. The calculations of the plastic capacity under both sagging and hogging moments are presented in Appendix A.

2.2 PNA position

Geometry and material strength not only determine the composite beams moment resistance, but also the position of the neutral axis. If the beam is subjected to a hogging moment, the PNA usually crosses the web, because the concrete slab is cracked and therefore offers a little resistance; whereas, the PNA crosses the concrete slab in the presence of sagging moment (Oehlers & Bradford, 1995).

2.3 The calculation of moment capacity

The calculation of the sagging moment depends only on the steel beam and the concrete slab, whose reinforcement is neglected. As the PNA normally crosses the slab, the whole steel beam is under tension while the slab above the PNA is under compression. **Error! Reference source not found.** (a) shows (C_c) and (T_s) which are the resultant forces into concrete and steel respectively. Thus, the internal equilibrium means the moment capacity is equal to (C_c) or (T_s) times their lever arm (see **Error! Reference source not found.**(a)). In hogging oment regions, the concrete slab is cracked due to tensile stresses, so that it is reasonable to assume that the concrete (C_c) is equal to zero. As a result, the PNA crosses the web. The internal equilibrium of equivalent forces depends only on the slab reinforcement and the steel beam (see **Error! Reference source not found.**(b)). All these details and the equations of the lastic moment capacity in case of hogging and sagging moments are illustrated thoroughly in Appendix A

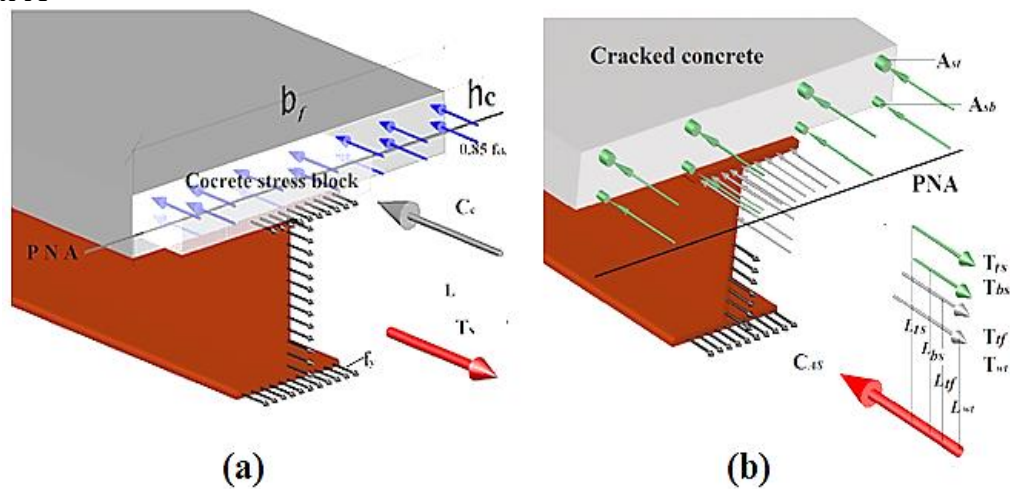


Figure 6: The stresses blocks, PNA and the equivalent forces in the plastic design under (a) sagging moments (b) hogging moments

3. RE-DESIGN CONCEPTS AND METHODOLOGY OF INVESTIGATIONS

The method of the re-design consists of two fundamental concepts: firstly, examining different geometries for the beam cross section that have the same cross sectional area of traditional (I) steel beam cross section and provides the required bond between the slab and steel. Secondly, calculating the plastic moment capacity of these composite beams and compare it with the moment capacity of the traditional (I) composite beam.

3.1 Re-design of beam cross section

To eliminate any welded shear connectors and achieve a more efficient bond between slab and girders for composite continuous beams, the beam cross section is re-designed to encase the top part of the steel beam in the concrete slab. Three major considerations underpin this proposal, namely re-designing the upper flange, using reinforced concrete dowels and exploiting deep connectors.

Re-designed upper flange

The condition of internal equilibrium shown in Figure 3 is utilised to have the same area of steel cross section, which is important in highlighting the economic efficiency of the proposed method. The upper flange width is reduced and the web depth is increased while the thickness of steel girder is constant, i.e. the cross-sectional area of steel beam is constant and the only change is in the shape of the steel girder. In case of hogging moment, the amount of steel reinforcement and the concrete slab dimensions were kept constant for comparison purposes. This enabled a direct comparison between the results of this research and other traditional designs.

Upper flange-web encasement

The bond in the proposed connection is achieved through an encased portion of the steel girder into the concrete slab, namely a part of the web, with or without the top flange. The encased portion has perforations along its length and penetrates the slab in such a way that allows the concrete and the rebars to pass and form reinforced concrete dowels. These dowels act as shear connectors to resist the separation between the slab and the beam. Dimensions of the perforations are proportional to the height of the encased portion, i.e. higher web encasement leads to larger perforations.

Depth of the encased portion (connection height)

Previous studies have investigated the effect of the connectors' height on their resistance. According to Klaiber et al. (1997), shallow perforated rectangular plates (less than 60 mm) are relatively ineffective compared with the deeper connectors. Rodrigues & Laím (2014) indicated that increasing the connector's height by 50% led to higher resistance, about 55% more.

3.2 Aspects of investigations

Base on the above considerations, this study has address the following points:

- The effects of upper flange and the depth of its penetration on the overall moment capacity;
- The relationship between the PNA position and the depth of upper flange penetration;
- The effect of the moment type, i.e. sagging or hogging, on the flange re-design;
- The possibility of fabricating the steel girders according to the bending moment diagram in composite continuous beams.

3.3 Method of investigation

To highlight the effect of the flange-web penetration into the slab on the moment resistance, various geometrical configurations are numerically analysed using the plastic analysis of composite beams. The geometry, the PNA and the composite beam moment capacity are identified initially for the traditional (I) shape of the composite beam. Then, several progressive steps of the top part of the steel beam penetration into the slab are numerically

investigated. Each step of web penetration produces a different shape, i.e. a new geometry, of the composite beam (see Figures 5,7 and 8). The numerical analysis of the resulting cross section consists of: the web penetration magnitude; the new flanged width and its percentage of change; checking the PNA position; the resulting moment resistance and compare it to those of the traditional (I) composite beam before the penetration. The process is carried out for each design proposal, i.e. at every step of web penetration into the slab (see Tables 1, 2 and 3). An Excel spreadsheet was utilised to conduct the numerical analysis.

3.4 Re-designed composite beams

Two composite beams under sagging and hogging moments were investigated to find the ultimate moment capacity of the re-designed cross section. The investigated designs are taken from the work by Garcia & Daniels (1971) and Caprani (2008) and have been selected for different reasons.

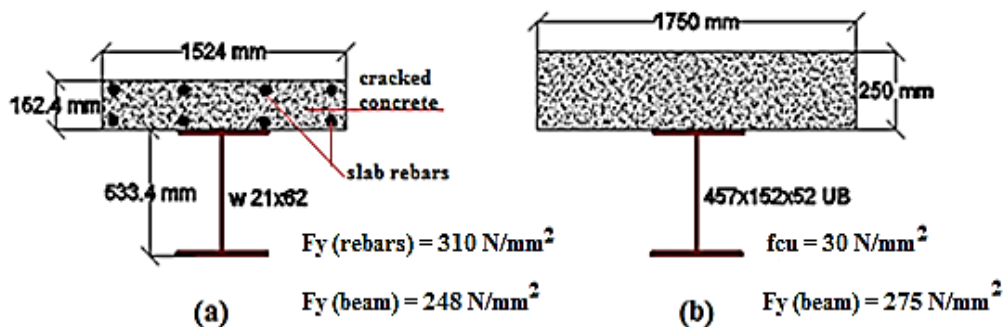


Figure 7: Cross sections of the composite beams from (a) Garcia & Daniels (1971) and (b) Caprani (2008)

Firstly, Garcia & Daniels (1971) studied the composite beams under pure hogging moment while Caprani (2008) designed the beam under pure sagging moment. Secondly, the dimensions of steel beams and concrete slabs are different in the two beams; nevertheless, the moment capacity of the two beams is nearly the same (3% difference in total). This similarity in the moment capacity provided the opportunity for a clear comparison between the effects of web penetration on the sagging and hogging bending moments.

4. ANALYTICAL INVESTIGATION

4.1 Hogging moment capacity of the re-designed beam

The beam shown in **Error! Reference source not found.**(a), which was tested by Garcia & Daniels (1971), consists of a reinforced concrete slab 1,524 mm (60 inches) wide and 152.4 mm (6 inches) thick, connected to a W21X62 rolled steel beam through headed studs. The top reinforcement steel of the slab was 1,612 mm² (2.5 in²) and the bottom reinforcement was 645 mm² (1 in²). The ultimate moment resistance calculated by researchers was 776.544 kN m. To check the validity of the calculations, it was found that the proposed model is in excellent agreement with value of the plastic moment provided in reference paper, within a 0.05% difference. **Error! Reference source not found.**(a) shows the original configuration of the composite beam. The calculated ultimate plastic moment is 776.544 kN m and the

neutral axis position is 281.2 mm from the top edge of the slab. In the intermediate configuration, **Error! Reference source not found.**(b), the moment capacity increases by .52% and the new flange width is 150.8 mm. With a web penetration of 139.7 mm (see **Error! Reference source not found.**(c)), the increase in the moment capacity and the new flange width are 10.33% and 101.6 mm respectively.

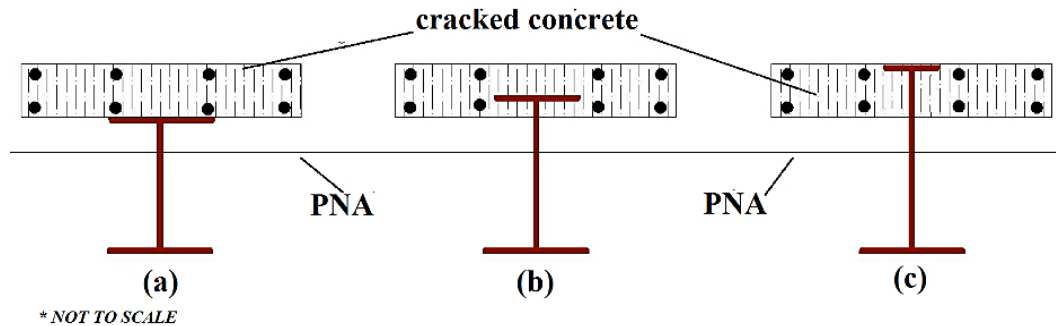


Figure 8: Web penetration into the concrete slab for a hogging moment

Error! Reference source not found. lists the penetration depth, the changes in upper flange width, and the increase in the moment capacity of the beam.

Table 4: The increase in the moment capacity according to the flange-web penetration

| Design number | Web's penetration into the slab | PNA location | New flangewidth | Reduction in flange width | % (new flange/ old flange) | Moment capacity | % of Increase in moment capacity |
|---------------|---------------------------------|--------------|-----------------|---------------------------|-----------------------------|-----------------|----------------------------------|
| | (mm) | | | | | (mm) | |
| Original beam | 0 | 281.2 | 209.73 | - | 100.0% | 776 | 0 |
| Design 1 | 25.4 | 281.2 | 190.10 | 19.63 | 90.6% | 795 | 2.46% |
| Design 2 | 50.8 | 281.2 | 170.47 | 39.25 | 81.3% | 812 | 4.60% |
| Design 3 | 76.2 | 281.2 | 150.85 | 58.88 | 71.9% | 827 | 6.52% |
| Design 4 | 101.6 | 281.2 | 131.22 | 78.51 | 62.6% | 840 | 8.21% |
| Design 5 | 127 | 281.2 | 111.59 | 98.14 | 53.2% | 851 | 9.68% |
| Design 6 | 152.4 | 281.2 | 91.97 | 117.76 | 43.8% | 861 | 10.92% |

Error! Reference source not found. shows that the beam moment capacity increases radually and steadily with the depth of penetration, from 776 kN m up to 861 kN m, corresponding to an additional 11%. The PNA location was fixed at 281.2 mm from the top edge of the slab so that the redistribution of the steel area from the top flange to the web maintains the equilibrium condition. The flange width at the maximum amount of penetration depth was about half the original one with no penetration.

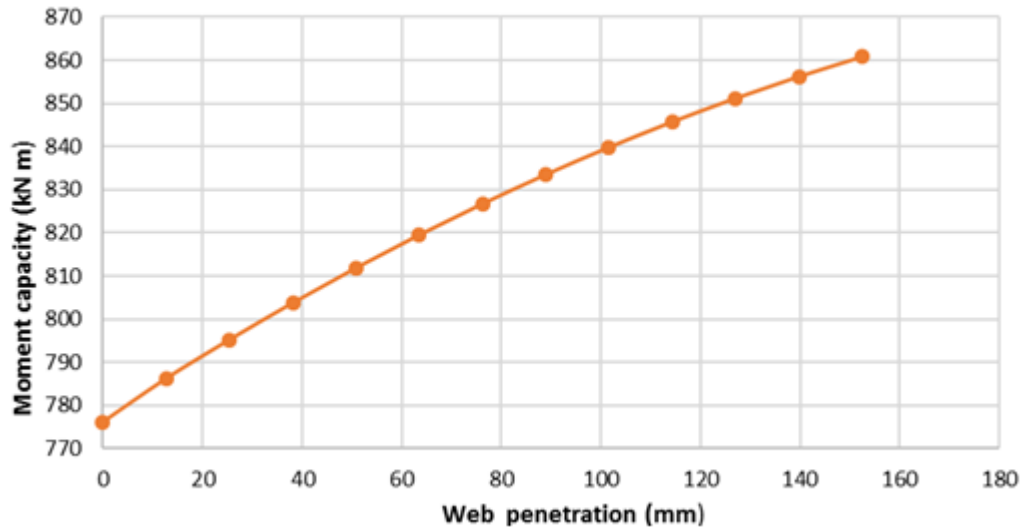


Figure 9: The increase in strength of the composite beam

4.2 Sagging moment capacity of the re-designed beam

In a second stage, the change in the moment capacity under sagging moment was investigated. In this case, the PNA was located within the slab. In the design presented by Caprani (2008) (see **Error! Reference source not found.**(b)), the moment capacity was 97.7 kN m, whereas it was found that the composite beam moment capacity is 789.5 kN m. This disagreement is due to the difference in computing the beam cross sectional area. Caprani (2008) computed an area of steel beam of 6,650 mm², while the area that has been calculated in the present work is 6,575 mm². The PNA is located at 76.54 mm from the top edge of concrete slab. As a result, the steel beam fully subjected to tension stress. This configuration could be utilised by using the upper flange in two different cases, as better explained below, and thus two alternative design solutions were considered.

Web- flange penetration into the slab

In this case (**Error! Reference source not found.**), both the top flange and the web penetrate the slab (similar to section 4.1.1). However, contrary to the design from hogging moment (**Error! Reference source not found.**), the penetration of the flange-web causes actually a reduction in the sagging moment capacity as evident from **Error! Reference source not found.**

The relationship between the reduction in flange width and the decrease in moment capacity is significantly different with respect to the previous case (see **Error! Reference source not found.**). For instance, decreasing by two third the flange width leads to a 6% reduction in the moment capacity, when PNA crosses the slab, while the moment capacity grows by about 11% when the flange reduces by 60% and the neutral axis crosses the steel girder.

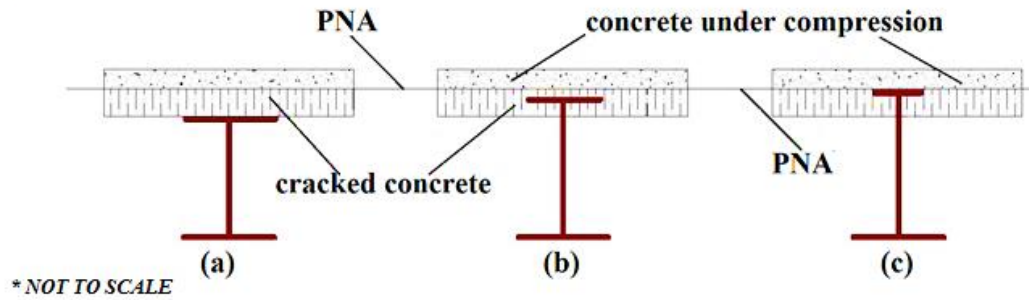


Figure 10: web-flange penetration into the slab

The explanation for this difference is that the PNA location in the first example divides the steel girder into two parts (compression and tension), whereas in the second case the entire steel girder is subjected to tension. The penetration was stopped at depth of 178mm from the bottom edge of the slab to maintain the equilibrium state. The results show that the moment capacity of the re-designed composite section strongly depends on the PNA location

Web-only penetration into the slab

Since this research attempts to present a practical, highly competitive solution, the economy of the new design is of great importance. Thus, a new solution has been analysed for the upper flange. Because the web penetration is essential to achieve the bond, the redundant steel area from the top flange has been added to the bottom flange.

Table 5: The decrease in moment capacity according to the flange-web penetration

| Design number | Penetration | Web length | Flange width | Moment capacity | % of decrease in moment capacity |
|---------------|-------------|------------|--------------|-----------------|----------------------------------|
| | (mm) | (mm) | (mm) | (kN-m) | |
| Basic design | 0 | 428 | 152.4 | 804 | 0% |
| Design 1 | 50 | 478 | 117.54 | 783 | -2.59% |
| Design 2 | 100 | 528 | 82.68 | 767 | -4.53% |
| Design 3 | 150 | 578 | 47.81 | 757 | -5.81% |
| Design 4 | 178 | 628 | 28.07 | 753 | -6.25% |

This modification maintains both the total area of steel beam and the PNA location (see **Error! Reference source not found.**). As a result, a considerable increase in the moment capacity has been observed. The first step of calculation was hypothetical; by assuming the web extending is zero. This was to illustrate the maximum realistic capacity that is virtually possible in the limiting case where the amount of penetration is zero, which resulted in an extra 26% of moment capacity.

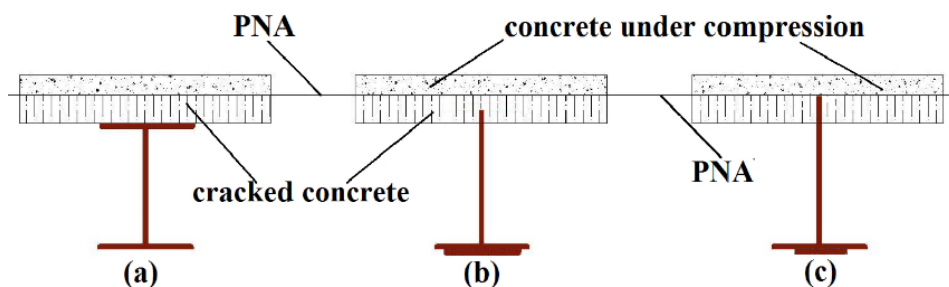


Figure 11: web penetration into the slab and deploying the top flange

This obviously reduces with the penetration of the web into the slab. **Error! Reference source not found.** shows the details of the penetration, the web length, the added width to the lower flange and the resulting moment capacity.

Table 6: The increase in moment capacity according to the flange-web penetration

| Design number | Penetration | Web length | Added flange width | Moment capacity | % of increase in moment capacity |
|---------------------|-------------|------------|--------------------|-----------------|----------------------------------|
| | (mm) | (mm) | (mm) | (kN-m) | |
| Hypothetical design | 0 | 428 | 152.4 | 1009 | 26 |
| Design 1 | 50 | 478 | 117.54 | 959 | 19 |
| Design 2 | 100 | 528 | 82.68 | 903 | 12 |
| Design 3 | 150 | 578 | 47.81 | 843 | 5 |
| Design 4 | 178 | 628 | 28.07 | 806 | 0 |

It is important to find the minimum depth of the web penetration into the slab that is required to achieve the bond between the slab and the girder because further penetration leads to less increase in moment capacity, i.e. indirect proportion between the depth of the web penetration and the resulting sagging moment (see **Error! Reference source not found.**). This is opposite o the hogging moment, the larger the web penetration into the slab, in which the larger the moment capacity, i.e. direct proportion between the web penetration and the resulting hogging moment (see **Error! Reference source not found.**).

Error! Reference source not found. shows a direct comparison between the two re-designed composite beams. Both have the same steel area, the same PNA position and the same resultant forces (C_c and T_s); nevertheless, there is a clear difference in moment capacity. The typical depth of rectangular perforated plates (perforbond), which have been used by the researchers in the past, is about 100mm. This makes the moment capacity of an inverted T section higher by nearly 125 kN m with respect to the original I shape of the beam. In general, for the design under sagging moments and PNA crossing the concrete slab, the inverted T section is more efficient.

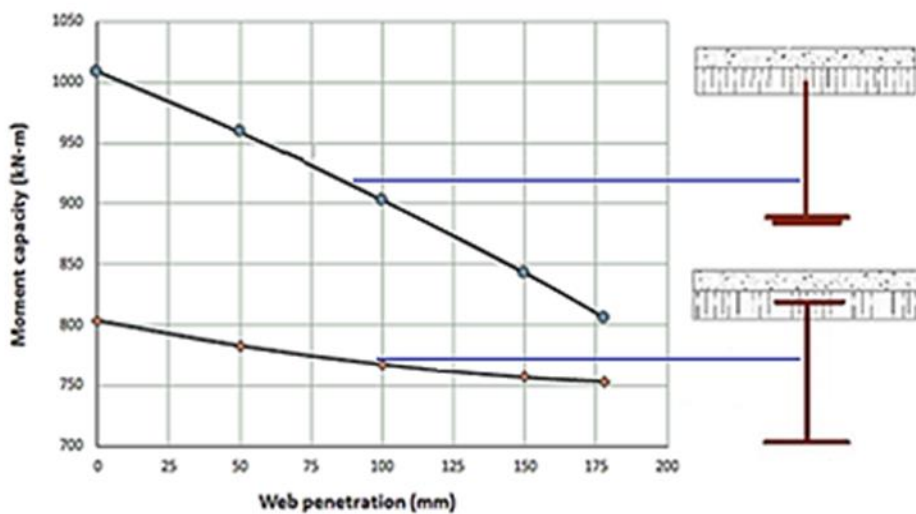


Figure 12: Comparison between the two re-design solutions under the sagging moment

4.3 The implementation of the proposed method in continuous beam design

The results of the analytical investigation presented in the previous sections can be used to suggest an innovative and highly efficient method for fabricating composite continuous beams. In this content, I steel girders are traditionally one of the most widely used forms in bridge constructions. The intermediate supports slab (subjected to hogging moment) are generally more critical than the mid-span regions (subjected to sagging moment) (Vasdravellis et al., 2012). One of the solutions is to encase the beam at the internal support within concrete (see **Error! Reference source not found.**). However, this structural form might be associated with increase in cost and time.

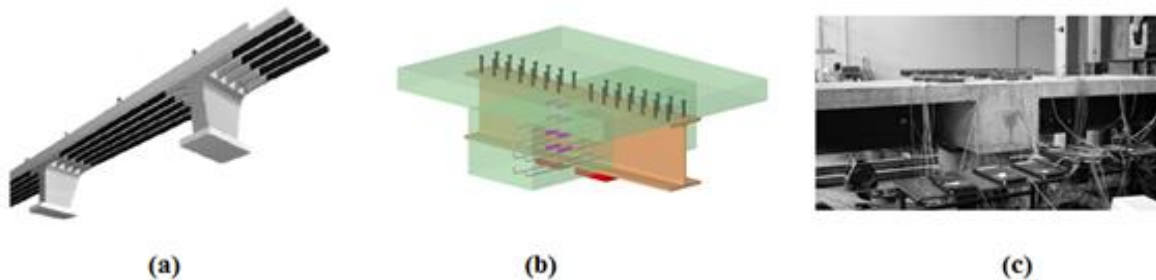


Figure 10: I-girders strengthened by reinforced concrete at the intermediate supports (a) Nakamura, et al. (2002), (b) Lachal, et al., (2011) and (c) Somja, et al.(2012)

In the proposed methods (see **Error! Reference source not found.**), the beam could be fabricated according to the moment distribution and magnitude of the bending moment diagram. Since the PNA position in the hogging region is typically within the web, two options were considered to fabricate composite beams based on the PNA position in the sagging regions. If the latter crosses the slab, then the fabrication could be done according **Error! Reference source not found.**(a). In this case, the web depth extends along the slab in hogging regions only while in the sagging regions the perforated web is simply needed to achieve the connection between the steel and concrete. In the second case, when PNA crosses the web in sagging regions, the web extends along the slab along the whole beam **Error! eference source not found.**(b).

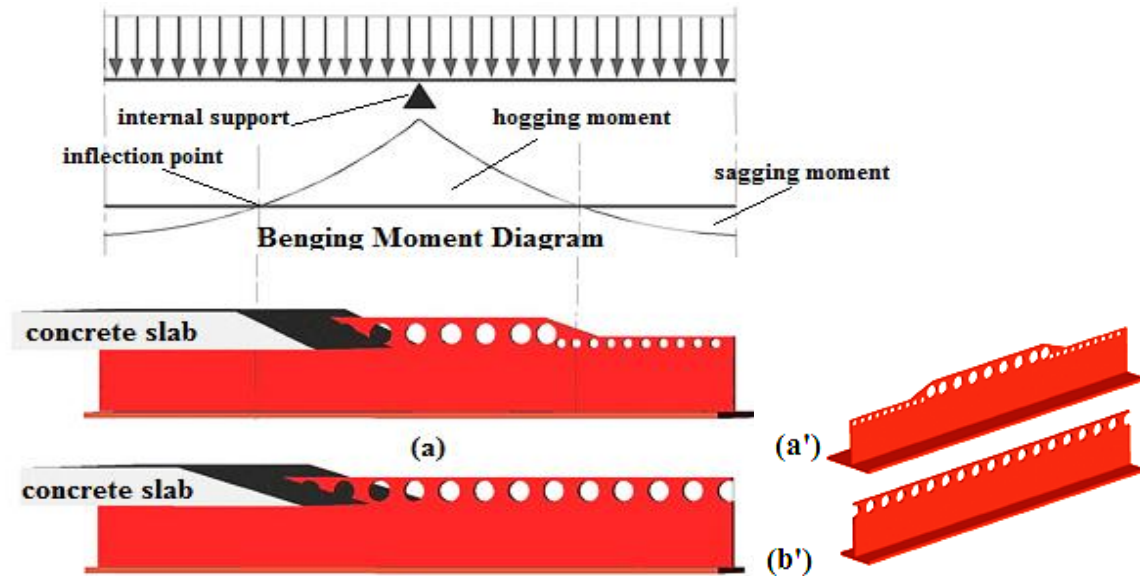


Figure 13: The proposed steel girders layout according to the bending diagram

These proposed solutions have another advantage, as continuous composite beams could be fabricated as precast segments (sagging and hogging segments), with the length of the segments determined by the distance between points of contraflexure (inflection points), where the bending moment diagram is zero. These segments could then be assembled together on site, potentially reducing the overall construction time and cost.

5. CONCLUSIONS AND RECOMMENDATION FOR FUTURE WORK

The aim of this paper was to present an initial study on the potential for efficiently re-design of continuous concrete-steel composite beams. This efficiency might be regarded throughout several economic and structural advantages, such as eliminating welded shear connectors, increasing the moment capacity of the composite beams and the possibility of fabricating precast continuous beams. Analytical investigations were conducted to quantify the effects of flange-web penetration into the slab on the moment capacity of the beam. This investigation highlighted the relationship between the web-flange penetration and the change in moment capacity. The results show that for the same area of steel, the moment capacity for inverted (T) section is higher than the traditional (I) section, even though a portion of the web is encased in the slab to achieve the bond. The increase in moment capacity depends on the depth of the web penetration into the slab. Depending on the PNA position, two solutions were suggested to fabricate precast composite beams based on the bending moment diagram along the continuous beam.

The concrete slab usually has two layers of steel reinforcement to resist bending, shrinkage and temperature and other structural requirements. In the plastic analysis of hogging moment, the quantity and position of slab reinforcement impact the moment magnitude, and this effect should be investigated further to increase the moment capacity along with the efficiency of the resulting composite beam.

6. ACKNOWLEDGEMENTS

The first author would like to gratefully acknowledged his sponsors, the Iraqi Ministry of Higher Education and Scientific Research and the University of Kufa, for their financial support in his Ph.D. studies at Loughborough University.

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8. APPENDIX A

Sagging moment resistance

The sagging moment resistance (M_{us}) can be calculated as

$$M_{us} = C_c \cdot L = T_s \cdot L,$$

where:

$$C_c = 0.85 f_{ck} \cdot h_c \cdot b_f \quad \text{and} \quad T_s = 0.95 f_y \cdot A_s$$

in which b_f is the concrete flange width ; h_c is the depth of the neutral axis ; f_{ck} is the cylindrical compressive strength of concrete; f_y and A_s are the yield stress for the steel beam and its area of cross section respectively (see **Error! Reference source not found.** (a)).

Hogging moment resistance

The hogging moment resistance (M_{uh}) is given by:

$$M_{uh} = T_{ts} + T_{bs} + T_{tf} + T_{wt}$$

Where :

$$T_{ts} = A_{st} \cdot f_{yr} \cdot L_{st} ;$$

$$T_{bs} = A_{sb} \cdot f_{yr} \cdot L_{sb} ;$$

$$T_{tf} = A_{tf} \cdot f_y \cdot L_{tf} ;$$

$$T_{wt} = A_{tw} \cdot f_y \cdot L_{tw}$$

M_{uh} the hogging moment resistance; f_{yr} is the yield stress of steel reinforcement; A_{st} is the area of top steel reinforcement; L_{st} is its the lever arm; A_{sb} is the area of lower layer of steel and L_{sb} its lever arm; T_s and L_s are the force in the steel girder subjected to tension and its lever arm, respectively; C_{As} equivalent force in the steel girder under compression. T_{tf} and T_{wt} are the components of the upper part of the steel beam (under tension stress) moment resistance; A_{tf} and A_{tw} are the area of the upper part of the steel beam; L_{tf} and L_{tw} are the lever arms for the upper part of the steel beam (see **Error! Reference source not found.** (b)).

FACTORS IMPACTING BUILDING INFORMATION MODELLING (BIM) IMPLEMENTATION IN COST MONITORING AND CONTROL

K. Sunil, C. Pathirage and J. Underwood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: k.sunil@edu.salford.ac.uk

Abstract: A vast majority of the construction projects suffer from cost and budget overruns and construction organisations continue to incur losses, reduction in profit and many of them often become heavily debt ridden and eventually go out of business. Therefore, drastic improvements are required in the current practice. BIM integration can bring the much needed improvement in the area of cost monitoring and control practice. There have been progressive developments in terms of BIM-enabled tools, costing techniques and standards that are becoming mature, but there has not been considerable change in the actual practice. Therefore, it is crucial to identify the most important factors affecting the BIM implementation cost monitoring and control in organisations in the UK in order to develop a practically feasible BIM implementation strategy. For this purpose the study uses the existing literature and empirical qualitative data collected through interviews from carefully selected practitioners from a large construction organisation in the UK and quantitative data collected through survey. This paper is focused on the identifying the key issues affecting BIM implementation in cost monitoring and control practice. Research findings indicate that there are a number of factors related to people, process, information and technology that influence their decision to implement BIM. These factors have been segregated as drivers and barriers for BIM implementation.

Keywords: BIM, cost control, cost management, cost monitoring, quantity surveying.

1. INTRODUCTION

The UK construction industry and the practitioners have failed to learn lessons from the past mistakes and wasted improvement opportunities. The prominent industry reports such as Simon's Report 1944, Latham's Report 1994, Egan's Reports 1998 and 2002 and Wolstenholme's 2009 have highlighted the problematic issues in construction industry practices and emphasised on the significant need for improvements (Egan, 1998, 2002; Hillebrandt, 2003; Latham, 1994; Wolstenholme et al., 2009). One of the most important project processes; the cost management is also significantly ineffective (Hanid, Siriwardena, & Koskela, 2011). Majority of construction projects suffer from cost and budget overruns and as a result the contractors and construction organisations continue to incur losses and going out of business (Cheng, 2014; Mahamid, 2012; Schleifer, Sullivan, & Murdough, 2014). Although there has been an increased use of computing and information technology but the overall improvement in the process and its effectiveness has been insufficient (Olatunji, 2011; Yusuf, Mohamed, Yusof, & Misnan, 2012).

Despite the improved awareness of BIM and software developments it has not yet been taken up in practice. Cost management professionals in particular have been considerably reluctant and slow to adopt BIM (NBS, 2014; Wu, Wood, Ginige, & Jong, 2014a, 2014b). Most of the developments have taken place the pre-construction phase and only a few of the research studies have been found to be focused on the construction phase. Their scope include

technology and process integration with planning and construction through BIM such as Elbeltagi et al. (2014), Willems & Vanhoucke (2015) and Zhao & Wang (2014). Dodge Data & Analytics (2015) has reported that there hasn't been significant development in this area in relation with implementing BIM. Considering the poor state of BIM implementation in cost monitoring and control there is a crucial need for identification of key factor responsible for this resistance or reluctance in order to overcome the barriers and challenge for improving the performance of the cost monitoring and control practice and its smooth transformation into a BIM-based process.

This paper is focused on the highlighting the key factors and issues impacting the BIM implementation in area of cost monitoring and control in construction phase through review of literature and preliminary findings from the thematic content analysis of the empirical data collected through in-depth interviews from the practitioners in a large construction organisation in the UK. This exercise will help in identification of most important factors due to which the sample contracting organisation "ORG-1" is struggling to adopt BIM. This will provide an insight of the practical challenges due to which BIM has not been adopted in practice and what are the most important drivers for cost managers. The first part comprises a brief literature review, the adopted research methodology for the research is discussed in the second part and the third part focuses on the analysis and presentation of data followed by a discussion on the findings and conclusion.

2. COST MONITORING AND CONTROL IN CONSTRUCTION

Cost monitoring and control during construction phase is a critical process for keeping the project cost within the predefined budget (Ashworth, 2010; Hanid et al., 2011). It involves regular conduct cost analysis, progress monitoring, reporting, interim estimating and valuations (Ashworth, 2010; Elbeltagi et al., 2014; Kern & Formoso, 2004; Pilcher, 1994). These operations enable cost managers to overcome budgetary/ cost shortfalls by making recommendations for adjustments in design, programme, construction methods, materials costs, payments, finances, stakeholder relationships, cost variances and changes in design or construction etc. It is a highly complicated mechanism involving management of a high number of work packages and costs accounts resulting from material, labour, plant, consultancies and other expenditures and also claiming payments from client and maintaining a reconciled record (Ashworth, 2010; Hanid et al., 2011). The cost managers have to maintain a critical balance during the whole process to ensure fulfilling the demands of both parties; the client and the contractor and the stakeholders (Al-Jibouri, 2003; Ashworth, 2010; Hanid, Koskela, & Siriwardena, 2010; Hanid et al., 2011; Jackson, 2002; Potts, 2008). The best possible value delivered for the money spent by the client and securing a decent profit for the contractor accordingly.

3. ISSUES AND CHALLENGES IN COST MONITORING AND CONTROL

A number issues and challenges exist in the practice related to knowledge, costing techniques being used, collaboration and coordination, quality of available data, communication and the technology being used (Cândido, Heineck, & Neto, 2014; Jaya, Pathirage, & Sutrisna, 2010; Sunil, Pathirage, & Underwood, 2015; Willems & Vanhoucke, 2015). There have been efforts for improving the costing practice from the RICS and academia such as introduction of new rules of measurement (NRM), partnering and collaborative working and advanced

costing techniques etc. But the practice has inefficient and ineffective and involves substantial amount of manual working and isolated processing (Olatunji, 2011; Smith, 2014; Yusuf et al., 2012). The project information and data are manually processed through paper-based documentation, spreadsheets and estimating software (Cho, Russell, & Choi, 2013; Zhao & Wang, 2014). Ideally the cost managers should monitor costs as they take shape, but in reality it is a retrospective process as cost managers assess and report the costs incurred in the past month (Ollmann, 2015). Therefore they are unable to take the control action in time to prevent any loss. It can be said they that in true sense they do not monitor the cost to control it, instead they manage it by keeping the overall cost within the budget. Also, the widespread culture of working to approximate cost also impacts the practice in addition to the other constraints which allows the cost managers not to be precise. All of these issues contribute in shaping the practice and determining the acceptable results.

The need for an integrated cost management system/ process has been recognized in order to improve the practice (Ballard, 2010; Isidore & Back, 2002; Jaya et al., 2010; Kulmala, Paranko, & Uusi-Rauva, 2002; Rasdorf & Abudayyeh, 1991; Turkan, Bosché, Haas, & Haas, 2012). They have highlighted the need for integration of cost management with other project processes for improved cost control along the project progress through collaborative working, inclusive decision making, and using advance costing techniques, IT system and streamlined project information flow.

4. BIM IMPLEMENTATION IN COST MONITORING AND CONTROL

BIM holds significant potential for resolving issues affecting the cost management such as non-collaborative and isolated operations, system incompatibilities, poor communication, low-tech and overwhelmingly manual documentation and processing etc. (Olatunji, Sher, & Gu, 2010; Popov, Juocevicius, Migilinskas, Ustinovichius, & Mikalauskas, 2010). Thurairajah & Goucher (2013) further state that cost managers can coordinate with project team and benefit from the readily available data and detailed information in the BIM model and from its technological, processing and information support.

Most of the BIM related developments are in the pre-construction area of cost management such as BIM enabled estimating and measurement tools etc. (Raphael & Priyanka, 2014; Thurairajah & Goucher, 2013; Wu et al., 2014a, 2014b). Only few research studies have been focused on the role of BIM in cost management during construction phase such as Elbeltagi et al. (2014), Willems & Vanhoucke (2015) and Zhao & Wang (2014). These studies are focused on highlighting the areas for improvement, development of software tool and integration of cost management with planning and construction processes respectively. BIM enabled QS tools are available in the UK market for cost monitoring, control and reporting such as Vico Office. But Dodge Data & Analytics (2015) has reported that it is fairly new area for BIM implementation and there has not been significant development in in this area. NBS BIM Survey 2016 has indicated that a high number of organisations have attained BIM maturity Level-2 (NBS, 2016). But the majority of the respondents of the survey were from the architectural background. Only 3% of the respondents were Quantity Surveyors. Therefore this proposition does not effectively imply to the QS firms or departments. Also the government mandate does not require using 5D cost management (Thurairajah & Goucher, 2013). Therefore, it is crucial to identify the key factors that impact the BIM implementation in cost monitoring and control practice/ cost management/ quantity surveying departments of the contracting organisations as they are the main players during construction.

5. RESEARCH METHODOLOGY

This research paper is part of the PhD research study that has adopted mixed methods research strategy involving multiple case study methodology and survey research methodology. Multiple case study method is aimed at conducting cross case analysis of multiple cases to identify the critical factors affecting BIM implementation. Multiple cases study also improves the validity and generalisability of the research findings as the data is collected from multiple sources (Saunders, Lewis, & Thornhill, 2012; Yin, 2014). Purposive sampling has been used to select three case study organisations which are large contracting organisations from the UK, depending upon the extent of BIM deployment in quantity surveying/ cost monitoring and control. Semi-structured interviews have been used to collect qualitative data from people in the cases study organisations. In-depth interviews allow the participants to express their views in depth (Saunders et al., 2012). The interview format has been designed to capture participant's opinion about the BIM implementation in the cost monitoring and control and the associated factors. The qualitative data has been analysed through thematic content analysis. It is "a set of procedures for collecting and organizing non-structured information into a standardized format, which facilitates making inferences about the characteristics and meanings of written or recorded material" (Kulatunga, Amaratunga, & Haigh, 2007, p. 501). For categorisation pre-defined themes; people, process, information and technology that have been identified from the literature are used but there is flexibility in the approach to add any further emergent theme. The survey collects quantitative data from the practitioners across the country to investigate wider trend of the critical factors the using descriptive analysis and factors will be ranked using factor analysis. The survey results are intended to improve the validity and generalisation of the qualitative research findings.

As the research is currently in progress, the preliminary findings from the first case study are presented in this paper highlighting the most important factors affecting the BIM implementation in the cost monitoring and control. A large contracting organisation "ORG-1" from UK has been selected for collecting the empirical data. ORG-1 does not use BIM for the project cost management which makes it ideal for investigating the actual facts due to which they have not adopted BIM. Five people from this organisation have been interviewed; two from the strategic level and three from the operational level in the cost management process for investigating both strategic and operational constraints.

6. FACTORS AFFECTING BIM ADOPTION

Research studies conducted during past 5 to 6 years have highlighted a number of potential factors that impact BIM implementation such as Ibrahim, Kado, & Bala (2014), Balfour Beatty (2015), Eastman et al. (2011), Hosseini, Azari, Tivendale, & Chileshe (2015), Kehily (2016), Shang & Shen (2014), Smith (2014), Stanley & Thurnell (2014) and Turner, Edwards, Curran, & Guillemet (2015). These factors include; drivers, barriers, challenges and other issues that are associated to people, process, information and technology in the practice. The designers and constructors have embraced and made progress in implementation but cost management/ quantity surveying discipline is lagging behind (Dodge Data & Analytics, 2015; Wu et al., 2014a). Therefore, it is essential to investigate this area to determine the most important factors responsible for this. The interviewees were asked to express their opinion about these factors such as the relevance of the factor, how it impacts, underlying causes and the practical implications. These factors are divided into two groups for analysis act as 'Drivers' that organisations and professionals find most attractive in terms of BIM's

impact in improving the practice and 'Barriers' that prevent/ make BIM implementation difficult. The case study findings are presented in the following sections.

6.1. Drivers Associated with People

Cost managers form the people component of the cost monitoring and control practice as they perform core QS tasks in cost monitoring and control practice. BIM implementation in this area will directly impact the people. Following are the most important drivers associated with people that have been identified from the analysis of ORG-1 organisation.

Role of Cost Manager

All of the respondents agree that BIM implementation will considerably enhance the traditional role of the QS through highly advanced technology and integrated process. It has been found that QSs role is confined to commercial management and mostly operate in isolation. They work in a constrained environment because of poor information availability, manual nature of processing and basic technology etc. and do not actively seek opportunities for cost savings and do not monitor the cost performance. It has been found that although the QSs and the management are satisfied with their current role, they expect that with BIM their role will be enhanced and can become more effective. The QSs are mostly busy and do not have time to look at other aspects of the project where greater benefits can be achieved. The QSs and management both feel that BIM would be beneficial if it can improve the cost control and ability to monitor leading to better performance and profit. Moreover, QS can actively participate with project team and through BIM support they can give faster cost feedback on alternative design, programme and materials. This enhancement in the QS role is seen as an important driver for BIM adoption.

Decision Making Support

Decision making is the main task of cost managers as they always have to assess the cost performance and make judgements and adjustments. Cost manager's decisions directly impact the commercial performance of the project and organisation's profitability. It has been found that the experience is considered to be the major competency factor for better decision making. But the BIM co-ordinator is confident that BIM significantly help cost managers' decision making. Although the QSs lack the detailed BIM knowledge but the model visualisation feature due to the multiple angle 3D viewing and model fly through is seen as a major factor that can play vital role in improving their decision making such as specific requirements and buildability issues leading to better cost certainty. It can also help in easing the time, labour and cost pressure. Other, important contributing factors are availability of right detail of detailed information and ability to integrate cost managers in the project team for inclusive and collaborative. BIM support for better informed decisions is a driver that is considered vital by the management and the surveyors..

Collaborative Working

It has been found that the QSs mostly work in isolation as they are not actively involved with the project team for example with designers, site management and planners etc. But they acknowledge the fact that cost monitoring and control is not solely the responsibility of the QS but in fact it is a team process. It has been found that QSs believe that site managers are also responsible for controlling cost because they oversee the works on site but QSs don't collaborate with them. As a result they are mostly unaware of the project development/ progress and are unable to provide immediate cost feedback. Moreover, they do not take control action unless there is a considerable problem and they have to conduct meetings and site visits to assess the situation and obtain information. However, the QSs emphasised on the need for improving collaborative working with other disciplines to provide quicker cost feedback and proactive identification of design and planning issues and variations can be better planned.

Although the QSs lacked in-depth BIM knowledge, the management however has been found keen about the BIM's capability to connect the project team members through its centralised platform as it can improve the required collaboration for improving the cost monitoring and control. Through BIM, QSs can closely work with subcontractors, suppliers and the client's team such as clients QS. BIM allows sharing information, communication and model/ project updates across the project team. It enables team to collectively deal with problems such as construction and cost issues and assess alternatives in more efficient and effective manner. It has been found that BIM can help in changing the traditional professional and cultural barriers in the construction industry including the QS professionals.

Support for QS Tasks

Although the QSs and the management emphasised that the current methodologies of cost management and the QS tasks and activities are satisfactory. They have been found to be confident about the accuracy of the CVRs, cost data, reporting and processing. It has been found that QSs in ORG-1 are responsible for a number of tasks during construction phase such as cost control, cost and value reconciliation, measurements and take offs, variations management, procurement, subcontractor and supplier accounts and corrective action for financial adjustments. Most of these tasks and processes are manual and time consuming. Moreover, at peak times the QS can be involved in up to three live projects and mostly work under time and work overload pressure. As a result they do not regularly monitor the costs or seek availing cost saving or value enhancing opportunities.

Through analysis it has been found that the QSs are keen about the automated features of BIM and the BIM enabled QS tools. They specifically emphasised on visualisation and clash detection as they have witnessed their benefits. They repeatedly mentioned that BIM can be useful if it can help them saving time and speed up their routine tasks such as quantification and updated information provision. They named some of the important benefits; detection of design, construction and programme issues and check and the manage subcontractor's work. From QSs perspective, the support for QS tasks and duties is an important factor for them to consider using BIM.

6.2. Drivers Associated with Process

BIM implementation will affect the process of cost monitoring and control. The most important process related drivers that have been found through analysing the ORG-1 are presented below.

Integration and Coordination

The QSs emphasised that cost management has to coordinate with the on-site construction progress in order to be able to monitor project cost performance and this coordination can be reached by integration of cost management and construction schedule. Lack of integrated processes and coordination has been highlighted by the QS professionals in ORG-1. It has been found that the quantity surveying, design, and construction processes operate in isolation. QSs are often not aware of the extent of development of design or construction on site and variation instructions. They cannot attend all meetings to coordinate with team. As a result they cannot properly conduct cost management. They rely mainly on the monthly CVR for analysing the performance of past month and that takes over a week. The QSs have to manually enter and process data into Excel and then produce cost reports from it manually. Due to the practical inability they don't monitor the project cost performance.

There is acceptance that the integration of cost, schedule and on-site construction progress is important for enabling cost monitoring. In their opinion BIM can play an important role in linking design, cost and schedule data. The QSs believe that through BIM the project team can be linked together and the process can be integrated with each other that can enable them to coordinate with the design and construction teams and the cost management can potentially become in-line with the development on site. Also the changes in in design or programme can be captured and cost data can be updated accordingly. They believe that the combined processing will ultimately help in improving the cost monitoring and control practice. Without BIM support they do not have enough resources to monitor project cost regularly. Therefore, the capability of BIM to integrated processed and improve coordination is seen as an important driver to improve the process.

Standardisation and streamlining

Another important factor that can act as a driver for BIM implementation in ORG-1 is standardization and streamlining the cost monitoring and control process. It has been found through the analysis that in ORG-1 organisation and project the non-standardised processes, methods and documentation are important issues. Due to using different methods and formats QSs often fail to understand the data and information and they have to spend extra time and effort to work with it. Also it creates cost uncertainty because people use different formulas and techniques and present information in various structures. Also, it has been found that in most cases the required level of detail is not provided which leads to queries, delays and uncertainty. Due to these issues the process cannot be streamlined.

It has been found that in the management and the QSs opinion BIM can definitely help in improving the standardisation and streamlining the process through the information standards and protocols. They emphasised that use of standardised medium, structure and file format is a very important aspect of working in BIM environment. From cost management perspective, as they use input from internal and external project team members it a key driver. The QSs

can avoid delays due to duplications and repetitions, direct access to the model and required data and use of dedicated QS software tools.

6.3. Drivers Associated with Information

Information is the core component of the BIM projects, the drivers associated with the information that have emerged from the analysis of the in-depth interviews with the practitioners are presented below.

Information Availability and Sharing

All of the participants concur that BIM has a significant potential in eradicating the chronic issue of lack of data and information availability for cost monitoring and control purpose. It has been found that most errors and delays occur due to the missing or incomplete information. The QSs emphasised that with BIM they will be able to obtain majority of the information with right level of detail at all relevant projects stages that can improve the speed and quality of their work. During construction phase if all people enter the correct information into the BIM model, QSs will be in better position than today in monitoring the cost expenditure. Also in case of a variation or problem they will be able to quickly assess the cost impact and produce proposals for the client's approval. They will be able to share the material specifications with the suppliers in quick manner to check and cross-check prices and generate subcontract packages with greater accuracy. Similarly, information sharing is also an important aspect as the QSs can easily send and receive information through centralised platform.

Quality of Data

It has been found that the QSs have serious concerns about the quality of information and data in the current practice. The problems are often caused due to use of verbal and hand written notes. Also the structure and vocabulary used by various people in the project are not uniform which creates problems for QSs and they have to chase people for right interpretation. This creates additional work and leads to delay and errors.

The improvement in quality of data is seen as an important factor by the QSs in relation with BIM adaptation. Some of the benefits they want to achieve through this decreasing the workload, delay and accuracy. It has been found that it is due the fast paced nature of the project construction and involvement of high number of people and activities in construction phase.

Information Format

It has emerged from the analysis that people in the UK construction always prefer their own preferred manner in which the structure the information and documentation. Also various isolated software system are in use that have file format and compatibility issues. Due to these issues often time and resources are wasted along with valuable data and sometimes QSs prefer printed information that they can manually enter into their spreadsheets.

Ability of BIM to standardise the information structure and support for a wide range of file formats has been mentioned as an important aspect that can improve the cost management process. It has been found that improved system compatibility can support the cost managers to conduct cost monitoring and control activities.

6.4. Drivers Associated with Technology

From the analysis it has emerged that Qs and the management of ORG-1 possess limited BIM knowledge in relation with cost management. The main source of their BIM technology knowledge has been acquired from introductory demonstrations. The important drivers associated with BIM technology from their perspective are presented below.

Visualisation

The Qs and management concur that the detailed 3D model visualisation feature of BIM can be very useful for the cost managers and the key benefits they aspire are better understanding of the design and features of the building and visual clash detection analysis. The Qs consider the ability to compare the physically built assets to the model during construction phase as very important development as they can verify the construction and identify issues easily. Moreover, they also highlighted the importance of embedded cost data for checking and verification. From cost monitoring and control perspective it has been stated that 5D BIM can enable the QS to assess the project cost performance during construction which was previously not feasible in the traditional settings. Also the visualisation can significantly support the valuation process from completed and pending works.

Automation

The management have been found to be keen about the automation of the time consuming tasks such as measurements, quantity take offs, clash detection etc. Whereas, the Qs are more interested in documentation, checks and reviews, report generation and access to data. The Qs repeatedly mentioned that due the work overload and fast paced nature of the construction projects, they often leave the crucial checks and analysis. They desire if the BIM can support them in measurements, quantity take offs and data collection, they can use that valuable time in detailed assessments to improve project cost certainty and performance.

Although the Qs seek speeding up their working through BIM, they emphasised on the importance of QS's role in supervising and controlling the process for accuracy and right detail because they assert that all cost items cannot be modelled. However, the automated features are seen as major technological developments that can improve the cost management during construction phase.

6.5. Barriers for BIM Implementation

Although there are a number of drivers highlighted by the practitioners in ORG-1 but still the BIM has not been taken in the QS department of the organisation. Therefore the thematic

analysis was conducted to identify the barriers that have prevented the BIM implementation. The main barriers that have been identified from the data analysis are presented below.

Resistance to Change

It has emerged from the analysis that there is resistance to BIM implementation in the QS department in the ORG-1. The senior management indicated that they are satisfied with current cost monitoring and control practice in the organisation and do not view BIM to add significant value. It has been attributed to the lack of BIM knowledge and advanced stage of career as the older people in the company are suspicious about the achievable benefits. The more experienced people prefer their existing methods and tend to resist the BIM implementation. Moreover, it has been found that Qs use different methods and tools and there is a strong culture in the industry to defend your preferences and challenge others. As a result there is certain level of resistance to change from their preferred methodology as each of them used different method for his calculation but remained assertive about its accuracy.

Fear

It has been found that there is a significant element of fear and uncertainty in relation with BIM adoption which is rooted in the low level of BIM knowledge. Although people tend to project lack of confidence in the accuracy and effectiveness of BIM based cost management but the actually there are other factor involved such as job security, uncertainty, decrease in wages etc. Also people in construction industry have low level of trust and they do not feel comfortability in sharing information due to reservation about security of their commercial interests. It has also emerged the people are unaware of the BIM standards that define the roles and responsibilities such as PAS 1192-5:2015 and BS 1192-4:2014 etc. As their BIM knowledge is at low/ basic level in the QS department, people have a lot concerns about the legal and contractual implication related to BIM implementation in a project. For instance one of the primary concerns is about the ownership of the data, and responsibility in case of issues in the model. One of the Qs raised concern that BIM model is open to human errors because people can make changes.

Knowledge and Competency

Lack of BIM knowledge and competency is one of the major barriers for BIM adoption in the cost monitoring and control practice. It has been found that QS professionals use generic tools and techniques for cost management. The QS department as a whole suffers from severe lack of advance digital IT skills vital for BIM adoption. In addition, it has been found that the senior management expect people to develop these skills at the university but the reality they lack core QS competencies which put the organisation under pressure to train the Qs first for quantity surveying first. Moreover, the organisation has already once failed to implement a popular BIM enabled cost management software package due to the lack of competency.

Cost Manager's Workload

From analysis it has been found that the cost managers are extremely busy as they are over occupied with a high number of important tasks and duties as discussed earlier under high time pressure. Upon investigation it has emerged that due to the high volume of workload, tight deadlines in the fast paced construction business it is not feasible for the QSs to dedicate time for learning and developing BIM competency. It has been found that the QSs prefer to get on with the jobs first so that the organisation can continue its business.

Leadership

ORG-1 is capable of delivering Level-2 BIM projects as the design department is BIM enable. The design department adopted BIM because of a strong leader who had previous knowledge and experience but had dedication and ability to withstand management and staff pressure. Whereas the QS department suffers from leadership crisis and as a result has not made progress with BIM adoption. However, there is expectation that recent change in the management can provide support and add a new member of team who can lead and mentor the QS department to become BIM capable.

Organisational Structure

The organisational structure plays a vital role in implementing new technology in the ORG-1. Head office governs the regional offices and the new technology is first trialled at the head office and then passed on to the regional offices. If something is being trialed at the head office, the regional offices cannot run its trail. It has emerged this policy has proven counterproductive in relation with implementing BIM in cost management department. Upon direction from the head office, the regional office started the implementation of BIM capable software demonstrations and training sessions to the QSs. But the head office postponed it for another year. As a result many people have lost interest and a lot of time, planning, and money has gone wasted. It has been found that people feel that as teams have different strengths and level of understanding, if something suits them they should be able to use it and then they can share the knowledge across the organisation.

Training & Learning

It has been found that the staff training and skill development in ORG-1 acts as a barrier for BIM implementation. The trainings programmes are focused on attaining professional accreditations and health and safety. There is no emphasis of developing new skills such as BIM competency. It has also emerged that most of the trainings are funded by the industry grants and are focused on Health & Safety and similar areas which do not contribute to improving the business, making it lean and more profitable. The QSs also revealed that the previous BIM trainings were not adequate and the knowledge was being force fed in short time. It is unrealistic to expect the professionals to be able to adopt new techniques and technologies after few hours of trainings.

Strategy & Investment

From the analysis it has emerged that ORG-1 does not have a robust BIM implementation strategy. At the regional office level there is no active programme for implementing BIM in the QS department. The head office allocates the budget for these purposes but due to the past experience of failed implementation now the people in regional office are reluctant to make such commitment. Also, in tight economic situation it is difficult for the organisation to take the QS off the project and get them trained up for BIM.

In addition to this the IT strategy and investment are not aligned. The organisation sometimes arranges training sessions but that is not backed up by providing the software to the QSs and gradually they forget everything learnt. Also the upgrading of the hardware is not satisfactory as QS have systems which are not capable of opening BIM model which puts them off and they cannot get involved in BIM project. The company has to adjust its BIM strategy if it is to succeed with BIM implementation.

Quality of data & information

One of the main barriers for implementing BIM in cost monitoring and control practice is the inadequate quality of data and information. It has been found that the management and QSs are concerned about the reliability of the BIM model information. Although it is a collaborative exercise and users can highlight the issues and notify the author but QSs feel that it increases their workload significantly if they have to verify the whole model. Similarly if extracted information has an issue, they have to re-check all of it and they suggest it is easier for them to create it by themselves. This uncertainty and lack of trust is an important barrier to overcome because otherwise it is difficult to convince them to use BIM.

Interoperability & Compatibility

The major technological barrier that has been found for the analysis is the issue of interoperability and compatibility. The senior management suggest that with rapid development in the area of BIM, new tools are emerging and it is becoming increasingly difficult for them to choose a specific one. As a large contractor in the UK they are struggling to find appropriate BIM capable cost management software package. Because there is a considerable investment required for acquisition of software and hardware, implementation and training.

Senior management has been particularly found concerned about the file format issues. It has been suggested that as there are various BIM software packages in the market; it is difficult for them to assess what type of file formats they may be working with in the future projects, what software the client's architect will be using and will there be any file compatibility issues.

7. CONCLUSION

Due to inadequate cost monitoring and control, construction projects exceed the budgeted costs and the main contractors continue to incur losses. There have been attempts to improve

the cost monitoring and control but those attempts have not been successful. It is suggested that BIM implementation can resolve the issues in the practice. The BIM enable QS software tools are available in the UK market but still in practice BIM has not been taken up by the practitioners. It is suggested that the QS professionals resist the change due to uncertainty, insecurity and lack of BIM competency. Also the construction companies are not adopting BIM due to the high cost of acquisition and implementation. A case study organization “ORG-1” has been investigated with aim of identifying the most important factors impacting BIM implementation in its cost monitoring and control. A number of factors have been identified and have been categorised as drivers and barriers.

The management and Qs identified that the most important drivers associated with people are enhanced role of cost manager, decision making support, collaborative working, and support for QS tasks. The most important drivers related to cost monitoring and control process include integration and coordination, standardisation and streamlining of the process. Information availability, sharing, quality of data and information format are considered most prominent information associated drivers. In relation with BIM technology Qs it has been found that visualisation and automation are most important drivers. Moreover, the most important factors acting as barrier for BIM implementation are resistance to change, fear of unknown and uncertainty, lack of BIM knowledge and competency, extensive workload, lack of leadership, organisational structure, training, organisational strategy and investment, inadequate quality of data and information, interoperability and software compatibility issues. From their perspective BIM has to provide the above mentioned benefits and identified barriers have to be alleviated in order to implement BIM in ORG-1 QS department.

Although the literature suggests a large number of drivers and barriers but this research has revealed that people in each organisation have their own opinion about BIM based on their specific needs, organisational structure, BIM knowledge, competency and experience. In ORG-1 the people lacked in-depth BIM knowledge and understanding and the senior management using inadequate training methods for developing BIM competency. There is also impression that the top management is not keen to implement BIM in the QS department and there is serious lack of BIM enthusiast leadership capable of leading and mentoring the team. As the research is currently in progress the next step is to investigate another organisation for further identification of factors impacting BIM implementation.

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DEVELOPMENT OF A BIM AND BARCODE BASED MATERIAL MANAGEMENT SYSTEM FOR CURTAIN WALL INDUSTRY

Q. You¹, G. Wedawatta¹, N. Xu² and N. Xu²

¹ School of Engineering and Applied Sciences, Aston University, Aston Triangle, Birmingham B4 7ET, UK

² China Smart Construction Group Co., Ltd., Nanhai Ecoool, 518067, China

Email: youq@aston.ac.uk

Abstract: The construction industry is slower to adopt new technologies than other industries. Traditional construction industry material management system involves tedious paperwork, frequent phone calls and challenging coordination, posing many difficulties for the project management. Recent development in the use of information and communication technologies in the Architecture, Engineering and Construction (AEC), namely the building information modeling (BIM), promises to introduce major changes in visualization, coordination and planning processes of the engineering projects.

The impact of the building's curtain wall has become increasingly more important when determining the operational and economic performance of construction projects. And as a recognized discipline of the construction industry, curtain wall design, and fabrication and installation process involves numerous stakeholders including designers, contractors, purchasing staff, suppliers, distributors, and on-site installers.

It is believed that the material tracking system, when integrated with BIM, can successfully address the major problems of the curtain wall industry. In this paper, the authors analyzed the current practice of material management in the curtain wall industry and proposed a BIM and barcode integrated material management system, which aims to provide a BIM based material management framework from the design phase to the construction phase, streamlining material management process and promoting collaborative working processes in the curtain wall industry.

Keywords: Curtain wall, BIM, Material Management, Barcode, China.

1. INTRODUCTION

Construction is the process of physically erecting the project and putting construction equipment, materials, supplies, supervision, and management necessary to accomplish the work (Clough and Sears 2000). Due to the complex and dynamic nature of the construction industry, construction material management faces many challenges from material planning, ordering, receiving and storing, handling and distribution, site usage and monitoring (Johnston and Brennan 1996).

Construction materials contribute 50-60% of the total project costs and material's tracking and locating is important to ensure that materials are available at the right time, in the right place and at the quantity required (Song and Haas and Caldas 2006). Because large amounts of materials and components are involved in the construction projects, tracking of materials and components in a construction project is not an easy task (Kasim et al. 2012).

Traditional construction material management processes in the construction industry still rely on manual data and paper lists to control large amounts of engineered components which not

only negatively affects construction performance but also has an additional negative effect on worker's efficiency and contributes to schedule and project delays (Kasim et al. 2012).

Issues regarding the tracking of construction materials on-site have received a great concern in the construction industry (Kasim et al. 2012). With the ability to automating and integrating some of the predefined tasks common to most projects, information technologies have the potential to significantly simplify the effort of responding to the complexity and demands that the construction industry are facing. Industry practitioners have also identified that current material tracking field practices could be improved if aided by new information technology devices(Liwan and Kasim and Zainal 2013).

A Building Information Model (BIM) is a data-rich, object-oriented, intelligent and parametric digital representation of the facility, from which views and data appropriate to various users' needs can be extracted and analysed to generate information that can be used to make decisions and to improve the process of delivering the facility (AGC, 2005). The main characteristics of BIM include 3D CAD-based presentations and easy updating and transfer of information in the BIM environment(Ho, Tserng and Jan, 2017). BIM has a positive impact of material deliveries,which helps project stakeholders understand the project, reduce uncertainty and improve predictability of the project(Ocheoha and Moselhi 2013).

Although one assumes these advantages, how BIM can be used from the design phase to the construction phase in an integrated manner to improve material management has not been fully understood.

The objective of this research is to fill this gap by analysing the practices of material management and proposing a BIM based material management framework for a recognized construction industry discipline:curtainwall industry, aiming to improve low efficiency in the traditional material information extraction and facilitate the information sharing and communication among dispersed projected related parties. The proposed framework consists of three parts :

- 1.Web based project management system for process management.
2. BIM software plug-in for quantity take-off and BOM generation.
- 3.A mobile app for on site material management.

2. RESEARCH METHOD

In order to identify the current practices of material management in the curtain wall industry and the ways of improving them, questionnaire survey and literature reviews were the methodologies conducted to achieve more valid and reliable findings. Questionnaire survey and interviews were carried out among three curtain wall companies in China. A BIM and barcode based material management system is presented based on the survey conclusions.

3. LITERATURE REVIEW

3.1 Material Management

Construction material management is critical for project success in the construction industry (Carlos et al.2015).Each construction project is the development of a single one-of-a-kind product which requires the joint efforts of different parties (Yeo and Ning 2002) .Owners, contractors, subcontractors, and suppliers collaborate for a definite period of time to deliver the project to the client (Carlos et al. 2015).

Another characteristics of construction material management is that construction materials are less homogeneous, less standardized, and more numerous than those of manufacturing industry and the characteristics of demand are different (Ibn-Homaid 2002).

Moreover, due to the dynamic nature of construction material management, many problems are created due to the lack of an integrated material management approach among different material management phases(Ren and Anumba and Tah 2010).Many contractors suffer losses in productivity resulting from insufficient material management which eventually affect a contractor's profit margin(Thomas and Sanvido 1989).

Problems identified from the literature regarding material management systems used by contractors include:

1. Material shortage and wastage due to inefficient management techniques;
2. Lack of material procurement collaboration system among different parties;
3. Lack of effective on-site material control techniques.

3.2 BIM and material management

BIM is a powerful tool to support life cycle integration and the information contained in the BIM-based design model can be shared directly among different parties which can reduce the heavy human workload and manual errors in traditional work(Aguiar and Grilo 2015).

The benefits of BIM based material management are the accurate and automatic quantity take-off and BOM generation, improvements in quality and waste reduction, visualization and productivity improvements, as well as improved communication and collaboration, and field co-ordination problems during deliveries(Ocheoha and Moselhi 2013).

An accurate quantity take-off is the start of a precise material management process.Traditional quantity take-offs generated from 2D drawings are based on the experience and assumptions of the engineers. The results can be overestimated and underestimated and may contain errors and omissions. BIM can increase the accuracy in the quantity take-off and allow precise future prediction of the construction costs(Choi, H. Kim & I. Kim, 2014).

Radio Frequency Identification(RFID)tags can help support the tracking of component delivery and installation onsite and BIM components that included references to RFID tags can automatically update with links to field scanning devices and provided the contactors with instant feedback of material status (Eastman et al., 2008).

4. SURVEY OF CURRENT MATERIAL MANAGEMENT PRACTICES IN THE CURTAIN WALL INDUSTRY IN CHINA

4.1 Curtain Wall Introduction

By definition, “curtain wall “is a light secondary rigid framing system filled or covered with a lightweight cladding(Karol 2008).Key requirements of the curtain wall are to provide air integrity in the cladding system, adequate wind, thermal and seismic response in addition to provide light transmittance to the interior space(Dudley 2017).Curtain walls are classified by their method of fabrication and installation in two categories: stick built system and unitized system (Dudley 2017).Unitized curtain wall systems are comprised of large units that are assembled and glazed in the factory. They are then shipped to the job site and erected on the building façade. Stick systems consist of the curtain wall frames and panels that are installed and connected piece by piece. Curtain wall material lists include panels, framing, connections, accessories and preembedded pieces(see Table 1).Table 1lists most common curtain wall materials.

Table 1: Curtain wall material list

| Material classification | Panels | Frames | Connections | Accessories | Preembedded pieces |
|-------------------------|------------------|-----------------------|------------------------|---------------------|--------------------|
| Material list | glass | steel | steel | weathering glue | steel |
| | clay board | aluminum | aluminum angle code | structural adhesive | cast iron |
| | aluminum veneer | stainless steel cable | stainless steel screws | foam rods | |
| | stone | stainless steel rod | bolt | tape | |
| | aluminum-plastic | | | rubber gasket | |

4.2 Survey of the current material management practice in the curtain wall industry

The questionnaire and interview methods were used in the survey and four curtain wall firms were selected from 2016 China’s top 50 curtain wall companies list. After the analysis of the response from the survey, one company was interviewed to achieve the detailed workflow of the current curtain wall material management practice.

The questionnaire was divided into the following sections:

1.Orgnization background

In this section ,factual information such as the value of the projects and the types of the contracts was requested.

2.Current material management practice

This section was designed to enable the author to identify the current material management practice adopted by the companies and the inherent problems of traditional method.

3.Application of BIM

The purpose of this section was to collect information on BIM maturity levels in different companies.

4.Opinion of the BIM based material management system

This section asked for the companies suggestions to the BIM based material management system.

4.3 Survey results

Current contract type and material management practice

In the survey, it is concluded that most curtain wall projects in China adopt the design build method which means the owner contracts with a single entity to provide both the design and construction of the building. All of the stakeholders have the same goal of developing a curtain wall system that meets the requirements and fulfilling the owner's and architect's vision for the building.

When adopting the design build method, curtain wall design and engineering is a collaborative effort among the curtain wall designer, project manager, procurement manager, processing plant worker and on-site material administrator. The process can be divided into the following phases(see Table2): Bidding and schematic design phase, project start-up phase, design development and construction document phase, construction preparation phase, engineering design and material preparation phase, material procurement phase, transportation phase, material receiving phase and construction phase.

In the traditional method, the curtain wall designer will calculate Bill of Materials (BOM) from 2D CAD drawings. The correctness of BOM relies on both the accuracy and level of detail of drawings and it is difficult to check if there are omissions or miscalculations from 2D drawings with the increasing complexity of the project. The BOM is then exchanged by each agent for printing and recreating, which frequently results in critical errors that could affect project cost and schedule. Besides that, some information ends up being unavailable to parties who need access to them for the decision making process and the data is difficult to be traced and accessed in the future. The current practice of material management is basic and depended on paperwork and subjective decisions which contributed to late ordering and delivery of key materials and high wastage.

Table 2: Material management process in curtain wall industry

| | Designer | Project Manager | Procurement Manager | Processing Plant | Material Administrator |
|---|--|--|---------------------|------------------|------------------------|
| A. Bidding and Conceptual Design Phase | Conceptual design | Construction organization planning | | | |
| Project Start-up Phase | Contract management design task issued and construction tasks issued | | | | |
| C. Design Development, Construction Documents Phase | | | | | |
| D. Construction Preparation Phase | | Prepare project plans, refine material preparation plan and send it to the designer. Review the designer's BOM list and send it to the procurement manager | | | |

| | | | | | |
|---|--|---------------------------|-------------------|---------------------|------------------|
| Engineering Design and Material Preparation Phase | Refine the design based on material preparation plan and send BOM list for project manager to review | | Receive BOM list | | |
| Material Procurement and Preparation Phase | | | Purchase material | Material processing | |
| G.Material Transportation Phase | | | | | |
| H.Material Receiving and Construction Phase | | Curtain wall construction | | | Receive material |

Suggestions to the BIM based material management system

The following summarizes the suggestions to the system by the respondents:

1. A systematic approach for project related parties to understand when and where the materials are need and instant material information sharing scheme.
2. A systematic classification system of the curtain wall materials.
3. Improvement of BIM software functions for automatic generation of BOM lists.
4. Automatic onsite material inventory management using IOT technology.
5. A historical database as reference for future projects.

5. THE PROPOSED BIM AND BARCODE BASED MATERIAL MANAGEMENT SYSTEM

5.1 BIM and Barcode Based Material Management System Framework

Information technologies can benefit the industry by automating and integrating some of its predefined task functions common to most projects. The American Institute of Architects has defined BIM as "a model-based technology linked with a database of project information". Considering this issues, the author proposes an innovative approach that uses BIM and barcode to support material management process in the curtain wall industry which integrates and streamlines material management processes throughout the project process. The shifts from traditional paper based to the information based environment could strengthen the automation of material management tasks and supports more accurate decisions and strategic approaches.

The proposed system is comprised of three parts: web based project management system for process management (see Fig1), BIM software plug-in for BOM generation (see Fig2)and a mobile app(see Fig3) for onsite material management. The proposed system allows the designer to initiate an automatic BOM takeoff (see Fig4)process using a BIM software plug in and strengthen instant information sharing among project related parties. The automating material tracking approach could have eventually provided a permanent and updated record of the received materials as they arrive onto the site, releasing material manager from inventorying activities. Fig5 shows the BIM based material management process.

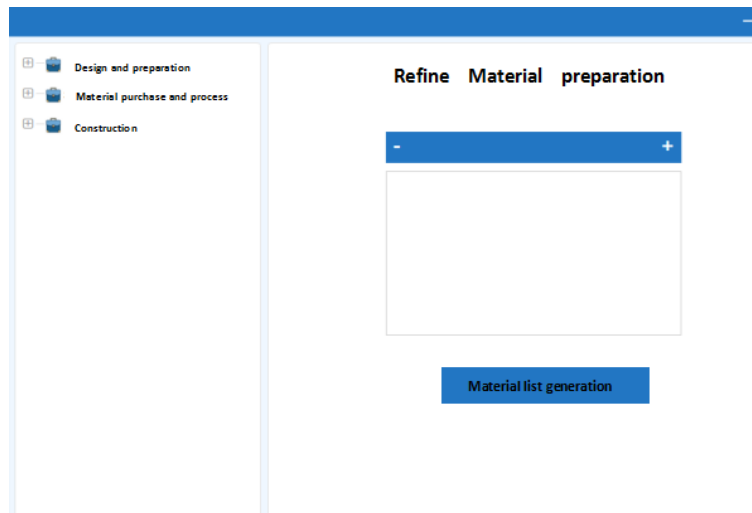


Figure 1: Web based project management system



Figure2: BIM software Revit Plug in

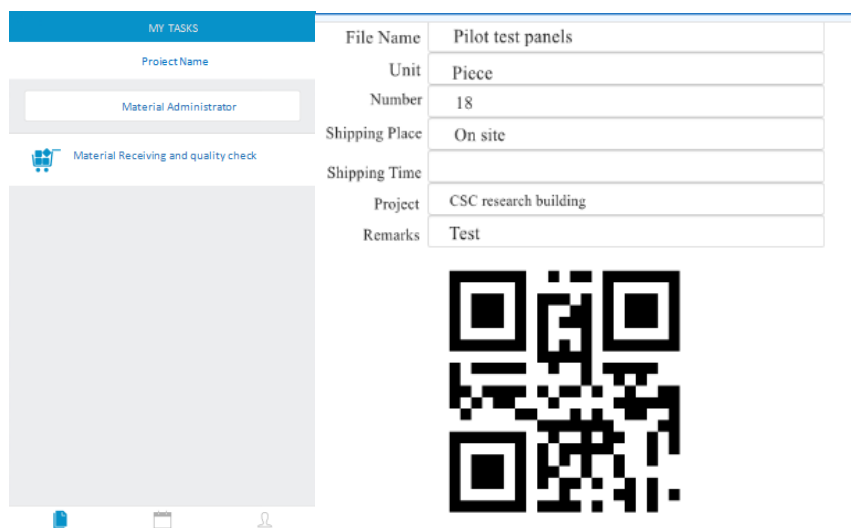


Figure 3:Material management app

| Company Name | | | Connections BOM | | | | | | | BOM Number | |
|--------------|------|---------|-----------------|--------|--------------|----------------|----------|-------------------|-------|----------------------|------------------|
| No. | Name | Version | Project Name | | | Project Number | | | Zone | | |
| | | | Number | Weight | Total Weight | Drawings | Material | Surface Treatment | Color | Process Requirements | Delivery Address |
| | | | kg | kg | | | | | | Factory/ Site | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| Total: | | | | | | | | | | | |

Figure 4:Automated generated BOM(connections)

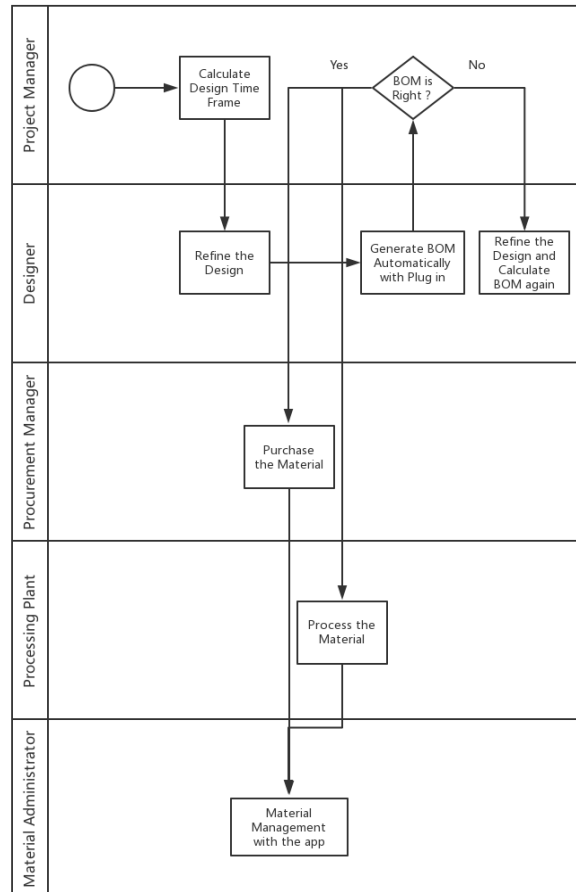


Figure 5:BIM based material management process

5.2 LOD of BIM Models

BIM models can be developed with the progress of a project. In different procurement phases, the model content may be different. The American Institute of Architects (AIA) published Document E202 in 2008 describes 5 levels of development (LOD) and model content requirements (see Table 2). For BIM model to be used for BOM generation in the system, LOD 300 should be respected and the information attached to the BIM model should correspond to a certain format predetermined. Fig 6 and Fig 7 are examples of LOD 300 BIM models.

Table 3: Level of development and model requirements of AIA Document E202-2008

| LOD | MODEL CONTENT REQUIREMENT |
|-----|---|
| 100 | height, volume, location, and orientation may be modeled in three dimensions or represented by other data. |
| 200 | Model Elements are modeled as generalized systems or assemblies with approximate quantities, size, shape, location, and orientation. |
| 300 | Model Elements are modeled as specific assemblies accurate in terms of quantity, size, shape, location and orientation. Non-geometric information may also be attached to Model Elements. |
| 400 | Model Elements are modeled as specific assemblies that are accurate in terms of size, shape, location, quantity and orientation with complete fabrication, assembly and detailing information |
| 500 | Model Elements are modeled as constructed assemblies actual and accurate in terms of size, shape, location, quantity, and orientation. |

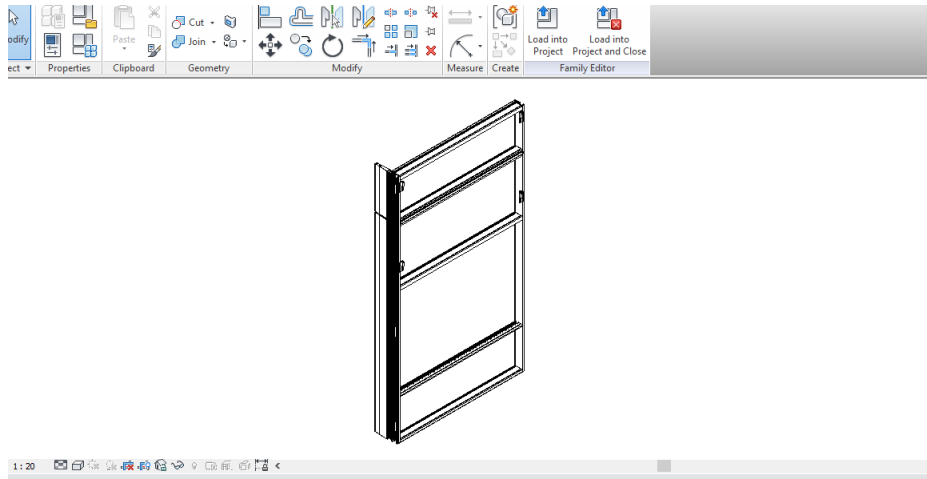


Figure 6: Unitized panel LOD 300 model

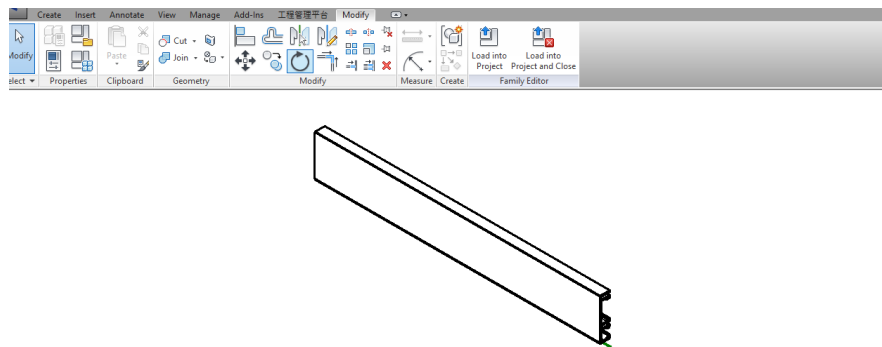


Figure 7: Aluminum frame LOD 300 model

5.3 Curtain Wall Material Classification System

To meet the need for exchanging the information of the BIM models with different partners, the organizing of the system in a systematic way is critical for data management (Howard, 2001). Despite the fact that there has been various classification

systems developed by several countries and institutions over fifty years such as Uniclass in the UK, and OmniClass in North America (Ekholm & Haggstrom, 2011), these systems are not specific enough for material management in curtain wall industry. For the information flow of the system, a classification system for curtain wall material management was developed which consists of four parts: company code, project code, delivery area code and material type code. The material type code is classified according to the typical unitized curtain wall materials: frames, panels, connections and accessories, preembedded pieces. Fig 8 shows an example of a type of aluminum frame described with the classification system.

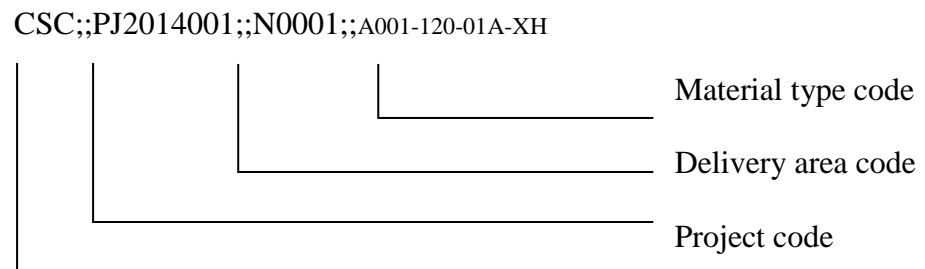


Figure 8: Example of the curtain wall material classification system

6. CONCLUSIONS

This study proposed an innovative approach of automating the material management process for curtain wall industry to improve information management and stimulate collaboration. For this purpose, the author first analyzed the current material management practice in the curtain wall industry and proposed a BIM and barcode based material management system prototype was proposed.

This BIM and barcode based material management system may reduce the time and effort variables related with material management activities as BIM model will serve as a unique repository of all this information used by various agents involved in the material management process, enhancing the integrity and reliability of information used and diminishing the errors due to information operation. This approach requires a deep understanding about how to create the curtain wall BIM models, set up modeling configurations, and how to classify the information included in the models using predefined properties. This is particularly important as information flow across different agents and the effort also requires standard business documents among various agents.

In the next stages of the research process, the author will apply the system in a pilot test and quantify the benefits of the system.

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BIOMECHANICAL TESTING OF ERGONOMIC INTERVENTIONS FOR REBAR TYING

W. Umer, H. Li, G.P. Szeto and A.Y. Wong

Department of Building and Real Estate, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR

Email: waleed.umer@connect.polyu.hk

Abstract: Work-related musculoskeletal disorders (MSDs) are one of the major barriers to achieve occupational safety and health in the construction industry. Despite the omnipresence of MSDs, construction/project managers and policy makers are not well aware of biomechanical and physiological demands of the various construction tasks. By comprehending the demands of these construction tasks, managers can play a vital role by introducing ergonomic interventions. This paper presents the same concept when applied to manual rebar tying. To alleviate risk factors of MSDs in rebar tying, four potential ergonomic interventions are identified to be tested biomechanically. Out of total four interventions, first one is coined by the authors whereas the other three are identified from the literature. An experimental protocol is developed and tested (with authors-coined intervention) on inexperienced rebar workers in a simulated environment and results are reported. The results indicate considerable efficacy against risk factors with authors-coined intervention. In the next phase, the protocol will be tested on actual rebar workers along with testing of other interventions. This could help in the quantitative biomechanical evaluation of ergonomic interventions for manual rebar tying and choosing the best one based on the evidence.

Keywords: biomechanical evaluation, construction ergonomics, ergonomic interventions, occupational safety and health, rebar tying.

1. INTRODUCTION

Among the various occupational safety and health issues in the construction industry, musculoskeletal disorders (MSDs) are one of the most prevalent predicament (Boschman et al. 2012; Inyang et al. 2012). These MSDs affects the construction industry negatively in a number of ways including absenteeism from work, compensation costs, increase in training and recruitment expenditure and delays in the work schedule (Lehtola et al. 2008; Rinder et al. 2008; Inyang et al. 2012). During 2012 in the US construction industry, 33% of all work absenteeism was because of MSDs (BLS 2013). Likewise, in Canada, the proportion of lost time claims because of MSDs was 42% in the year 2008 (ACSA 2009). Similarly, MSDs are a serious threat to occupational health in Germany and UK (Arndt et al. 2005; Stocks et al. 2011).

In order to mitigate the MSDs, it is important to identify the risk factors contributing to MSDs. Among various ergonomic risk factors, repetitive work tasks, forceful movements, prolonged work duration and awkward postures are quite common in the construction industry (Forde and Buchholz 2004; Haslam et al. 2005; Umer et al. 2017). In management perspective, it is often said that if it cannot be measured, it cannot be managed (Cioffi 2006). Previously, the ergonomic techniques utilised to identify the MSDs` risk factors mostly relied on observational techniques (Umer et al. 2017) and did not quantify the risk factors (Marras et al. 2010) which are necessary for appropriate evaluation (Spielholz et al. 2001). Authors`

previous research study presents how various biomechanical and physiological measurements can be used to quantify the potential risk factors of MSDs among rebar workers, which could help in proposing appropriate ergonomic interventions (Umer et al. 2017). This study presents an experimental protocol to evaluate various alternatives which have a potential to alleviate the respective risk factors of MSDs for rebar tying.

2. LITERATURE REVIEW

Four major MSDs risk factors` identification methods which have been used in the construction industry include self-reporting, observational methods, computer vision and direct-sensor based measurement methods. Self-reporting method make use of self-perceived risk factors by the construction workers (Holmstrom et al. 1992; Latza et al. 2000; Ekpenyong and Inyang 2014). Such data is either collected using reporting questionnaires or interviews. Since the results are subjective and qualitative in nature, the underlying biomechanical risk factors may remain hidden in such methods.

Observational methods are used by the experienced observers, who make use of work-sampling technique to record different awkward postures, other risk factors and the respective time proportion by the construction workers during work shifts (Li and Lee 1999; Hajaghazadeh et al. 2012; Lee and Han 2013). The use of such observational methods is non-invasive in nature, does not impede the actual construction work and also does not require specific tools. However, such methods cannot precisely quantify the risk factors and are heavily dependent on the observer`s experience and subjective judgement.

Recently, computer vision based methods to identify the ergonomic risk factors have been quite popular (Han et al. 2013; Han and Lee 2013; Seo et al. 2014). Despite many advantages of such methods such as remote monitoring of the construction workers without hindering their work, there are some limitations too. Such limitations include the need for direct line of sight and appropriate brightness for proper functioning and detection of the postures of the workers (Chen et al. 2014).

In addition to the other methods, direct-sensor based methods have also been deployed for identifying ergonomic risk factors, though their usage had been limited to laboratory studies only. Examples include fusion of physiological monitoring and localization data of the construction workers (Cheng et al. 2013), monitoring of angles of the body-joints (Alwasel et al. 2013) and risk of falling among construction workers using motion sensors attached to them (Jebelli et al. 2012). Although these methods have helped in identifying the risk factors, monitoring of muscle activity and precise body joint movement could enhance the process.

3. BIOMECHANICAL EVALUATION OF MANUAL REBAR TYING

Among various construction trades, rebar workers are much prone to MSDs (Albers and Hudock 2007). To identify possible risk factors of lower back disorders while manual rebar tying, initially a laboratory biomechanical study was conducted (Umer et al. 2017). While simulated rebar tying, muscle activity of the trunk and neck muscles was monitored using wireless surface electromyography and trunk motion was precisely studied using IMU based wireless motion sensors. The study revealed multiple biomechanical risk factors involved in rebar tying in three postures investigated namely squatting, stooping and one-legged

kneeling. The risk factors included: excessive trunk flexion beyond the limit of static work tasks by ISO (ISO11226:2000), sideways bending and axial rotation of the trunk together with end range trunk bending, and static trunk postures. Additionally, stooping posture involved myoelectric silence of lower back muscles which indicated a swap of load transfer from active lower back muscles to passive lower back tissues which itself is a risk factor for lower back disorders (McGill and Kippers 1994).

To counter the risk factors, ergonomic interventions could offer potential mitigation. However, before onsite field testing and deployment of an ergonomic intervention, a prior biomechanical laboratory evaluation is imperative. Such an evaluation could provide objective data for evaluation of the intervention. Nevertheless, subjective feedback of the workers who will eventually use the intervention is still an important factor in the successful deployment of an ergonomic intervention (Choudhry and Fang 2008). The current research is focused on the first step of evaluation of ergonomic intervention i.e. biomechanical testing of the intervention.

To identify potential ergonomic interventions for manual rebar tying, the authors searched the literature and conducted a few brainstorming sessions. Three potential ergonomic interventions were identified from the literature namely Bending Non-Demand Return (Ulrey and Fathallah 2013), Happyback (ErgoAg Company, CA) and Personal Lift Assist Device (PLAD) (Lotz et al. 2009). In addition to these relatively complex interventions, the authors came up with a low-cost solution of attaching a low-sitting stool to the trousers of the rebar workers. This could enable the workers to do rebar tying while sitting instead of squatting or stooping postures. Figure 1 illustrates the ergonomic interventions for rebar workers.



(a) Authors' idea (b)BNDR (Ulrey and Fathallah 2013) (c) HappyBack (Fathallah et al. 2004) (d) PLAD (Graham 2008)

Figure 1: Potential interventions for the rebar workers

4. METHODOLOGY

The experimental procedure will require each rebar worker to undergo the testing protocol for four days, each day for one intervention. The protocol is intended to be the same for each intervention. On the experiment day, the rebar worker will first perform reference isometric contractions followed by 30 minutes of rebar tying with or without the intervention (randomized). While performing the simulated rebar tying, sEMG (surface electromyography) will be used to monitor muscle activity and post-task neuromuscular fatigue, IMU based motion sensors will be used to monitor trunk kinematics, whereas an oximeter will be utilised to monitor blood circulation in the lower extremity of a rebar worker. Afterwards, the participants will immediately perform reference isometric

contractions as performed before rebar tying. Then, a rest of 30 minutes will be provided and the same procedure will be repeated with the untested rebar tying method (with or without an intervention). This procedure will be followed so that a rebar worker completes 4-day testing protocol within a single week.

Rebar tying will be performed on a laboratory simulation setup of 1.2m by 1.2m plastic pipes separated by 0.2m c/c (Umer et al. 2017), as depicted in Figure 2. The rebar workers will use pigtail tool and spool wires for rebar tying.



Figure 2: Laboratory rebar tying setup

4.1 sEMG Measurement

A 16-channel wireless bipolar surface electromyography system (TeleMyo, Noraxon) will be used to monitor muscle activity of the lower back, quadriceps and calf muscles. Lower back muscles will include multifidus and lumbar erector spinae, quadricep muscles will include rectus femoris whereas gastrocnemius lateralis and medialis will be monitored as calf muscles.

Post-task neuromuscular fatigue of the aforementioned muscles will be assessed by comparing the median frequency of the sEMG signals during the reference isometric contractions performed before and just after rebar tying. The decrease in median frequency is considered as an objective indication of neuromuscular fatigue (Potvin and Norman 1993). Reference isometric contractions for each muscle will be consisting of three 5-second contractions separated by five seconds. Firstly, contractions will be performed for the lower back muscles as standardized by Coorevits et al (2008). Then quadricep specific contractions will be performed as suggested by Pincivero et al (2000) followed by contractions of calf muscles as recommended by Kasahara et al (2007).

4.2 Trunk Kinematics

For quantification of precise trunk flexion angles, movement of the upper back and lower back will be tracked by placing three IMU based wireless motion sensors (MyoMotion, Noraxon) placed at spinal levels of T4, T12, and S1. The data will be captured throughout the rebar tying task at the frequency of 100Hz. Erect standing posture prior to rebar tying will be calibrated as zero-degree flexion whereas subsequent forward bending will be considered as positive flexion.

4.3 Blood Circulation in the Lower Extremity

A sports-grade oximeter will be utilised to measure blood oxygen saturation levels (SpO₂) as a measure of blood circulation. The oximeter will be placed on the toes of the participant and data will be collected continuously during the rebar tying.

4.4 Data Processing

Surface electromyography data will be band passed through a filter of 20-500Hz followed by removal of noise associated with 50Hz frequency. Data captured during rebar tying will be normalized to pre-rebar tying reference isometric contractions to make the comparison. Amplitude probability distribution function (APDF) will be used to compare average sEMG activation of the respective muscles at 50% APDF (Xie et al. 2016). Motion sensors data will be filtered using Kalman filters and comparison will be made for 50%APDF of flexion angles. Lastly for the blood circulation in the lower extremity, 50% and 90% APDF levels of the blood oxygen saturation levels will be used to compare the effect of the interventions as compared to rebar tying without ergonomic intervention.

5. INITIAL RESULTS

Based on aforesaid methodology, few pilot tests (involving five inexperienced rebar workers) were performed using the low-sitting stool as an intervention. Five participants performed rebar tying initially for a duration of 12.5 minutes with and without a low-sitting stool to make sure that the methodology is working and to foresee any potential issues in it. Figure 3 illustrates the average muscle activity in the various muscles (right side muscles only).

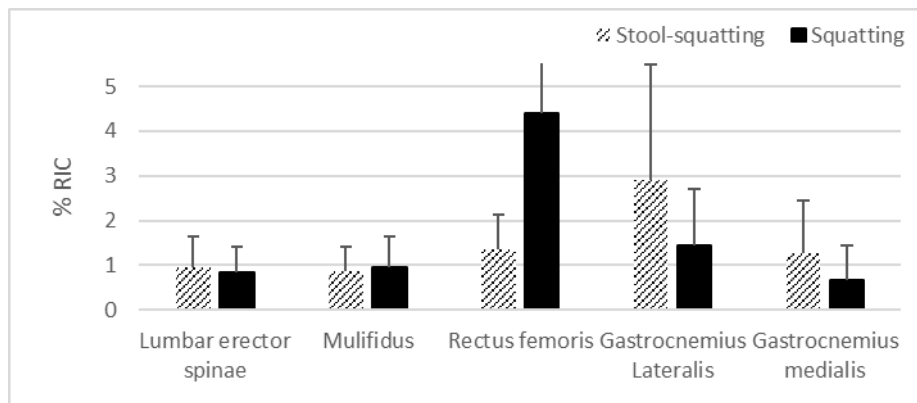


Figure 3: Average (50%APDF) muscle activity during rebar tying

RIC = reference isometric contraction, APDF = amplitude probability distribution function

Figure 4 illustrated the neuromuscular fatigue analysis of the muscles after the rebar tying task (right side muscles only).

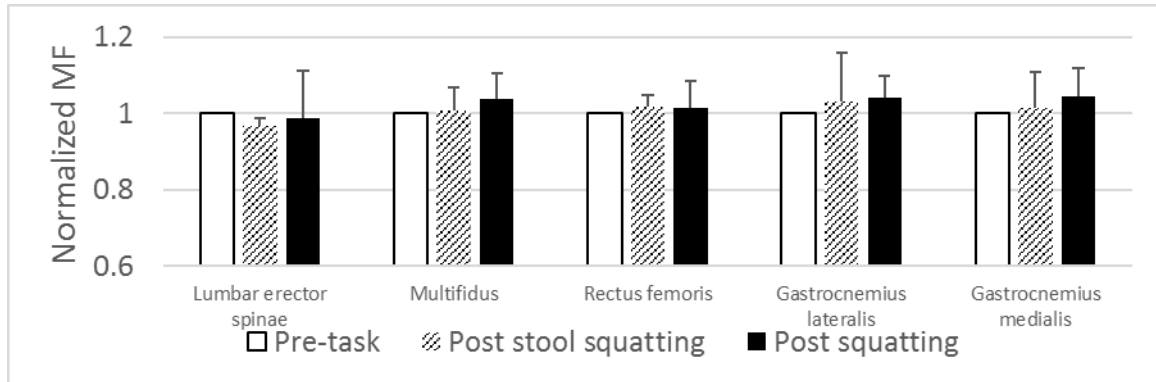


Figure 4: Muscle fatigue analysis using median frequency of sEMG during RICs
 RIC = reference isometric contraction, MF = median frequency

Figure 5 depicts the variation in trunk angles in two different rebar tying technique i.e. with stool and without the stool.

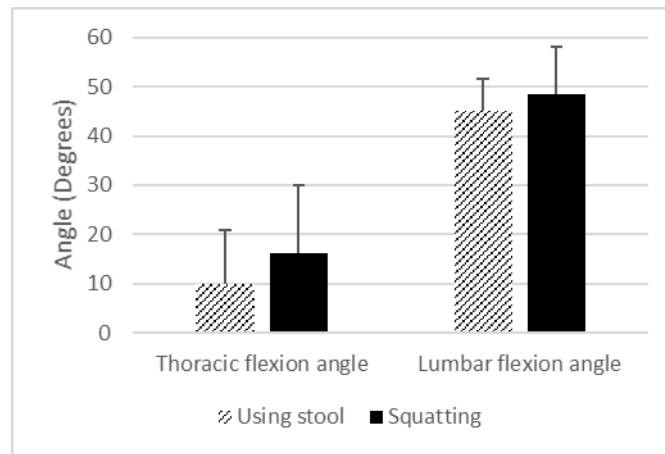


Figure 5: Trunk flexion angles during rebar tying

Figure 6 shows the variation in SpO₂ levels between the two rebar tying techniques.

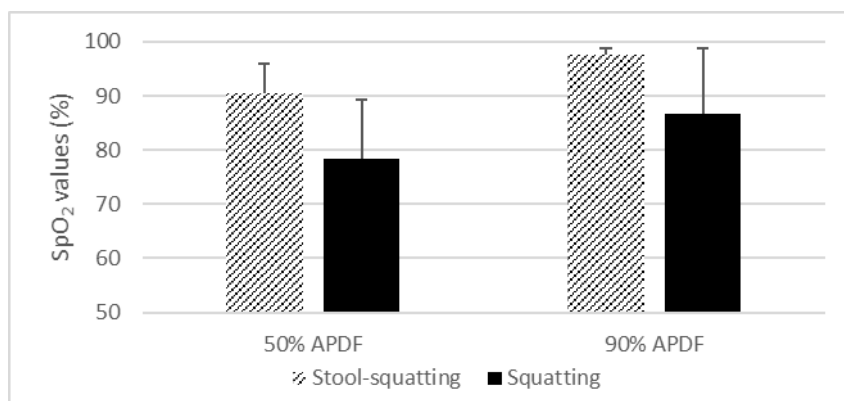


Figure 6: SpO₂ levels during rebar tying
 APDF = amplitude probability distribution function

6. DISCUSSION

The initial experiments have revealed that the methodology is viable to biomechanically evaluate various interventions among rebar workers. Because of the small sample size involved in the initial experiments, any statistical test is not conducted. It is hoped that with an increased sample size in actual experimentations, statistical differentiation among various parameters will be there for distinct interventions. Nevertheless, some trends can be still seen in these initial experiments.

Muscle activity for various muscles has been noticed to be of lower magnitude i.e. less than 5% of reference isometric contraction during rebar tying with or without low-sitting stool. This indicates that while squatting or stool-squatting does not require a large activity by the respective muscles. This notion is also supported by median frequency analysis which reveals no substantial decrease i.e. absence of neuromuscular fatigue post rebar tying. However, the use of stool seems to be beneficial in decreasing the flexion angles for both upper and lower back. Similarly, stool-sitting rebar tying has shown to be enhancing the blood circulation in the lower extremity as compared to rebar tying in squatting posture.

Although subjective measurements of perceived discomfort/pain were not measured in the pilot tests, the participants reported severe discomfort after rebar tying in squatting posture. This could be related to blood circulation in the lower extremity. It is known that poor circulation is linked to poor muscle oxygenation which in return could cause muscle fatigue and pain. Conversely, stool-squatting enhanced the blood circulation and the participants did not complain of any discomfort. This suggests including measurement of perceived discomfort scores too in such evaluation of ergonomic testing. Overall, stool-squatting seems to be helpful in relieving the postural loads and seems to be a better alternative to rebar tying in squatting posture.

7. CONCLUSIONS

MSDs are extensively prevalent in the construction industry. To alleviate the problem, there is a need for a systematic approach to cater these issues. Biomechanical evaluations and subsequent effective ergonomic interventions could potentially help in mitigating the wide prevalence of MSDs in the construction industry. Based on the identical strategy, the authors have previously biomechanically evaluated the risk factors of MSDs in the manual rebar tying. Now a framework is presented, showcasing the probable ergonomic interventions that could minimize or eliminate the risk factors of MSDs and a biomechanical scheme to evaluate these interventions. The initial results have shown that scheme is workable. Future experiments with a larger pool of actual rebar workers and involving all identified interventions would better highlight statistical-biomechanical advantages and disadvantages of various proposed interventions.

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BUILDING INFORMATION MODELLING (BIM) EDUCATIONAL FRAMEWORK FOR THE QUANTITY SURVEYING STUDENTS: SRI LANKAN PERSPECTIVE

A. Rathnayake, U. Kulatunga and P. Coates

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: prasadini88salford@gmail.com

Abstract: Building Information Modelling (BIM) still not implemented within the Sri Lankan construction industry. Hence recent years the wave of BIM has been hitting the shores of the Sri Lankan construction industry. Nevertheless, the Conventional practice of quantity surveyors (QS) undermines the effectiveness and efficiency of quantity surveying profession. The QS profession adheres to the 5th dimension of BIM, which invariably translates to the context of costing, offering the capability to generate quantity take-off, counts, and measurement directly from a model. BIM digitalized data lead to accurate automated estimation which reduces variability in cost estimation. However, several barriers hinder the usage and acceptance of BIM into QS practice. From the academic point of view, requirements to meet this paradigm shift to BIM requires an enhancement to the existing set of skills and knowledge available in Sri Lankan institutions of higher learning. Nevertheless, most of the BIM adopted countries adopted BIM through nationally developed strategies and frameworks. This paper describes the educational framework, to integrate BIM with quantity surveying education with a prime focus on the QS scope of work. The primary aim of the framework lies in integrating BIM with quantity surveying higher education by equipping QS graduates with the necessary BIM skills in project delivery.

Keywords: Building Information Modelling, Education, Framework, Quantity Surveying, Sri Lanka.

1.0 INTRODUCTION

It is important to complete a construction project within predetermined parameters of time, cost and quality for a successful outcome. Cost is one of the critical success factor and prominent parameter among time, cost and quality. Therefore, managing construction cost within client's budget is one of the challenging roles in construction project life cycle (Azar et al 2008). Quantity Surveyor (QS) is an expert in the art of costing a building at all its stages who offer expert advice on construction costs (Kulasekara, Jayasena, & Ranadewa, 2013). Table (1) highlights the areas of QS involvement during the construction lifecycle of a project both pre-and-post construction.

Table 1: Stages of QS involvement in construction (Olatunji et al., 2010; Fung et al., 2014)

| Pre-Construction Stage | Post-Construction Stage |
|---|--------------------------------|
| Preliminary estimates and feasibility studies | General contractual advice |
| Cost plans and schedules | Assessing interim payments |
| Bills of quantities preparation | Evaluating variation |
| Procurement and tendering procedures | Preparing finance statements |
| Evaluation of tenders | Settling final account |
| | Alternative dispute resolution |

However, it is noticeable in Sri Lankan Quantity Surveyors still following the old-fashioned practice which involves dull and time-consuming wastages (Kulasekara et al; 2013, De Silva

et al; 2014, Amaratunga et al; 2006, Dissanayake et al; 2015). Even though there are developed technologies available to make life easier, Quantity Surveyors still using Excel spreadsheets, 2D CAD and departmental silos (Ingram, 2015). According to the result of a recent survey conducted by the (Abeywardhana, 2016), Microsoft Excel, AutoCAD, Autodesk quantity takes off, build soft takeoff 2 are the most popular software tools among Sri Lankan quantity surveyors. Adoption of traditional methods prone to human errors, wastages, and less efficient work. Therefore, there's a need of adopting modern technology into Sri Lankan quantity surveying firms to eliminate these fundamental challenges from the construction process.

According to Farida and Iman (2001), Abdullah and Haroon (2006), Ching and Sia (2013),

- Building information modeling
- CAD
- Master Bill
- BUildsoft global estimating system
- RIPAC estimating system
- Quality service management system (QSM) and
- CATO

are the specialized software for quantity surveying practice.

Even though CAD is the most popular and widely used tools to address issues in on-site or off-site, according to EIU (2015), BIM has identified as true industry game changer. "BIM has brought huge benefits to the construction industry, being able to visualize things from a 2D drawing in three dimensions gives us the ability to avoid design conflicts before construction even starts" (Halvorson, 2015). Nevertheless, BIM is relatively a new "BUZZWORD" for the Sri Lankan construction industry (Jayasena and Weddikkara 2012). Hence, BIM is more likely to become an industry standard for project design and also a fundamental tool in project procurement in near future (Jayasena et al 202, 2013). However, BIM currently not practicing among the Sri Lankan quantity surveyors.

Therefore, a systematic approach is required to identify the key components that require for implementing BIM (Jayasena et al, 2013). **Education** is one of the **key requirement** to adopt BIM into Sri Lankan context. There is a great opportunity for educators to train quantity surveying undergraduates, in the use of BIM and the concepts of quantity surveying, before they learn about the "old ways" of working in the industry. These new QS graduates are likely to have a profound effect on the industry and to lead the charge in adopting BIM and developing innovative approaches to working practices (Macdonald & Mills, 2011). Nevertheless, Sri Lankan higher education still fails to integrate BIM with the existing quantity surveying curriculum. However, most of the developed countries have adopted BIM through nationally developed strategies and frameworks (Rogers et al, 2015).

These frameworks may not be readily adaptable for the Sri Lankan context due to considerable levels of industry and technological maturities. Jayasena et al, (2013) also, emphasized that a proper technological framework for BIM adoption will be a key requirement. Therefore, **the aim** of this paper is to develop a **BIM adoption educational framework** to integrate BIM with existing quantity surveying education curriculum for the Sri Lankan quantity surveying students. The structure of the paper are as follows,

- Conventional QS practice
- BIM Competencies for Quantity Surveyors
- Challenges to implementing BIM in Sri Lankan context

- Existing frameworks in BIM education
- Methodology and Data Analysis
- Framework and discussion

1.1 Conventional Quantity Surveying practice

Most of the project information comes in the form of 2D drawings prepared by architects (Kelleher, 2016). These drawings consist of objects created with lines, arcs, and circles which define it's all set of properties such as length, width, material, weight (Jayasena et al, 2013). Even though these lines, arcs, and circles are sources of information they are not linked with the object for which they display information for. Also, changing the properties (lines, arcs, and circles) of the object requires and information updating accompanying it. Notwithstanding this results risk of double checking and updating of the same object represented on several different elevations such as plans, sections, and elevations (Crotty, 2012). Repeated information and missing elements in incomplete design drawings result in misinterpretation (Crotty, 2012).

Quantity surveyor's role based on these 2D drawings mainly in taking off quantities and preparation of BOQ. The accuracy of the work depends on complete drawings with good quality information provided by the design team (Pittard & sell, 2016). Hence, most of the drawings come with multiple errors as mentioned above. It will undermine the accuracy of the quantity surveyor's role by creating following factors,

- Errors associated with moving data between files
- Risk of double counting
- Risk of missing elements
- Multiple 2D drawings themselves are likely to contain many errors compounding the problem further.

Incomplete drawings increase the complexity of the drawing causes quantity surveyor's role to become inefficient and timely process (Crotty, 2012). Most of the problems occur when documents passed between different members of the project team. Misinterpretation, misalignments, and assumptions all result in an inaccurate and inefficient process, which undermines the accuracy of quantity surveyor's role (Crotty, 2012). Eastman, et al., (2011) also notes the cost and delays that are associated with a paper transaction within the Quantity surveying process. However, Dada & Jagboro, (2012), stated that "Quantity Surveying profession is constantly confronted with challenges and opportunities in new markets" due to increased demand for modern technological concepts and rapid changing construction environment. With that, in most of the countries quantity surveying profession going through a transforming period (Carlidge, 2006).

1.2 BIM Competencies for Quantity Surveyors

Building information modelling (BIM) is capable of handling and providing better solutions for most of the challenges in the construction world. "Building Information Modelling (BIM) is a digital representation of physical and functional characteristics of a building creating a shared knowledge resource for information about it forming a reliable basis for decisions during its life cycle, from earliest conception to demolition" (Snook, 2011). As an emerging enabling technology, Building Information Modelling (BIM), is widely promoted in the UK, USA, Ireland, Canada (Zhou et al, 2012). For Quantity Surveyors BIM provides many advantages into their daily business on following areas (RICS (2011).

1.1.1 Preliminary cost estimates

Traditional QS's practice at this stage prone to errors as well as being time-consuming due to complexities in 2D drawings (Jayasena et al, 2013). BIM models offer accurate cost estimates by enabling more accurate quantity to take off at an early stage of the design process (Boom, 2009). Moreover, BIM assists QS's through various tasks like cost effects of additions and modifications to avoid cost and time overruns (Zhou et al 2012). Compensation can increase by reducing the time for detail estimate if BIM model shared with the contractor (Colleen, 2009).

1.2.2 5D Cost planning

Cost planning provides a basis for cost control (Hua, 2010), by predicting contract sum by providing cost targets to different parts of the building. This ensures that the client receives expected project outcomes from inception to execution of the project (Brandtman, 2013). Nevertheless, BIM provides facilities for QS to do cost plan automatically through the building elements rather doing it manually.

1.2.3 Cost Estimating

Whatmore (2012), highlighted "one of the key benefits of BIM is that it allows our Quantity surveyors to focus more on other value-adding services for their projects-rather than spending up to 80% of their time measuring quantities". Unlike 2D drawings, BIM models integrated with cost information from an estimation database which reduces the errors and omissions (Jayasena et al, 2013). Therefore, it can reduce the time for quantity take off by allocating more time to other activities such as assemblies, generating pricing and factoring risks (Autodesk, 2013). However, BIM models can provide alternative cost information to the client throughout the project lifecycle. In terms of life cycle costing BIM offers an opportunity for QS's to provide further data to the client (Saint, 2012).

1.2.4 Preparing Bills of Quantities

4D modelling capabilities of BIM is now liable for executing most of the traditional QSs functions automatically (Jayasena et al, 2013). It allows computerizing the measurements of quantities from construction drawings. This provides QS to have quantities and specified materials in electronic format. BOQ can be generated automatically with the utilization of correctly configured BIM models (BIM outsourcing, 2013).

Apart from above-mentioned points, BIM provides high-quality information at the bidding stage to by enabling more accurate bids (AIA, 2008 & Graham, 2010). 3D BIM enables accuracy and transparent cost control with quality information management throughout the project lifecycle (Green, 2008). Therefore, following reasons evaluated the importance of adopting BIM into the QS profession,

- 30% of projects do not meet original program or budget
- 92% of clients said that designer's drawings are typically not sufficient for construction
- 37% of materials used in construction become waste
- 10% of the cost of a project is typically due to change orders
- 38% of carbon emissions are from buildings not cars (Thomas, 2010).

Moreover, BIM is considered as highly significant to the future development of construction information technologies and to the construction industry (Azhar and Brown, 2009). Therefore, BIM-based project delivery will be highly benefitted for the future of Quantity Surveyors.

1.3 Challenges to implementing BIM in Sri Lankan context

BIM is relatively a new buzzword, for the Sri Lankan construction industry (Weddikara). According to a recent study conducted by Nagalingam, Jayasena and Ranadewa (2013) have found that the BIM still not adopted into Sri Lankan Quantity surveying industry. Several barriers undermine the adoption of BIM into QS practice described in the literature. Eastman et al (2011) posited that the barriers to BIM adoption fall into two categories: process barriers to the business including legal and organizational issues that prevent the adoption; and technology barriers related to readiness and implementation. A recent survey conducted UK reported the lack of education and training is one of the primary barriers to adopting BIM into quantity surveying firms (Abubakar et al). Similarly, another survey by RICS (2011) revealed the following as the potential barriers to BIM adoption amongst quantity surveyors, lack of clients demand for BIM in their projects, lack of standards to guide implementation, lack of government lead/direction, lack of IT infrastructure, lack of new or amended conditions of contract; and lack of **education and training (BCIS, 2011)**.

To implement BIM among Sri Lankan quantity surveyors skilled graduates required for the employment. The McGraw-Hill report (2009) opined that BIM inclusion into education pedagogy is crucial in preparing skilled graduates for employment in the industry. However, due to absence of BIM in Sri Lankan education curriculum, inadequate time and resource deployment to develop curriculum, lack of available BIM reference materials, inadequate skills on software, reluctance by students and faculty on the need to transform in line with advancement in technology-based curriculum (Sabongi and Arch, 2009; Clevenger et al. 2010; Enegbuma et al., 2010; Sylvester and Dietrich, 2010) and limited occurrence of research into BIM potentials in the QS profession (Mitchell, 2012; Perera et al., 2011; Fung et al., 2014) have undermine the use of BIM within the industry.

1.4 Existing frameworks in BIM education

An established BIM education framework will guide to incorporate BIM into AEC industry (Macdonald and Mills, 2011). Moreover, IMAC BIM education framework developed by Macdonald in 2012, help teachers to alter their existing education curriculum to improve BIM education among AEC students (Macdonald 2012). The framework consists of four stages such as Illustration, Manipulation, Application and Collaboration. As proposed by Bloom et al. (1956), all the stages merged with three different taxonomy such as cognitive, affective and psychomotor and Krathwohl et al. (1964), which extended the classification to include

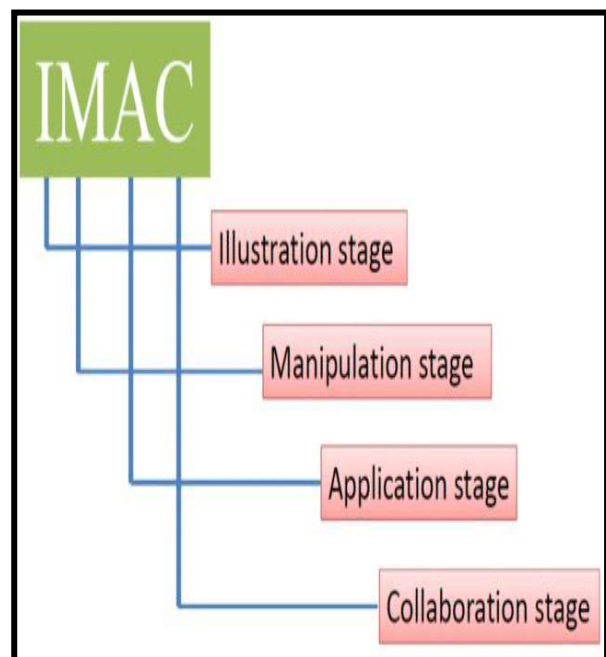


Figure 14: IMAC BIM Education Framework Australia (Macdonald, 2012)

changes in interest, attitude, and values. The full IMAC education model is illustrated in figure 1.

BIM Academic Forum (BAF) the UK, have also published BIM learning outcome framework (HEA, 2013), by highlighting desired to learn outcomes on BIM; industry to push for student employability with BIM competence; framework for learning and; the need to keep pace with the development of BIM (Ali et al 2016). The learning outcomes of the framework being established considering the need to improve the skills of staffs to support the delivery of the desired learning outcomes on BIM; industry to push for student employability with BIM competence; a framework for learning and; the need to keep pace with the development of BIM. The learning outcomes of the following framework are divided as follows,

- level 4 (year one of undergraduate study) - Where students will be introduced to context and background of the industry professions and how collaboration within the BIM technology works
- Level 5 (year 2 of undergraduate study) - entails developing the knowledge and understanding of BIM as a business driver for collaborative works which affects the whole life cycle cost of projects.
- Level 6 (year 3 and potentially after a year out in industry) - focuses on building competence and knowledge around people, systems, and process (HEA, 2013).

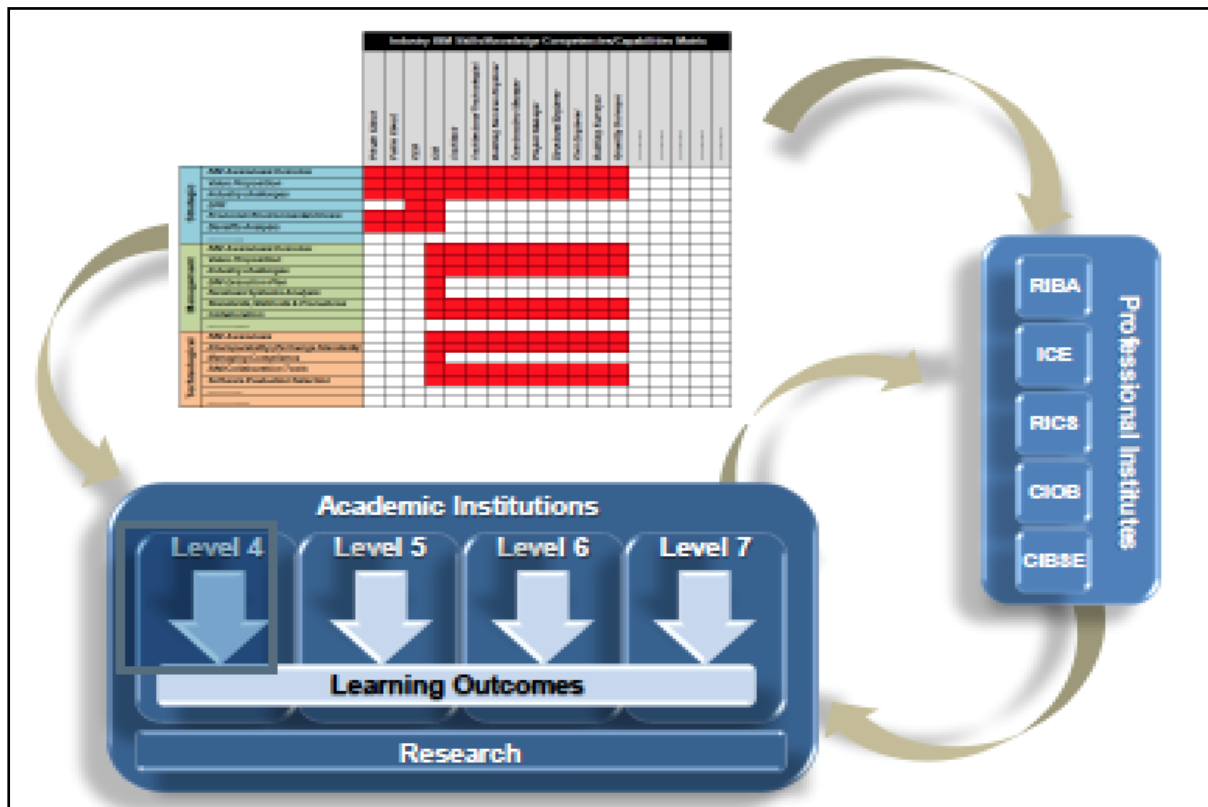


Figure 15: Initial UK BIM Learning Outcome Framework (HEA, 2013)

Colorado State University (CSU) deployed BIM framework into two stages such as introductory BIM software course and integrating BIM with stand-alone modules like sustainable

design and construction, pre-construction, cost estimating, scheduling, contracts, and material and methods (Ali et al, 2016). The framework illustrates the need for teaching BIM with fundamental construction concepts for its best-practice. BIM implementation can be done into following three processes such as single course module (Hu, 2007; Nielsen et al., 2009), interdisciplinary (Hedges et al., 2008; Plume and Mitchell, 2007) and distance collaboration (Hedges et al., 2008; Dilg, 2008), (Barison and Santos, 2010a).

2.0 METHODOLOGY

The findings of this paper were represented through the process of critical literature review and a questionnaire. The first step of the study involved the gathering of more insight into educational research and framework across the globe. An extensive literature review was carried out to derive the objectives, medium, and learning outcome to be adopted in the BIM education framework for quantity surveying students (Creswell, 2012). The second step was conducted to gather required data to established framework. Findings were collected through a questionnaire survey among 25 participants. This number consists of quantity surveyors and academic professionals. Construction professionals consist with trainee quantity surveyors and professional quantity surveyors who are having more that 10 years of industry experiences in quantity surveying profession. Most of the respondents were registered members of the IQSSL (Institute of quantity surveyors' Sri Lanka).

The questionnaire was designed into 5 stages namely

1. To identify the level of academic qualifications of construction professionals
2. To identify the fundamental deficiencies in Sri Lankan quantity surveying practice
3. Capabilities of BIM
4. Barriers to implementing BIM
5. How to integrate BIM into current Sri Lankan education curriculum

To identify and ascertain the factors which can make a significant impact on the current QS practice, Relative Importance Index (RII) was employed. (MS Excel was used to analyse the quantitative data collected in this study).

The following formula was used for the calculation of the Relative Importance Index (RII),

$$RII = \frac{\sum (0 \leq RII \leq 1)}{A * N}$$

$$A * N$$

Formulae 01: RII formulae

W - Weighting is given to each statement by the respondents and ranges from 1 to 5.

A - Highest response integer (5).

N - Total number of respondents.

The sample population for the questionnaire survey was selected to cover overall quantity surveying practitioners in various sectors such as trainee QSs, lectures, senior QSs and chartered QSs in Sri Lanka.

3.0 DATA ANALYSIS AND RESULTS

According to the collected data 55% of assistant quantity surveyors, 4% of chartered quantity surveyors, 15% of senior quantity surveyors, 20% of trainee quantity surveyors and 6% of academic professionals were involved for the questionnaire surveyor of this study. Out of them, the majority of the respondents have obtained a Higher National Diploma (HND) which is 42% as their academic qualifications. Apart from that 2% obtained MSc, 30% were BSc and 26% of them were diploma holders. This result reveals that the diploma and BSc level is the most fundamental education level for Sri Lankan quantity surveyors.

Table 2: Significant issues in conventional QS practice

| Factors | 1 | 2 | 3 | 4 | 5 | 6 | 7 | W | RII | Rank |
|----------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|------------|-------------|
| Measurements | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 56 | 1.000 | 1 |
| Draughtsmanship | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 54 | 0.964 | 2 |
| Cost planning | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 53 | 0.946 | 3 |
| Estimation | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 52 | 0.929 | 4 |
| Poor communication and conflicts | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 51 | 0.771 | 5 |

As shown in Table (2) the questionnaire survey demonstrated that the “Measurements” is the most significant issue that has been faced by the Sri Lankan construction sector due to deficiencies of the conventional methods being used in the current Sri Lankan Quantity surveying practice. Apart from that, it is being identified that traditional practice of Draughtsmanship, Cost Planning, Estimation and Poor communication and conflicts are also undermining the accuracy of quantity surveying profession. Hence, "Poor communication and conflicts" was considered as an insignificant issue, because its RII value ranked below the average of RII value ($RII \geq 0.922$). Even though the literature review this study anticipated that the most of Sri Lankan QSs were not aware of BIM; the majority of respondents (64%) stated that they were aware of BIM and its potentials and the percentage of respondents who do not aware about BIM can be identified as 36%. Results demonstrate that most of the present QSs are aware of BIM and its potentials than past years.

Table 3: Barriers to implementing BIM

| FACTORS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | W | RII | Rank |
|--|----------|----------|----------|----------|----------|----------|----------|----------|------------|-------------|
| Unawareness of benefits that the adoption of BIM can bring to the organization | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 54 | 0.964 | 1 |
| High costs of software/hardware upgrades | 0 | 0 | 0 | 0 | 0 | 3 | 5 | 53 | 0.946 | 2 |

| | | | | | | | | | | |
|---------------------------------------|---|---|---|---|---|---|---|----|-------|---|
| Lack of experience and knowledge | 0 | 0 | 0 | 0 | 1 | 2 | 5 | 52 | 0.929 | 3 |
| High cost for training existing staff | 0 | 0 | 0 | 0 | 0 | 5 | 3 | 51 | 0.911 | 4 |
| Lack of client demand | 0 | 0 | 0 | 0 | 1 | 4 | 3 | 50 | 0.893 | 5 |
| Lack of BIM specialists in the region | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 47 | 0.839 | 6 |

According to the results shown in Table (3) High cost for training to existing staff, Lack of BIM specialists in the region, Unawareness of benefits that the adoption of BIM can bring to the organization, Lack of experience and knowledge and Lack of client demand are the significant identified barriers for the adoption of BIM applications to the Quantity surveying practice in Sri Lanka.

Table 4: Solutions to Overcome BIM implementation within the education sector

| Factors | 1 | 2 | 3 | 4 | 5 | 6 | 7 | W | RII | Rank |
|---|----------|----------|----------|----------|----------|----------|----------|----------|------------|-------------|
| Conducting Seminars, workshops and short courses | 0 | 0 | 0 | 0 | 0 | 2 | 6 | 54 | 0.964 | 1 |
| BIM is required to be added as a mandatory module to the Quantity Surveying Education | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 52 | 0.929 | 2 |
| Recognize the benefits and importance of using BIM | 0 | 0 | 0 | | 1 | 3 | 4 | 51 | 0.911 | 3 |

According to the results shown in Table (4) majority of the interviewees highlighted that the "Conducting seminars, workshops and short courses" as the most significant strategy required to be undertaken in order to promote the adoption of BIM applications. In addition, "BIM is required to be added as a mandatory module to the Quantity Surveying Education" and "Recognize the benefits and importance of using BIM" were ranked by them for the second and third places with RII of 0.929 and 0.911 respectively.

4.0 FRAMEWORK AND DISCUSSION

The FW were developed based on the findings of the literature review and the questionnaire surveyor conducted among the Sri Lankan quantity surveyors and the professionals related to education. The analysis of BIM education framework leads to the divisions of quantity surveying into four objectives namely Draughtsmanship, Cost planning, Measurements, and Estimating. These stages were decided based on the responses received for the questionnaire survey mentioned above. The results of the questionnaire survey demonstrated that the most common education level is degree and diploma among Sri Lankan quantity surveyors, therefore this framework **limited** to the Sri Lankan undergraduate quantity surveying students. Hence, the framework does not dictate in which academic year each stage should be introduced. Students from the different education disciplines study courses of varying lengths and some skills are introduced earlier in some courses than others. For example, diploma could be finished within two years whereas degree gets four years of time.

In order to achieve in-depth knowledge about BIM models, Draughtsman courses will be further enhanced to include awareness of BIM, use of BIM software as a basic tool for design 3D models and digital databases. The developed framework is outlined in the table (5). Cost planning principles will be integrated with 4D costs and scheduling and the use of appropriate

BIM software for cost planning will improve the level of quantity surveying students understanding of BIM for effective cost planning. Measurements will be integrated with 4D and 5D BIM applications, Quantity takes off and spreadsheet software and Computerize measurements.

Table 5: Developed framework to incorporate BIM with quantity surveying education

| OBJECT | OUTCOME | Target Disciplines | | | |
|------------------------|---|--------------------|--------------|-------------|---------------|
| | | Illustration | Manipulation | Application | Collaboration |
| Draughtsmanship | BIM awareness | | | | |
| | 2D design | | | | |
| | Basic 3D models | | | | |
| | Digital databases | | | | |
| Cost planning | BIM awareness | | | | |
| | Fundamental principles of cost planning | | | | |
| | 4D cost and scheduling | | | | |
| | Integration of 4D with appropriate software | | | | |
| | Application of appropriate software | | | | |
| Measurements | BIM awareness | | | | |
| | Quantity take off and spread sheet software | | | | |
| | Integration of 4D and 5D | | | | |
| | Computerize measurements | | | | |
| Estimating | BIM awareness | | | | |
| | Quantity extraction from 3D models | | | | |
| | 5D lifecycle costing analysis | | | | |
| | BOQ preparation with 3D views | | | | |

To overcome deficiencies in traditional methods of measurements the framework considered the need to upgrade quantity surveying student's skills in Microsoft Excel from the basic knowledge to a more advanced use of the software. The task of quantification and automatic take-off from BIM models is improved through upgrading the skills through BIM interoperable software. Also by computerizing measurements will limit the use of paper works which is prone to errors. Estimating will be integrated with Quantity extraction from 3D models, 5D lifecycle costing analysis and BOQ preparation with 3D views.

Apart from adding BIM as a mandatory module to the quantity surveying education curriculum, conducting seminars, workshops and short courses were also major suggestions by the respondents. Therefore, considering the results of the questionnaire survey to provide

suitable delivery methods to achieve deeper levels of learning as students' progress through their education four target disciplines were added to the developed framework.

4.1 Illustration Stage (Knowledge/Comprehension and Receiving/Responding) -

This is an introductory stage. Building Information Models are used to illustrate key concepts to students and students will typically be taught in their separate disciplines at this stage. For example, how BIM enhance to improve Draughtsmanship.

4.2 Manipulation Stage (Comprehension/Application and Responding/Valuing)

At this stage, students start to interact with and manipulate existing models themselves. They will be required to make simple changes and/or create basic elements within the models in relation to their disciplines.

4.3 Application Stage (Application/Analysis and Valuing/Organising)

At this stage, students have acquired basic theoretical knowledge in their disciplines and are starting to apply this knowledge to solve discipline-related problems. For example, to develop cost plans using 4D BIM.

4.4 Collaboration Stage (Synthesis/Evaluation and Characterising)

At this stage students required to have proper training for the taught modules so far. This will provide students to deal with real-life situations such as Quantity extraction from 3D models in a live project. This will also improve the group and team work.

However, as shown in framework depending on the learning outcome appropriate target discipline will be varied.

5.0 CONCLUSIONS

This paper developed a framework to incorporate BIM with Sri Lankan quantity surveying education curricula with the necessary knowledge and practical skills to mitigate identified deficiencies in conventional quantity surveying practice via literature review and questionnaire survey. Also, this framework will aid to meet the industry demand for BIM competent graduates. The framework compromised with four objects of Draughtsmanship, Cost planning, Measurements and Estimating. These objects were linked with various learning outcomes. The framework further demonstrates the suitable delivery methods via four target disciplines of illustration, manipulation, application and collaboration. The framework emphasized the importance of integrating BIM with quantity surveying degree programs and delivery methods for suggested modules. Nevertheless, the success of the framework depends upon the commitment and willingness to overcome the resistance to change by higher education institution both private and public sector. The framework also recommended an increase in the awareness of BIM in institutions of higher learning, an organization of BIM design competitions and initiating BIM software proficiency training in line with quantity surveying. Future research could be directed towards curriculum

development, assessing perception of students and lecturers and extension of a framework for higher graduate courses.

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A BIM MATURITY-KPI ASSESSMENT: LITERATURE REVIEW

A. Aboumoemen, and J. Underwood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: A.A.Aboumoemen@edu.salford.ac.uk

Abstract: Building Information Modelling (BIM) maturity was addressed as a measurement process and set of progressions on capabilities and performance in relation to BIM implementation. Key Performance Indicators (KPI) presents a set of improvement targets that aims to deliver overall improvements within the UK construction industry. Literature on combined approach (BIM and KPIs) existed that addressed possible links of BIM implementation on primarily used KPIs across construction projects through assessing project performance. This paper presented the literature on existing BIM maturity levels and Key Performance Indicators; and both attempted together. An absence of delivering a standardised set of KPIs to be linked with the BIM maturity to extract benefits that could impact on overall performance of the industry existed. Therefore, this research aimed to combine different BIM maturity levels that existed in different places by delivering a standardised set of BIM maturity elements, and integrated KPIs developed through providing a standardised set of KPIs that assessed capabilities and impacts on construction performances. Strengths and weaknesses for the presented BIM maturities / KPIs / BIM-KPIs were outlined, and as a result; a conceptual framework for Level 2 BIM maturity-KPI assessment that shall link them both together was proposed.

Keywords: BIM, KPI, Maturity Assessment, Project Performance, UK Construction Industry.

1. INTRODUCTION

Building Information Modelling (BIM) has been approached in various ways from academic publications, and governmental bodies. They all agreed that technological applications are essential drivers being operated within BIM. However, the UK industry has defined BIM as a modelling process to be facilitated for a building life-cycle through human interactions. The UK government imposed a mandate to their governmental projects across the UK to implement Level 2 BIM by 2016. Level 2 BIM has been defined by: “A series of domain and collaborative federated models” (BIM Task Group, 2013). The mandate was implied because recent published construction strategy report by the UK Government aims to cut off public sector assets cost to 20% by 2016 (HM government, 2012). Figure 1 demonstrates a sample of the UK Level 2 BIM Guides and Processes used for their Level 2 approach (NBS, 2015).

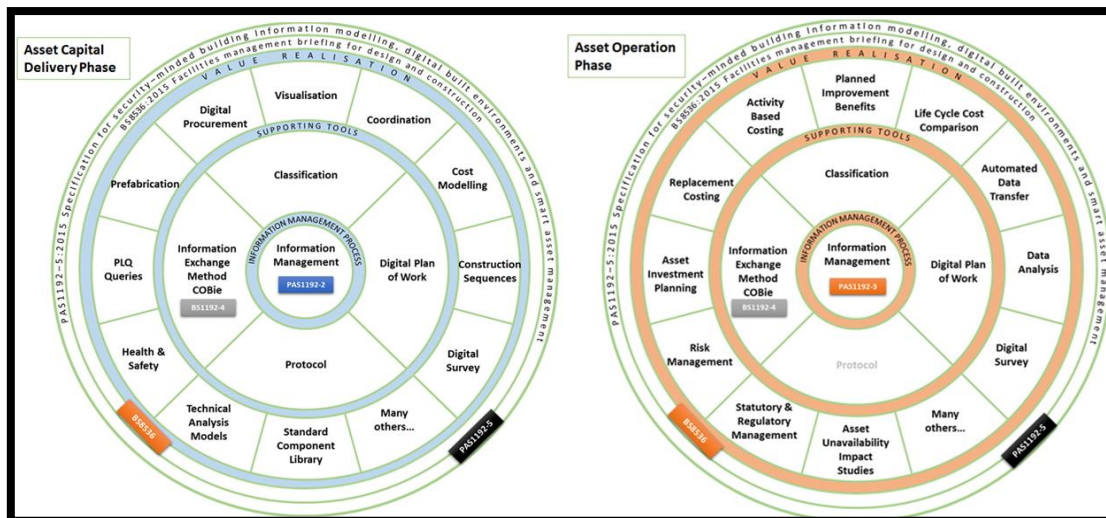


Figure 1: Level 2 BIM Guides and Processes (Source: NBS, 2015)

The BIM maturity was introduced as a measurement process with a set of progressions on capabilities and performance in relation to BIM implementation based on levels of accomplishment. It has been defined by: “the extent to which a specific process is explicitly defined, managed, measured, controlled, and effective” (Paulk, Curtis, Chrissis, and Weber, 1994). After identifying the main purpose of BIM and its application across the UK, BIM maturity models has emerged from various studies by different authors across the globe. There are a set of BIM maturity assessments that have been conducted. The main purpose of BIM maturities is to measure effectiveness of BIM capabilities and adoptions across the construction industry, which may reflect on the UK governmental mandate and examine success of BIM projects across the UK (Aboumoemen, 2016).

BIM Maturity assessments has delivered various benefits and its importance has been examined across the UK, and therefore the Key Performance Indicators (KPIs) shall be presented in a similar direction to outline its benefits. Target improvements were proposed which resulted in emergence of KPIs that aimed to deliver overall improvements within the UK construction industry (Wolstenholme, 2009). Project performance measures were specified on Cost, Time, and Quality, but other measures were introduced, such as safety and performance that differed from one study to another. They shall help recognise impacts that could occur on overall performance of projects and organisations through the usage of KPIs. An approach has existed in combining both parameters BIM and KPIs through outlining how they can operate together within construction organisations. A few set of publications have been published that addresses possible links of BIM implementation on primarily used KPIs across construction projects through assessing project performance.

1.1 Research Methodology

The literature review aimed to identify various sources including journal articles, books, reports, and websites that investigated the usage of BIM maturity assessments, KPIs and both combined together in the construction industry, For this research, an extensive literature review was conducted that included the keywords of BIM maturity assessments, KPIs, and BIM KPIs using search engines of Google Scholar, Scopus, etc.... Literature that contained information regarding the stated keywords were included and classified into categories to meet the research needs. As a result, 25 publications on BIM maturity assessments were

acknowledged, a selection of 20 KPI publications relevant to the research were outlined, and finally 16 previous attempts of linking BIM and KPIs together were identified. For this paper, a summary of the strengths and weaknesses for the presented categories on BIM maturities, KPIs, BIM / KPIs will be presented, and will propose a conceptual framework for Level 2 BIM maturity-KPI assessment that combines all the existing literature together.

2. BIM MATURITY ASSESSMENTS

BIM maturity presents a measurement process being introduced as a set of progressions on capabilities and performance in relation to BIM implementation based on levels of accomplishment (Paulk et al., 2004). The assessments are based on a 5 level maturity to assess BIM capabilities and measure their adoption and effectiveness across the industry (Aboumoemen, 2016). A set of assessments were developed by industry practitioners and academics to evaluate BIM within the Architecture, Engineering, and Construction (AEC) industry (Giel & Issa, 2014). Based on an analysis conducted on BIM maturity, 7 categories were established. They are: 1) Scoring criteria percentage on a model with possible certification; since the scoring criteria with certification could help identify where the models are in relation to BIM adoption (NIBS, 2007; Indiana University, 2009; Du, Liu, & Issa, 2014; Alaghbandrad et al., 2015), 2) Maturity model on levels 1-5; where maturity models are based on 5 levels known as: a) Initial, b) defined, c) Managed, d) Integrated, and e) Optimised, driven from the Capability Maturity Model and assess BIM maturity (Succar, 2009; CIC, 2013; ARUP, 2014; Succar & Kassem, 2015), 3) Assessment framework; to outline requirements of BIM maturity through provision of an assessment framework (Bew & Richards, 2008; Gao, 2011; Manzione et al., 2011; Mom, & Hsieh, 2012; Shin, Choi, & Kim, 2015; Aboumoemen, 2016), 4) Scoring criteria percentages for projects; to identify where projects are in relation to adopting BIM through delivery of a project's scoring criteria (Vico. 2011; bimSCORE. 2013; Kam et.al., 2013; BIMexcellence. 2016; Liang et al., 2016), 5) BIM competencies and capability assessment (self); to assess individuals competencies and capability within organisations through a self-assessment tool (CPI. 2011; BIMTASKFORCE. 2013; Giel & Issa, 2014), 6) BIM Functional model (tool); to deliver BIM progression on models through BIM functional model (Berlo et al., 2012; Chen, Dib, & Cox, 2014; Lee, Yu, & Jeong, 2015), and 7) Assessment method (other); Other methods that were used and could be considered to assess BIM (Cerovsek, 2011; Won & Lee, 2014).

Based on a review of the presented categories, a summary of the overall strengths and weaknesses, and a highlighted set of selected categories are available in Figure (2). The literature on BIM maturity has demonstrated 1) A certified percentage scoring criteria on models with the ability to deliver impacts on the projects and organisations operating BIM, 2) Models through the 5 maturity level to assess projects and deliver a comprehended model, 3) Various types of framework that delivered a set of BIM guidelines and standards to be reflected upon, 4) Project's percentage scoring criteria that examined delivery of BIM across a set of models provided for the targeted projects, 5) BIM capabilities and competencies self-assessments to be examined and completed by individuals to demonstrate where they currently stand, 6) Maturity related models leading to BIM function model (tool) to examine how is BIM being operated within organisations, and 7) Alternative assessment methods that were considered to assess BIM implementation across projects and organisations. Yet, a set of distinctions existed such as: 1) BIM being approached as a software for the certified scoring criteria that doesn't follow the BIM maturity concept, 2) 5 Levels of maturity being demonstrated differently from one place to another, resulting in absence of standardisation

for BIM maturity, 3) Frameworks being regarded as conceptual and not examined enough across projects and organisations, 4) BIM maturity criteria not followed in the scoring criteria for projects assessments, causing a delivery of a meaningless percentages that doesn't comprehend the maturity criteria, 5) Various BIM elements are assessed by different individuals, resulting in no consideration of BIM maturity approach, 6) Various BIM functional models being proposed and not validated widely across the industry, resulting in lack of standardisation for the presented functional models to follow a BIM maturity criteria and invalidated functional models' delivery across projects, and 7) Alternative assessment methods being unrelated to BIM maturity and relying on individual perceptions on BIM.

| BIM maturity assessments in Literature approaches purpose of usage, their strengths and weaknesses | | | |
|--|--|---|---|
| No. | Nature of the category | Summary of strengths | Summary of weaknesses |
| 1 | Scoring criteria percentage on a model with possible certification | A positive impact of the delivered scoring criteria percentages with certificate on the projects and organisations operating BIM that are being assessed against. | Scoring criteria focused on assessing BIM as a software, resulting in assessing a BIM model that doesn't follow a BIM maturity criteria. |
| 2 | Maturity model on levels 1-5 | A comprehensive model through the 5 levels of maturity was delivered within organisations and across various projects. | A delivery of a BIM maturity that varied from one industry to another, causing an absence of standardisation for BIM maturity. |
| 3 | Assessment framework | Various types of frameworks was delivered, which reflected positively on them and delivered a set of BIM guidelines and standards to consider. | Some frameworks are considered as conceptual, and might not operate well amongst various projects and organisations. |
| 4 | Scoring criteria percentages for projects | Scoring criteria percentages were focused on projects used in organisations that examined BIM deliverables across a set of models used in the industry. | A delivery of a scoring criteria that doesn't include a BIM maturity criteria in it, which resulted in not being validated in the industry. |
| 5 | BIM competencies and capability assessment (self) | A self assessment strategy through the BIM competencies and capabilities that shall be completed by various disciplines to visualise where they stand. | Individuals are being assessed on a limited set of BIM elements, and thus no consideration of a BIM maturity approach. |
| 6 | BIM Functional model (tool) | Previous maturity related models were reviewed which lead to development of a functional model (tool) to examine BIM operations within organisations. | The proposed BIM functional models are not validated widely, and thus various BIM requirements are considered with different users. |
| 7 | Assessment method (other) | A consideration of alternative assessment methods existed which could be reviewed for assessing BIM implementation across projects and organisations. | No approach have been considered to deliver assessment methods related to BIM maturity, and depends on individual perspectives. |

Figure 2: BIM maturity assessments strengths and weaknesses

3. KPI ASSESSMENTS

BIM is about assessing capabilities, and construction performance measurements is done through Key Performance Indicators (KPIs), so in order to outline its potential benefits, then it will be necessary to provide a linkage between BIM maturities and KPIs to demonstrate KPIs progressions. KPIs are measures of a process that is critical to the success of an organisation, and there are a number of performance measures that define the success of a project or organisation (Constructing Excellence, 2004). Having conducted an analysis on the existing KPIs assessments, they have been classified into 9 categories. They are: 1) Listed set of KPIs; since those studies included a listed set of KPIs recognised to support project and organisations (Chan, & Chan, 2004; Swan & Kyng, 2004; BRE. 2016), 2) Framework attempt; where a framework approach existed to outline KPIs distribution in these studies (Toor, & Ogunlana, 2010; Takim & Akintoye, 2002), 3) European Foundation for Quality Management (EFQM) excellence model; EFQM excellence model used as a continuous improvement strategy that consists of: Cause and effect relationships between what their organisation does on 2 Criteria's: 1) Enablers with its 5 areas of: a) Leadership; b) Strategy; c) People; d) Partnerships; e) Processes and products, and 2) Results with its 4 areas of a) People, b) Customer, c) Society, d) Business it achieves (Beatham et al., 2004; Bassioni, Price, & Hassan, 2004), 4) Balanced Scorecard; Balanced Scorecard presented and used to measure goals which is: A scorecard that included 4 perspectives known as: a) Financial, b) Customer, c) Internal Business, and d) Innovation and learning (Luu et al., 2008), 5) Relative Important Index (RII); Relative Importance Index presented as a method that indicates the importance of parameters which is: a mathematical formula aimed to identify the importance of used KPIs through a numerical ranking procedure that will be correlate amongst others (Yeung et al., 2013), 6) Rating criteria; Rating Criteria that ranks the most used parameters in projects which is: a Criteria to rate the KPIs used in the study to outline their importance (Ali, Al-Sulaihi, & Al-Gahtani, 2013), 7) Questionnaires or surveys with the use of Likert scale; Likert scale used in questionnaires to collect data on KPIs from, which is: a scale that uses a

rating scale of 3 and above through delivered questions which expects participants to answer them according to the questions by selecting the necessary ratings (Cox, Issa, & Ahrens, 2003; Ramirez, Alarcon, & Knights, 2004; Vukomanović, Radujković, & Nahod, M. 2010; Alkilani, et al., 2015; Sibiya, Aigbavboa, & Thwala, 2015), 8) Other; to include other methods to outline KPIs than those being presented (Bassioni, Price, & Hassan, 2005; Scottish Government. 2012; NWCH. 2015), and 9) All (except Other and Likert Scale); since it included a set of methods being used to outline the KPIs (Cha and Kim, 2011). A set of KPIs were identified by industry practitioners and academics to evaluate KPI performance and implementation within the AEC industry. The performance measures and KPIs of project performance and success were generalised on Cost, Time, and Quality aspects; however, other assessment aspects have been introduced differently; such as Safety and Performance that varied from one place to another. The KPIs aim to deliver overall improvements within the UK construction industry. (Wolstenholme, 2009).

After reviewing the KPIs, 9 were extracted that are believed to reflect on the suggested BIM-KPI framework. Cost, Time and Quality were considered as Primary KPIs since they demonstrate the basis of measuring key performance indicators in any project or organisation and form the essentials of KPIs that are available in all previous studies and across the industry. Safety, Satisfaction, Performance, Profitability, Productivity and Sustainability are regarded as Secondary KPIs since their representation varied from one study to another, which could present a start of standardising the existing KPIs, and additional KPIs have existed that were classified as others. The relationship between the number of appearance and the percentages in the 20 selected publications on KPIs are presented in Figure (3).

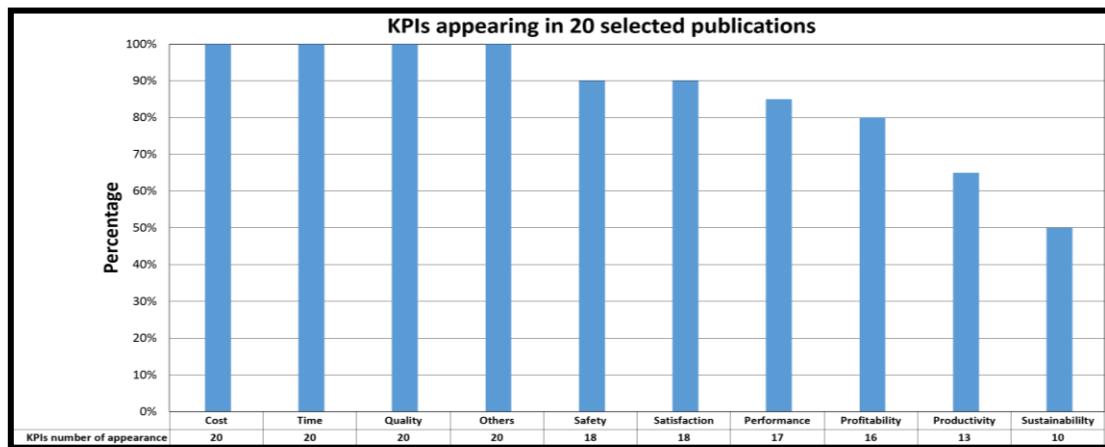


Figure 3: KPIs emerging from the literature

Figure (4) presents a summary of the overall strengths and weaknesses, and a selected set of categories are highlighted. Having reviewed the presented categories, the highlighted categories are based on their existing features; such as the usage of a balanced scorecard, Relative importance index, and Likert scale that presents the KPIs requirements to consider for the BIM-KPI assessment discussed earlier. The literature on KPIs has delivered 1) A listed set of KPIs required, which were examined across projects and organisational levels, 2) Concepts such as (IEDF0 diagram) used in frameworks to evaluate projects performance, 3) EFQM model and balanced scorecard as a benchmarking system and integrated together to assess KPIs in organisational level, 4) RII and rating criteria as methods to rank the KPIs and define their importance to measure their performance on projects, 5) Usage of a Likert scale through questionnaires to evaluate importance, and usage of KPIs across projects, and 6) Methods such as (SMART) to examine provision of KPIs and combined methods of (listed

set of KPIs and RII) to verify importance of KPIs being used. However, a set of variances existed such as: 1) Delivering different sets of KPIs according to each study's requirements, resulting in absence of a standardised set of KPIs used, 2) Various frameworks used to examine KPIs, therefore absence of a standardised framework to be used in projects, 3) Not understanding the usage of KPIs through the EFQM model, resulting in lack of understanding and misinterpretations to the KPIs, 4) Non comprehensive performance measurement tool existed as a result of the provided balanced scorecard that was not validated, 5) Measures are not well defined through the RII method, causing a variance of KPIs delivery across projects, 6) KPIs are ranked randomly without having a basis of rating them, resulting in the KPIs not reflecting necessary on projects, and 7) Multiple methods not examined amongst project lifecycle, resulting in absence of strong relationship between various methods together.

| Selected KPIs in Literature approaches purpose of usage, their strengths and weaknesses | | | |
|---|--|---|--|
| No. | Nature of the category | Summary of strengths | Summary of weaknesses |
| 1 | Listed set of KPIs | A listed set of KPIs delivered to be examined across project or organisational levels through KPI engine. | Different lists of KPIs are used according to study's requirements, resulting in absence of standardised set of KPIs being delivered. |
| 2 | Framework attempt | New concept(s) introduced in frameworks to examine and verify performance of projects across organisations (IDEFO diagram). | Various framework are used to examine the KPIs existence, therefore not delivering a standardised framework to be used in the project level. |
| 3 | EFQM excellence model | EFQM excellence model used to deliver a benchmarking system for KPIs to be assessed in the project level. | KPIs are not fully understood from using this method, causing misinterpretations and lack of understanding to the presented KPIs. |
| 4 | Balanced Scorecard | Balanced Scorecard integrated with other systems (EFQM model) to examine KPIs across project and organisational levels. | The method was not validated across organisations, which delivered a non comprehensive performance measurement tool. |
| 5 | Relative important Index | Method for defining the importance of KPIs and correlating them to measure the performance of projects and organisations. | Quantitative measures are provided but are not well defined, causing discrepancies across project and organisational levels. |
| 6 | Rating criteria | Simplified method to rate the KPIs used across several projects. | The basis of rating the KPIs were not defined or provided, resulting in the KPIs not reflecting on the projects necessary. |
| 7 | Questionnaires or surveys with the use of Likert scale | KPIs being assessed on importance, frequencies and usage amongst organisational levels through delivery of questions. | Questions provided for the KPIs were answered by individuals based on their personal views, which could vary from one place to another |
| 8 | Other | Methods such as (SMART) used to examine the delivery of KPIs. | KPIs used extensively in studies, and requirements varied from one study to another, resulting in absence of standardisation |
| 9 | All (except Other and Likert Scale) | A set of methods used (Listed KPIs, RII) to verify the importance of the KPIs being delivered | Not examined amongst the whole project lifecycle and data is not rigorous, resulting in absence of a strong relation of methods together |

Figure 4: KPIs assessments strengths and weaknesses

4. BIM-KPI ASSESSMENTS

A limited number of publications were available that collected possible relationships between BIM maturity and KPIs across construction projects (Smits, Buiten and Hartmann, 2016). This implies that there has been a failed attempt to link BIM maturity and KPIs together to realise the benefits that could be extracted. Having conducted an analysis on the existing combined BIM/KPI assessments, 6 categories form the essentials of the BIM/KPI combination in previous studies. They are: 1) Assessment Framework; since an assessment framework have existed to combine BIM and KPIs together (Mom & Hsieh, 2012; Aboumoemen, 2016), 2) KPIs impact on BIM implementation; where the impacts of KPIs on the implementation of BIM existed and varied from one study to another (Coates et al., 2010; Manzione, et al., 2011; Sarkar, Raghavendra, & Ruparelia, 2015), 3) Assessment method; Balanced scorecard being presented and used to be compared together (Park et al., 2013; Won & Lee, 2016), 4) BIM implementation within Organisations; to outline the impacts of BIM with construction industries / firms / organisations (Barlish & Sullivan, 2012; Sun & Zhou, 2010; Poirier, Staub-French, & Forgues, 2015; Shin, Choi, & Kim, 2015), 5) BIM impact on construction projects (KPIs); to demonstrate the effect of BIM on KPIs and construction projects performance (Suermann, & Issa, 2007; Hassan, 2012; Eadie, et al., 2013; Smits et al., 2016), and 6) Assessment tool; since an assessment tool was presented to demonstrate the relationships of BIM and KPIs together. (Sebastian & Berlo, 2010).

Following a review of the presented categories, the highlighted categories are believed to have a direct link with the development of a BIM-KPIs suggested assessment. A set of variations existed; starting from 1) Delivering different sets of BIM and KPIs specific to each study's requirement, resulting in provision of various frameworks that operates in certain studies and are not generalised, 2) BIM being approached in various ways, causing absence of standardised set of BIM elements being delivered and KPIs to then be used, 3) Diversity of methods being used to integrate BIM and KPIs together, which resulted in absence of a standardised method to be used for their integration across organisations, 4) Variation of BIM and KPIs set of numbers and implementation across projects and organisations, causing an absence of standardised set of BIM and KPIs elements being used, and 5) KPIs treated as a set of questions to meet BIM requirements of a certain study, and as a result, delivering a different approach of KPIs. The literature on BIM/KPI has presented: 1) A review of the BIM and KPIs, which resulted in delivering a framework that reflects on combination of both together, 2) Delivered BIM as a main driver and through the help of data collection tools, has presented reflection of KPIs on the BIM implementation within the industry, 3) Offered a set of methods, (i.e. balanced scorecard) to signify how can BIM and KPIs be integrated together, 4) KPIs as the main use in construction projects and organisations and how will BIM be integrated with KPIs, and 5) Proposed a tool that combines BIM and KPIs together through delivering a set of questions related to KPIs to meet BIM needs. The BIM-KPIs set of strengths and weaknesses, and highlighted set of categories are available in Figure (5).

| Combined BIM-KPIs in Literature approaches purpose of usage, their strengths and weaknesses | | | |
|---|--|--|---|
| No. | Nature of the category | Summary of strengths | Summary of weaknesses |
| 1 | Assessment framework | A framework that reflects on the combination of BIM and KPIs together | Different set of BIM and KPIs elements were used, resulting in a delivery of a framework that suits specific studies and not general |
| 2 | KPIs impact on BIM implementation | BIM as a main driver and how KPIs tend to reflect on the BIM implementation within the industry | BIM being approached in various ways, resulting in absence of standardised BIM. |
| 3 | Assessment method | Methods such as (balanced Scorecard) that assists the integration of BIM and KPIs together | Different methods also existed, which results in diversity of methods being operated in some organisations |
| 4 | BIM implementation within Organisations | KPIs as main use in organisations and how will BIM be implemented within organisations | Variation of BIM implementation across organisations, causing an absence of standardised BIM elements across organisations |
| 5 | BIM impact on construction projects (KPIs) | KPIs as main use in projects and how will BIM be implemented within the projects | Variation of KPIs set of numbers and implementation across projects, resulting in absence of standardised set of KPIs across projects |
| 6 | Assessment tool | A tool that combined BIM and KPIs together through delivered a set of KPI questions to reflect on the BIM elements | KPIs treated as a set of questions to meet BIM requirements of study, resulting in a different approach to KPIs for a single study |

Figure 5: BIM-KPIs assessments strengths and weaknesses

5. A LEVEL 2 BIM MATURITY-KPI ASSESSMENT CONCEPTUAL FRAMEWORK

Having visited the previous publications on BIM, KPIs, and combined BIM / KPI; a proposed assessment that combines them all together is available in Figure (6). The framework presented addresses strengths that existed in previous studies; such as the delivery of a set of progressions for BIM, and an initial set of KPIs that presents benchmarks on measuring the performance of projects and organisations within the industry, which could be used to link BIM and KPIs together and begin to populate the suggested assessment.

The approach to the framework:

Following a review and analysis presented in the literature, the framework has been distributed into 3 stages: 1) Level 2 BIM and KPIs begin the framework's 1st stage since it requires to identify essence of both elements and begins to deliver an aligned standardised set of elements to understand how they shall be related together, 2) Level 2 BIM and KPIs assessment is then introduced to establish relationships and how assessments are expected to occur on both elements to deliver a standardised set of assessments to be considered, and 3)

Benefits of aligned BIM and KPIs and their relationship assessment shall be presented to demonstrate benefits expected to emerge from the combination of both elements together, and how to assess strengths of the elements' relationships presented previously through correlating them together. A detailed analysis of the framework shall be presented separately.

1st stage= Level 2 BIM and KPIs:

A preliminary list of BIM and KPIs separately are provided in the assessment's 1st stage, where some were presented in Figures (1 and 3). The links conducted in the framework's 1st stage shall help bridge the missing combination of previous given Level 2 BIM and KPI parameters that has not existed previously, and thus allows recognising how both parameters could be linked together in the framework's early stages. Furthermore, shall deliver a set of KPIs and Level 2 BIM elements to be assessed together and display their possible relationships (i.e. the KPI [Cost], and its relationship with some Level 2 BIM elements [Collaboration]). This allows to recognise how both elements could be linked together in the early stages. The stage has been identified as "The What" since it aims to outline what are the expected standardised elements to emerge that shall meet the UK governmental mandate on Level 2 BIM.

2nd stage= Level 2 BIM and KPIs assessment:

The relationship assessments of Level 2 BIM and KPI elements together is available in this stage. The proposed assessment methods in the 2nd stage shall support in realising strengths of the potential link that both elements will have, based on the assessment performed on them. This stage has been signified as "The How" since it aims to assess relationships of Level 2 BIM and KPI elements together to see the possible strengths of these relationships, and how are level 2 BIM elements being acknowledged in projects and organisations within the industry. This stage delivers strengths that existed in the previous literature; such as the impacts of Level 2 BIM and KPIs together and levels of maturity assessment, which could help recognise how they shall be assessed and what current positions does the UK industry stand to meet their Level 2 BIM mandate. The Strength of relationships between BIM and KPIs shall help visualise how they are related together, and what could be necessary actions required to be taken to strengthen the relationship or to maintain them. Some of the presented studies followed a 5 level maturity assessment, but other studies follows a 3 level maturity. The reason for considering a 3 level maturity in this framework is to deliver necessary distinction between each level since 5 levels have delivered a similar relationship between levels (i.e. levels 2 and 4 being close to levels 1, 3, and 5). The assessment in this stage shall help deliver a standardised set of assessment for both elements that will avoid unnecessary distinctions of multiple assessments existing. Furthermore, delivery of the standardised assessment method to depend and rely on shall elude existence of multiple assessments that could cause potential misunderstanding, and thus allows results to be validated across the industry. Moreover, this assessment method will be able to measure performance of projects and organisations, and neglect variations of the inability for both elements to be assessed.

3rd and final stage= Benefits of aligned BIM & KPIs, and their relationship assessment:

This stage shall be examined to see what benefits will be expected to emerge from the previous assessment, which defines "The Why" level and how will the Level 2 BIM and KPI elements correlate together, known as "The Evidence" level. The benefits will be aligned with the maturity assessment conducted to see how improvements have occurred within the

industry and actions may be proposed to enhance weak relationships that may have existed. Previous studies on BIM maturity and KPIs presented methods of assessing both elements through correlations and multiple regressions, which demonstrates a potential strength existing in this stage and could help signify strengths of relationships between them. Extracted benefits shall be vital in realising importance of the previous assessment, where it shall offer benefits that is expected to occur on the previous stages. Furthermore, a delivered standardised assessment method for both elements together will exist in this stage that will evade the excessive set of assessments conducted before, which did not deliver the necessary relationships required. Finally, will present a standardised set of elements to be correlated and avoid variances of elements that may be included and allow a higher validity of results within the industry.

Problem identification, presented framework's justification, and expected contribution:

Finally, there has been an absence of a rigorous relation between Level 2 BIM maturities and KPIs, lack of understanding of what both are exists, and how they operate within construction organisations separately, which resulted in a failed attempt to link them together. This framework aims to combine different BIM maturity levels that existed in different places through delivering a standardised set of Level 2 BIM maturity elements. It will integrate KPIs developed through providing a standardised set of KPIs, in order to assess capabilities and impacts on construction projects and organisational performances. This will be used to develop a suggested Level 2 BIM Maturity-KPI assessment framework for assessing BIM level 2 adoptions in line with the UK construction strategy, to test and examine its practicability within the UK. As a result, the aim of the presented framework is to measure the performance and demonstrate how benefits extracted from Level 2 BIM maturity could have an overall impact on construction performance through linking the KPIs with BIM together. The framework intends to introduce a new method of standardised Level 2 BIM maturity approach along with a generalised KPI to be considered within the UK.

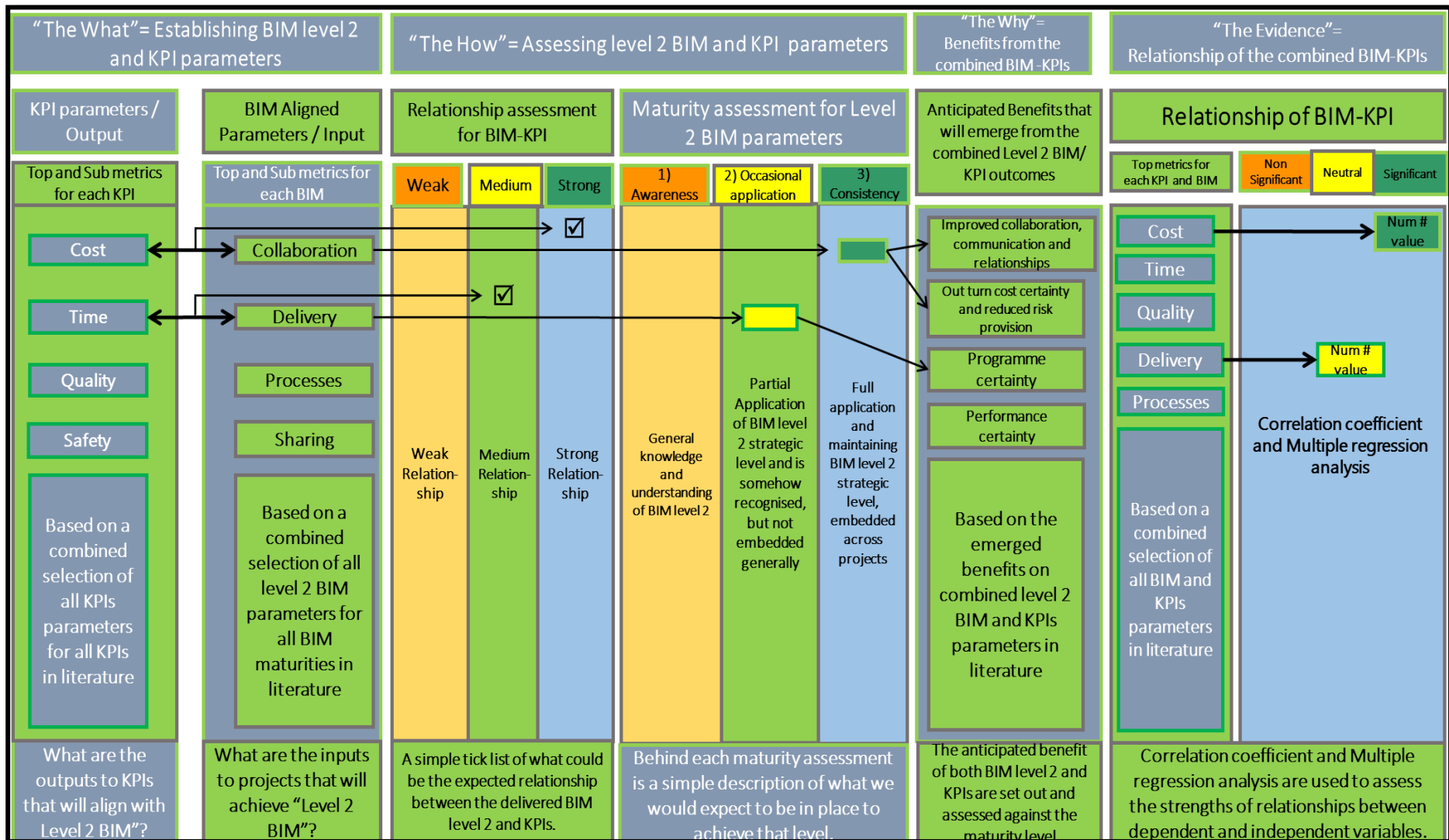


Figure 6: A Level 2 BIM Maturity-KPI assessment conceptual framework

6. CONCLUSION

From the previous discussion, it can be concluded that BIM maturity assessments, KPIs, and combined BIM-KPIs available in literature could be used in the UK. However, a set of adjustments must be attempted in order to deliver a standardised set of KPIs to be linked with the BIM maturity to extract benefits that could impact on the industry's overall performance. This is due to lack of understanding on what BIM and KPIs are and how they operate within construction organisations separately, which resulted in a failed attempt to link them both. BIM was presented in several ways but has led to slow uptake and low awareness to UK disciplines, and thus BIM maturities are developed to assess capabilities and measure their adoption. This shall help extract benefits that could be realised from usage of BIM maturity across organisations; however, those benefits could be meaningless. As a result, KPIs are presented through project and organisational types along with different accomplishment levels, where KPIs could be used to link them with BIM maturities; in order to demonstrate benefits that could be extracted from usage of BIM maturities amongst UK disciplines. An approach has existed to combine BIM and KPIs together and how both shall deliver direct impacts to the industry. Although the potential strength that could exist through linking both elements, however; a limited set of publications has addressed such possible links. Since these publications have failed to deliver an approach on both parameters working together, it has been encountered as an existing knowledge gap and weakness resulting in a total absence of such link, and therefore how both parameters could work together shall be acknowledged. Lack of understanding of what BIM and KPIs are exists, and how are both being operated within construction organisations separately resulted in a failed attempt to link them both together to realise the benefits that could exist. As a result, an assessment for Level 2 BIM-KPIs has been suggested. This assessment shall be easy to understand relationships between BIM maturities and KPIs. The proposed assessment is available to all potential users to use in the present time, since it is expected to test and validate it amongst the UK construction industry, but it is expected to address the suitable users required to attempt the framework as the study continues and based on the UK construction industry requirements (i.e. Clients).

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LIBYAN HIDDEN GEMS: VERNACULAR ARCHITECTURE ON THE NAFUSA MOUNTAINS

M. Milod¹ and .C. Trillo²

¹ School of the Built Environment, University of Salford, UK

² College of Engineering, School of the Architecture, Libya University, Libya

Abstract : Vernacular Architecture (VA) is an essential driver of cultural identity and plays a major role in ensuring the preservation of local identity and cultural values. Sometimes, but not always, VA is protected by law as heritage architecture and framed within clear conservation policies. The Libyan area of the Nafusa Mountains Region (NMR) is rich in history and traditional architectures, veritable hidden gems not yet well known. However, due to the lack of specific conservation strategies, VA has been overlooked and neglected by both institutions and local communities, and its unique historical and cultural value abandoned to decay. This paper draws from a broader research aimed at raising awareness and promoting necessary measures for preserving VA in the NMR and its unique architectural and historical heritage. Since no comprehensive study exists on the typical and specific architectural features related to the VA in the NMR, the first step of this study has been to explore and document, by complementing a systematic review of the literature on the NMR with field work and direct survey, selected examples of VA in a single case, the Yifran municipality. Building on these primary data, a taxonomy of the VA typologies has been firstly developed and then related to the main characteristics of the different typologies. This paper presents preliminary findings from this stage, providing readers with an initial understanding of the physical elements characterising the uniqueness of the VA in the NMR.

Keywords: Vernacular Architecture, Heritage Architecture, Nafusa Mountains, Libyan Region.

1. INTRODUCTION

The Vernacular Architecture (VA) is an indigenous building style using traditional methods of construction and local materials and ornament especially as distinguished from academic or historical architectural styles. The term “vernacular” acquires different meanings and implications depending on the context (Oliver 2006). This term has been used, among others, by architects, historians, archaeologists and folklorists (Brunskill 2006). Vernacular Architecture (VA) has been defined as the architectural relationship among people with respect to the use of traditional resources. Sometimes described as “popular” (Rapport 1969) or “spontaneous”, this architecture is seldom the work of a specialist. The “*Architecture without architects*” (Rudofsky 1964) is produced without an intermediary. VA is increasingly becoming a subject of major interest not only amongst architecture theorists, but also designers and technologists all over the world. VA is an essential driver of cultural identity and plays a major role in ensuring the preservation of local identity and cultural values. Sometimes, but not always, VA is protected by law as heritage architecture and framed within clear conservation policies.

It is worth noting here that VA is increasingly becoming a subject of major interest not only to architecture theorists, but also to designers and technologists all over the world. For example, Filippi (2006) defined it as the architectural relationship among people with respect

to the use of traditional resources. Filippi (2006) observes also that VA is an essential component of cultural heritage, a repository of a tradition of integration of different cultures. Thus, VA can work to preserve and to protect a sense of traditional community identity. Recently, it is notable that VA has been declining, not only because of new materials and the shortage of local components; it is also affected by the breakdown of the traditional professions in construction, which were family based architecture (Atroshenko, 1991; Oliver, 2003). In general, the literature picture has focused on Sustainability of cultural heritage as a critical in the core of human culture and to future generations (Oliver, 2003; Sheibani, 2008; Deslagen, 2009). For example, in the Libyan area of the Nafusa Mountains Region (NMR), due to the lack of specific conservation strategies, VA has been overlooked by both institutions and local communities, and its unique historical and cultural value abandoned to neglect. More in general, in Libya, ineffective state strategies and local management are currently hindering the implementation of conservation policies. This paper draws from a wider study, which aims at supporting the preservation of vernacular dwellings in the NMR. The ancient settlement of the Yifran municipality is considered one of the most important municipalities in NMR and therefore has been selected as case study. This paper presents some preliminary findings from an extensive fieldwork and direct survey conducted in the Yifran municipality, with the aim of starting to document the main characteristics of the different typologies of VA in the NMR region. In so doing, it fills a gap in the current knowledge of the VA in Libya, since no comprehensive study exists on the typical and specific architectural features related to the VA in the NMR. Further studies will develop a more comprehensive framework for the preservation of VA in the NMR.

2. LIBYAN VERNACULAR ARCHITECTURE

Libyan traditional architecture differs according to the diverse cultures of the regions. Factors influencing the different architectural traditions are related to religion, to the geographical context (desert, mountainous and Mediterranean / coastal) and to the type and origin of the people (Berber - Amazigh and Bedouin cultures and a mix of more than one of these cultures). Figure 1 shows different types of Vernacular Dwellings (VDs) according to different main geographical context. The suggested taxonomy has been developed drawing from the literature review, allowing to identify four main typologies (e.g. underground, multi-story, courtyard and non – courtyard dwellings), the first three located in the mountainous regions. Figure 2 shows their geographical distribution in the country.

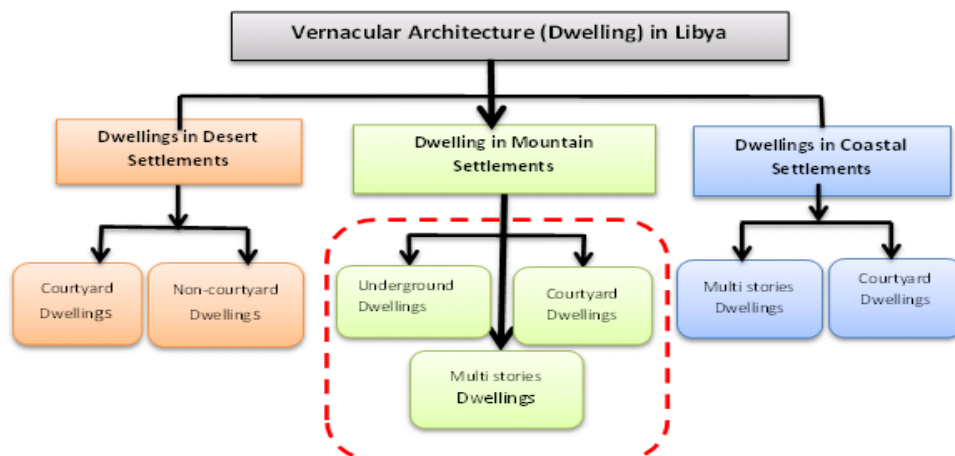


Figure 1: VD types in Libya. Source: author

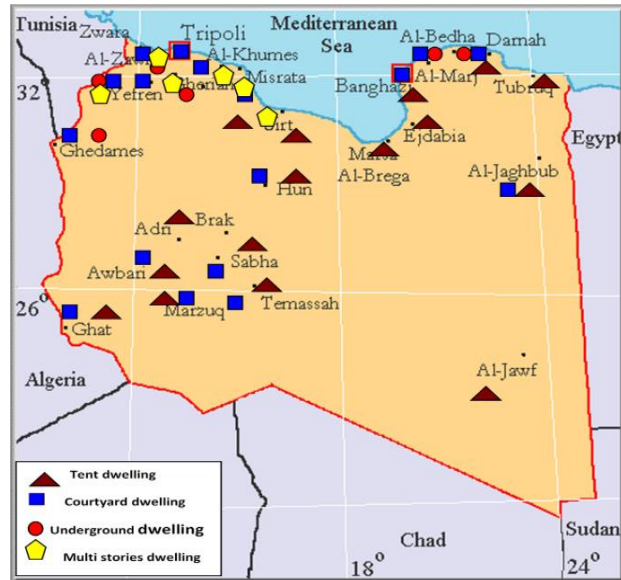


Figure 2: Sites of Libyan VD types Source: author

The coastal zone is located on the Northern border of Libya along the Mediterranean Sea and it extends from Egypt, in the East, to Tunisia, in the West. A part of the North African coast, it mainly consists of fertile agricultural flat land. On the coastal strip, there are some commercial towns such as Tripoli, Misurata, Alzawia, Khoms and Benghazi. The most common type of traditional house in this zone is the courtyard house. Elwefati (2007) indicated that the consideration of climate, customs and traditions were major factors in shaping this type (See Figure 3).



Figure 3: Scheme and courtyard houses of the old city of Tripoli. Source: Urban Planning Tripoli

The desert zone in Libya forms a major part of the Sahara Desert. In the Southern part of the country, it extends from the edge of the coastal strip along the Mediterranean Sea and North mountains, the Nafusa Mountains to the West and Jable El-Akhdar to the East. Generally, the houses in this region are either courtyard dwellings or covered dwellings (non-courtyard dwellings) (See Figure 4).



Figure 4: Courtyard dwellings and non-courtyard dwelling in desert region (Author's photos)

Finally, Libya consists of two mountainous areas, one of them being the Mountains of Nafusa, located in the North-Western region of Libya extending from Tunisia, in the West, to Khoms, in the East. This is an irregular hilly expanse rising in some places to 900m from the sea level. The houses in the mountain area have rural characteristics and appearance and are arranged in a compact grouping (Figure 5), which means that relatives usually live together, or live as close neighbors. The case study of the NMR falls in this area, thus, the three main typologies, as shown in figure 1, are the underground, the courtyard and the multi-story dwellings. As shown in figure 2, the Yifran municipality (North West in the map) includes examples from the three main typologies.



Figure 5: The compact grouping of under and above ground VD in NMR (author's photos)

3. VERNACULAR DWELLINGS IN THE YIFRAN MUNICIPALITY

The research strategy focuses on a single case study, the VD of ancient settlements of Yifran municipality in NMR, this latter being situated in the North-Western part of Libya, South of the Tripoli region and close to the Tunisian frontier (Figure 6).

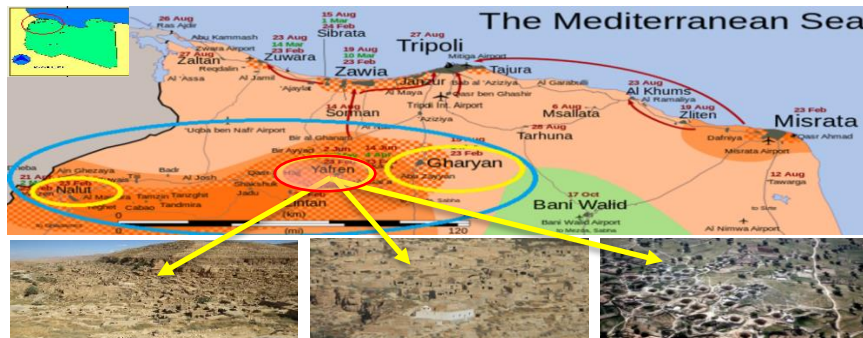


Figure 6: The plan and some sites of VA in ancient settlements of Yifran in NMR (Author's photomontage)

The focus of this study is the VD in the municipality of Yifran. As anticipated in the previous section, Yifran is representative of all the main typologies of VD in the NMR, thus, it offered the opportunity to select samples for direct survey covering the three typologies. In the next sub-sections, each typology will be discussed by referring to 3 actual examples, which were selected following a preliminary survey because they showed all the typical characters of the given typology (figure 7). They have been surveyed over a several weeks fieldwork encompassing photographic survey, direct measurements, visual survey complemented by annotations on structural and technological details. The analysis of the data was conducted with a comparative approach and allowed depicting in a systematic manner the different features characterizing the VA in the three typologies of VD. It is anticipated that VA is here featured by three main criteria: flexibility, adaptability to the climate conditions and re-usable building materials.

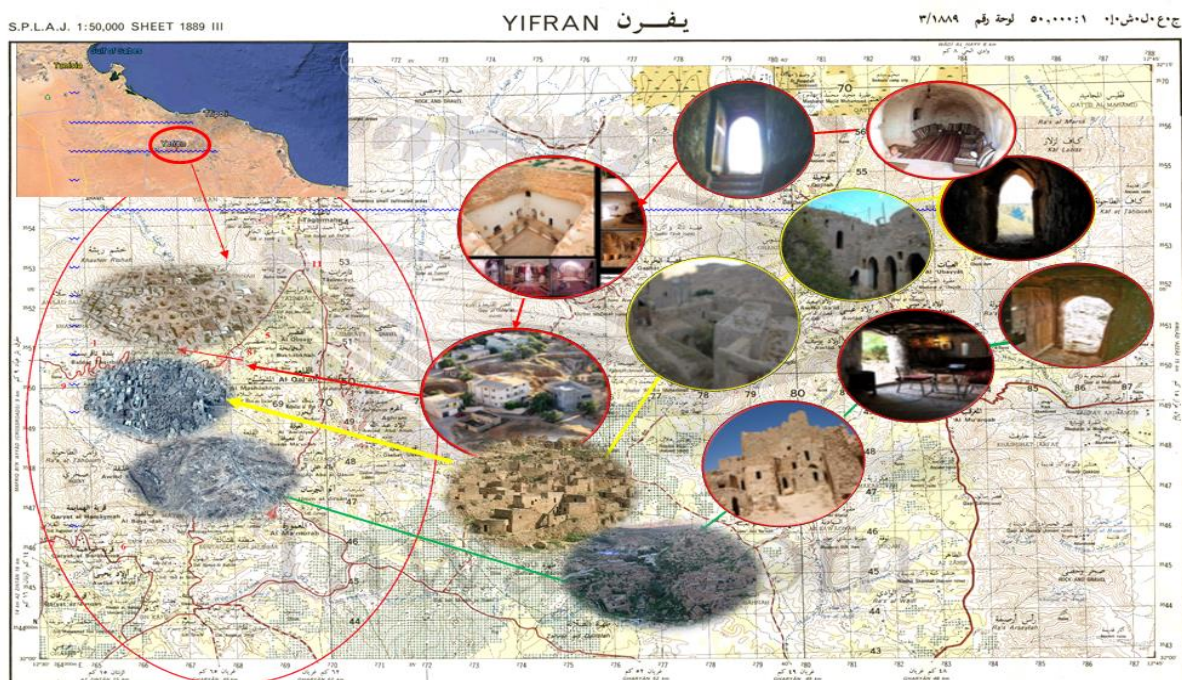


Figure 7: The survey projections of some sites of VA in ancient settlements of Yifran in NMR.
Source: Department of urban planning, NMR

3.1 Vernacular underground dwelling

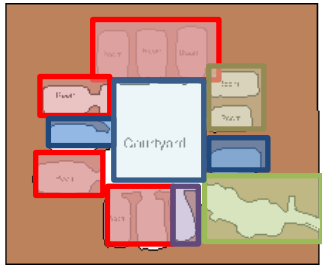
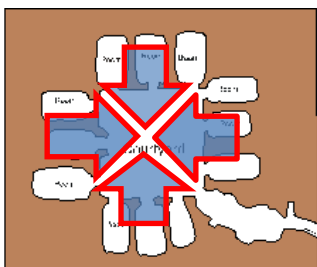
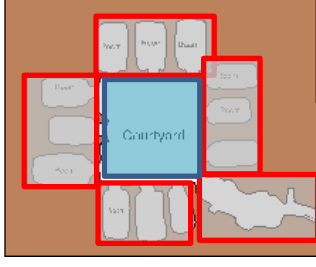
The vernacular underground dwellings (VUD) or troglodyte houses in the ancient settlements of Yifran are very simple in design and most of them were built around a century ago. They are created by digging a huge cube in the clayey ground, which forms the VUD (Table 1). Each troglodyte house hosts related families. In general, the VUD in the ancient settlements of Yifran are distinguished by a minimum use of construction materials, since the only ones used are in the entrance area. Troglodyte houses do not depend on any built structural element. Hence, in fact there are no built walls in the rooms, although, in some troglodyte houses a wall is sculptured, whereas the room is dug, to divide the room into two parts.

As it is seen from table 1, the house under study was built at least two centuries ago and is classified as medium in size with its total floor area is about 100sqm and 4 floors. Normally, this type of house consisted of 6 or 4 rooms with a variety of floor areas, some very small and

some very large. There are no standards or specifications of the room areas from one house to another; the areas depend on the needs of the house owner. All the houses are separated from each other by thick party walls. This system makes the houses attached one to another for increased support and provides isolation from the outdoor climate. Windows are rare in number or do not exist at all in most houses, nor in most cases are there windows overlooking the street.

Table 1: various features of the VUD (Source: author's elaboration on primary data)

| Architecture drawings | Dwelling | Type | Location | Date of construction |
|-----------------------|-------------------------------|--|-------------------------|----------------------|
| | Vernacular | Underground | Ancient settlements NMR | 700 years |
| | Plan | | Sections & Elevations | Images |
| | | | | |
| ItemNo:1 | Features | Description | | |
| 01 | Layout | | | |
| a) | Underground dwelling | Dimensions vary from 8m to 10m deep and 9m by 10m width. All the rooms open into the courtyard. | | |
| b) | Rooms | Dug deep with a nearly trapezoidal shape. The shortest dimension is in the entrance area, about 1.5m to 2m wide. It then gets wider towards the inside, where it reaches a width of about 5m to 7m. Curtains or fabric stretched between walls used to divide rooms into two areas, the sleeping area, at the rear of the room, and the living area. | | |
| c) | Fenestration | No frontal windows. Dimensions of the doors of approximately 75cm×175cm. The main entrance door is wide enough to provide access to the cattle of the residents when necessary. | | |
| 02 | Structure | | | |
| a) | Walls | Entrance of bearing walls, about 50cm to 70cm thick and 2.5m to 3.5m high. | | |
| b) | Roof decks | The ceiling height is about 2.0m to 2.5m at its highest point, and it is shaped as a barrel vault. | | |
| c) | Staircase | Located at the entrance, with landing about 1.5m to 2.0m deep, and leads to the courtyard inside the house. The area of the hallway depends on the presence of cattle. | | |
| 03 | Construction Materials | | | |
| a) | Hard limestone | Used to construct the bearing walls and foundations of the entrance. | | |
| b) | Rubble stone | Also for the walls of the entrance. | | |
| c) | Wood | Olive tree branches were used to construct the ceiling of the entrance and the staircase. | | |




| | | | |
|----------------------------------|---|--|---|
| d) | Small stones | To construct the roof placed over the branches. | |
| e) | Clayey soil and lime | Used as mortar and plastering of the walls and roof, and also used in decoration work in the rooms. | |
| 04 Utilities and Services | | | |
| a) | Electricity | Installed recently | |
| b) | Gas | Not existing | |
| c) | Plumbing | Simple toilets partly exist outside the house, at the surface level; and inside as a small cave about 1.5sqm to 2.5sqm accessible from the courtyard. No water supply in the house and the water is carried from a well outside at some distance from the house. | |
| d) | Sewage System | Not existing | |
| e) | Light | Natural through courtyard by the doors | |
| f) | Ventilation | Natural through courtyard by the doors | |
| 05 Auxiliary spaces | | Small caves “ <i>niche</i> ” about 2sqm exist inside some rooms and used as sleeping area for children or storages. Other auxiliary spaces of about 2sqm are placed between the rooms, without shutters at the entrances; these spaces are used as kitchens, toilets and/or storage. Small storage areas placed above the rooms about 2m over the ground level of the courtyard to store grain | |
| Spatial Analysis | Zoning Analysis | Inside-Outside Relation | Built up/ Open |
| |  |  |  |

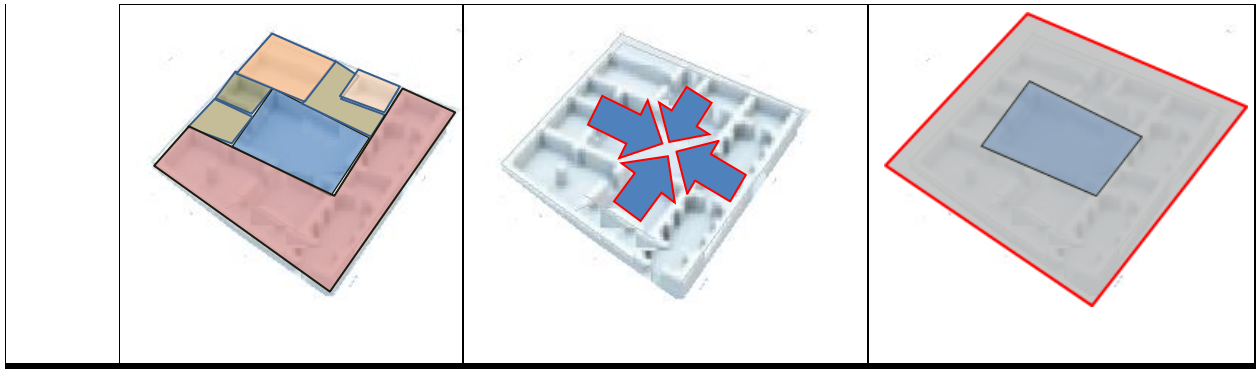
3.2 Vernacular courtyard dwelling

The vernacular courtyard dwelling (VCD) is the second typology considered in this study. The dwelling selected for survey is located at the edge of the mountain. It was built at least a century ago and can be classified as medium in size; total floor area is about 250sqm, and having all modern utilities. The courtyard provides air circulation to the interior. The modest depth of the rooms with their tall widows and high ceilings, allows natural sunlight to penetrate all of them. The structural system of VCD depends on connected load bearing walls for the whole cluster; it provides more strength and support to all the courtyard dwellings that were built next to each other. In some VCD in ancient settlements, iron-rods between the walls are used to increase the rigidity of the structure. The extensive deterioration seen throughout the ancient settlements was also observed in vicinity of the case study house, where most buildings were in a dilapidated condition while some had nearly collapsed. Some owners of these houses had carried out extensive repair work. Contemporary building materials and structural elements were also used to repair the dwelling, such as concrete

blocks, cement plaster and pre-cast concrete tie beams to keep the walls together and to prevent the house from collapsing, as shown in Table 2.

Table 2: various features of the VCD (Source: author's elaboration on primary data)

| Architecture drawings | Dwelling. | Type | Location | Date of construction |
|-----------------------|---|---|--|---|
| | Vernacular | Courtyard | Ancient settlements NMR | |
| | Plan | | Sections & Elevations | Images |
| |  | |  |  |
| Item NO;2 | Features | Description | | |
| 01 | Layout | | | |
| a) | <i>Courtyard</i> | Semi-square in shape dimensions about 6.5m×5m. Most windows overlook the courtyard, and all the rooms are accessible from it. | | |
| b) | <i>Rooms</i> | Roughly rectangular, not governed by a strict geometric grid. Longer side overlooking courtyard, Dimensions range from 2.5m to 4m wide and 3m to 9m long. | | |
| c) | <i>Fenestration</i> | Windows are classified as medium size, being about 80cm to 1m wide and about 1.6m high. Door dimensions of approximately 1m by 2.2m. | | |
| 02 | Structure | | | |
| a) | <i>Walls</i> | Internal walls thickness varies from 25cm to 35cm. External ones about 50cm to 60cm. | | |
| b) | <i>Roof decks</i> | Ceilings are quite high at about 4 m. | | |
| 03 | Construction Materials | | | |
| a) | <i>Limestone</i> | Blocks of sizes 80cm × 40cm × 45cm, used for foundations and walls. | | |
| b) | <i>Sandstone</i> | For construction of roofs and foundations and walls same dimensions as for limestone. | | |
| c) | <i>Timber</i> | Wood from palm and olive trees were used for ceiling joists, beams and joinery work. | | |
| 04 | Utilities and Services | | | |
| a) | <i>Electricity</i> | Installed in the last four decades. | | |
| b) | <i>Gas</i> | Provided by buying gas bottles recently | | |
| c) | <i>Plumbing</i> | Upgraded later in the 1980s. | | |
| d) | <i>Sewage System</i> | Upgraded later in the 1980s and connected to the nearest city sewage system network. | | |
| e) | <i>Light</i> | Natural through courtyard | | |
| f) | <i>Ventilation</i> | Natural, through courtyard | | |
| ia | | Zoning analysis | Inside-outside relation | Built up/ open |


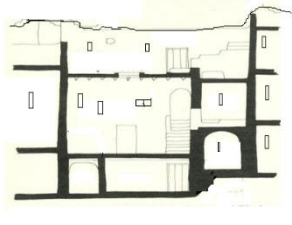



3.3 Vernacular multi-STORY dwelling

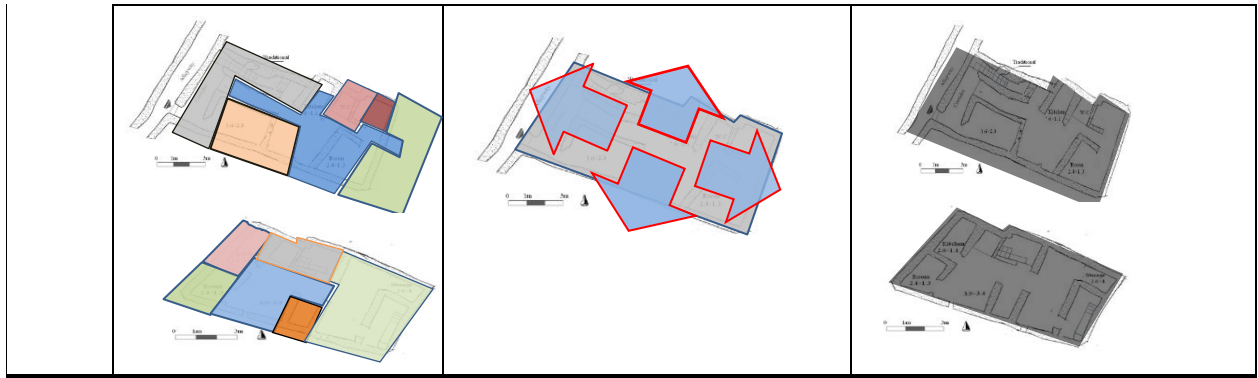
The vernacular multi-story dwelling (VMD) is the third and last typology considered in this study. The house selected for survey was built at least two centuries ago and it is classified as medium in size: its total floor area is about 100sqm and has 4 floors. Same as most VD in NMR, the house consisted of 6 or 4 rooms with a variety of floor areas, some very small and some very big. There are no standards or specifications of the room areas from one house to another; the areas depend on the needs of the house owner. Each house is separated from another by thick party walls. This system makes the houses attached to each other for increased support, and provides isolation from the outdoor climate. In some houses, the stone bearing walls can extend to the first floor only, depending on the financial capabilities of the owner, and proximity of the house to the quarry. Windows are rare in number or do not exist at all in most of the houses, there are small and high windows overlooking the street in most of them.

The various features of the house are tabulated in Table 3.

Table 3: various features of the VMD (Source: author's elaboration on primary data)

| Architecture drawings | Dwelling | Type | Location | Date of construction |
|-----------------------|---|---|--------------------------|---|
| | Vernacular | Multi-story | NMR- Ancient settlements | |
| | Plan | Sections & Elevations | | Images |
| |  |  | |  |
| ItemNo:3 | Features | Description | | |
| 01 | Layout | | | |
| a) | Rooms | <p>Sizes range between (1.4m by 2.6m to 1.8m by 6.2m).</p> <p>The largest room which is the central hall is two floors high; measuring 4.7m×4.0m.</p> | | |

| | | | |
|----------------------------------|-------------------------|--|-----------------------|
| b) | Fenestration | <p>Doors of the house are quite small, about 0.8m by 1.7m.</p> <p>Windows are few and exist in many shapes, such as a rectangular opening with 15cm×25cm, and a triangle shape with 20cm×20cm×75cm, there is no glass or shutters for the small openings.</p> <p>Windows are generally located on the upper floors but in this house, they were located on the third floor at level 4.75m.</p> <p>The important opening of the house is the largest one, positioned on the ceiling of the living area; it is about 1m×1m and it is the only source of light.</p> <p>Small openings overlooking the living area about 25cm×25cm exist in the rooms.</p> | |
| 02 Structural | | | |
| a) | Walls | <p>These walls are built on top of strip foundations; the minimum height of foundation is about 60cm to 80cm above the ground level.</p> <p>The thickness of the external and internal walls is nearly the same in many houses; about 40cm to 60cm.</p> | |
| b) | Roof decks | <p>Ceiling height differs from one room to another; the living area can be two floors high up to 5m, while the bedrooms are 1.8m high and storage rooms can be as low as 1.6m.</p> | |
| 03 Construction Materials | | | |
| a) | Hard stone | <i>Sawwan</i> , as called locally, for foundations. | |
| b) | Natural Stones | For constructing wall, about 40cm×30cm×10cm in dimensions, the sizes are almost standard. | |
| c) | Timber | Palm wood and olive trunks for ceilings, beams for the fenestration system. | |
| d) | Filler materials | Used as fillers for ceilings such as small stones, mud, and lime. | |
| 04 Utilities and Services | | | |
| a) | Electricity | Installed in the last three decades | |
| b) | Gas | Not existing | |
| c) | Plumbing | <p>A simple toilet room is available, without any water supply, located at half way up from the ground floor and accessible from the landing; the room's dimensions were about 0.7m×1.9m wide and 2m high. (Figure 7.102)</p> <p>A modern plumbing system was added recently within the last five or seven years, located at the ground floor, with limited facilities.</p> | |
| d) | Sewage System | <p>The commode is just a hole in the ground connected by a channel to a sump pit, which is like a small closet opened from the street, of dimensions about 0.7m wide 1.5m high that is filled with sand to absorb the organic waste.</p> <p>Septic tanks are used here.</p> | |
| e) | Light | Natural through the top opening by reflecting light through the rooms | |
| f) | Ventilation | Natural through the top opening to all rooms. | |
| | Zoning analysis | Inside-Outside relation | Built up/ Open |



4. CONCLUSIONS

This study is driven by the need to bridge the gap in the current literature in terms of identifying the sustainable institutional aspects VA. Yifran is considered one of the most important municipalities in the NMR and it includes significant examples from any of the three main typologies of VD. This paper represents a first attempt to document and critically discuss the main features of the VD in Yifran, aiming at filling the current gap in the knowledge of VA in Libya. However, this study represents only the first stage of a broader research, aimed at supporting the conservation of VA in the NMR in Libya, a veritable gem still hidden. Several factors currently challenge this goal: lack of national and local adequate policies, loss of the traditional skills related to the local techniques, and finally the local armed conflict. To achieve successful conservation of the VA in the NMR, the co-operation of all officials, conservators, owners and local people will be required. Filling the gap in the knowledge of the specific features of VD is necessary, to raise awareness and set the context for a tailored conservation strategy. Hence, this paper represents the first step of a wider study contributing to the preparation of a most comprehensive conservation policy for the VA in the NMR.

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A CRITICAL REVIEW OF THE PERCEPTION, AWARENESS AND IMPLEMENTATION OF THE LEVEL 2 BUILDING INFORMATION MODELLING (BIM) REQUIREMENTS BY THE UK AEC INDUSTRY

B. Parllaku and J. Underwood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: j.underwood@salford.ac.uk

Abstract: In May 2011, the UK Government announced a serious commitment through its Construction Strategy, to transforming the UK construction industry, in a bid to increase productivity and reduce lifecycle costs on centrally public procured project. On 16th April 2016 the UK Government mandated that any construction suppliers wishing to tender for central government construction projects must be operating at Level 2 Building Information Modelling (BIM) maturity. However, since the launch of the UK Government Construction Strategy, and a year on from the official mandate, while some organisations have embraced this new way of working and are clear of what Level 2 BIM entails, others remain somewhat confused and lack an understanding of what is required of them complying with the mandate. Moreover, there has been a raft of industry surveys, year-on-year, from various institutions, organisations, bodies, etc. along with trade journal articles, academic papers, and other literature, all reporting on the adoption of BIM in the UK AEC sector. This paper aims to provide a critical review of the key literature to explore the perception, industry awareness, and level of implementation of the Level 2 BIM requirements a year on from the official mandate.

Keywords: UK AEC Industry, Building Information Modelling, Level 2 BIM Requirements, Perception, Awareness, Implementation

1. INTRODUCTION

The UK construction industry has been a consistent poor performer compared to other industries over many decades. A series of reports such as Bossom (1934), Simons (1944), Banwell (1967), Latham (1994), Egan (1998), Wolstenholme (2009), and the more recent Farmer (2016) have continually criticised the nature of the industry; describing it as “fragmented” and “incapable of delivering value for its customers”. The concern was so great that the government set up the Construction Task Force, Chaired by Sir John Egan, which resulted in the publication of the ‘Rethinking Construction’ report. Within this report, Egan called for better ‘integrated processes and teams’. Some 12 years on from the Rethinking Construction report, Wolstenholme (2009) suggested that the industry had made some improvements. However, the Government Construction Strategy report Cabinet Office (2011) concluded that the industry continues not to provide value for public sector construction and called for greater collaboration through Building Information Modelling (BIM) and higher levels of standardisation. Furthermore, the recent industry report ‘The Farmer Review of the UK Construction Labour Model’ (Farmer, 2016) once again echoes similar issues regarding the nature of the UK AEC industry.

BIM is an approach that has evolved over the last 30-40 years in response to improving the low productivity, inefficiencies, adversarial nature, etc. through a change of culture to the traditional nature of the construction industry. Moreover, while numerous definitions exist, in essence BIM is recognised as not just being about technology, but also process and people in

relation to generating and managing digital information about a built environment asset during its whole life (Eastman et al., 2011; Lee, Sacks, & Eastman, 2006). From April 2016, through its Construction Strategy, the UK Government mandated Level 2 BIM as a minimum requirement for construction suppliers tendering for centrally government procured projects in a bid to increase productivity, communication, reduce cost by 20%, and delivery value (NBS, 2014). The UK Government BIM Task Group (2011) define BIM as “... *other than a digital-tool set you do not actually use BIM, it is way of working, it is what you do, information modelling and management in a team environment which facilitates collaborative working and shared understanding*”. In addition, the UK Government BIM Task Group has defined BIM in terms of a number of 'levels of maturity' in relation to progressively moving the construction industry to 'full' collaborative working; within a range from 0 to 3 (Figure 1). Starting at Level 0, this describes unmanaged CAD (Computer Aided Design), whereby there is no collaboration and only 2D CAD drafting is utilised, mainly for Production Information. Level 1 represents managed CAD in 2D or 3D to BS1192:2007, with the electronic sharing of data being carried out through a common data environment (CDE); however models are not shared between project team members. Level 2 is distinguished by collaborative working and involves the development of built environment asset information in a collaborative 3D environment with data attached, but created in separate discipline models. Level 3 (Digital Built Britain) (DBB, 2014) is currently perceived as the 'holy grail' and a real game changer in representing 'full' collaboration between all disciplines whereby all parties can access and modify a single, shared project model, through a centralised repository (i.e. 'Open BIM'); removing the final layer of risk for conflicting information (BSI, 2017; NBS, 2014). Moreover, the life-cycle management of the built environment is enabled through digital procurement based on a data-driven approach, which not only embraces the capital delivery and operational management of assets, but extends to performance management across assets, sectors, society/ies, etc.

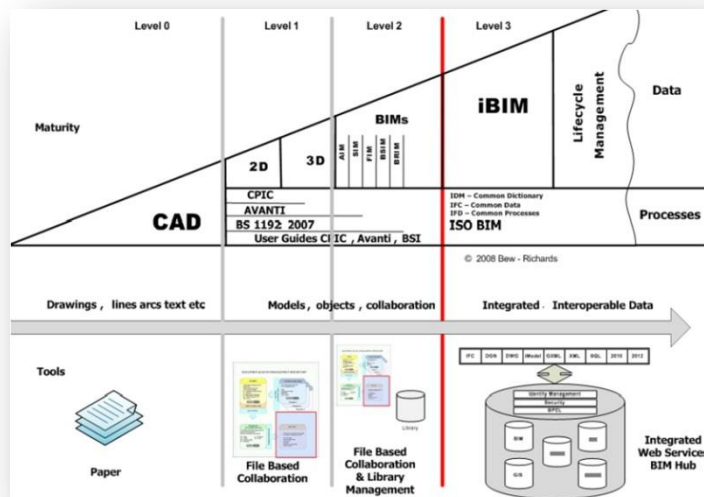


Figure 1: BIM maturity level definition (BSI, 2017)

Although there are numerous studies justifying the benefits of the adoption of Level 2 BIM in the UK (BSI, 2016; Payneni, 2016), research carried out by the Chartered Institute of Buildings (CIOB) (2016), National Building Specification (NBS) (2016), and BRE (2015) suggest that the Architecture, Engineering, and Construction (AEC) industry is somewhat

confused as to what the Level 2 BIM requirements are together with having differing perceptions of them, which in turn, leads to differing levels of implementation. Furthermore, there has been a raft of industry surveys, year-on-year, from various institutions, organisations, bodies, etc. along with trade journal articles, academic papers, and other literature, all reporting on the adoption of BIM in the UK industry. This paper aims to provide a review of these reports in order to explore the perception, awareness and implementation of the Level 2 BIM requirements by the UK AEC industry. In addition, the vast majority of the literature relating to BIM is primarily focused around the technological aspects, rather than the people aspects. Such shortcoming is also highlighted by Deutsch (2011) whereby he describes this as ‘people problems’. This paper therefore also seeks to address this research deficiency around the Level 2 BIM requirements that currently exists. Finally, this paper aims to answer why the differing interpretations exist and provide a more balanced overview.

2. LEVEL 2 BIM: THE REQUIREMENTS

The AEC industry has faced huge challenges with respect to fragmentation and the CAD system inefficiencies. Although there is evidence from surveys carried out by National Building Specification (NBS), which suggests that things have improved, there are still misunderstandings and differing interpretations of BIM and its different levels of implementations.

To be deemed BIM-compliant, the AEC industry has adopted the ‘BIM Levels’ concept in a bid to take the industry from the drawing board to the digital age, which according to National Building Specifications (2014), this is now the accepted term to define the criteria of the requirements. The BIM Industry Working Group (2011) suggests that by defining levels it “enables concise descriptions and understanding of the processes and takes some of the ambiguity out of the word BIM”. This also corresponds to the GCS (2011) report, which argues that “distinct and recognisable milestones being defined within the BIM process, in the form of ‘levels’ providing clarity and transparency to the supply-chain and enable the client to understand precisely what is offered by the supply-chain”. Most of the literature and research is in complete agreement that BIM level definition is a positive step towards a structured ‘learning’ progression and understanding of the level of experience of the construction clients and their supply chain currently possesses.

Although everyone understands the UK Government’s BIM levels of maturity definitions that range from 0 to 3, as set out by the UK Government BIM Task Group (2011) (Figure 1), debate exists in relation to the specific meaning of each level, particularly Level 2 due to this level being the first mandatory BIM requirement from 2016 (NBS 2014 and Turpin 2016). In the BIM Task Group (2011) report, ‘the body set up by the government to be at the forefront and oversee the implementation of Level 2 BIM’, the Level 2 requirements is defined as “a series of domain specific models with the provision of a single environment to store shared data and information”.

However, this definition is somewhat imprecise and lacks detail. Fortunately, the NBS BIM surveys that have been carried out from 2011, and following its publishing of the 2014 report, continues further by defining the requirements of Level 2 BIM in more detail. It prescribes that “Level 2 BIM requires stakeholders to use their own 3D CAD models, but not necessarily working on a single, shared model; with the collaboration coming in the form of

the information exchanged between different parties through a common file format”. Payneni (2016, p 29) also agrees to an extent, but expands further, stating that “Level 2 BIM adaptation requires the stakeholders to consider issues beyond 3D modelling and have procedures in place for collaboration and communication”. Therefore, it is evident that the Level 2 BIM requirements are defined and interpreted differently by various organisations and therefore, it follows, that there is still ambiguity about the Level 2 requirements definition, mainly in part according to Paul Oakley (2015) (a director at BRE), due to the overabundance of definitions of the Level 2 BIM requirements and the lack of a single source in order to ascertain those requirements. Therefore, this is somewhat ironic considering the BIM fundamental principal of information being delivered from a single source. Despite the above mentioned pitfalls, the best single source of information delivery regarding the Level 2 BIM requirements, according to BRE (2016), is PAS1192-2:2013, PAS1192-3:2014 and PAS 1192-5:2015; which defines the requirements as “a development of information models that reference, federate or exchange information with other models within a common data environment such as Industry Foundation Class (IFC) or Construction Operations Building Information Exchange (COBie)”. Additionally, this definition recommends that the technology used by each stakeholder must be capable to export to IFC or COBie file formats. The former being “a standard data format facilitating interoperability between different software systems”, while the latter is “a spreadsheet data format for the publication of a subset of building model information” (RICS, 2014). The adaptation of this definition is paramount as it stirs the focus of the review presented in the paper.

3. RESEARCH METHODOLOGY

The scope and focus of the exploratory study presented is on establishing an understanding of the holistic perception, awareness and implementation of the Level 2 BIM requirements by the UK AEC industry through a critical analysis of the vast governmental, industry and academic literature published to date, since the launch of the UK Government Construction Strategy and Level 2 BIM mandate. Therefore, the approach adopted to conduct this research is secondary data analysis, based on both qualitative and quantitative form due to the nature of the various sources. This approach is best defined by Glaser (1963) as “the study of specific problems through analysis of existing data, which were originally collected for another purpose”. Furthermore, Naoum (2013) describes this method as a “very useful comparative tool for existing and new data to examine differences, patterns or trends”. The selected data has been sourced from a wide range of key sources, including official governmental statistics and industry and academic reports, journal and conference papers, trade journal articles, etc. (Figure 2).

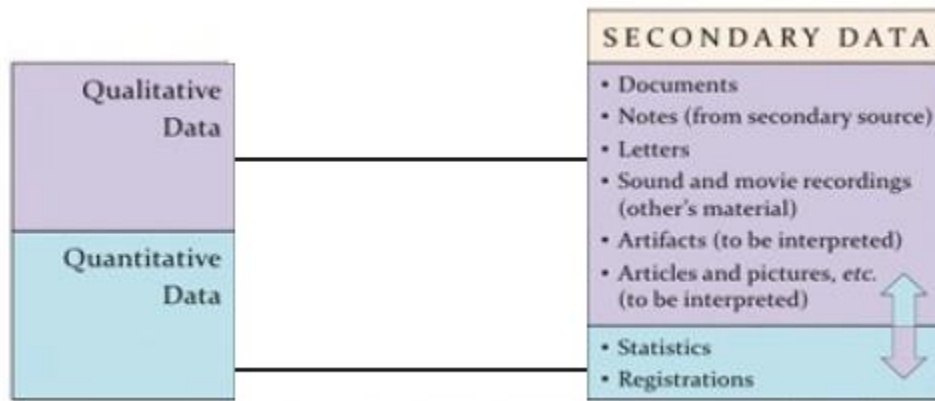


Figure 2: Secondary data analysis approach (Naoum, 2013)

4. ANALYSIS AND FINDINGS

4.1 Perception of Level 2 BIM

According to the Oxford Dictionary (2017), ‘perception’ is “the way in which something is regarded, understood, or interpreted” and as Turpin (2016) illustrates in his piece in ‘BIM Plus journal’, when things are open to interpretation it leads to differing opinions and ambiguity. Eastman et al. (2011, pp. 19-26) argues that the backbone of any technology or process implementation relies on the perception of people and unless BIM is clearly defined from a single source, then it is left open to interpretation, leading to differing levels of adaptation; which, correlates to Enegbuma et al. (2015) findings that “there is a significant relationship between process perception and Level 2 BIM adoption”. Furthermore, Graham (2017) argues that the confusion over the Governments 2016 Level 2 BIM mandate has led businesses to lie about their BIM maturity level due to the ‘adopt or die’ nature of the mandate, and also argues that the confusion over the requirements has led to businesses being BIMwashed; a term used by the AEC industry to describe the misconceptions of Level 2 BIM requirements and the organisations that are trying to BIMwash businesses on the basis of ‘compliance’ with the mandate (BIM Plus, 2017). It is clear that since the launch of the UK governments construction strategy, back in May 2011, there has been a considerable amount of confusion over what the requirements entail. However, the governments launch of the BIM Task Force in 2016 has improved the perception of Level 2 requirements through a series of documents, which, according to Simpson and Underwood (2016) are the “eight pillars of BIM”. These documents include PAS 1192-2:2013, PAS 1192- 3:2014, BS 1192-4:2014, PAS 1192-5:2015, Digital Plan of Works (dPOW), CIC BIM Protocol, Classification (Uniclass 2015) and Government Soft Landings (GSL).

Every year since the 2011 government construction strategy report, a plethora of studies and annual surveys have been carried out by such industry bodies and organisations such as the Chartered Institute Of Building (CIOB), National Building Specifications (NBS), Construction Manager in partnership with BIM Plus, Pinsent Masons, to determine the level of BIM maturity in the UK AEC industry and in particular, the perception of the Level 2 BIM requirements. However, the data from 2011-2014 does not include Level 2 BIM specific questions and is BIM generalised in the survey questions. The NBS (2017) has carried out surveys with around 1000 respondents each year from 2010-2016, and they show that the use of BIM has increased from 3% in 2011 to 54% in 2016. Furthermore, from the 50% using

BIM in 2015 and the 54% using BIM in 2016, 18%-28% believe that BIM is about software and 11%-15% believe it to be a 3D CAD synonym. Moreover, from 2014-2016 the NBS included a question about “trust in what they hear about BIM”; to which, the answer was that 27%-29% of the 3000 respondents over that three year period did not trust what they had heard about BIM.

The perception of Level 2 specific data from the NBS survey shows that in 2014; 51% of the 61% using BIM were claiming to be at Level 2 BIM, which grew to 59% from the 50% using BIM in 2015, and is currently at 65% of the 54% using BIM in 2016. However, these figures are somewhat contradictory, as in the same surveys, 64% are not clear about what they have to do in order to meet the 2016 government mandate, and only 10% believe they are ready to meet the mandate. Moreover, this is also reflected in the Pinsent Masons (2015) survey, where 72% of the 600 respondents believe the industry will fail to meet the mandate due to a lack of understanding of the requirements. The Civil Engineering Contractors Association (CECA) (2015) survey echoes those findings and finds that only 26% of organisations expected to meet the mandate. The gap in perception against the realities and possibilities is highlighted further by the NBS (2016) and CIOB (2016) surveys showing that 77% (NBS) and 58% (CIOB) of the respondents are not using COBie; while 65% of the 54% using BIM in 2016 claim to be working at Level 2 maturity. This according to Boutle (2017) underlines the communication challenge the AEC industry faces within itself, the supply chain, and its clients. More concerning, the BIM+/CM (2017) and CIOB (2016) surveys report that clients have a far worse perception of BIM and the Level 2 requirements, as put simply by Guthrie in Chevin (2017), who stated that “Clients still do not understand what they are asking for or what BIM is. The majority do not have any idea and basically see BIM as a cost”. The survey also reports that the number of clients making Level 2 BIM a requirement on their projects has fallen from 25% to 20%. This decrease, according to Francis Ho in Chevin (2017), can in some way be attributed to Brexit as it has “robbed a bit of the momentum from BIM”.

4.2 Awareness of Level 2 BIM

The Oxford Dictionary (2017) defines ‘awareness’ as “having knowledge or perception of a situation or fact”. It is clear to see that the UK BIM Task Group, since it was established in 2011, has according to Ravenscroft (2016), been successful with defining and increasing awareness of Level 2 BIM within government departments. However, the government has stated that the responsibility of moving Level 2 BIM from mobilisation to ‘business as usual’ should be with the industry and as such, the cross industry UK BIM Alliance was formed in 2016 to drive Level 2 BIM adaptation and increase awareness across all sectors of the AEC industry; not just for centrally procured public sector projects (UK BIM Alliance, 2016).

According to a report published by the UK BIM Alliance (2016), knowledge and awareness of Level 2 BIM is growing, but it is inconsistent and in some cases, diverging. This was confirmed by their survey, whereby awareness factors such as guidance, publicity, and access to good speakers were amongst those cited as some of the main challenges to Level 2 adaptation. Moreover, these findings are also mirrored in the CIOB (2016) survey, which highlighted that 70% of the respondents acquired Level 2 BIM information from colleagues with a further 60% from colleagues outside their organisations. This, according to Kemp in Ravenscroft (2016) points towards a lack of a ‘single source information’ and recommends that the 50 organisations that currently make up the alliance should increase awareness through clear guidance that is easily understandable, obtainable and spoken with the same

powerful voice. Moreover, according to the Chartered Association of Building Engineers (CABE) (2015) survey of 1200 respondents, an overwhelming 96% replied that there is a need for greater awareness and training in BIM in order to achieve the mandate.

The NBS surveys carried out from 2011-2016 (NBS, 2016) suggest that awareness of BIM in general has increased from 58% to 96%, and in that same period the awareness of different BIM levels has improved from 51% to 77%. In contrast, the same survey shows that in that same period, the use of IFC and COBie; the file format that is independent of software vendors and supports collaboration and is a key requirement of Level 2 BIM, has only increased from 39% to 63% (IFC), and 15% to 27% (COBie). This, according to NBS (2016) is due to a “lack of awareness and skills across the board as people do not know what to do with a COBie spreadsheet and most clients (even government departments) are barely up to speed with CAD drawings let alone COBie”. The survey findings echo Mallesen in Dunton (2016) school of thought, suggesting that the construction industry is ‘Level 2 BIM positive’, but not ‘Level 2 BIM aware’. All the evidence for this, Hunt (2015) believes, points towards a “disproportionate amount of awareness being given on the use of BIM software alone with too little invested in the collaborative working and common working practices that truly lie at the heart of a BIM-based approach to project delivery”. Furthermore, according to Boutle (2017), the level of knowledge is even worse down the supply chain, where a good proportion still struggle with BIM Level 1 (BS1192: 2007). Furthermore, the figures from the CABE (2015) survey further support this claim as they found that 71% of the non-manufacturing respondents believe that suppliers are not engaging quickly enough to provide Level 2 BIM collaboration. Moreover, this also corresponds to the NBS (2016) BIM report stating that “all the evidence points towards the people are using standards, but fewer use the range of standards than have adopted BIM”.

4.3 Implementation of Level 2 BIM

The UK Governments 2016 mandate has been brought in with the objective to take the AEC industry towards a more productive, less wasteful and fragmented direction, and according to Davidson (2014), Level 2 BIM implementation will go a huge way into achieving the governments objective, but also represents a stepping stone for a more data driven, digital and a smarter industry with dynamic collaboration at the heart of it. Although, there is an abundance of literature and industry agreement as to the benefits of Level 2 BIM implementation (Ghaffarianhoseini et al 2016, Johnston Partnership 2017, NBS 2017, and Payneni 2016), there is also evidence that suggests there is a long way to go before the industry can claim to have met the mandate, pointing to a lack of understanding of Level 2 defining standards (NBS 2016, UK Construction Week 2015, Blackman 2015, Schouten 2015, CIOB 2016, and Simpson and Underwood 2016). The NBS (2016) BIM report in particular, suggests that Level 2 BIM implementation has increased to 65% amongst the 54% that were using BIM overall. However, the report also suggests that faith in BIM is not being matched by progress, which according to Boutle (2017), is due to the lack of interest from small companies in relation to the cost implication of BIM. Furthermore, Schouten (2015), Blackman (2015), Eadie et al. (2015) and Robson (2014) concur with Boutle, and also stipulate further that the implementation of Level 2 BIM is being held back somewhat by subcontractors and the supply chain, which they cite that “Level 2 adoption is primarily client driven and is not necessarily being used to improve internal workflows and efficiencies by harnessing technology and process”. In contrast, Chevin (2017) expresses some scepticism as to whether low implementation is limited to the supply chain; arguing that the client, be it

from central government departments or the private sector are not making Level 2 BIM a mandatory requirement on their projects. To this end, the Construction Manager and BIM Plus (2017) survey confirms that Level 2 BIM progress is unlikely to be client driven, and the results from its 392 respondents show that only 38% of the central government departments make Level 2 BIM mandatory on all projects, while 23% do not make it a requirement at all. Furthermore, only 11% of the private sector demanded Level 2 BIM on all projects, with 50% not at all. Shepherd (2015) and Boutle (2017) are in agreement that part of the reason for the lack of client enthusiasm towards Level 2 implementation is that “often BIM costs more in the capital phase, rather than delivering savings via efficiencies gained therein, perhaps putting clients off to the initial investment to realise lifecycle benefits”. However, Shepherd (2015, p 9) suggests the industry is seeing some signs of improvement through increased affinity of BIM strategy with client strategy.

One of the main benefits of Level 2 BIM is collaboration through an open common project file sharing format such as IFC or COBie and understanding of whole-life performance of buildings. However, NBS (2016) reports that the industry is barely scratching the surface. Regarding the uptake of IFC and COBie, the NBS survey notes that 63% of organisations polled said they were using IFC and just 27% were using COBie; an increase of 9% (IFC) and (COBie) from the 2015 NBS survey. Although a good annual increase for both, COBie is much less used, which according to NBS (2015) is perhaps due to that the “whole Excel sheet concept contradicts the fundamental principle of a common data environment”. However, the NBS (2016) report and Eadie et al. (2015) presents a different view, and note that from the small number who use COBie, two thirds find it useful and concludes that “the slow rate of adoption may be as a result of BIM models being restricted to the design stage as opposed to the whole life of the building”.

In contrast, Ghaffarianhoseini et al. (2016) and IStructE (2016) present a valid point and instead, point to a lack of skills, cyber security and legal concerns over the ownership of data/design, and liability when something goes wrong as the reasons for the slow uptake of Level 2 BIM. Utiome (2010) and Enegbuma et al. (2015) present a different view, arguing that cultural change is a huge factor in the implementation of any new system of working, especially in the AEC industry, which has always been resistant to change of its organisation structure.

Another school of thought is presented by Simpson and Underwood (2016), which points to a lack of use and understanding of PAS 1192-2 (the standard that defines Level 2 BIM Capex delivery). To this end, the results of the Institution of Civil Engineers (ICE) (2016) survey suggests that although the industry is showing good progress in its Level 2 BIM implementation, for most large companies, unfortunately there is continued resistance from people to review the BS/PAS 1192 family of documents and continued confusion around the acronyms associated with them. The ICE findings are further supported by the NBS (2016) and CIOB (2016) reports, which report that 71% (NBS) and 52% (CIOB) of the respective respondents have never used PAS 1192-2 and also report a similar high non-use of the other pillars that define Level 2 BIM, e.g. PAS 1192- 3:2014, BS 1192-4:2014, PAS 1192-5:2015, CIC BIM Protocol, Digital Plan of Works (dPOW), (Uniclass 2015), Government Soft Landings (GSL).

4.4 A year on from the UK Government Level 2 BIM mandate

Just over a year since the UK Government's April 2016 mandate, surveys carried out by the Construction Manager and BIM plus (2017), IStructE (2016) and ICE (2016) report that there has been progress in experiencing of all eight pillars of Level 2 BIM. Furthermore, according to the CM BIM Plus (2017) survey, the number of respondents using Level 2 BIM on ten or more of their projects has almost doubled from 10% to 18%. Interestingly, the surveys also report that awareness of Level 2 BIM has increased from their respective surveys carried out in 2016. However, the IStructE survey reports that 40% of the smaller practices and 60% of the sole practitioners do not see BIM as relevant to their business. These statistics reflect Dainty et al. (2017) view, which suggests that political reform agendas centred on BIM may actually be "disenfranchising small firms that are unable (or unwilling) to engage with them".

Furthermore, the IStructE report also suggests that not enough directors or principal staff are being trained in BIM; reporting that 50% of those being trained are graduates, while only 9% are senior staff. The chairman of ICE, David Shields, commenting on the report, recommends that more management are required to be trained in order to be at the forefront and act as BIM champions, as the current levels of training according to him may be compounding the problem of cultural change. To this end, Oliver (2017) suggests "the reality is that embracing BIM and reaping these benefits remains a cultural not technology challenge", and as technology develops further, managing people, process and cultural change will be the main challenge. Bew (2017), Head of the Digital Built Britain Strategy, agrees to an extent, but also points to the fact that "the UK has the biggest cohort of skilled data-aware engineers, designers and suppliers, which places the UK at the front of the queue to capitalise on the next stage". Although smaller practices, training and cultural change are clearly factors restraining Level 2 BIM uptake, a lack of clients enforcing the mandate is also identified by the CM BIM Plus survey, which reports that only 38% of central government departments respondents currently make Level 2 BIM mandatory on all projects, while that figure is much lower at 11% in the private sector. A further reason for the low mandate implementation figures may be due 'weak government messaging' such as seen in the recently released Housing White Paper, which did not contain a single mention of BIM/Digital Construction (Ruddle in BIM Plus, 2017).

5. DISCUSSION AND CONCLUSIONS

The findings presented show that the definition of the Level 2 BIM requirements is open to interpretation, based on the different circumstances in which they are applied, be it from organisations or even individual users. While there is industry wide understanding of the different levels of BIM, the literature is split on the exact definition of the Level 2 BIM requirements. However, although different views on what defines Level 2 requirements are presented in the literature, a common aspect to these views emerge, which states that Level 2 BIM facilitates collaboration. Therefore, if the varying definitions are to be adopted then the argument will be ongoing. On the other hand, if the holistic definition based on the common aspect of those differing definitions is to be adopted, then on that basis, collaboration is the common ground that the differing interpretations of Level 2 BIM agree upon. Thus, going forward, industry or individuals should undertake a level of research when seeking the definition of Level 2 BIM; while always following the official Level 2 BIM defining BS/PAS1192 standards.

In addition, the paper aimed to explore the perception of Level 2 BIM among the UK AEC industry. On the one hand, literature argues that the differing perceptions emanate from the approach in which Level 2 BIM is put to use in different organisations. However, on the other, literature suggests that perceptions also vary from team to team, and shows that perceptions of the design team vary from those of the client, the contractor, and those of the supply chain. It is hard to gauge an exact measurement of the statistics on perceptions of Level 2 BIM overall, as they vary in numbers and participant types from survey to survey. However, a holistic picture of the surveys studied emerges, showing that there is a clear disparity between the number of firms saying they have achieved Level 2 BIM maturity and the number claiming to use IFCs and COBie information sharing and the Level 2 BIM defined by PAS1192-2:2013. Therefore, the findings presented indicate that the actual number of organisations that have reached Level 2 maturity is much lower than that to which they perceive themselves to be at. Design teams should engage more with clients in particular to make clear the advantages of Level 2 BIM as a cost reducing process over the lifecycle of the project, as they are the group with the perception of Level 2 BIM as a mere cost, rather than adding value.

Moreover, another aim was to explore the level of awareness of the Level 2 BIM requirements within the UK AEC industry. It would appear that overall they agree that the awareness of BIM has increased dramatically from 58% in 2011 to 96% in 2017. Moreover, the literature also mirrors the survey findings and suggests that the awareness of Level 2 BIM is diverging due to a lack of access to information from a single source; also highlighting that there has been an unequal amount of awareness given about the technology side of Level 2 BIM and not enough on collaborative working aspect. The surveys also point to a lack of awareness of the eight pillars of Level 2 BIM, which is reflected in the in the low percentages of organisations claiming to be aware of what they are. The UK BIM Alliance together with educational institutes should increase awareness of collaborative working and the eight pillars of Level 2 BIM, through a single point of information and using a common language to reduce confusion and ambiguity. Finally, this paper has also explored the implementation of Level 2 BIM within the UK AEC industry. The literature and surveys are in agreement that this has slowly increased among all users, but more so with the large organisations. However, they disagree on the current barriers of Level 2 BIM uptake. On the one hand, literature alludes to small organisations being the reason for the low uptake, while on the other, it is suggested that it is due to the supply chain. The statistics of the surveys, however, point towards a lack of mandate enforcement from the central government departments and a lack of use of the BS/PAS 1192 suite of standards as the reasons for the slow implementation of Level 2 BIM. Furthermore, since the mandate came into force, the literature and surveys report that the supply chain and small organisations have no interest in adopting Level 2 BIM. The findings of this paper conclude that Level 2 BIM is slowly being implemented, however, it is being used as a mere bit-part tool instead of a whole lifecycle process. This trend has also continued after the mandate has come into force, indicating that enthusiasm is not matched by the uptake of Level 2 BIM. The UK BIM Alliance should increase awareness further among clients and the supply chain in order to reveal the true benefits of BIM as a process, not a mere tool for a certain stage of the design, construction or maintenance phase, but across the whole life. Furthermore, the UK Government should also be relentless in its continuation of delivering a strong message that BIM/Digital Construction is the future of transforming the UK AEC industry.

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CLOUD COMPUTING FOR DISASTER RESPONSE MANAGEMENT STEMMING FROM TERRORISM IN IRAQ

H. Al-Dahash¹, S. Al-Shammari², U. Kulatunga¹ and M Hardman³

¹ *School of the Built Environment, University of Salford, Salford M5 4WT, UK*

² *Computer Engineering Department, College of Engineering, Al-Nahrain University, Baghdad, P. O. Box 47077, Iraq*

³ *Salford Languages, University of Salford, Salford M5 4WT, UK*

Email: H.F.Al-Dahash@edu.salford.ac.uk

Abstract: Effective response to disasters requires assessing information prior to, during, and after potentially catastrophic events, as well as initiating activities that will lessen their impact upon society. The post-war transitions in Iraq have affected the institutional capacities of the state to respond in an efficient manner. Although the draft National Disaster Risk Reduction Law acknowledges the importance of information and knowledge management, it fails to provide a framework for establishing a dedicated information system. Due to the importance of an effective and efficient disaster management information system, this should be linked to local authorities, local early warning systems, and the media, to ensure effective use of disaster risk information for public awareness. The fact that disaster management data is often complex, large, and from different organisations, this requires a fast, scalable and accessible system to manage the complexity of the collected data. As cloud computing is considered a technology for providing synchronous, on-line information management with accessibility of data regardless of the storage resources' location, this paper highlights the advantages of using cloud computing in managing information and communication in disaster response management, with particular reference to terrorism in the context of Iraq. The paper contributes to the existing knowledge on disaster response management, a field of study that is still largely under explored in the context of the Middle East, and in the context of terrorism more specifically, by reviewing its literature, through a systematic review methodology. This paper will focus, therefore, on the use of cloud computing as a solution to information sharing and communication, during the immediate response to a terrorist attack, due to the advantages of cloud computing in this context, in terms of data availability, reliability, IT and cost reduction.

Keywords: Cloud Computing, Communication, Disaster Response Management, Information System, Terrorism.

1. INTRODUCTION

In light of increasingly frequent and catastrophic attacks, particularly terrorist attacks, on public and private infrastructure, in Middle Eastern countries such as Iraq, disaster response management is becoming an increasingly important research topic (Hale, Dulek, & Hale, 2005). According to recent literature, the 'response' stage of the disaster management cycle is arguably the most critical, the other two stages (prevention and recovery) are not at the point of crisis and therefore there is time for thought and planning. Response is the point when decisions are made that may save lives and contain the attack in terms of impact (Hale et al., 2005). The unique environment present during disaster response (immediate risk of significant loss, time pressure, and stress) requires research effort in order to save lives and property (Hale et al., 2005). Terrorist attacks can cause high-rise building collapses, major nuclear facility malfunctions, and catastrophic damage to infrastructure, and these pose an

ever-present challenge to public emergency services (Meissner, Luckenbach, Risse, Kirste, & Kirchner, 2002).

Terrorist attacks often occur without warning, in order to have the most serious impact on lives and property, therefore, there is no time for long negotiations or prearrangements for different stakeholders, such as public and non-profit organisations. Since these organisations might have little experience in disaster response management activities, under extreme circumstances, different problems can emerge from a fragmented performance, including a lack of coordination, inadequate information exchange, and lack of trust (Comfort, 2007; Nolte & Boenigk, 2013). Appropriate communication decisions within the response stage could, therefore, effectively improve the disaster response by limiting or reducing the impact of the attack. Ultimately, this could save lives and property (Hale et al., 2005).

Achieving coordinated action among several stakeholders depends fundamentally on their access to timely, valid information and their ability to conduct immediate information searches (Comfort, 2002). Pathirage, Amaratunga, and Haigh (2007) asserted that the integration and coordination of resources during the exchange of critical disaster information and knowledge can influence stakeholders' actions, thus enhancing the effectiveness of the response.

The UNISDR and UNOCHA (2008) explained that assistance during a disaster is provided from a wide range of potential stakeholders, such as the military, NGOs, utility companies and private sector entities, and skilful coordination among them is critical to avoid confusion and to facilitate an effective response. The Emergency Operations Centre, for instance, is essential to ensure a clear central focal point and location for coordination. In Iraq, Humayun and Al-Abyadh (2014) identified that there are a number of stakeholders involved during disaster response, namely, the General Directorate of Civil Defence, the Health Department, NGOs, and the Iraqi Red Crescent Society, but at the same time, there is no national platform to organise the efforts of multiple institutions at all tiers of government. Although the draft National Disaster Risk Reduction Law acknowledges the importance of information and knowledge management, it fails to provide a framework for establishing a dedicated information system (Humayun & Al-Abyadh, 2014).

The main challenge after an attack is timely delivery of information and communication for first responders and disaster management workers (Manoj & Baker, 2007). The sharing of information is crucial, yet can also be problematic, since people may have difficulty deciding whom to trust in that moment of disaster (Manoj & Baker, 2007). In order to effectively address the problems in the aftermath of an attack, the optimal provision of information concerning the situation is an essential prerequisite (Meissner et al., 2002). Situational awareness, in terms of understanding the unpredictable circumstances in a terrorist attack, is critical to an effective response. Disaster responders require timely delivery of accurate data in order to make the best decisions at that moment (George et al., 2010). As with all aspects of organisations, government and industry, responders to disasters and other emergency services are almost always reliant on information and communication technology. Yet, in the immediate aftermath of an attack, communication is often limited because infrastructure can be destroyed or the attack may have happened at a place where there was no infrastructure, (Midkiff & Bostian, 2002) Another possibility, in Iraq, is that the authorities sometimes cut the communications technology in the interests of safety and risk reduction of further attacks. For example, terrorists often use mobile technology to detonate devices, so to avoid this potential risk, mobile communications are often cut for a period of time.

Cloud computing is considered the best information technology for managing the complex and dynamic nature of disaster environments (Habiba & Akhter, 2013). Establishing such communication structures prior to the attack can save valuable time and ensure that key government agencies and other stakeholders are empowered to coordinate the disaster response in an effective manner (GSMA, 2012).

This paper aims to highlight the importance of cloud computing in managing information and communication in disaster response management, with particular reference to terrorism in the Iraqi context. Moreover, cloud computing infrastructure could significantly increase the efficiency and effectiveness of disaster response management, by facilitating the sharing of appropriate information and communication between different agencies participating in the response to terrorist incidents. This would provide the opportunity to have an integrated response management information system, this system would therefore link the different agencies together. The use of cloud computing would help to expedite the sharing of information in the crucial minutes following an attack, and hence the overall management response time. However, it is a requirement that the data from different agencies is kept up-to-date and available on time to the authorised agencies at the point of need. As a result, this would provide integration of early warning systems with public alerts, and also enable a timely evacuation of the victims through such a disaster response information system, for the different cities in Iraq.

The new technology era and the tendency to use cloud technology in managing different aspects of life has highlighted a need for a solution to bridge the gap in the current disaster response system.

2. BACKGROUND

2.1 Disaster Response Management in Iraq

The government of Iraq has traditionally responded in a reactive manner to disasters associated with flooding, earthquakes, drought, conflict and industrial accidents (Humayun & Al-Abyadh, 2014). Similarly, Goodyear (2009), also found that historically, there has been a reactive response to crisis incidents in Iraq, whereas a more proactive approach, in terms of planning for potential disaster incidents, by demonstrating a political will to adopt and then adapt proactive mechanisms, would be beneficial. This could be done, for example, by developing a strategic and sustainable all-risk disaster management structure, at the central, provincial/regional and community levels, interlinked with the national development plan. It is widely acknowledged that many essential services are needed to manage hazards, reduce risks and respond to disasters. Unfortunately, in Iraq, because of the war and post-war conflicts, such services have been crippled (Humayun & Al-Abyadh, 2014). In addition to that, the post-war transitions in Iraq have affected the institutional capacities of the state to respond in an efficient manner. Furthermore, it appears that the lack of a national platform to organise the efforts of multiple institutions at all tiers of government have serious limitations for the current institutional and legislative systems for Disaster Risk Reduction (Humayun & Al-Abyadh, 2014). The impact of war in Iraq has therefore had significant consequences and this has been compounded by the natural disasters caused by climate change (Goodyear, 2009), therefore it is necessary to have an integrated solution to the problems facing disaster responders.

Responses to catastrophic incidents rely on the assets and manpower of the central and provincial government and with support from non-governmental agencies and international donors (Goodyear, 2009). Most of the limited disaster response capacity of the Government of Iraq lies in the General Directorate of Civil Defence of the Ministry of Interior and the General Directorate of Public Health and Primary Health Care. In order to respond to disasters, ad-hoc support to the Government of Iraq is provided by the International Committee of the Red Cross, the United Nations, and national/international non-governmental agencies (Goodyear, 2009).

An alarming increase in the frequency of terrorism occurrences has been seen in recent decades. For instance, terrorist attacks in Baghdad have significantly increased since mid-August 2009, following the withdrawal of the Multi-National Forces-Iraq troops (Goodyear, 2009). Violence in Iraq has also become normalised, ranging from the Iraqi and US military assaults and sectarian militias, the threat of suicide bombings, to violent street crime (Wong, al-Saiedi, & Silva, 2005). According to the Statistic Department (2016), more than 270,000 terrorist incidents took place in Iraq between 2009 and mid-2016. Iraq has experienced considerable internal conflict, causing the well-being of the population to be damaged, with the internal displacement of over 2 million people (Goodyear, 2009). To lessen the threat of violence and terrorism, at the Central Government level, several institutions have been created to respond to disaster incidents. These are coordinated and led by the National Operations Centre, (NOC), which was established to present the Office of the Prime Minister with information pertaining to risk levels regarding acts of terrorism (Goodyear, 2009). The Crisis Action Cell, which was formed in November 2006, was a group made up of the National Security Advisor, Ministers of Defence and Interior and the Prime Minister's Chief of Staff. This was a national-level crisis management team tasked by the National Security Council and the Prime Minister, with the authority to lead and manage all the line Ministries. However, the Crisis Action Cell does not seem to still be in effect (Goodyear, 2009).

At the provincial or regional level, in 2006, the Prime Minister and the Governors established the Governorate Emergency Cells (GECs) as new structures. GECs were established in nine of the 18 governorates in Iraq: Missan, Kerbala, Wassit, ThiQar, Erbil, Sulaymaniah, Dahuk, and Babylon. Each GEC, chaired by the Governor of the region, operates a response function with members of the local branches of line ministries addressing local crises in accordance with their respective aptitudes and resources. Goodyear (2009) points out that some of the GECs have begun to develop their own emergency preparedness strategies to respond to localized crises.

The involvement of communities in the design and implementation of activities helps to ensure that they are well aware of the actual vulnerabilities and needs of the affected people (UNISDR & UNOCHA, 2008). Early warning and information systems are key tools for mitigating disaster impacts, but in addition, there is also a need for information systems to support longer-term risk assessment and monitoring, focusing on vulnerability as well as hazards, as a basis for disaster risk reduction initiatives within a development framework (Goodyear, 2009). People must be properly informed of the risks they face as well as what they can do to reduce the risks, making decisions based on reliable disaster risk information from hazard mapping and vulnerability assessment (Goodyear, 2009).

2.2 Cloud Computing

The term ‘cloud computing’ refers to providing services by supplying IT resources (such as storage, computing, and networking) on the internet (Sarna, 2010). Cloud services and resources are used in a pay as you go way, so that cloud users can use the service without the need to install the cloud applications on their machines (Vaquero, Rodero-Merino, Caceres, & Lindner, 2008). This introduces many advantages to cloud users, in terms of reducing the infrastructure resource cost and improving the process of developing these applications, which is achieved by saving the need for IT maintenance, which is managed by the cloud providers. The use of the cloud provides an elasticity feature through extending the used resources in the providers’ servers, the cloud user is not responsible for managing the resources for data storage. Cloud computing is based on the virtualization technique, which insulates the cloud software from the underlying hardware resources. This isolation ensures the availability of data in case of infrastructure destruction (Rittinghouse & Ransome, 2016).

Three main services are defined in cloud computing; these services are: Infrastructure as a Service (IaaS): which represents the computing and storage resources used in the cloud; Platform as a Service (PaaS), which is used by the application providers to develop their applications; and Software as a Service (SaaS), which introduces the cloud applications used by the users through a web browser without the need to install these services (Mell & Grance, 2011).

3. LITERATURE REVIEW

The importance of sharing knowledge and ensuring availability and reliability of disaster information was discussed by (Pathirage et al., 2007). The authors highlighted the need to share knowledge in disaster management (natural and manmade), and mentioned that disaster knowledge and practitioners are still in the individual domain and that coordination is required among the different groups. This could help in preparedness and mitigate the effect of disaster, in addition to providing better warnings.

A study presented by Alazawi, Altowaijri, Mehmood, and Abdljabar (2011), suggested the use of cloud computing for developing a vehicular disaster emergency response system, focusing on the transportation system using Vehicular Ad hoc Network (VANET). This was considered by gathering the data from different sources and providing it to the people in vehicles and other actors in the system. Although the study considered Al-Ramadi city in Iraq, the research was dedicated to the transportation system only, overlooking managing the data among the different government’s response management agencies.

The study presented by Hitachi (Ogasawara, Tanimoto, Imaichi, & Yoshimoto, 2014) proposed a solution for disaster response and prevention based on the information collected from ‘Social Network Services’ (SNS) such as Twitter and blogs, sensors and field reports. However, the authors discussed the importance of including the SNS data in decision making, but they mentioned the possibility of including false reports and rumours. In contrast, the proposed solution in this paper would take data from authorised agencies and this would ensure the reliability of the collected data.

The need for using cloud computing as a solution in disaster management has been discussed by several researchers, although not in the context of Iraq. Velez and Zlateva (2011)

discussed the main principles of cloud computing and the need for considering it in a disaster response management system. The authors mentioned the advantage of cloud computing in reducing the cost of recovering the data after the disaster, as an internet connection is enough to connect to the cloud servers. This study has been extended by Velev and Zlateva (2012) to discuss the importance and feasibility of considering the cloud as a solution in emergency systems of disaster management, and highlighted the need for a backup system to manage the disaster information. The author argued the need for a platform to facilitate the information sharing and collaboration among the central and local governments, organizations and companies.

The use of cloud computing for managing natural disasters was first introduced by Habiba and Akhter (2013). The authors argued that cloud computing is the best solution for managing disaster situations because of its capabilities of managing the significant amount of complex disaster data. They proposed a management system using web Amazon (web services). Again, this research was solely focused on natural disaster management and overlooked the effect of manmade disasters.

Zong, Li, Yang, He, and Velev (2016) proposed using cloud computing for managing natural disasters in China. Although the authors discussed natural disasters, in doing so they overlooked discussing manmade disaster and, particularly, terrorism. They also discussed the fact that the telephones are overloaded in disaster periods, where the use of the cloud could help to improve the disaster emergency management by providing real-time data. They concluded that cloud computing is considered a mature solution for disaster management.

The study presented by Zou (2017) discussed the use of cloud computing to manage the data collected from the various sensors for disaster monitoring. The authors mentioned the need for a fast and automatic solution for disaster management, and proposed the collection of data from various spatial sensors before extracting the required data using cloud computing.

4. GAPS AND CHALLENGES

4.1 Information

Effective directing of resources, when responding to terrorist incidents, requires assessing information prior to, during, and after such events. According to Ren, Kiesler, and Fussell (2008), due to sparse empirical studies in the area of sharing and coordinating information, little is known about the challenges and obstacles when it comes to sharing and coordinating information effectively. It is widely believed that effective response to both natural and man-made disasters requires assessing information prior to, during, and after potentially catastrophic events, as well as initiating activities that will lessen their impact upon society (Belardo, Karwan, & Wallace, 1984). Moreover, to create and orchestrate an effective disaster response and recovery effort, obtaining accurate information about the extent, impact, and scope of the disaster is critical (Madry, 2015). Goodyear (2009) supports this view, stating that information plays an extremely important role in effective disaster reduction and response. Because information quality and quantity is highly unpredictable, it is considered one of the challenges facing institutional systems that are in charge of managing disaster response (Baker & Refsgaard, 2007). According to Sinclair, Doyle, Johnston, and Paton (2012), poor decisions lead to poor disaster management, therefore, more information and practice are desired and needed by local government organisations. George et al. (2010) noted that to respond effectively to disaster, situational awareness in a disaster is critical, as

timely delivery of high volumes of accurate data is required by disaster responders to make correct decisions. Accordingly, Ogasawara et al. (2014) stress that, in the case of large, wide-area disasters, gaps in available information probably lead to the problem of delayed decision making. Such an information vacuum in the immediate aftermath of a disaster can cause fatal delays in decisions for the most urgent lifesaving response activities. Sinclair et al. (2012) added another challenge to this context, which is a lack of awareness of the existence of information about decision making or lack of understanding of its relevance to disaster management from some disaster managers. Therefore, according to Goodyear (2009) due to the importance of efficient disaster risk management information systems, such systems should be effectively linked to local authorities, local early warning systems, and the media to ensure effective use of disaster risk information for public awareness and education, among others. In Iraq, although the draft National Disaster Risk Reduction Law acknowledges the importance of information and knowledge management, it fails to provide a framework for establishing a dedicated information system (Humayun & Al-Abyadh, 2014).

Further, because the complex, dynamic and unpredictable nature of the environment in which many groups of professionals need to collaborate, sharing and coordinating information is very difficult for such groups, and due to collective decision-making, actions are negatively influenced by poor information sharing and coordination during inter-agency disaster response. Therefore, a lack of coordination might lead to a number of possible failures, for example, counter-productive ordering of sequential relief processes, delayed evacuations, and inappropriate allocations of first responder resources, which often result in disaster growth and even higher numbers of casualties (Bharosa, Lee, & Janssen, 2010). Ferdinand, O'Brien, O'Keefe, and Jayawickrama (2012) support this view, stating that poor information sharing meant there were cases of duplication of activities leading to community division and conflict of interests. Moreover, Bharosa et al. (2010) noted that although the people are aware of the need for information sharing and coordination, they find themselves challenged by a lack of information and system quality. Comfort et al. (2003, 2004) stated that different phases of disaster response require different types of information and management skills. They also presented the common assumption in disaster management, that "a lack of information is the basic factor in limiting the efficiency of response among organisations". Further, the efficiency of response actions can be enhanced by accessing core information, as well as coordination throughout the network of responding organisations, which can be increased because cooperation without information is not adequate to raise response effectiveness (Comfort, Ko, & Zagorecki, 2004). Handmer and Parker (1991) added that effective information flow can partially help to overcome a high degree of fragmentation in disaster and hazard management, despite the limited exchange of information in some cases (Handmer & Parker, 1991). Not only that, Comfort (2002) argued that to achieve coordinated action among different groups of people, timely, valid information should be accessed. In addition, they should be able to conduct information absorption search, exchange, search, and adaptation. Accordingly, Madry (2015) stressed that the heart of the disaster response effort is represented by the key information that is accurately updated in a timely way.

4.2 Communication

According to Jones and George (2003, p. 11), "Leadership depends on the use of power, influence, vision, persuasion, and communication skills to coordinate the behaviours of individuals and groups so that their activities and efforts are in harmony". In larger disasters, disaster responders face a huge challenge, which is a lack of communications infrastructure.

Not only that, degraded communications also have a large impact on response, in addition to escalating demands of victims which exhausts the remaining capacity (George et al., 2010). Comfort et al. (2004) stress that if the telephone lines are damaged, communication fails. In addition, communications will be overloaded by an unexpected increase in the number of connections resulting from many people simultaneously switching their communication means from land telephone lines to wireless or cellular, which in turn, makes mobile phones not work. During the 2005 Katrina flood, failures in communication were considered one of the shortcomings in the federal emergency response (Baker & Refsgaard, 2007). However, Banipal (2006) found that the inter-operability issue was a major operational problem experienced during hurricane Katrina. Because the existing system was not scalable enough to support hundreds of additional users, the out of state volunteers were unable to use it. In agreement, Manoj and Baker (2007), stress that the primary challenge of communication break-down was highlighted by disasters such as the 9/11 terrorist attacks and Hurricane Katrina. A problem frequently cited by responders is the lack of radio interoperability. Further, Comfort (2007) stress that the capacity for coordination, among multiple actors, depends on effective communication. Comfort (2007) stated that “if the communication processes do not elicit sufficient shared understanding among the parties to align their priorities for action, the likelihood of achieving a common action framework among multiple actors will be seriously diminished”. Manoj and Baker (2007) noted that the lack of radio interoperability is a primary challenge in responding to both natural and man-made disasters, as different response actors communicate with radios set to orthogonal frequencies. This makes inter-agency communications very difficult. Consequently, when more local, state, and federal agencies become involved, the problem is compounded. Therefore, Smith (2011) found that communication is needed to establish collaborative organisation, particularly within network-type organisations. Smith (2011) also found that communicating with the community affected by the disaster is important, in terms of transparency regarding response operations. Further, according to GSMA (2012), in countries that have highly centralised or authoritarian regimes, coordination between mobile network operators and governments can be difficult in times of disasters. Consequently, to manage the disaster response processes effectively and efficiently, the support of ICT is considered a desirable feature (Saeed, 2012). In addition to that, integration of early warning systems with public alerts, evacuation and disaster response systems across sectors is vital for disaster management (Goodyear, 2009).

5. THE USE OF CLOUD COMPUTING IN MANAGING THE IMMEDIATE RESPONSE IN IRAQ

Due to the lack of connection and collaboration between the different response agencies in Iraq, there are currently some shortfalls in the efficiency and effectiveness of the response. Therefore, it is important to find a way to overcome these challenges. The use of cloud computing is widely used in everyday activities, such as checking emails, social networks, and using Google Apps. In other words, the emergency responders would need a mobile device (like PDAs and mobile phones) and an internet connection to access or update the data in the cloud servers. This would reduce the need for using personal computers, which are difficult to access at the time of disaster. The potential solution lies, therefore, in using cloud computing in the specific context of disaster response management in Iraq. Figure 1 illustrates the main steps of the management process. This includes gathering the disaster data from the different response agencies and saving it in the cloud. The gathered data can be used for making decisions about managing the response process and evacuating the victims from

the scene of the disaster. This also can be used for issuing warning alerts and notifications to the correspondent actors, in addition to the public.

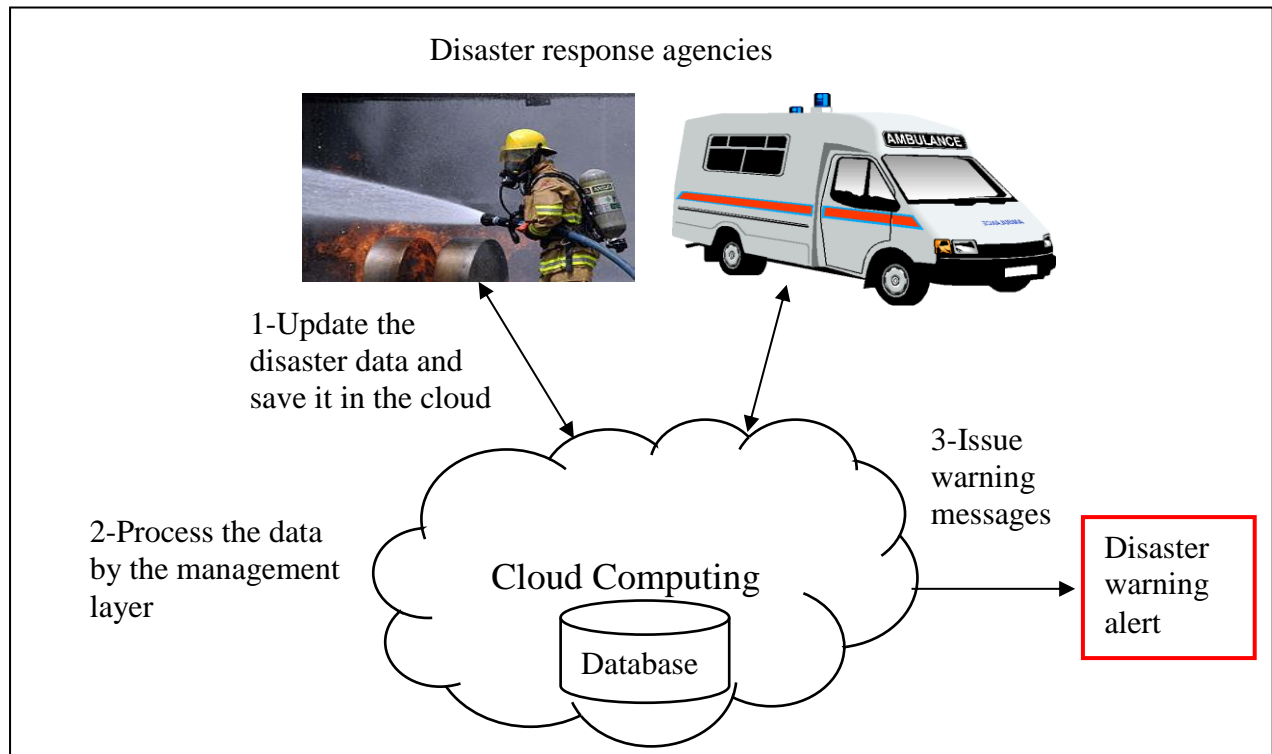


Figure 1 Using Cloud Computing in Disaster Response Management

The disaster management architecture is composed of three main layers as depicted in Figure 2. These layers are:

- **Cloud Application (SaaS):** A user friendly interface allows the agencies to update the disaster dataset without the need to use complicated applications. This layer provides a web application with a GUI interface, authorized access is considered to ensure the reliability of the data. This layer is used for gathering the data.
- **Management layer:** The layer used to process and analyse the collected data by the user interface (cloud application layer). This layer informs decision making about the groups (agencies, companies) to be alerted in a disaster. The decision made can be used for activating the warning alerts and notifications to the response organizations and the people in the disaster affected area.
- **Cloud Infrastructure:** This layer represents the cloud hardware resources and database storage used to store the collected data.

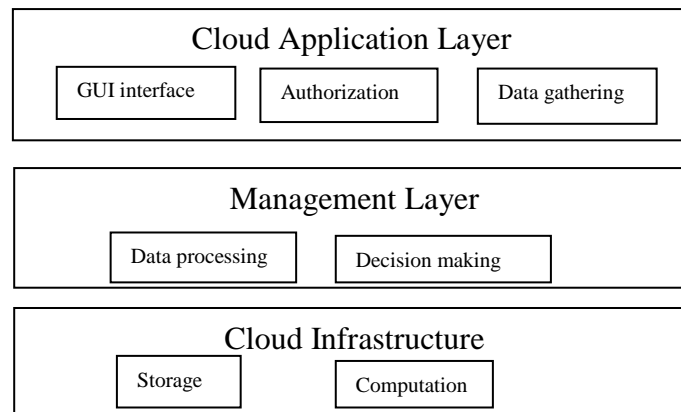


Figure 2 System Architecture

The use of cloud computing provides the following benefits to the context of disaster response management in Iraq.

- 1- Connecting the different disaster response agencies together would help to keep the agencies' information up-to-date about the damage in the infrastructure, buildings, roads and the number of victims. This would be achieved through real time collaboration to avoid the actions overlapping. In addition, it would help to accelerate the disaster response management process by creating a network connection among the response agencies, thus increasing the ability to share accurate data about the disaster. This could be synchronized across multiple agencies, regardless of location and devices used. This would therefore be a platform for managing communications and collaborations between the different disaster response agencies and managing the collected data.
- 2- Ensuring the availability of the data even in the case that the infrastructure resources had been destroyed, since the data is saved on the cloud servers. For example, the data would be available even though a local government department or response agency had been attacked. Although the disaster could cause a temporary disconnection from the internet, the data would be saved in the cloud, unlike the data saved on local infrastructure, which could be destroyed, as discussed by Zong et al. (2016).
- 3- Reducing the cost of saving the data, through reducing the need for extra resources to manage data storage. In other words, the different response agencies would not need to keep the data in their own servers, but in the cloud servers.
- 4- Accessing the data in any situation using mobile devices. This means that the disaster information saved in the cloud can be accessed at any time and retrieved quickly in case of a disaster.
- 5- Increasing the scalability of the used hardware resources. This is due to the scalability and flexibility features of cloud computing, which allow the scalability of the underlying resources, when handling large amounts of data or increasing the number of companies / agencies, which presents an efficiency cost saving.

6. CONCLUSION

This paper contributes to the existing knowledge on disaster response management, a field of study that is still largely underexplored, especially in the context of the Middle East and in the context of terrorism more specifically. A systematic review of the existing, pertinent literature has been examined in this paper. The need for a structured, collaborative and

strategic approach to information sharing and formulation of disaster management capacities, in terms of preparedness, mitigation, early warning, relief, rehabilitation and recovery actions at the provincial and district level, is essential in providing a reliable communication system during a terrorist attack.

In practice, results of this research may be used to enhance the effectiveness of disaster response communication through expediting the process of response. The ultimate end may prove to be not just improved communication within the response stage of the disaster, but also a reduction of the damage from the disaster. The proposed solution presented here is to use cloud computing to aid in the management of disaster response management and provides a mechanism for knowledge sharing, through managing collaboration among the different response agencies. The use of cloud computing provides advantages, in terms of managing the complexity of the disaster data and ensuring data availability, reliability, and cost reductions. This guarantees real-time collaboration among the response agencies and hence a fast response and automatic disaster data management, and, as a result, could potentially save lives.

7. ACKNOWLEDGMENTS

This research would not have been possible without the assistance of the Iraqi Ministry of Higher Education, who supported this work. The authors also acknowledge the financial support received from the Centre for Disaster Resilience, University of Salford for the publication of this paper.

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PEOPLE, SKILLS AND EDUCATION

POSITIONING COST OVERRUN RESEARCH IN THE PHILOSOPHICAL DEBATE: A CASE FOR CRITICAL REALISM

A. Amadi¹ and T. Omotayo²

¹*School of the Built Environment, University of Salford, Salford M5 4WT, UK*

²*Robert Gordon University, UK*

Email: amadialolote@yahoo.com

Abstract: Construction management research, as a form of social research is confronted with the fundamental paradigmatic dilemma of determining a core philosophical orientation, to be considered adequate and best suited to enquiry about construction phenomena. The underpinning argument being that, the differences in world views, will yield marked differences in the type of knowledge generated. An empirical profiling of cost overrun research reveals the predominance of mono-method studies based on questionnaire survey methods, correlative analysis and archival data modelling techniques, all of which are underlain by positivism. Such positivist philosophies, although methodologically valid, cannot adequately explain and provide in-depth understanding of the contextual drivers in construction organisations, that trigger the more tangible technical constructs, leading to the phenomena of cost growth in projects. Joining in the chorus call for methodological pluralism in construction industry research, this study makes a case for critical realism specifically in the context of cost overrun research.

Keywords: Cost Overrun, Critical Realism, Methods, Research Philosophy.

1. INTRODUCTION

Construction management research, as a form of social research is confronted with the fundamental issue of determining a core philosophical orientation, to be considered as adequate and best suited to enquiry about construction phenomena (Dainty, 2008; Fellows and Lui, 2015). Dainty (2008) stated that construction management, as an emergent field of research, is yet to have a recognised methodological orientation, characteristic of other more established domains, and therefore builds on the traditional philosophical assumptions of related natural and social science research. The term “*Methodological pluralism*”, was thus used to describe the use of multiplicity of philosophies and methods, compatible with the study of construction phenomena (Dainty, 2008). The underpinning argument being that, the differences in world views, will yield marked differences in the type of knowledge generated. As Bryman’s (1988:34) espouses “*different research paradigms will inevitably result in the generation of different kinds of knowledge about the industry and its organizations*”.

2. AIM OF THE RESEARCH

This study narrows down the philosophical argument in construction management to within the specific domain of cost overrun research, with a view to systematically articulate the shortcomings in the methodological/philosophical tradition embraced by previous studies.

3. LITERATURE REVIEW

The cost performance of construction projects is often identified as a fundamental measure of success for project sponsors. Yet against this, a large number of construction projects documented in the public domain, have been censured for notoriously running over their original budget estimate. Cost overrun in construction projects remains a topical issue, with the media, technical press, and scholarly literature, rife with publications analysing cost overrun trends, identifying their primary causes, and offering broader explanations for this pervasive trend. This section reviews the nomenclature of the empirical literature on the problem of cost overruns in construction projects.

Studies Analysing Structured Responses

An analysis of the literature on cost overruns reveal a predominant leaning towards the use of survey researches, mostly based on analysis of questionnaire surveys which sample the opinions of construction professionals. See for example Mansfield *et al.*, 1994; Chang 2002; Aibinu and Odeyinka, 2006; Kaliba, *et al.*, 2008; Memon *et al.*, 2011; Ubani, 2015. These studies often generate a long list of factors, which are sometimes subsequently ranked. Aibinu and Odeyinka, (2006) identified 44 factors, prioritising the 39 factors on a ranked profile, as a source of useful information for construction industry stakeholders, in curbing delays and cost overruns. Some authors including Cantarelli *et al.* (2010); Allahahium and Lui (2011) and Brunes and Lind, (2014) have taken the evidence one step further, by seeking to categorize and classify the myriad of causative variables identified, into a typology of causes, on the grounds that generating a long list of factors, without tracing their fundamental defining characteristics, was insufficient. For example, Allahahium and Liu (2011), analysed 90 causes of cost overruns, identifying five major triggers for cost overruns including: (1) Market volatility principally due to micro and macro-economic variations; (2) novelty/unpredictable events such as unexpected ground conditions; (3) estimate distortion; (4) time pressures and finally (5) project complexity.

The methodology of listing factors, ranking, and categorizing causative variables, based on impersonal questionnaire surveys, which is the most rudimental and simplistic approach to explaining cost overruns, appears to have flooded the literature. Although this adds to the body of scholarly literature on cost overruns, and are methodologically valid, the researchers believe that these forms of empirical analysis cannot be used as a basis for inferring specific cause-effect relationship. With Ahiagu Dugbai *et al.* (2014:868), describing the bulk of cost overrun research, as replicative, stating:

“It is argued that questionnaires alone may not be suitable for investigating complex and systemic problems like cost overrun on construction projects... It is no surprise that the same factors seem to come top of the list most of the time ...”.

This characteristic feature of questionnaire based studies, limits the usefulness of the output of such research, in generating context specific explanations that can be relied on in practice.

However, a scant number of studies based on questionnaire surveys, are methodologically more robust (Memon and Rahman, 2013; Sharma and Goyal, 2014). These studies have gone a step further to develop explanatory relationships amongst the identified costoverrun factors. For instance, Memon and Rahman (2013) investigated the effect of cost overrun factors based

on survey responses of client, contractor, and consultant representative involved in handling small scale projects in Malaysia. A total of 54 survey responses were analysed using the Partial Least Square Structural Equation Modelling, a form of factor analysis, to model the relationship amongst various factors. The outcome of the analysis revealed latent factors which triggered the highest variance: contractor's site management related factors, had the most significant effect on small scale projects. Whereas Sharma and Goyal (2014) developed a fuzzy logic model for assessing cost overrun, based on a preliminary questionnaire survey, conducted to judge the level of importance of the identified factors. A fuzzy logic model was then developed, and used in mapping out decision trees on an input and output basis, complemented by graphical representation of the variation induced by different combination of cost overrun factors, to understand their combined effect. Sharma and Goyal (2014) fuzzy model showed that the largest hypothetical variation in cost overrun will be largely due to inadequate planning and scheduling, followed by variation due to short bid preparation time and experience of contractor.

However, a discernible shortcoming of the models developed by both Memon and Rahman (2013) and Sharma and Goyal (2014) is that the data used in their analysis was not sourced in relation to specific projects or based of any form of project information. These studies relied solely on the general opinions of construction professionals, to infer abstract statistical inferences about the generality of factors that lead to cost overruns. It is thus probable that these models can explain the relationships amongst the cost overrun factors, but may have little explanatory power to account for recorded cost overruns on a project specific basis. This can be rationalised in lieu of the fact that technically projects are unique, which is in stark contrast to the underlying assumptions of the findings of these studies. Furthermore, matters of sensitive dependence arise, in the generalisability of the study by Memon and Rahman (2013) with respect to small scale projects in Malaysia, as the study assumes that projects of a similar size will experience similar issues.

Studies Advancing Spurious Correlations

In addition to the afore mentioned groups of cost overrun studies, few others provide and analyse cost overrun data, to test specific project variables in accounting for the trend in the data, as explanations for the cost overruns. Typically, Hinze and Gregory (1991), empirically tested for the effects of project size, location and complexity on the level of cost overruns experienced on projects executed by the Washington State Department of Transport. Flyvbjerg *et al.* (2002, 2004), conducted a similar study, from a sample of 254 transportation infrastructure projects drawn from countries in different regions, mostly located in the northern hemisphere. Akoa (2011) conducted a similar study on highway projects in Cameroun. These studies concluded that the bigger sizes and complexity of infrastructure projects are correspondingly reflected in the increased levels of cost overrun. Hinze and Gregory (1991), further inferred, that the simultaneous nature of projects execution by highway agencies, invariably implied lesser amounts of pre-and post-contract engineering hours available to each, thus accounting for the higher levels of cost overruns often induced in highway projects. Additional engineering, was thus stated as requisite, to overcome risks occasioned by the complex and simultaneous nature of highway project execution, which often creates a propensity for such projects to run over budget. Whereas, Flyvbjerg *et al.* (2004), asserted that the average length of implementation phase of transportation projects significantly impacted on the level of cost overruns recorded. This was inferred based on an analysis of cost overruns experienced on bridges, tunnels, and roads, which showed that cost

overruns varied in relation to project duration. Bridges and tunnels, with average duration of 6.6 years recorded higher cost overruns than rail and road projects with an average duration of 6.3 and 4.3 years. Flyvbjerg *et al.* (2004:15) thus concluded, sluggish planning and implementation of transportation projects had direct financial repercussions, stating: “*Sluggishness may, quite simply, be extremely expensive*”.

However, other studies, such as those by Odeck (2004) in Norway, revealed that larger cost overruns were experienced in smaller projects. Morris (1990) also arrived at a similar conclusion, as Odeck (2004), for 290 Indian projects analysed. Yet, contrary to the findings of these studies, both Love (2002) and Love *et al.* (2013) revealed that cost overruns do not vary by project type or size. The conflicting results, from various studies, further reinforces the discernible shortcoming of these studies, that conclusive inference is mostly drawn based on exploratory statistical analysis. Typically, the use of correlation analysis, which by virtue of reporting significant association between bivariate groups of variables, cannot be used to conclusively infer causality. These studies thus assume that the dependent variable (Cost overrun) changes solely because the independent variables (project size, project type complexity etc., change). Citing the popularly used phrase in statistics: ‘*Correlation does not necessarily imply causation*’.

Studies Analysing Causation Based on Project Data

Quantitative analytical techniques, which analyse cause-effect relationships, are generally grouped as Mathematical models (An *et al.*, 2007). Models are reductions of reality replicating an intricate system using variables within those systems (Ahiagu Dugbai, *et al.*, 2014). Mathematical models have however been scantily used in the literature to infer causality in relation to project cost overruns. The techniques which have been used to analyse cost overrun in a limited number of older and more contemporary studies include: Linear modelling techniques such as regression modelling, Networking and data mining techniques such as Artificial Neural Networks, Heuristics based models such as Case Based Reasoning /Reference Class Forecasting, Stochastic techniques such as Monte-Carlo simulations; and Logic based methods such as Binary Logistic modelling and Fuzzy Logic (Love 2002; Trost and Oberlender 2003; Attala and Hegazy 2003; Ahiagu Dugbai *et al.*, 2014; Lee and Kim 2015 and El-Kholy 2015):

Typically, older studies such as Trost and Oberlender (2003) as well as Attala and Hegazy (2003) have used linear modelling techniques, based on regression analysis, to analyse cause-effect relationships in explaining recorded cost overruns in projects, and further tested the validity of these models with respect to their use in decision making for future projects, at specified levels of confidence. A more recent study by El-Kholy (2015) generated a regression based model, while comparing its predictive capacity to a Case Based Reasoning (CBR) model for similar data sets derived from 30 projects. The outcome of the study showed that the regression modelling had higher levels of accuracy to predict potential cost overrun in projects. El-Kholy (2015) further applied a CBR model to predict the likely cost overrun given the degree of similarity of the project characteristics. El-Kholy (2015) used this method to analyse cost overrun factors, whose presence as part of a future project, is indicative of a potential to result in a similar degree of cost overrun, useful in reference class forecasting and decision making to minimise cost overruns for future projects. Ahiagu Dugbai *et al.* (2014) used data mining techniques based on artificial neural networks, to analyse the complexity of non-linear interactions amongst quantitative project variables such

as compensation events, project duration, as well as qualitative information on tendering method, location, project type, fluctuation measure and project's delivery partner. Lee and Kim (2015) used monte-carlo simulations to analyse the statistical distribution of change orders issued during the construction period, which lead to significant cost overruns. Love *et al.* (2013) developed a probabilistic Log-Logistic distribution of cost overruns for 49 road projects (new roads including upgrades and elevated highways) in relation to rework occasioned by errors and omissions in contract documentation, leading to cost overruns.

Although this class of technical studies on cost overruns which rely on modelling to understand cause-effect relationship, have a robust and methodologically valid underpinning, rooted in the specifics of project data, with a direct applicability useful in monitoring and reassessing future projects, there is a discernible lack of context.

A Case for Critical Realism

It is often argued that the selection of a research philosophy by the research community is mostly an intuitive decision, often in line with the researcher's ontological and epistemological stance and preference, which may not necessarily ensure the rigor and robustness of the research effort (Holden and Lynch, 2004). This argument clearly reflects a discernible shortcoming in the bulk of cost overrun research, which is the sole reliance of positivists philosophy to provide explanation for the poor financial performance of construction projects. This trend equally reflects the bigger picture in construction management research, which has been shown to exhibit a continuing adherence to positivism (Dainty, 2009). Such methods strip the context narrative, which is necessary to *elucidate the role of social action from the standpoint of project actors*. This is despite the wide array of research philosophies which can be compatible with the study of construction phenomena, by virtue of being technical as well as social constructs. As Dainty (2009:6) asserts:

“Researchers use the real-world context of the construction industry as sites for developing research questions ... It could be reasonably expected that their methodological positions and the methods adopted may have broadened and diversified to reflect the multiple traditions from which it draws upon.

It is thus the researchers' conviction that methodological pluralism, applied to cost overrun research, would yield less artificialized and more methodologically valid explanations for cost overruns, which describe context and show causality. Using a practical analogy Mingers (1997:9), illustrated the need for methodological adventure:

“Adopting a particular paradigm is like viewing the world through a particular instrument such as a telescope, an X-ray machine, or an electron microscope. Each reveal certain aspects but is completely blind to other... Thus, in adopting only one paradigm one is inevitably gaining only a limited view of a particular intervention or research situation ... it is always wise to utilize a variety of approaches”.

Various opinions have thus been expressed on the criteria for choosing a research philosophy (Grix, (2001; Holden and Lynch, 2004; Rooke and Kaguoglo; 2007; Gajendran, 2011). Holden and Lynch (2004) argued: *“Research should not be methodologically led, rather that methodological choice should be consequential to the research philosophical stance and the social science phenomenon to be investigated*. Yet, Grix (2001:23) asserts *“methods*

themselves should be seen as free from ontological and epistemological assumptions, and the choice of which to use should be guided by the research questions". Some other researchers, for example Panas and Pantouvakis (2010:77), have predicated the selection of an appropriate methodology, by identifying those typically deployed in similar studies, with the ultimate objective of *"Preserving research validity and establishing of a seamless methodology that could be repeatedly applied"*.

The researchers build on the argument of Holden and Lynch (2004), and are of the view that the most appropriate philosophical orientation for cost overrun research should be objectively defined, devoid of personal or discipline based paradigmatic preferences, in relation to their merits for achieving the research aims and objectives. The researchers, believe stereotyping or basing methodological decisions, on existing philosophical traditions or trends in previous studies, would amount to methodological stagnation, which will ultimately stifle innovation and creativity in research. Rooke and Kagioglou (2007), further reinforce the researchers' stance by asserting that a fundamental requirement in research is its *'Unique Adequacy'*. Unique Adequacy, a criterion for adjudging reliability and validity in qualitative research, means that: *"the methods of analysis used to report, should be derived from that setting*". The implication of this logic for cost overrun research and academic enquiry in the construction industry is that the method of analysis should not necessarily be determined *a priori*, being *'transplanted in-situ'* from similar studies in the knowledge domain, but should rather emerge from the peculiarities of the problem and context under investigation.

In view of the significant gap in the cost overrun literature, the study posits that critical realism presents itself as a valid philosophical position, relevant to carry out rigorous and methodologically robust research on construction phenomena, which can withstand the critique plaguing the use of mono methods in construction management research. This is considering that construction phenomena, are social constructs, which can be also objectively studied. In conducting cost overrun research, the researchers thus adopt the philosophical stance of the critical realist, via the retention of ontological positivism, which rejects the view of multiple realities, with epistemological interpretivism/constructivism, which acknowledges the role that values and societal ideology play in the derivation of empirical knowledge.

However, in advocating for critical realism, the researchers are not unaware of its criticism, mostly accused of being *'logically contradictory'* (Nune, 2013). From the physical and social sciences, proponents and advocates of the critical realist philosophy have erected categorical philosophical defences in readiness for such criticism, (Frazer and Lacey, 1993; Campbell, 2002). To the constructivists, such justification was provided by Frazer and Lacey (1993:182): *"Even if one is a realist at the ontological level, one could be an epistemological interpretivist . . . our knowledge of the real world is inevitably interpretive and provisional rather than straightforwardly representational"*. Critical realism was thus further conceived by Lawson (2003) as a methodologically valid lens for the social sciences, on the issues of ontology, as it relates to the nature of the study phenomena (sensory abstractions or real/tangible?). To the positivist, it was contended: *"all scientists are epistemological constructivists and relativists in the construction of scientific knowledge"* (Campbell, 2002: 29). More specifically in the engineering sciences, Panas, and Pantouvakis (2010) noted that quantitative experimental frameworks and models require scientific data, which are primarily sought through human subjects, who are inherently subjective in their representations.

Philosophical flexibility in cost overrun research is thus warranted. Ontologically the reality of cost overruns is a tangible construct that can be measured precisely. However,

epistemologically, factors leading to cost growth, has a wide range of differing explanatory perspectives, and has been established in the literature to be closely linked to subjectivity of project players in organisations. To understand the phenomena of cost growth therefore requires that an interpretivist epistemology is necessary, while retaining the singular ontology of the reality of cost overruns in highway projects, typical of critical realism (Figure 1).

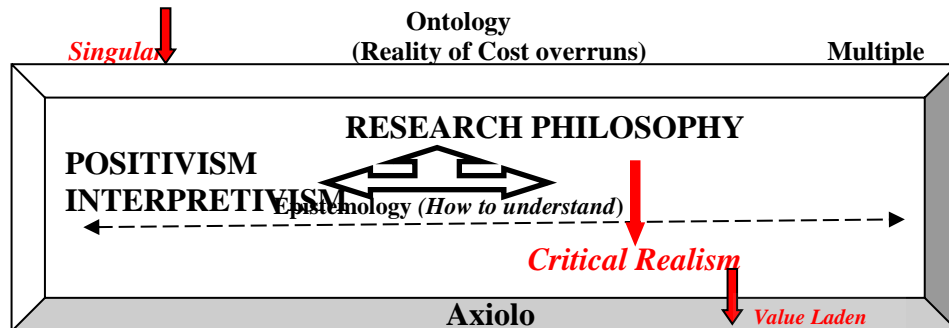


Figure 1: Philosophical Position of the Critical Realist in Cost Overrun Research

The philosophical appropriateness of relying more heavily on the interpretative world view as opposed to the positivist view at an epistemological level, is defined by the need to gain knowledge on the propagation of cost overruns through human subjects, who are the executors of projects, as well as the need to factor in the organisational dynamics surrounding construction projects.

The ability of the critical realist to infer causality within a predominantly interpretative epistemology, further defines its appropriateness to provide contextual explanations for the propagation of cost overruns in projects, which is fundamentally driven by actions/inactions of the human actors in construction organisations. According to Huberman and Miles (1985:21), critical realism is an “*an approach designed to yield verifiable knowledge of human group life and human conduct*”. This is predicated on the critical realist assumption that there are ‘*reasonably stable law-like links of causality*’ amongst social constructs, whereby human actors in social and historical setting have always exhibited ‘*sequences and regularities that link phenomena together*’ (Miles and Huberman,1994:429). This unique feature of critical realism, its terms its ability to retain objectivity, while incorporating multiple perspectives derived from the interpretative understanding of the human factors in organisational practice, that drive the more technical concerns, is thus a core requirement, necessary to infer causality in cost overrun research.

4. CONCLUSION

The study has examined the methodological and philosophical leaning of cost overrun research, highlighting the predominance of mono-method studies, which are mostly based on questionnaire survey methods, correlative analysis and archival data modelling techniques, all of which are underlain by positivism. The study argues that such positivist philosophies, although methodologically valid, cannot adequately explain and provide in-depth understanding of the contextual drivers in construction organisations, that trigger the more tangible technical constructs, leading to the phenomena of cost growth in projects. The study thus advocates for critical realism, which affords the use of multi-methodologies, and as well as maintain both objective and subjective realities of the constructs associated with a cost

overruns in projects. The study posits that critical realism lends itself as potential lenses to study construction phenomena.

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UTILIZING INNOVATION POTENTIALS ON CAMPUS OUTDOORS: FOR THE DEVELOPMENT OF THE UNIVERSITY OF SALFORD

M. Gabr, H. Elkadi and S. Biscaya

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: M.Gabr@edu.salford.ac.uk

Abstract: This paper illustrates how design links to the dynamics of the use of campus outdoor spaces can influence students' motivation and creativity. It investigated aspects of possible development that balance today's market realities with facilitating tomorrow's innovative experiences of different students and the desired diverse student-community-university interaction. The study presents innovative yet practical ideas prioritizing the greatest impacts of the campus outdoor design intentions on students' behavioural reactions, inspired from the campus planning and environments literature along with a tour of campus masterplans supporting these descriptive analyses. With a particular focus on the design of the University of Salford, UK; this study provoked integrated and reliable recommendations to overcoming the lack of vertical walls (incorporating arts and visual-related implications) and shaded areas in the case study location in order to encompass and enhance various cooperative student activities at different times. The study contributes to encourage learning and discovery, gaining the benefits of engaging students in university campuses, and dramatic increase in student numbers and overall satisfaction in the challenges of maintaining the student-community attachment in today's universities.

Keywords: Informal Learning Spaces, Campus Open/Public Space Design, Outdoor Design Impacts, Campuses as Nodes of Innovation.

1. BACKGROUND

As capital and people are more mobile than ever, the quality of a place plays a much larger role in today's innovative transformations than in recent years. Universities nowadays are small cities, in terms of their large size, population, and the various complex activities taking place in campuses. Crossing roads of academics, social activities, and community culture, the campus outdoor physical environment is an important deciding factor for students to retain their learning interests/abilities and attract positive reactions for university challenges and beyond. Campus masterplan therefore, are regularly updated to tackle significant opportunities or challenges in response to ever-increasing pressures and changing needs, thus compete new image/heart for the student, university and city. This paper focus towards the impacts and practicalities of renovating open spaces for more inspirational campus through exploring suggestive ideas and experimental results for the potentials of dominant outdoor students' inspirations (e.g. (Eberhard and Patoine 2004)). It reviews relevant literature in campus outdoor planning development combined with the performance context for student on-campus experience, especially around the ideas of place-based outdoor learning commons. Although the results of this study are based on a university context, they are expected to contribute to developing methods to study how to enhance people experience when perceiving and using outdoor/public spaces. The main ongoing research question is: Which improvements of new campus planning development are of the most importance to engaging students in sharing and contributing their ideas, for regenerating brighter communities and cities?

By revealing how student perceive and use campus outdoor spaces, this paper aims to appraise more creative links between space and its occupation for supporting and enhancing innovative activities, in a way that help evaluate how positive campus planners have responded to supporting informal learning open spaces. Assessing the outdoor physical design for 21st century learning involves cross-examining typologies of:

- Introducing how students outdoor activities - applying, reflecting, engaging and sharing experiences - are realized in creative manner [Sec2: patterns of outdoor space use].
- Posing urban/landscape qualities from unique campus masterplans - spaces like productive and rain gardens, welcoming paths/links to surrounding structures, biodiversity corridors, etc. - that best yield motivation to innovation [sec3].
- Bridging aspects of crossed design values of student-environment intersections by remarking the physical features - that either supporting or declining students' creativity - related to the use of space at the University of Salford (hereafter referred to as UOS) [Sec4].

1.1 Rational for the Study: Campus Outdoor is as Important as Indoor

University campuses socialize its activities within campus and with communities and notably undergoing an exciting transformation from formal to informal spaces. Arguably, the development of informal campus open spaces, natural and built, is integral to learning and discovery (Hanan 2013, Ibrahim and Fadzil 2013) and improves overall student satisfaction with formal pedagogical approaches and environments (Douglas, McClelland et al. 2008, Hopkinson, Hughes et al. 2008, McFarland, Waliczek et al. 2008, Salama 2008). While the physical character and quality of a campus is defined by both its buildings and its open space, it is the open space which has the greatest potential for enriching the individual and socio-cultural wellbeing and stimulating the places of a community's collective life (Morris 2003). Besides being healthy and appealing, innovative campus spaces are distinguished by a concentration of talent, where talent is defined as a combination of knowledge, creativity, and entrepreneurship (Curvelo Magdaniel 2016). Innovative, welcoming quality places retain and attract skilled and talented students who in turn generate experiences of planned and chance innovation, and enrich a sense of community (see (Curvelo Magdaniel 2016, Rissola, HervÃ et al. 2017)). Students also choose to live and stakeholder invest in places that offer community amenities, social and professional networks, resources and opportunities. As campus planners prioritize projects, and to think differently about the ways students create, plan, and experience urban life; massive future investment must be assessed to efficiently value which improvements are of the most significance to students creativity and would yield the highest student satisfaction (e.g. (Tepper 2004, Boys 2010). Comprised of streets, walkways, greens, courts, plazas, gardens and playfields, campus outdoor planning aims to design more spaces for discovery and collaboration where integrating diverse elements together in a coherent way.

1.2 Methodology & Conceptual Framework

In order to support both the creation of a place-based campus outdoor space plan and the search for related innovative outdoor activities, a comprehensive literature of existing support

for urban green space was deemed and analysed properly. Meaning that it investigates the student behaviours associated with or anticipated at an innovative setting; the physical parameters of that setting; and whether positively or mutually influence innovation. Considering of the multidisciplinary nature of the campus outdoor factors encouraging or hindering students' creativity, the literature review consisted of three phases:

- A systematic search is made from social and educational perspective, revising models of outdoor activities and related informal learning styles. Related databases are AEI Database of Research on International Education, Australian Education Index, British Education Index, Conference Papers Index, Current Educational Research in the UK, ESRC Society Today, ERIC, Index to Theses, International Bibliography of the Social Sciences (IBSS), JSTOR, UK Official Publications (UKOP), UK Education Database, ZETOC.
- Then, a broad set of campus outdoor planning (exemplar masterplans) is retrieved. Related databases are Design and Applied Arts Index, UCLA Space Inventory System, ScienceDirect, Scopus, EBSCO, SocINDEX and ABI/INFORM (ProQuest) databases. They facilitate in-depth investigation and looking at the outdoor corporate campus: siting, planning and the relationship between campus and community; providing access to nature for employee health and wellbeing key landscape considerations; and finally promoting innovation, collaboration and connectivity.
- After conceptualizing the drivers of innovative campus outdoors, an advance search query turned to phenomenological analysis of human environment interaction (design intentions and the resulted experience or reactions) with focus on the University of Salford. Today, the UOS, with over 20,000 students, 900 faculty members, and around 2,500 employees enrolled at 7 schools in 60 acres (24 hectares), has remarkable ongoing developments grown to serve the needs of industry, commerce and education (Douglas, McClelland et al. 2008). UOS has a prized location with high profile assets offering room to grow at a time when Manchester is increasingly constrained. Equal promises, Salford city is an area that is expressively changing in the near future. Over the next 20 years, the Greater Manchester Forecasting Model suggests Salford will report the strongest employment and GVA growth rates in Greater Manchester. A review of the baseline information, site appraisal, review of current and proposed campus planning (campus outdoor-specific innovative plan) is conducted with a proper understanding of the design principles and parameters.

Following these phases, final database is composed of about 90 papers published in international journals, books, proceedings or research studies; then entered and classified in an EndNote database. Areas where the literature in the database seemed inadequate were identified, and further searching was undertaken, either to obtain further supporting evidences or to show gabs/lacks. The study strive to be a source of new ideas on how campus outdoors can succeed as nodes of innovation, leisure and community actions, and fitted place-driven urban landscapes. Findings contribute towards ranking some factors that constitute the various outdoor space settings as most meaningful and beneficial to users, university, and the city.

2. STUDENT EXPERIENCE: OUTDOOR BEHAVIOURS/PRACTICES

Recognizing college campus landscapes as vital learning spaces will utilise the holistic potential of college campuses as attentional resources. Social areas and outdoor learning commons, including nature trails and ecological study areas, lend more opportunities for community interaction and social encounters that foster a sense of belonging. Such meaningful spaces go beyond advertising the aesthetic value of the campus open spaces for student recruitment purposes to recognizing the entire campus landscape as a learning space and advertising its educational value – that is more than just its visual appearance. Hence, this section introduces the outdoor needs and activities that if creatively considered in the design process will promote well balanced and connected networks of open spaces with a deeper awareness to the environment and community.

2.1 Creative Interactive Planning Process

Masterplans that bring forward student experiences and patterns of use for the public realm approach are more likely to facilitate on campus innovation. Open spaces, as active part of the campus, are sometimes described and designed as “rooms.” The type, frequency, duration of activities, and the arrangements are dependent on the physical characteristics of these focal points, which may serve to encourage or hinder communication and innovation. The study is boosting the role of ‘innovative’ planning process in understanding students’ needs/experiences by mapping their movement and usage, thus prioritize and encompass related features.

2.2 Patterns of Outdoor Space Use

User experience is a term used to describe the overall student’s interaction and satisfaction a user has when using a space (Temple, Callender et al. 2014). It is the characterization of what a user feels while using any space. In a market where students are recognised as customers, universities have to implement strategies to maintain and enhance their competitiveness. They need to develop a competitive advantage based on a set of unique characteristics. Furthermore, universities need to communicate these characteristics in an effective and consistent way to all of the relevant satisfactory students’ needs and experiences. In addition to attending lectures, working in labs, and participating in other formal educational activities, experience outside of the classroom, including social gatherings and co-curricular programs, enhances personal development and helps facilitate meaningful connections with faculty, peers, and the university. Varied involvement opportunities and motivating factors stimulate students for example to form relationships within the external space and contribute to the quality of student life as well as creating a connection to the campus. Such bonds lead to a strong campus community. However, wide ranges of out-of-class environments, which foster learning experiences, can be utilized to maximize this end (see informal science-learning environments such as science museums, zoos and outdoor settings, science youth programs, science media) (Hofstein and Rosenfeld 1996). Some of which design parameters are discussed below.

An appreciation of student’s needs is one key social dimension which raises important issues concerned with people’s values and choices of urban development interventions in a society

(Carmona 2010). Designers within the built environment should cater for those needs in order to ensure a built environment that fulfils users' needs and aspirations. According to Maslow's pyramid of human needs (McLeod 2007):

1. Physiological needs including food, warmth and survival;
2. Safety and security needs;
3. Affiliation needs of belonging and acceptance;
4. Esteem need by feeling valued by others through a person's education/status/ownership;
5. Self-actualisation needs through artistic expression and fulfilment.

Next to fulfilling those needs or "human factors" - the social, cultural and ideological dimensions of the human being - it is essential to achieve innovative perception of a place, or place meaning for linking human needs and reacts (his natural, psychological and sociological composition) with the spatial environmental elements. However, designers and planners face many challenges while trying to respond to and link the varying needs of different individuals/groups to a space. In practice, it is difficult to respond appropriately to students' motivational experiences and preferred modes of interaction/instruction (Hofstein and Rosenfeld 1996). Abu-Ghazzeah proved that place meaning can be conveniently thought of involving three major research areas: knowledge about the place's objective attributes, knowledge about its affective quality, and knowledge about the behaviours that occur there. Environmental psychologists have investigated the knowledge of objective attributes and affective quality of spaces in more detail than knowledge of behaviour-space associations (Russell and Ward 1982). Analytic techniques have been widely used in many studies of such spaces as a means of obtaining responses from the public regarding design preferences for the site under study. Many studies have described a behavioural approach to environmental design (e.g., (Appleyard 1973, Balling and Falk 1982, Abu-Ghazzeah 1999). A search for published literature on how campus open spaces are used has revealed that such literature either is devoted to technical innovations and issues of form (e.g. Schemertz, 1972) or concentrates on the explanation of fiscal issues, education policy, and large-scale planning. There is a paucity of research about how individuals use the outdoor environment in campus settings. The use of patterns facilitates the re-use of techniques wherever a similar problem recurs. This spark a major focus on regenerating and boosting inward investment into the university campus with wider benefits for the community, city and beyond. In practice, patterns may be applied in combination to create different kinds of space with different effects on behaviour.

2.3 Transforming Outdoor Practices within Students & Community

(Strange and Banning 2001) formalized a set of four guiding categories forming the basis that identifies, classifies and provides provision for transformation of students learning and experiences from indoor/formal spaces into outdoor/informal spaces. Enhanced experiences related to student achievement/outcomes summarized in table (1).

Table 7: Outdoor student activities/experience (summary by author)

| Student experience associated with preferred spaces and predicted outcomes | | | |
|---|----------------|------------------|---------------|
| A. Applying | B. Engaging | C. Reflecting | D. Sharing |

| Physical / Spatial | Ecological & Therapeutic / Environment | Social & Recreational | Educational / Academic |
|--|---|---|---|
| Individual adaptation-use of space. Fit between indoor and outdoor. Spatial perception. Legibility-wayfinding (new user ability to scan/perceive the context (Strange and Banning 2001)) Creativity and critical thinking. | Environmental awareness. Student comfort and wellbeing. Student ownership. Student given choices. Build competency. Personality/identity | Social interaction (creating social bonds, group experience). Engagement (students feel connected, advisory programs, peer mentoring-counselling, community service). Social & behaviour activities, skills (variety, independence, confidence, self-esteem, personal/social effectiveness, communication, group cohesion & teamwork (Dillon, Rickinson et al. 2006). | Contribution (enrichment of the learning experience). Involvement (the desire to be involved or the amount of time & energy students devote to these activities). Curiosity (more about their interests). Challenge (complexity of a topic). Compliance (to meet another's expectation, to do what one is told). Recognition (to be publicly acknowledged) & Competition; Cooperative learning. |

3. CASE ANALYSIS AND MEASURES FROM A SERIES OF CAMPUS ASTERPLAN: IMPERICAL STUDIES

Campus planning are not formed for infrastructure foundations only, but also further supporting and satisfying students experience that make up the student community. This section is a summary of recognised aspects of innovative parts of campus that encourage students to mix, play, meet, sit, relax, read, and manners of extra-curricular activities that activate public spaces. Literature is centred on interaction, collaboration, physical movement and social engagement as primary elements of the students learning and discovery experiences (Marcus 2003, Stanton 2005). Those values are reinforced by many studies (Strange and Banning 2001, Bender and Parman 2005, Kenney, Dumont et al. 2005, Gutierrez 2013) who maintain that learning is a campus lifelong activity rather than just limited by closed instructional spaces.

3.1 Types “Context” & Typologies “Content” of the Campus Exterior Space

Outdoor space types on campus vary from broad to narrow, complex to simple, and openness to closeness. Designing outdoor spaces in universities may also vary according to their shapes and sizes, their location in relation to buildings and the whole campus, the designated space functions/activities, and the activities of the surrounding spaces. Besides, climatic elements are considered one of the key determinants in the design of the urban spaces. (Dober 1992) described three types of styles for campus design: (a) monoform (one unifying style per full campus or sector of campus, such as Collegiate Gothic, or Georgian), (b) metamorphic (disparate styles united by one or more unifying characteristic), and (c) mosaic (no unifying characteristics) as options for campus design.

According to (Schmertz 1972), a typical campus outdoor space type with components and parameters is classified in table (2). This classification differs from study to another, for example, some studies classified outdoor academic spaces as formal (outdoor portion of a central plaza, transportation hub, outdoor amphitheatres, campus commons); and informal meeting spaces (seating walls, picnic tables, overhangs, small greens, or other spaces not

specifically built for masses, yet (Dober 1992) did not suggest the separation of formal from informal meeting spaces.

Table 8: Components of the basic campus space: type, size, uses and features (summary by author)

| Space type | Components | Parameters |
|-----------------|---|---|
| Common turfs | Green areas | Provide a healthy breath and enhances student life |
| | Main courts & plazas | For students to socialize and interact, connects to various buildings/spaces. Important component to place making |
| | Campus entrances | Welcoming gateways to campus, inwards-towards views |
| Academic spaces | Adjacent to specific buildings including the front entrance space, front yard, backyard, and secondary/service entrance | Technology, ecosystems (e.g. birds, fishes, etc.), zonings, Microclimate (shading & seating), barriers from noise, winds and severe weather conditions. |
| Sports spaces | Recreational fields, open courts and sports facilities provided on campus (or with a close direct access from campus) | Open lawns to accommodate wide range of field games, large and high canopy trees as edges to provide shade for spectators and to help screen prevailing winds. |
| Circulation | Roads, pathways and parking areas | Friendly walkable corridors and walkways (Dober 1992, Amsden 2005); Safety and stability of walkways; can be critical for effective circulation on campus, ring roads (separate campus from outside). |

3.2 Design Indicators for Campus Outdoor Innovation

Interaction: Social interactions include conversation, reflection, debate, discussion and group working. They are proved to provide an influential role on students' learning experiences, in which students share knowledge or gain new information (Acker and Miller 2005, Kolb and Kolb 2005). The existence of shared public spaces like cafeterias, dining halls or student union on a campus increases the interaction between students, and take part in a group activity planned beforehand. He designed indicators like general layout, site selection, size, sub-spaces etc. that affects the way of interaction between students on any informal learning space.

Collaboration: Collaborative team work as alternative informal study areas has a triggering affect on motivation, diversity, and observe and absorb new attitudes, behaviours or knowledge through members of the group (Harrop and Turpin 2013).

Social Engagement: According to (Jamieson 2003), student commons, green spaces and other hospitality areas are needed to enhance social engagement on a campus, with feeling more pleased and comfortable (Marcus and Francis 1998).

Multiple Experiences: According to (Jamieson 2003), increasing possibility for diverse campus experiences to cross paths and connections is viewed via spaces which are 'softer, less rigid, and where the character of the space is formed by the 'shape and identity of the relationships created within it'.

Sense of Campus: (Halpenny 2006) calls ‘sense of place’ as a personal phenomenon, having as much to do with individual’s own experiences and cognitions as with the physical environment. He defines campus as “a tapestry of sensory, cognitive, and intellectual practices that are meaningful in and of themselves, and that can profoundly reinforce one another.

3.3 Experience-Led’ Landscapes for Innovative Design of Space

This part exposes various innovative ideas in masterplans that developed landscapes as and where necessary in response to changing circumstances.

Lessons from the University of Manchester: The Graphene Engineering Innovation Centre (GEIC) development, which will re-invigorate Brunswick Park, part of the University’s North Campus, will include a Pocket Park and a new landscaping scheme promoting biodiversity and improving access. Diana Hampson, Director of Estates and Facilities, said:” The University is transforming the campus through its £1 billion Campus Masterplan and that includes a commitment to environmental sustainability by improving our green spaces and public realm. These proposals form a centrepiece of our vision and will create a heart of the University campus for staff, students, visitors and the local community to enjoy.”

Lessons from Art-based Activities: There has been growing recognition of creativity as a means of addressing issues such as social exclusion, urban regeneration and community development (Carey and Sutton 2004, Nordh, Hartig et al. 2009). Recently, US artist and urban planner Candy Chang’s interactive experiments in public places have been receiving attention for their unorthodox methods of engagement that combine installation art with social activism, enabling people to engage with their public spaces so their opinions are heard. Chang theorises that one of the best ways to shape public space is in the space itself. She achieves this through the installation of blackboards, vinyl stickers and posters in high traffic areas of the chosen site, enabling communication of ideas on site and in real time. She uses ‘fill-in the blank’ questions to provide a mirror for the community to reflect on a site (Chang 2013).

Lessons from University “Educational Campus”: Classifying various landscape zones and identify a portfolio of prioritized themes that neighbourhood might want to visit and students would be proud off. Envisioning and overlapping networks of those compelling zones/hubs and offering generic space types, will positively influence the power of planning for interaction. Such classifications are:

- Learning Landscape: manifesting the curriculum activities via workshops, outdoor class, art & meeting places;
- Ecological Landscape: as in forests and wetlands;
- Productive Landscape: seen in growing spaces and green roofs;
- Social and Cultural Landscape: used for public events such as concerts, markets, sporting and large-scale events;
- Entertaining Landscape: as parks and pools with fountains, green spaces, public art, relaxation and play, and healthcare activities;
- Entrepreneurial Landscape: connecting students to innovation & investment (Incubator units, Business forest);
- Commercial Landscape: such as museum, retail and office accommodation.

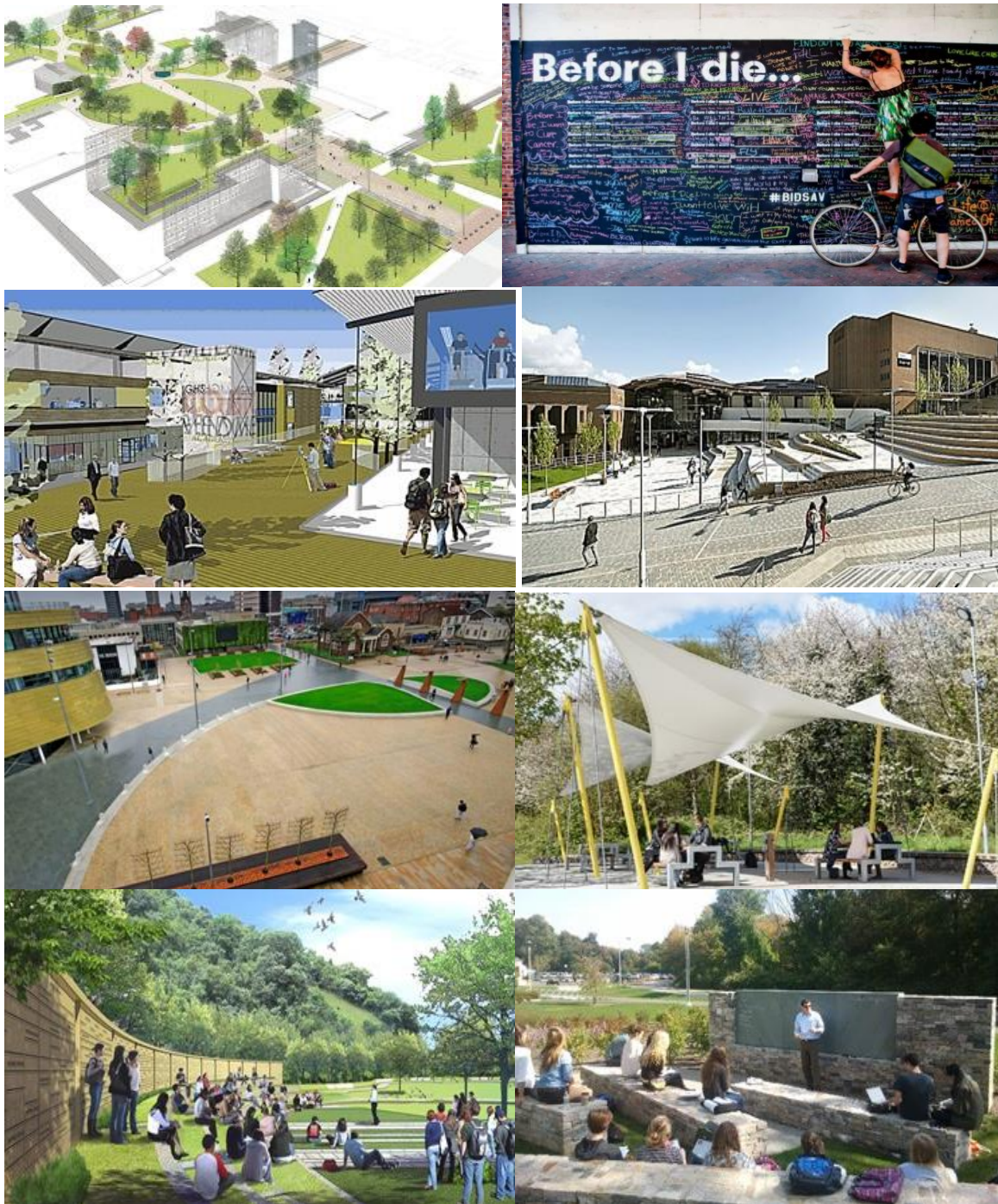


Figure 16: (1) Lessons from the University of Manchester, (2) art-based activities “Before I Die” by Chang (3) Outdoor Commons at Marysville Getchell “Learning Retreat”: Elevated boardwalk floats and serving as a social and learning focal point, connecting with the Community Commons. (4) The buildings and spaces in the University of Exeter Forum are related closely to the campus topography. (5) Teesside University (the curve). (6) CBE space at the Loughborough University. (7) & (8) Exemplar outdoor learning environment.

Lessons from UCD strategic campus planning: Another innovative concept that emerged in 2005 for a new university campus and was subsequently integrated into the strategic programme Campus of International Excellence by the Spanish Ministry of Education in 2009. It aimed to reflect a modernized process to quality and be dedicated to the intellectual, psychological and social development of its students. It is a pragmatic place-based approach

within universities focusing on policy, philosophical, sociological, practical and recreational aspects, which all promote to the student entire satisfaction.

Parallel views, such as the Outdoor Learning Commons, Small Learning Communities, and Media Centre, have raised to support flexible spaces as a part of the campus landscape and community focusing entirely on student potential and learning for learning to take place everywhere. The design patterns would be such: Transparency, welcoming entry, Student display space, science labs/parks, art labs, life skills areas, outdoor physical fitness, dispersed technology, Indoor-Outdoor connection, campfire space, watering hole space, cave space, full spectrum lighting, accessibility & connectivity within campus and to the community, flexible/all-in-one space.

4. ASPECTS OF STUDENT-SPACE INTERSECTIONS: THE CASE OF UOS

This section provides practical guides through relating the previous sections (3 & 4) in to the UOS. Resulted design impacts has its own components and parameters used in specific space type and typology, as represented in the literature on outdoor campus spaces – for valuing positive urban space that suits the purpose for which it is designed, whilst meeting users' needs.

4.1 UOS Context: Contextual Enabling Factors

The UOS (Fig1), originally the Salford Technical Institute opened in 1896 and then a college of Advanced Technology in 1956, has gained university status into Higher Education in 1967.



Figure 17: UOS land ownership (www.salford.ac.uk/about-us/our-developing-campus)

4.2 Opportunities, Constraints and Problem Areas: Campus Physical Features Related to Use of the Space

Conserving and enhancing the natural environment and social sustainability both approached through examination where appropriate of the social value of natural capital elements such as the utilizing biodiversity assets in Peel Park, and the creation of living campus for blue and green infrastructure. Identifying the value of social infrastructure such as green spaces: cycle racks, leisure facilities and community spaces to aid financial modelling and decision making. The Quays Strategic Framework vision for the area: “the UK’s smartest place to invest, innovate, create, and produce, in an environment where people work, live, learn and relax”. In addition, the regeneration of Pendleton to the west of the masterplan area will generate a further push factor. These latest facts and proposals build on the early successes driven by the Central Salford Strategic Regeneration Framework, which helped to kick-start change for the University planning.

The campus plan realize the arrangement of buildings with spaces created between them. However, the use of outdoor spaces at the UOS for circulation, study, relaxation, and aesthetic pleasure deserves attention. The UOS uses LiFE and EcoCampus tools to help deliver and monitor both building a culture of sustainable behaviours and embedding sustainability through collaboration, as two key targets within developing Sustainability Strategy Map for the next 5 years (Douglas, McClelland et al. 2008). The UOS Phase 1 Masterplan has developed a campus wide public realm strategy to integrate the various building projects and delivered a high quality public realm. The initial phase procured with the Gateway project cost £3m and was completed (Douglas, McClelland et al. 2008).



Figure 18: (1) New Adelphi development (iconic gateway), (2) New hospitable entry at Allerton Building

The current built form of the site is sometimes barrier to both social and physical engagement with the space and did little to facilitate social innovation, as it did not provide adequate levels of comfort that would encourage students to remain in the space. Primary observations show three key themes or problems with the space that hinder innovation and engagement: transitional spaces (connectivity between indoors and outdoors); vertical walls (arts-based activities); and landscaping (shade, shelter and design features). The desire for art based activities and multipurpose creative walls allows for artistic activities and interactive experiences (e.g. a screen for movies or digital installations or outdoor gallery space). The piazza is characterised by lack of shade and shelter, with large expanses of concrete that do not encourage pedestrian traffic or offer a desirable place to relax. This calls for more trees, grassy areas, communal gardens, a water feature and vertical garden walls. Comfortable, moveable seating is favoured so activities such as group work or socialising could be conducted easily within the space.

4.3 Campus-Wide Choices/Directives: Campus transformations for Innovative Students

Micro-climate conditions strongly influence how people experience a space and uncomfortable conditions can distress people and stop them using an area (Nikolopoulou and Steemers 2003). The findings from basic observations propose that spatial developments should be examined holistically on the three experience layers: visual, physical, and social, through impacts on most affected levels of satisfactions. Based on the findings, types can be identified and distinguished mainly in terms of collaborating with different partners and supporting a spatial transformation of the university. Suggested options which could enhance the identity and attachment to place included the addition of a water feature in the central piazza area, vertical green walls, increasing trees and shading elements, and providing comfortable, natural, meeting places for students to study in groups. By incorporating suggested features such as lightweight, moveable, comfortable seating; and strategic use of shade cloth or wind breaks, the area could be reclaimed as a comfortable, natural setting that is a pleasant environment for social interaction and building connections to community. This will encourage places that are diverse, interesting, active, and offer a mix of activities that will facilitate the chance of spontaneous interactions between people, and contribute to place identity, attachment and sense of community.

5. CONCLUSIONS: TOWARDS COMPETITIVE CAMPUS LANDSCAPE TRANSFORMATIONS

The paper highlights critical areas where attention is needed in order to improve innovative performance of landscape design and students' experience (practice & perception) with open spaces in UK University campuses. Considering that student experience is not about just equipping students with an academic qualification and a path to employment, although it is important, the paper seeks social development where external events and exhibitions could be located, transforming the functional into social, communal and recreational. The study demonstrated that the campuses used could elicit rich environment input for consideration and provide evidence to initiate change based on a host of student and place-based ideas. For linking students needs with innovative design solutions within Higher Education campuses, this study highlighted innovative lessons from both theoretical and efficient masterplan visions to adapt for encouraging and engaging sustainable student practices out and between academic buildings at UOS campus. This ranges from high-level visions of influencing wider social or community behaviours, to very specific techniques applied to influence particular behaviours in a particular context. To this end, the following recommendations are concluded:

- Innovative Planning/Design process: Fostering a highly collaborative design process with students through honest listening, approachability, and open-mindedness to discuss potentials of fostering activity, connectivity and creativity. Planning considering co-creative design processes blend seamlessly buildings with the creation of green, interactive, collaborating spaces and encouraging more people (not just students) to visit and revel in the campus. In the case of UOS, traditional campus planning and design with little student engagement resulted in a central area of campus being under-utilised and even inhospitable (now under development).
- Green innovation: Recognising of the role of landscaping and greenery in reinforcing student-derived themes and providing well-being, attachment and social interaction and engagement in a raining university. People want to gather, socialise, study and be creative in a comfortable and

inviting space that offers shelter and shade from the elements, places to sit, eat and drink, and a space in which to enjoy cultural and artistic activities.

- Innovative Connectivity: Adding interest and activity along main green multi-purpose spine/s that accommodate, energise and inspire students and community in a vibrant, engaging, and fitting environment (e.g. enhancing with trees, placing wayfinding signs at intersections, adding curves to capture architectural views and installing a bike path): A powerful, welcoming space that also connects the university and city. *“The best learning-research outcomes are achieved when a diverse range of environments are offered, this will be a quality space which will blur the traditional boundaries between places to socialise”* (Michael Ahern, Chief Operating Officer, UCLan, 2017).
- Investment and Innovation: The type, location and aesthetic appearance as well as size of main activity areas are the most predominant factors that determined satisfaction and indeed the performance of the buildings in meeting users' needs and aspirations.
- Innovative activities: accommodate wellbeing, outdoor entertainment activities - arts and gathering areas- for improving human-space connection on campus and; such as gym, running paths, bee keeping, kitchen garden, pop up coffee shop, farm, roof terrace, etc. - encourage and enhance the student experience spending time while in higher education.

It is difficult to sum up an ideal, multi-dimensional space setting for innovative student experience, yet, the paper represented a scientific way of approaching the design of campus outdoor spaces for exceeding student's expectation and stimulating people's creativity. The findings are scientifically reliable derived from literature review combined with basic observations at UOS. However, so as to broaden the impacts and deepen the practicality of innovation-led designs; further field work with the participation of larger respondent groups in various settings should be carried out, in further case studies according to their typologies.

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BUSINESS INTELLIGENCE AND CULTURAL CHANGE IN SOCIAL HOUSING

C. Duvier and C. Oltean-Dumbrava

Faculty of Engineering and Informatics, University of Bradford, Bradford, BD7 1DP

Email: cduvier1@bradford.ac.uk

Abstract: Social housing is looking towards business intelligence to help with handling and analysing the vast amounts of data collected. This paper presents a qualitative case study carried out at a social housing provider, trying to implement a business intelligence system in order to work more effectively and efficiently. The process is outlined in five steps, together with lessons learned, such as the importance of good leadership and communication. Recommendations include following a detailed step by step process and implementing a data governance framework. This work is potentially useful for other organisations interested in business intelligence systems, especially regarding factors influencing willingness to adopt and willingness to change. Future work will need to incorporate other provider's experiences, as well as continue to follow the path to completion, as this paper only outlines the initial steps towards implementing a business intelligence strategy.

Keywords: social housing, business intelligence, data warehouse, cultural change

1. INTRODUCTION

The regulation of social housing in the UK has recently changed towards tighter control of providers' adherence to financial viability and governance, for example through "maintaining a thorough, accurate and up to date record of their assets and liabilities and particularly those liabilities that may have recourse to social housing assets." (p. 2, HCA, 2015). Non-adherence to the regulations will result in being downgraded and is therefore taken very seriously by providers.

1.1 Social housing data not collected to standard.

A challenge that many social housing providers currently face is finding a way to effectively handle data within the organisation (Leach 2016) once processes to identify and collect data are defined.

One way to deal with data issues is to implement a business intelligence system. Business intelligence can be understood as a "process composed of methods that organizations use to develop useful information, or intelligence, that can help organizations survive and thrive in the global economy" (p. 121, Jourdan, Rainer, & Marshall, 2008), with the goal of predicting behaviour of people or products.

1.2 Business Intelligence as a possible solution

Business intelligence (BI) is a broad field, encompassing areas such as data warehousing, data mining, data modelling, decision modelling and decision-making, artificial intelligence and various project management areas such as customer relationship management (CRM) (Jourdan et al. 2008). Arnott and Pervan (2014) define BI as “large-scale systems that use data and analytics to support decision making at all levels of an organization. BI systems are often based on a data warehouse or data mart.” (p.275). They categorise BI as belonging to the branches of executive management systems and data warehousing within the field of decision support systems, and as related to the very modern term business analytics. BI has received increasing research attention in recent years, but adoption in practice is low (Skyrius et al. 2016). The right implementation of a business intelligence strategy is crucial to the success of the project. BI projects are complex, require time, appropriate infrastructure and resources, and cannot be implemented quickly (Yeoh & Koronios 2010). Critical success factors for a BI system (BIS) include committed management support and sponsorship, a clear vision and well-established business case, business-centric championship and balanced team composition, business-driven and iterative development approach, user-oriented change management, business-driven, scalable and flexible technical framework, and sustainable data quality and integrity (Yeoh & Koronios 2010). Marinela (2008) argues that the following need to be considered: “[W]ho needs BI, which information is needed, when do users need the information, where must the solution be implemented, why is information important, how may BI represent value-added” (p. 105). Such challenges are complex projects themselves; for example data quality alone is considered imperative to a BI project, and has itself received considerable research attention. Yoon et al. (2014) further found that adoption of a BI project depends on four factors: motivation, situational constraints, technology, and social influence. Person-centered factors, such as commitment, support, management sponsorship, and a focus on the business case are strongly related to the success of a BI project, whereas a purely technology-focused approach is likely to lead to failure (Yeoh & Popovič 2016). Ideally, a BI project will target critical success factors in the following order: organisational factors first, then process, and lastly technological success factors.

Overall, organisational factors, especially human factors, are now considered most important for the success or failure of a BI project. In 2008, Gartner highlighted nine common mistakes that lead to failed BI projects: (1) Building a system without explaining its value to the organization. (2) Data analyses processes are not transparent or fact based, and can lead to barriers in terms of internal politics and cultural change. (3) Data quality is not seen as important, but firms do need an automated control process to block low quality data entering the BI system. (4) Firms choose the standard company vendor without shopping around, which can lead to loss of vital BI functions other vendors might offer. (5) BI is seen as a discrete and fixed project, whereas in reality it is a moving target that needs constant changes. (6) BI efforts are outsourced with the hope to get a better product at lower cost, but building skills within the company is very important. (7) Companies demand dashboards as part of the BI strategy early on, without realising that dashboards are silo-specific and often not founded on corporate objectives. (8) BI is supposed to create a single version of the truth, but within the organization, departments and people do not agree on fundamental definitions for terms. Departments need to work together cross-departmentally and agree on standards such as data definitions and performance metrics. (9) The lack of a BI strategy, or a poorly developed or implemented one, is seen as the biggest flaw. A good strategy should be developed as part of the IT team and across the organization (Anon 2008). As Watson et al. (2002) state: “change

and the truly momentous benefits are far more likely when the vision comes from the business side of the house rather than the IS side.” (p. 501).

Data warehousing represents one area within business intelligence, where data across an organisation is stored in a single place. This facilitates decision making and when monitored, can lead to high data quality, and most importantly, large revenue (Watson et al. 2002). Data warehousing can provide “a single version of the truth” (p. 435, Watson, Fuller, & Ariyachandra, 2004). The Housing and Development Board (HDB) in Singapore implemented a data warehouse to move data from over 120 databases into a single system (Ang & Teo 2000). Throughout this process, seven management issues were identified: (1) Identifying the process, (2) Choosing development options, (3) Adopting incremental change approach, (4) Overcoming resistance, (5) Choosing project leader, (6) Providing formal, systematic training, (7) Scalability and data warehouse maintenance – the data warehouse needs to be flexible to changing demands and increases in data volume. It also needs continuous excellent maintenance, which is crucial to its ongoing success.

This paper will outline the case study of a social housing provider in the UK that is implementing a business intelligence project. This is an ongoing project, as the above section has highlighted. Initial efforts, together with the methodology applied, will be discussed, as well as lessons learned up to this point in the project.

1.4 Study – Initial steps and problem identification

In the following section the approach taken by a social housing provider towards business intelligence is outlined. The provider is considered one of the larger social housing providers in the UK, with over 20,000 properties. The organisation employs more than 800 staff and is managed by eight different boards. The executive management team consists of the CEO and three Assistant Executives.

Social housing in general faces upcoming challenges in the years ahead due to changes to the welfare reform. From 2016 onwards, all rents are reduced by 1% for the next 4 years (Department for Communities and Local Government n.d.). This will lead to financial losses of over £2.3 billion for the entire sector (Adam et al. 2015). Welfare reform changes are also likely to lead to less financial solvency for tenants not currently in work or disabled.

2. METHOD

In the following section, the five steps implemented towards the business intelligence strategy in the organisation are outlined. A parallel process was adopted, meaning that steps were implemented alongside each other. The illustration below shows the process, with a detailed description following in the text after.



2.1 Implementation of Strategic Team responsible for finding out the business needs for each department

This team consists of five members from the neighbourhoods and asset management branches of the organisation. The team agreed on the following strategy:

- Identify strategic business needs at higher management level,
- Identify business needs at middle management level,
- Identify business needs at the operational level.

Members of the team identified the strategic needs, which include, for example, knowledge of past, present, and future income and costs for each asset, reasons why customers terminate a tenancy, or the energy efficiency of installed heating systems. Each member then scheduled meetings across the organisation to establish the middle management and operational needs regarding data in terms of business intelligence. Six meetings have been held to date, including members of the income team, neighbourhoods, and three sets of meetings with different areas in asset management. More meetings are scheduled to take place in the near future with departments such as finance, estate services, technical services, and new builds (see Figure 1 for an organogram of the organisational structure). Participant numbers ranged from three to ten depending on the size of the team. Asset management meetings had the highest number of participants. Each meeting lasted between 1.5 and 4 hours. Apart from job-specific business needs, the meetings were useful in terms of identifying overarching issues experienced through a lack of business intelligence within the organisation.

General needs targeted by business intelligence project:

- Better communication between departments
- Fewer systems, less spread of information
- Easy access to information, and access to information from other departments
- Clear business goals
- Clear responsibilities for tasks and data, including ownership of data
- Greater effectiveness in every-day tasks

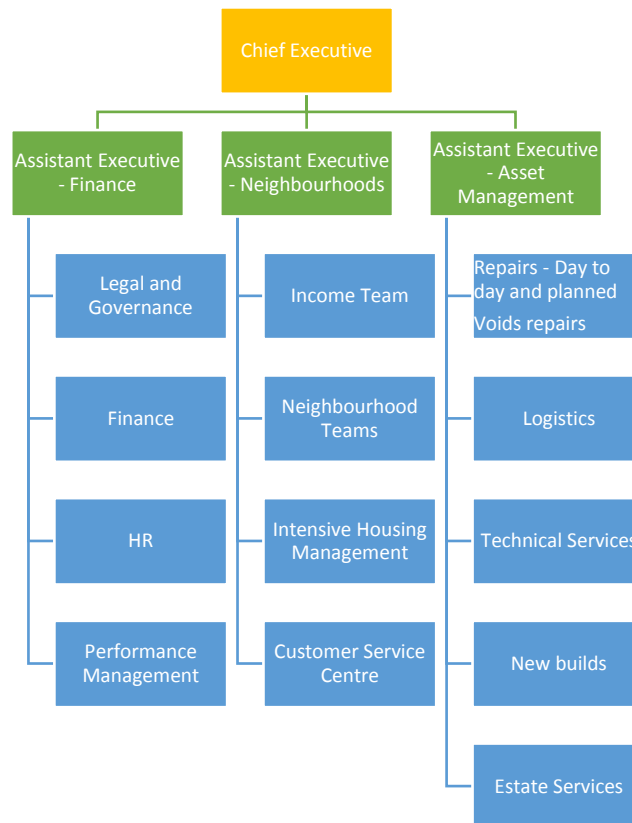


Figure 19. Organisational structure of the social housing provider

2.2 Identify problems with data and its management across the organisation

Several events were held across the organisation within the past year which gathered useful information for the BI project, although these events were not specifically targeted to find out business intelligence needs, rather, they focused on staff feedback on general business practices. The events all identified one underlying problem: Too many systems are used for different areas of the organisation, resulting in a lack of communication between systems and people. From these meetings, and the business needs meetings conducted by the Strategic Team, several different issues are identified with the way data are stored, as seen in Figure 2:

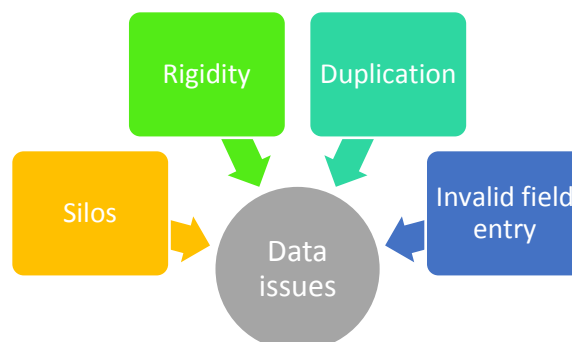


Figure 20. The main issues with data at the social housing provider

- **Silos:** Data are stored in systems, spreadsheets, or paper files that only specific departments or people have access to. This creates issues for data sharing and cross-

departmental comparisons of data. Data systems do not talk to each other, data first need to be converted into a comparable format, which is a lengthy process.

- **Rigidity:** Externally managed systems do not offer the option to add new fields, which limits the amount of data that can be collected.
- **Duplication:** Data for a specific field, for example, telephone number of a customer, is collected in different systems, like repairs and income. Since systems are siloed, some departments have more up to date information than others, which creates difficulties.
- **Invalid field entry:** Some data fields are overwritten with invalid data. For example, built date has the original value in one system, but another system is overwritten with the date for renovations.

2.3 Executive Management Team: on the importance of business intelligence

Several meetings were held with the executive management team (EMT) on business intelligence over the last year. Initial meetings outlined problems identified with data, as outlined above. Subsequent meetings concentrated on the outcomes of a BI system, in particular its abilities to manage data and provide predictive analyses on future performance and behaviour. The EMT supports the effort to create a BI system and has provided resources within the ICT department to develop a data warehouse.

2.4 Data Quality: initial data quality check

Data quality is recognised as being an issue across the organisation. Rudimentary data checks were carried out through most departments, but so far, the organisation lacks a coherent strategy to deal with data quality issues, and criteria to assess data with. However, since this was an initial check, once data are ready to be integrated into a new data warehouse, a more scientific approach to the data quality check is recommended, following recommendations from the literature (Pipino et al. 2002; Redman 2012; Strong et al. 1997). Some of the most common data quality criteria include accuracy, completeness, consistency, and timeliness (Batini et al. 2009). Both the criteria that will be assessed, as well as measurement approaches, such as ratio, minimum or maximum calculations, will need to be considered. Root causes of poor data quality also need to be identified (Batini et al. 2009).

2.5 Resources creation within ICT to build a business intelligence system

The ICT department has a designated team working on business intelligence. This team's responsibilities lie with creating a data warehouse from data the Strategic Team selects. The ICT BI team removes itself from the task of selecting data needed for the project, and this is a recommended strategy within the data governance literature (Wende 2007). The architecture of the BI system needs to sit within ICT, but ICT will have little knowledge of the organisational requirements regarding what kind of data is needed, how it needs to be collected, and frequency of recording data. Therefore, the Strategic Team decided to feed data needed to the ICT BI team, who then implement the architecture of the system.

In the first instance, data related to asset income and costs will be implemented in the data warehouse. This aligns with the approach taken by the HDB, where an incremental approach

to implementing the BI strategy is recommended. The ICT BI team is in the process of checking data according to three criteria:

- Existing data and easy to get
- Existing data but difficult to get
- Non-existing data, therefore very difficult to get.

3. RESULTS WITH RECOMMENDATIONS

In the following section, lessons learned and recommendations for improvement will be outlined. The social housing provider followed a relatively intuitive approach to business intelligence, which lead to a pathway different to what is recommended. The recommendations are split in two sections, with the first discussing the use of a path with step by step processes, and the second section recommending the implementation of a data governance framework. First, issues identified are outlined. These include communication, establishing clear leadership roles, common goals and achievements, data quality, and resources.

3.1. Issues identified with current business processes

Common goals and achievements: Overall, the BI Strategy Team agree on the common goal to make better decisions as a business. However, disagreements arise concerning achievements of the project, especially regarding front end applications. The ICT BI Team is currently researching available front end tools, which will have to be aligned with business needs, as well as organisational capabilities to train users in using these tools.

Communication: Communication between the team members and across the organisation needs to be guided by the common goals and achievements. A communications plan needs to be established regarding communicating the projects across the wider organisation. This will help in establishing awareness of the project and will also facilitate training and development later on in the process.

Clear leadership roles: At this point, there is no clear leadership role driving the project, mainly due to the fact that members of the Strategic Team carry out the BI project alongside their normal job roles. Therefore, willingness to take on more responsibility is low. The next issue, resources, touches on this point as well.

Resources: Resources allocated to the overall BI project are relatively small. The ICT BI team consists of two full time members and one part time member. However, creating the data warehouse is not their only responsibility, as these members also work on a range of other projects. The Strategic Team is working on the BI project alongside their regular work load. The organisation would greatly benefit from recruiting new talent and creating positions whose sole responsibility lies with helping move the BI project forward.

Data Quality: Although every member of the Strategic and ICT team acknowledges issues with data across the organisation, a strategy how to deal with low quality data, or even missing data, is currently not in place.

3.2 A Step by Step Process

Following from the initial steps taken, it is recommended that a more focused approach is adopted going forward. The Data Governance Institute (Thomas 2006) recommends a process as outlined in Figure 3. The social housing provider implicitly provided a value statement by stating that the BI system should lead to greater effectiveness and efficiency in decision making in order to provide the best service to its customers.



Figure 21. Process recommended by the DGI – Seven Steps in the Data Governance Life Cycle (Thomas 2006).

At the second stage, preparing a roadmap, an emphasis should be placed on issues identified in the process so far. Further processes within the seven steps will be primarily guided by the roadmap, as it entails details for all these steps, including milestones, capacity, stakeholders, and expectations. Figure 4 outlines how a template for a roadmap could look like.

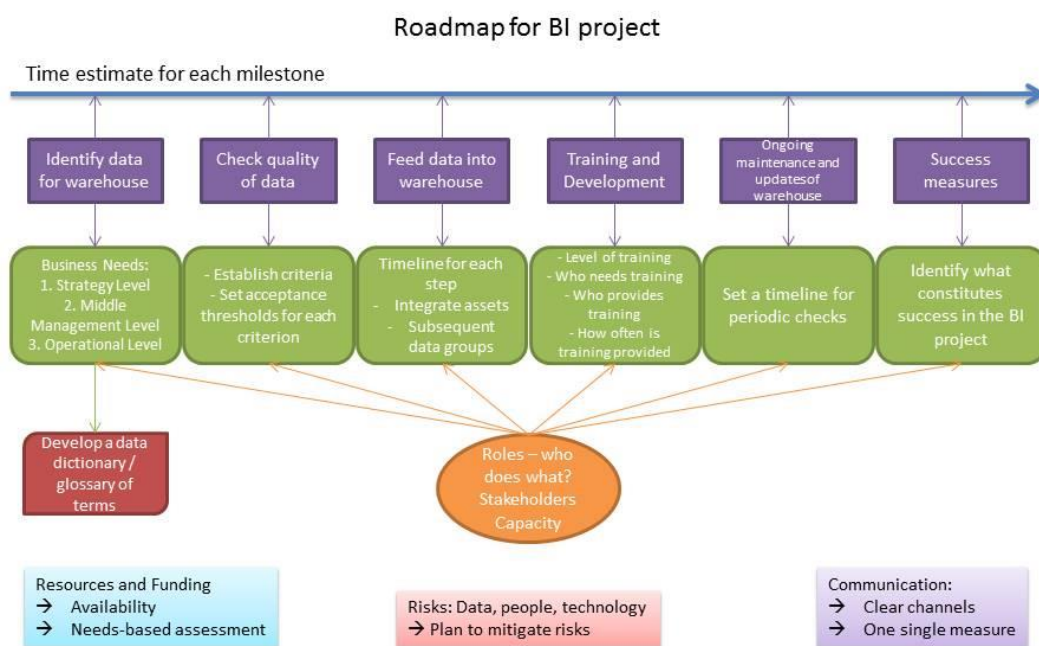


Figure 4. Template for a roadmap for a BI project.

3.3 Develop a Data Governance Framework

In line with focusing on a process for the BI project, a data governance framework should be established. Otto (2011) defines data governance as aiming to “maximizing the value of data assets in enterprises” (p. 241). Others adopt a data governance approach based on literature from IT governance (Wende 2007; Khatri & Brown 2010; Cheong & Chang 2007; Weber et al. 2009), where data governance is the decisions made that ensure efficient management and

use of IT and who is making the decisions. The Data Management Association (DAMA) sees data governance as the central knowledge domain connecting all other data management domains (Anon n.d.), and defines data governance as “the exercise of authority, control, and shared decision making (planning, monitoring and enforcement) over the management of data assets”, p. 11, (Ladley 2012) and Ladley’s own definition is “the organization and implementation of policies, procedures, structure, roles, and responsibilities which outline and enforce rules of engagement, decision rights, and accountabilities for the effective management of information assets.” p. 11, Ladley 2012). According to the Data Governance Institute, a data governance framework outlines decision rights and responsibilities for data-related processes, and would incorporate the ten aspects outlined in Figure 5 (Thomas 2006). In this paper, data governance is defined as guiding strategies and principles that define data at all levels (entry, management, analysis) to maximise business efficiency and effectiveness.

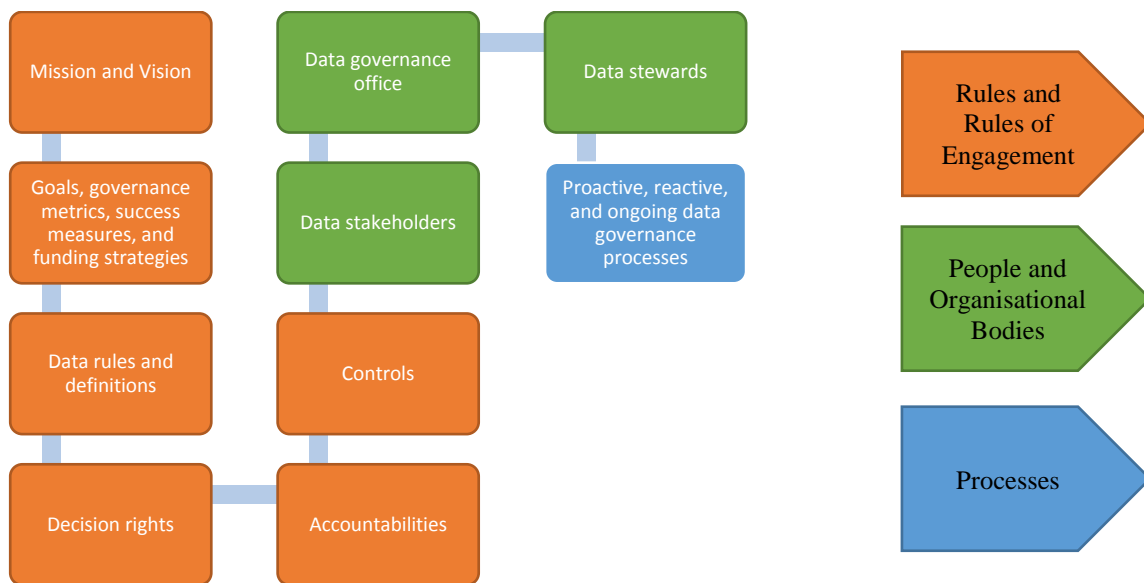


Figure 5. Ten steps in data governance, adapted from the DGI (Thomas, 2006).

4. DISCUSSION

Implementing a business intelligence system in any organisation is a challenge, but public organisations seem to pose a particular challenge. A possible explanation for many of the issues encountered might be due to the highly bureaucratic nature and hierarchical processes in place in public organisations, which define its organisational culture (Parker & Bradley 2000). This makes innovation difficult, and a BI project is very innovative. Ang and Teo (2000) outlined that many issues they faced at the HDB, another public organisation, were due to the company culture regarding lack of willingness of data sharing and data protection practices by individuals.

In order to achieve change in organisational culture, Liebowitz (2006) suggests to match the approach to the current culture for quick wins, and as people embrace the changes and individual learning starts, collective learning and transformation should slowly follow. Schein (2010) argues that ways to change a culture include sub diversity within a company, introducing outsiders with new assumptions, or implementing new technology, but also adds that these processes might be slow or not even possible. He further purports that leaders play a large role in creating an organisation’s culture.

A further aspect to changing an organisation's culture is training, and leading by example. Schraeder et al. (2005) outline a case study in which they show that leading by example and sustained training brought positive change to a university's unpopular and low performing department. Training is a necessary feature of a BI project, but poses challenges due to the nature of BI systems (BIS), which are long-term and benefits are indirect benefits. User acceptance of BIS might be therefore be low (Grublješič & Jaklič 2014), but training could provide a mechanism to increase acceptance and adoption.

5. CONCLUSION

The business intelligence strategy is an ongoing effort within the organisation. The steps taken so far highlight issues both with the data itself, but also management issues around data. While it is very early in the process, it became clear that for this housing provider, dealing with the people aspects of a BI implementation will have to be the main focus. The next steps should concentrate on establishing a clear framework within which to operate in terms of responsibilities and data quality assurance, and to start thinking about training and development of staff in order to make the most use of the BI system, and to increase acceptance and understanding of the system.

A further aim of this project is to provide a framework that other organisations can use in their implementation of a business intelligence system. Future work should therefore focus on the creation of a single framework that links the individual pieces highlighted in this paper. Lessons learned from other providers, as well as a strong foundation in the academic literature, are recommended steps as well.

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A THEORETICAL MODEL FOR BUILT ENVIRONMENT PRACTITIONER RESEARCH AT DOCTORAL LEVEL

J. Balogun and A. Higham

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: o.j.balogun1@edu.salford.ac.uk

Abstract: The delivery and achievement of practice-based doctorates, particularly in built environment, are seen as problematic due to the differences in process between practice-based doctorates and academic doctorates. Underlying this assumption may be the reconciliation of tacit knowing with explicit externalisation of knowledge and the concern about the rigour of the process for the acceptability of knowledge from practice-based doctorates as valid knowledge. Using a combination of theory and literature, a conceptual model for the execution of a practice-based doctoral qualification is proposed. The aim of this paper is to conceptualise a model to harmonise all strategic components of a practice doctoral process towards demonstrating the rigour and robustness of the process and the validity of knowledge created using the platform of the DBEnv. This paper argues that although the process of practice-based doctorates such as the DBEnv is different from that of the PhD, it is as rigorous. Knowledge generated therein, having fulfilled the requirements of the Framework for Higher Education Qualifications, do qualify as valid knowledge. Consequently a new conceptual framework is proposed which may assist the practice-based doctoral researcher through the research process.

Keywords: Conceptual Framework, Explicit Knowledge, Professional Doctorate, Practice-Based Research, Tacit Knowledge, DBEnv.

1. INTRODUCTION

The concept of practitioner research has opened a fracture in academe between academic purists and applied scholars, with the former seeing such research as different from the robustly theoretical doctoral research. However, academics such as Gray (1996) have been unequivocal in their defence of practice led research. In her seminal work on inquiry through practice, Gray (1996:3) defines practice-led research as, “research which is initiated in practice, where questions, problems, challenges are identified and formed by the needs of practice and practitioners”. Although her perspective is grounded in the arts and offered through the lens of an art practitioner, she nevertheless robustly argues that the research strategy and methodology adopted for any research should be those, which are familiar to practitioners and thus grounded in their practice. On the same note, writers like Winter *et al* (2000) see practice-based doctorates as problematic due to the seeming differences between its process and that of academic doctorates, which are often seen by the custodians of the academe as the route that grants membership to the fabled ‘club’.

The academe has developed its research ethos over centuries wherein research is defined as “a systematic enquiry whose goal is communicable knowledge” (Archer, 1995:6). The seeming problem in the definition, for it to fit practice-based research, appears to be the need for it to be seen as an enquiry and consequently a research. Archer (1995) posits that while the act of a practice may be seen as a goal directed to providing communicable knowledge, it needs to be about an enquiry and must follow an agreed systematic procedure for it to be

classified as research. In the words of Archer (1995:11), “all studies about practice, if they are to be recognised as research studies, must employ the methods, and accord with the principles, of the class to which they happen to belong”.

In a way, there seems to be a synergy between the views of Gray (1996) and those offered by Archer (1995). However, researchers in practice, unlike those in the academe, are left with inadequate support in the form of process frameworks to guide practice research process even though Nelson (2013:48) suggests “it is no longer tenable to take the methodologies of the sciences as the gold standard of knowledge, instead we find ourselves in a situation in which different approaches to knowing have different criteria for what is to count as true or valid”.

It was therefore resolved as part of this work to propose a framework for practice-based research in the built environment through a review of existing models, theories and concepts and viewed from the lens of a practitioner-researcher at the doctoral level. Support for this endeavour is found in the work of Winter *et al* (2000) who demonstrate such application in a research setting and Mills (1959:196) who opines that, “you must learn to use your life experiences in your intellectual work: continually to examine and interpret it”. A way to use ones life experiences may be by reporting it directly from the horse’s mouth but Mann (2014) advises on the need to be provisional by anchoring ones position with the views of others because research is always “an act in progress”.

Nelson (2013:53) of course argues that language “is not a neutral medium but a structuring agent in the perception of reality”. In consideration of Nelson’s (2013) position, perhaps it may be better, even at the risk of a fierce frown from academic researchers, to infer that reporting in the first person is likely to reduce the layers of interpretation and therefore blesses the prying eyes of the practitioner-researcher with the gift of experiencing reality directly. Bakan (1969) cited in Mann (2014) infers that any gap between phenomenon and data, which requires interpretation, is susceptible to error. Hence, by closing the gap between phenomenon and data, practice-based researchers are reducing errors in research. Using the first person, Mann (2014) offers that the practitioner is the instrument and that “the measure of the world and the position taken on it cannot be truer than the instrument”. However, due to the disjointedness of research in the real world, Mann (2014) equally advises being provisional by “waxing slow of wit” and by “raising the impact of your message, by lowering the volume of your voice”. This approach will enable a practitioner-researcher to develop the capacity to reconcile contradictions, as there will be many of such along the research process.

2. LITERATURE REVIEW

2.1 Knowledge Generation in Practice

Research philosophy encapsulates the way a researcher views the world. It therefore predicates on what reality is, otherwise referred to as ontology; how to acquire the knowledge of reality, otherwise referred to as epistemology and how distanced the researcher is from the views expressed in the research, otherwise referred to as axiology (Sanders *et al.*, 2007; Miles and Huberman, 1994). While Lennon and Whitford (1994:2) opine that, “genuine knowledge does not reflect the subject who produced it”, Winter *et al.* (2000: 28) counter by espousing that, “a claim to practice-based knowledge is an obvious example of a claim to knowledge which is context-bound, and in which the subjectivity of the producer of the knowledge cannot be eliminated”. The latter appears to be the intention of Mann (2014) when he refers

to the practitioner-researcher as the instrument that measures phenomenon and that the results cannot be better than the instrument.

The challenges of practice-based research in the opinion of San Miguel and Nelson (2007) are the difficulties of using theory to contextualise phenomenon, framing the practice problem as a research problem and incorporating the researcher's professional knowledge. Mann (2014) subsequently classifies those challenges into the problems of engaging the research in ones own voice; doing the research within the academe and dealing with the plurality of the social nature of research. After all, the academic research process hardly recognises the researcher's voice but in practice, a professional does have a voice surely. A voice that is reinforced by their tacit knowledge of their discipline gathered from years of practice and often validated by their professional standing and qualifications. A perspective that has been uniformly accepted in English Law through the operation of expert witness testimony. There is therefore the challenge of trying to sound authentic by being quietly self-evident (Mann, 2014). Secondly, research requires academic legitimacy. And like Mann (2014) posits, research is like a football game with rules. To play football, you have to play by the rules.

Practitioner researchers therefore need to convince the academe "how they know what they know" (Mann, 2014). Finally, practice-based doctorate needs to harmonise issues in the form of an extended essay by noting the differences and similarities between one thing and the other. It has to be explicit in the criteria that inform its choices. Why this and not that? Why interviewing A and not B? Decision parameters must be clear and explicit. Therefore, the practitioner-researcher's ultimate challenge is therefore how to bring out the tacit knowledge and make it explicit in what Mann (1998:viii) calls "externalize tacit knowing". Various models like the experiential learning model (Kolb, 1976; Nonaka and Takeuchi, 2005) are available as frameworks to bring out tacit knowledge.

2.2 Framework for Higher Education Qualifications

Externalising the tacit knowing appears to be a major way through which what is known could be subjected to the peer review mechanism and subsequently admitted as knowledge within or into the academe. In research at doctoral level, such knowledge needs to be appraised using the generic qualification and level descriptors identified in the *Framework for Higher Education Qualifications in England, Wales and Northern Ireland* (QAA, 2008) in the sub-section of the guidance entitled *Key Requirements for Level 8 Awards*. This guidance advises that doctoral degrees are awarded to those candidates who have satisfied the four basic requirements of the Framework for Higher Education Qualifications at level 8.

In the first requirement, a candidate must demonstrate having undergone training resulting in a systematic acquisition and understanding of existing knowledge within a specific discipline or practice. The understanding of what constitutes an academic discipline here is considered within the context of the arguments of Jantsch (1972), Biglan (1973) and Chynoweth (2009) to the effect that the built environment, due to the heterogeneous nature of its structure, could not be referred to as an academic discipline but an academic interdisciplinary with Design, Technology, Management, Law and, Economics as the key knowledge areas. It therefore means that to fulfil the first requirement for the award of a Doctorate in Built Environment (DBEnv), the candidate might have systematically acquired and understood the body of

knowledge in those five knowledge areas as it relates to the built environment. The entry qualification and the taught element of the doctorate in built environment appear to meet this.

For the second requirement for the award of a doctorate of the built environment, the candidate must demonstrate attainment of a detailed understanding of the research methods and techniques applicable in the built environment interdisciplinary. There are a plethora of research methods and techniques within the built environment interdisciplinary but they could be broadly classified into: quantitative, qualitative and mixed methods. Dainty (2008:8) states the dangers of relying exclusively on research approaches that are based on a single paradigm and then argues for “methodological pluralism”. However, Fellows (2010:11) argues that the future has ample accommodation for “stochastic perspectives” and the consideration of complexity in future methods. This requirement appears to be met by the taught element of the doctorate in built environment.

The third requirement for the award of a doctorate in built environment relates to the candidate’s ability to conceptualise, design and implement a research project for the generation of new knowledge and the ability to change such research concept and design as situation demands. The cognitive requirements of being able to conceptualise a research is very critical. Research is becoming a very elitist word because it conveys the use of considered and thoughtful intelligence in the recognition and analysis of problems and seeking ways of engaging phenomena (Drake & Heath, 2011) and consequently creating new knowledge or advancing existing ones. Doing this requires a whole lot of hard toolkits (Lee, 2009) and most importantly the soft skills of personal management, project management, time management, commitment and inquisitiveness. Both the taught element and the process of the doctorate in built environment appear to meet this requirement.

The final requirement for the award of a doctorate in built environment according to QAA (2008) is “the creation of new knowledge or the advancement of existing knowledge through original research or advanced scholarship of a quality that has met peer review standard and that merits publication”. In summary, QAA (2008) sees the creation of new knowledge as the end of the process and also as a product of the process. However Drake & Heath (2011) propose a radical view of the creation of new knowledge and opine that research does engage with new knowledge at every stage from initial conceptualisation of the problem, through the research design phase and to the final implementation phase of the research. This means that new knowledge therefore is part of the process at every point in time. Similarly, in their seminal text, Phillips and Pugh (2010) extended the work of Francis (1976) to identify fifteen potential ways for a doctoral student to make a valid contribution to knowledge that is worthy of a doctorate. However, neither Phillips and Pugh (2010) nor Drake & Heath (2011) indicate whether the new knowledge created at every stage of the process could merit publication or not. There lies the catch as it could be argued that the new knowledge proposed by QAA should be quantified or validated through the peer review mechanism and through publication or more realistically determined by the examiners during the *viva voce*.

2.3 The Concept of Psychological Contract

Working on the problems of recruitment, Kotter (1973) proposes a solution through the concept of psychological contract, which seeks to harmonise the implicit understanding of the expectations of both parties. This ensures that the implicit expectations of the employee are in line with that of the employer. Kotter (1973:92) defines a psychological contract as, “an

implicit contract between an individual and his organisation which specifies what each expects to give and receive from each other in their relationship”. This concept can be borrowed from human resource management for application in the understanding of the implicit relationship between the university and the doctoral researcher.

There is an existing formal contract, learning agreement, between the university and the research candidate; but more than the formal contract, the understanding of the informal/implicit contract by the candidate and the university could be more critical in determining the success of that relationship or the successful execution of a research and the award of a doctorate. This understanding relies significantly on harmonising the deep-seated implicit or hidden assumptions of one party with the other. Central to the concept of psychological contract is the matching process (Kotter, 1973), which enables a compromise to be reached between these two and sometimes opposing implicit assumptions of both parties. These assumptions from both parties would need to be matched so that a compromise could be reached in conflicting areas.

2.4 Expectancy Theory

Vroom (1964) proposes the expectancy theory, which submits that the behaviour of an individual on an issue is not based on clear objective reality but on the individual’s perception of reality. This perception of reality is formed from the context, worldview and expectations of individuals according to Balogun (2001). Therefore, the expectancy theory submits to the socio-constructivist school of thought that reality is socially constructed. In a way, it appears that the expectancy theory complements the concept of psychological contracts in determining what informs the decision and action of individuals when faced with a situation of bargaining with other parties in which implicit expectation can significantly influence the outcome.

From the context of the practice-based research candidates, these expectations have to be properly managed in a way that can make the implicit assumption to be explicit and open for discussion and negotiation. In addition to the submission in psychological contracts to the extent that the process should be managed through purposeful discussion between the candidate and the supervisor, the use of experiential learning model (Kolb, 1976; Mann, 1998) appears to have the capability of adequately managing the process.

2.5 Experiential Learning Model

Kolb (1984) offers the experiential learning model that could help managers and practitioners learn and generate valid knowledge in practice as shown in Figure 1. A key feature of the experiential learning model is reflection, which is the art of looking back at a previous occurrence, drawing up inferences and bringing such inferences to bear on a present situation or scenario in an iterative manner. The cardinal points of the experiential learning model are: concrete experience, reflective observation, abstract conceptualisation and active experimentation. From concrete experience of phenomenon, necessary data are collected through reflective observation. These data are subsequently reinforced with abstract and existing concepts and theories before finally embedding change in active experimentation. Adapting the experiential learning model of Kolb (1984), Mann (2011) demonstrates that the reflective practitioner oscillates between the two realms of professional practice and

academic practice in an iterative way (see Figure 2) of trying to make explicit the tacit knowledge of practice. This is applied as the core of the proposed theoretical model. Hence, just like the academic researcher, the practitioner researcher utilises theory in its research but unlike the academic researcher that starts with theory, practice based researcher starts with a problem in practice but utilises theory in shaping the problem and in collecting data on the phenomenon.

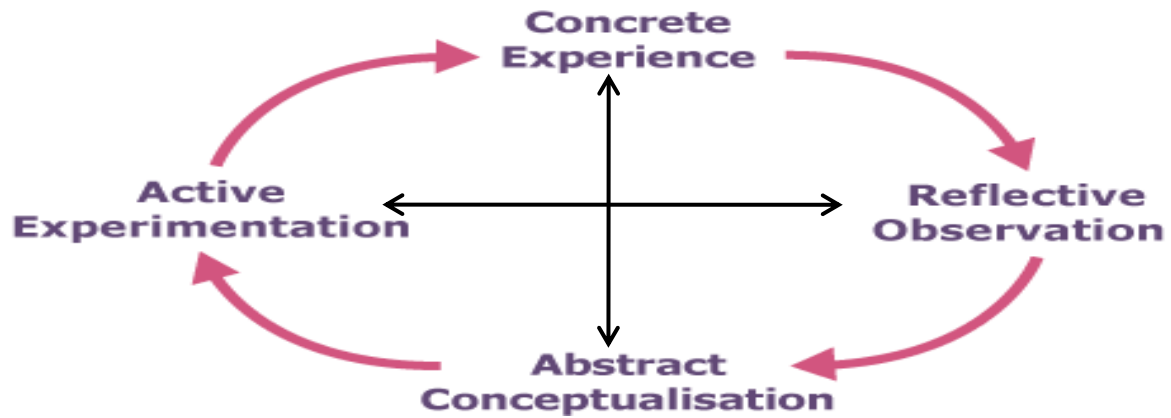


Figure 1: *Experiential Learning Model (Kolb, 1984)*

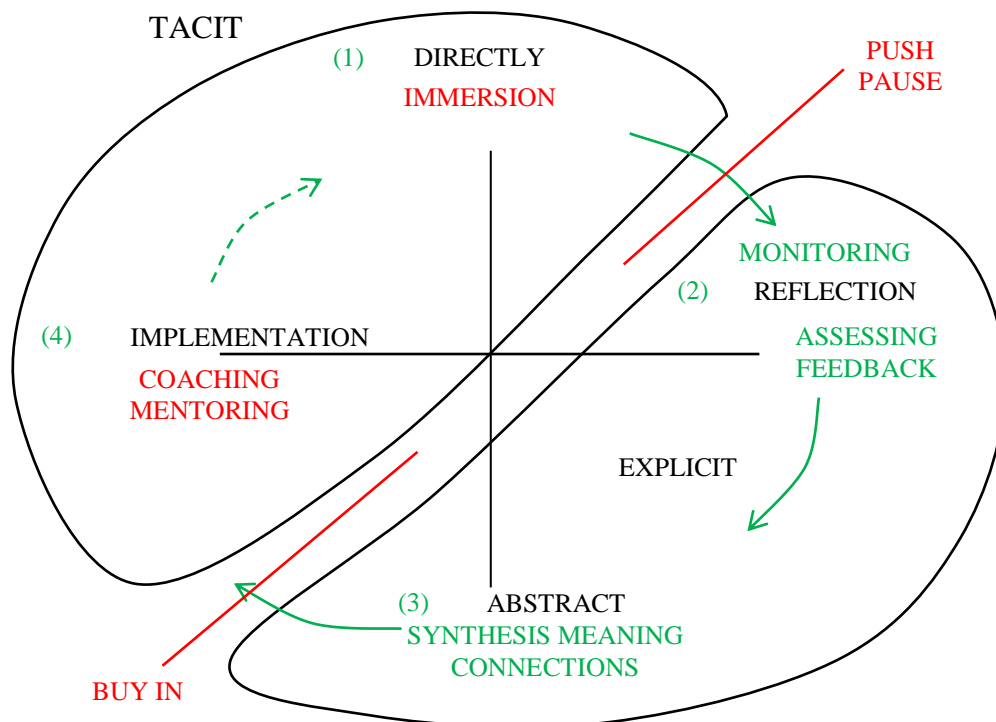


Figure 2: *Reflection and the Practitioner Researcher (Mann, 2011, Nonaka & Takeuchi, 2005)*

2.6 Summary

The professional doctorate process is essentially the management of relationships between the candidate and the university partly as explicitly expressed in the learning agreement but more importantly as latently expressed in the form of implicit assumptions and expectations

of both parties. For the success of the process, there may be need to use time-tested concept of psychological contract (Kotter, 1973) combined with the expectancy theory (Vroom, 1964) to harmonise these expectations and manage them. Literature has shown that knowledge generated in practice is context-bound (Winter *et al.*, 2000; Gray, 1996) and better expressed by the insider, the practitioner, through processes that he/she is familiar with (Gray, 1996; Mills, 1959). Since the practitioner is the instrument, the measure of the phenomenon and the knowledge it provides cannot be truer than the instrument (Mann, 2014). However, practice-based knowledge suffers from the problem of explicit externalisation (Mann, 2014) to make it acceptable to the academe through the fulfilment of the requirements of the Framework for Higher Education Qualifications (QAA, 2008) and that of *viva voce*. Using the experiential learning model (Kolb, 1984; Mann, 2011) appears to have the capacity of providing the rigorous process that the practitioner requires in externalising tacit knowledge (Polanyi, 1966).

3. RESEARCH METHODOLOGY

This is a concept paper developed to propose a framework for practice-based research in the built environment. It therefore reviews relevant literature, concepts and models and synthesises these with the intention of trying to resolve, through a model, the key problems of practice-based research viz., harmonising implicit assumptions and expectations, externalising tacit knowledge and achieving rigour in the research process.

However, should this research be taken further in the future to test and validate the model, it would surely benefit from a methodology that is familiar with the practice process like auto-ethnography (Wall, 2006) to be carried out by a researcher who has experienced the professional doctoral process. Auto-ethnography is about telling one's story in one's own voice and Wall (2006:9) recognises "the voice of the insider being truer than that of the outsider". Auto-ethnography which tells personal stories and relate it to the cultural is founded on postmodern ideas and "exposes the flaws in our traditional reliance on neutrality and objectivity.... we cannot separate ourselves from what we do" (Wall, 2006:9).

4. MODEL DEVELOPMENT

4.1 Emergence of the Framework

The conceptual framework to guide practice-based research in the built environment could be seen as eclectic; combining ideas from a plethora of disciplines with individual paradigms, approaches and methods but with a unified or collective focus towards a common goal of understanding and responding to the phenomenon. The different concepts or theories advanced hitherto provide the building blocks for the theoretical model for practitioner doctoral research in the built environment while the production of knowledge from practice that is acceptable to the academy must consider the key parameters espoused. Such knowledge must come through an established epistemological foundation of whether knowledge is external to the researcher or if the researcher has a role to play in its creation (Knight and Turnbull, 2008).

The framework in this paper assumes the research philosophy of idealism, interpretivism and value-laden. Nevertheless, meeting the four basic requirements of the Framework for Higher Education Qualifications at level 8 is required as the objective consideration opined by Mann

(2014) to the effect that when one is on academic turf, academic rules must be obeyed for research to achieve legitimacy. However, objective requirements alone may not ensure a successful research, as tacit knowing may be more critical to success particularly within the knowledge base that is predominantly soft and applied, within the purview of the expectancy model and the context of the opinion of Polanyi (1966) to the effect that we actually know much more than we can express.

The process of doctoral research in the built environment is simply the management of expectations towards successful outcomes. Expectations can be explicit or implicit (Kotter, 1973; Armstrong, 2006). How the individual behaves therefore depends on what the individual expects from reality (Vroom, 1964). Since expectation is mostly tacit and hidden within the subconscious, it could therefore pose great challenge to externalise and understand it (Mann, 1998). The relationship between the university and the doctoral student is also a contractual one with two types of contractual arrangements. There is the formal written contract as detailed in the learning agreement and the university code of practice for research degrees (University of Salford, 2015) and there is the unwritten psychological contract, which resides in the minds of both parties (Kotter, 1973; Armstrong, 2006).

The framework therefore emerges from the need to use literature to harmonise the implicit assumptions and expectations of both the doctoral candidate and the university so that they can be on the same pedestal. Literature provides for this through the concept of psychological contract (Kotter, 1973) and expectancy theory (Vroom, 1964). Secondly and based on the research philosophy of idealism, interpretivism and value-laden, it is necessary to develop a system that can externalise the tacit knowledge from practice. Literature equally provides for this through experiential learning model (Kolb, 1984; Mann, 2011).

4.2 The 5-Level Conceptual Framework

As shown in Figure 3, both the learning agreement and the implicit assumptions produce expectations for both parties as shown at Level 1 of the model. Level 1 is therefore based on the identification of all the expectations and sending them for rationalisation and harmonisation in the matching process unit. Most of the discussions here are done between the candidate and the supervisor who represents the university. It is therefore important for the candidate to be comfortable with the supervisor particularly in relation to the area of research interest of the supervisor and the availability of the supervisor to give appropriate guidance and direction when needed.

Level 2 of the model is about problem engagement and the support system that is available to the professional doctoral candidate. The experiential learning model (Kolb, 1984; Mann, 1998; Nonaka & Takeuchi, 2005) has been used here as the framework for engaging with the problem and obtaining meaning which provide learning and knowledge because the research in context is a practitioner research. In engaging the problem, the candidate must first understand the phenomenon by establishing the main focus and consequently try to step outside the problem in order to have an objective reflection of it. This is the movement from the tacit to the explicit environment of problem resolution. A robust problem resolution or practitioner research methodology involves the continuous movements between the tacit and explicit environments in an iterative way of combining tacit knowledge base with the explicit framework of objective reality (Mann, 1998 & 2011).

Data of the phenomenon could be generated from personal experience through reflection or the experiences of other people through interviews. This stage should be closely linked with appropriate theories to reinforce abstract connections with the data and the problem in context. The conversion between the data collection stage and the conceptual framework stage is referred to by Nonaka & Takeuchi (2005) as explicit to explicit conversion. Having collected the relevant data and considered the relevant connections or concepts and axiomatic within the explicit environment, the application of the results of the analysis is achieved by moving into the tacit environment again in a repetitive cycle. The key component at this level is the iterative movement between the familiar domain of practice and the alien terrain of academia (Mann, 2011). The result of the iterative process is then sent into the central matching process. However, during the period of problem engagement, the candidate is availed with the university support system including among others, supervision, communities of practice (cohort, etc.), library, workshop and conferences. There is need for constant interaction between the support system and the experiential learning model to ensure efficiency and effectiveness. In fact, the operations of the experiential learning model are shaped by the quality of the support system that is provided. These processes are not sequential or linear but iterative.

Level 3 is the matching process or the central processing unit that takes expectations from the parties, results from the problem engagement, and results from the support system. Added to these are policies, procedures, agreements, payment systems, academic culture, assignments, research proposal, interim assessment, internal evaluation and *viva voce*. They are all matched together to produce outcomes. During the matching process, some items are sent back either to problem engagement or support system for refinement or further processing. Although the matching process is shown as a single item at Level 3, there are however mini matching processes on-going at Levels 1 and 2 and these mini cycles help to refine most of the decisions that finally feed into the big matching process at Level 3. At Level 4, outcomes have emerged from the process. This is the time for stocktaking where parties compare the outcomes with their initial expectations. Of course some planned expectations may not be realized while some unplanned expectations may be realized depending on the matching process. Finally at Level 5, the DBEnv is awarded. It should be noted however that this model could be applied to any professional or practice-based doctorate.

5. CONCLUSION

Through established literature, theories and concepts, a theoretical model is proposed. This conceptual paper argues that although the methodology of practice-based doctorates like DBEnv is different from the PhD, it is as rigorous. Knowledge generated in practice-based research, having fulfilled the requirements of the Framework for Higher Education Qualifications, do qualify as valid knowledge. This theoretical model could therefore assist the practice-based researchers in their research engagements. This has been demonstrated through the instrumentality of the academy - the doctoral process. With this model, it is more likely that the perception chasm between the two sides of the divide would be significantly resolved. All research uses *language* to express its process and the research outcome. However, since language is now seen not as a neutral and objective medium of expression in the perception of reality, the claim of objectivity in academic research process may not be absolute after all. This model may enable academic researchers to show more understanding and consideration in their objections to the contextual subjectivity of practice-based research. Those in academia are more likely to be convinced not only of the rigour and robustness of

the processes of practice-based research, but of the validity of knowledge generated from practice. However, it is now very clear that in order to be classified as research, knowledge in practice may have to be about a systematic enquiry such as that which the proposed model in this paper offers.

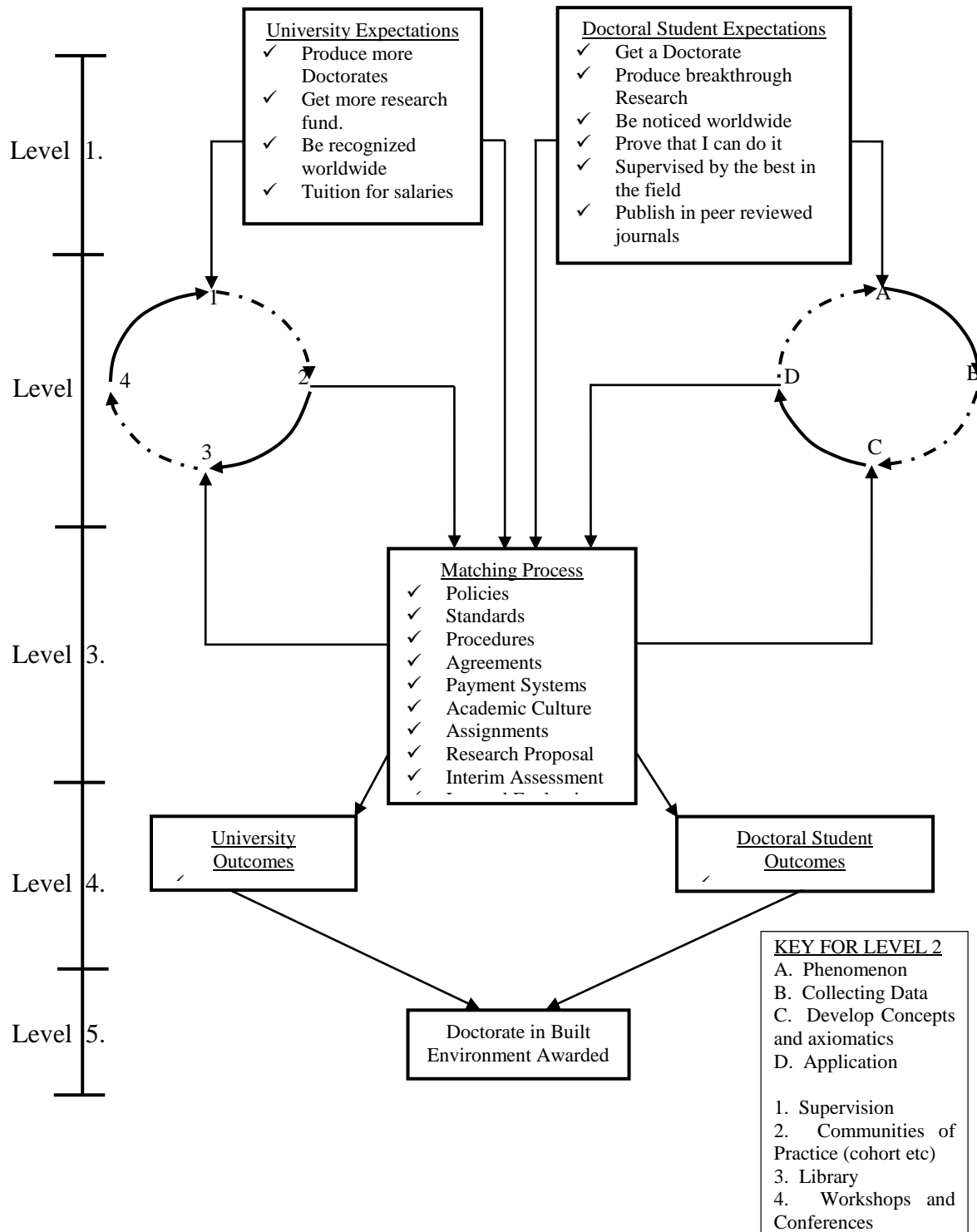


Figure 3: A 5-Level Theoretical Model for Practitioner Doctoral Research In Built Environment After (Vroom, 1964; Kotter, 1973; Armstrong, 2006; Kolb, 1984; Mann, 1998 & 2011; & Nonaka & Takeuchi, 2005)

The proposed model is further likely to improve the perception by the academy, of professional doctorates and academic PhDs as equal in status even though different in contexts. Those in practice are likely to be buoyed and encouraged in conducting more research at the workplace thereby improving industrial processes and industrial products. With the funding from industry, it is not unlikely that increasing joint platforms for collaborations on future research engagements between practice-based and academic researchers would be developed. Since it is now established that practitioners know more than they could express, industries may consequently step up funding for practice-led research and there seems to be no current signs that this lifeline to practice-based research funding may wane in the future. However, further research is necessary to test this model through the whole professional doctorate process using auto-ethnography.

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ENHANCING NURSE LEADERSHIP THROUGH RESEARCH, EDUCATION AND TRAINING

T. Adunola, A. Marshal-Ponting and A. Fleming

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: tadunola@gmail.com

Abstract: This paper aims to highlight the need for research, education and training as a means of enhancing nurse leadership. Nursing, just as many other aspects of the National Health Services (NHS) in United Kingdom (UK), has been in the public eyes in the recent times. The public image of nursing is always under scrutiny, because nursing can be perceived as ‘the face’ of the health system.

This article traces a brief history of nursing and nursing leadership in order to gain an insight into how research, training and education had helped nursing and its leadership in the past and highlight the role that research, training and education can play in shaping the immediate future and beyond, of nursing and its leadership, in UK.

This paper argues for a unified training route for all nurses in UK. It also contends that degree education is most helpful in preparing the twenty first century nurses for the medical and technological advancements. This article argues for the upgrading of nursing education as a means of boosting its professional image as well as enhancing its research capabilities. The second point addressed in this article is the public image of nursing-which, in a way, is exogenous; as, this stems from inadequate hospital resources which has led to high burn-out among nurses in the UK and, which consequently is affecting the quality of care given by the nurses and midwives in UK. This is a serious factor that is also affecting public perception of nursing. The methodology adopted in this report is a review of relevant literature.

Keywords: Education, Leadership, Nursing, Research, Training.

1. A BRIEF HISTORY OF NURSING IN UK

Nursing, in UK, started a long time ago (Kozier et al, 2008). Prior to the Crimea war with Russia in 1854, there was no formal school of nursing established in UK. Although there were the sisterhoods- such as The Church of England’s St John’s House sisterhood; and, the All Saints’ sisterhood.. These sisterhoods trained the probationers (nurses in training) (Black, 2005). Florence Nightingale was a British woman who trained as a nurse in Germany. Upon her return to the UK, she established the first formal School of Nursing at St Thomas’ Hospital in London in 1860 (Dingwall et al, 1991, Baly, 1986), specifically to train nurses.

Prior to that time, many people performed similar and different roles, who were referred to as nurses, in hospitals and health care services centres. Most of them had little or no training, compared to a modern day nurse (Dingwall et al, 1991).). Many people (especially women) performed many ‘nursing’ duties in different establishments. Many had learned to do their work through experience, thus training, experience and standards differed widely (Dingwall et al, 1991). In the middle ages, when voluntary hospitals such as St Bartholomew’s (1123) and St Thomas hospitals (1207) were founded, they were mainly run by monks and nuns (Helmstadter & Godden, 2011), hence, the name ‘Sister’ for a senior female nurse is still used today.

The important role played by Florence Nightingale during the Crimea war, especially, in reducing mortality rate among the wounded soldiers by fifty percent (although that claim is challenged by some critics, see especially Dingwall et al, 1991), highlighted the valuable contribution that nurses can make to the lives of the soldiers and the war effort (Baly, 1986). The struggle for a national registration for nurses took a long time (Thomas & Richardson, 2016)-having started in 1858 after the doctors had gained registration and lasted until 1919 when the bill was passed (Thomas & Richardson, 2016; Abel-Smith, 1960). By 1858, after the medical profession had gained registration status, opinions were being voiced by others for a similar status for nursing. Prominent among the voices was the Nursing Record (later renamed British Journal of Nursing). However, the nursing organisation was plagued by internal disagreement. The Matrons Committee was in favour of registration, but disagreed on the length of training. The Hospitals Association over-ruled the Matrons Committee and established a non-statutory voluntary register of nurses in 1887. This led to a division among the Matrons Committee. Surprisingly, Florence Nightingale was neutral, because she was opposed to any form of registration. Ethel Gordon Fenwick and her group continued to argue for registration of nurses, their effort led to the formation of British Nursing Association in 1887 (Thomas & Richardson, 2016).

However, the British parliament did not take any action about the registration of nurses until 1919. Public opinion was changing in favour of nurses registration, especially because of the great contributions nurses had been making towards war efforts (Abel-Smith, 1960); coupled with the influence of Princess Helena and Queen Alexandra, who became presidents of military nurses association. A private members bill raised by a backbencher, Major Richard Barnett, was passed in December 1919. The bill was for the establishment of a regulatory body for nurses as well as registration for nurses in England/Wales; Scotland and Northern Ireland (Abel-Smith, 1960).

Ethel Gordon Fenwick (often referred to professionally as Mrs Bedford Fenwick) was the first nurse to be registered in the UK, in 1923. Although, New Zealand had begun registration of nurses in 1902, and so, Ellen Dougherty of New Zealand was the first nurse to be registered in the whole world.

Worthy of note are the roles played by some other people such as Princess Helena (the daughter of Queen Victoria), and her sister-in-law, Princess Alexandra who became the Queen after the death of Queen Victoria in 1901. Helena had a very strong interest in nursing and she became president of the British Nursing Association, the position which was later occupied by the new Queen Alexandra. Helena was a strong supporter of nursing (Dingwall, 1991).

Before discussing nurse leadership, it is necessary to briefly describe or define leadership. Defining leadership is not a very easy task. However, literature is full of many definitions, that Bass (1990, p11) said '*There are almost as many different definitions of leadership as there are persons who have attempted to define the concept*'. But, simply put leadership exists where there is someone or group of people who are leading one or a group of persons. In other words, there must be a leader and at least a follower (Bass. 1990).

Leadership is very similar in many organizations, including the NHS. The NHS recognizes the importance of leadership and has taken some bold steps in its leadership development initiative. In 2010, it launched Leadership Council and at local levels Strategic Health Authorities, in order to meet the challenges it faces as a result of economic constraints and increasing demands (Storey, 2010).

2. NURSE LEADERSHIP PRE NINETEENTH CENTURY ERA

Nursing training was carried out by each institution according to their own needs. Prior to the establishment of the school of nursing by Florence Nightingale in 1860, there was nursing training provided especially by the voluntary organizations such as St Bartholomew's which was run by monks and nuns and other groups such as the sisterhoods.

To fully understand the social history of nursing in the UK (a fuller account of which can be found in Dingwall et al, 1991, Abel-Smith, 1960), it is important to understand that the British aristocratic and class system, is directly intertwined with nursing leadership in the UK. It is not expedient to delve into such details here. However, it will suffice to mention that prior to the nineteenth century, sisters were people of nobler birth or class whereas, nurses were people of lower classes (Black, 2005; Dingwall et al, 1991). The sisters trained nurses. Nurses got paid for their work, whereas sisters (who were of a higher class) worked as volunteers and philanthropists (Dingwall et al, 1991; Abel-Smith, 1960).

In the nineteenth century, a number of factors affected nursing and nursing leadership. The practice of medicine started changing due to a number of reasons. Doctors' needs were changing as a result of doctors now specialising, so the type of nurses they required had to change. Doctors began to have a say in what training the nurses they needed should have (Glasgow, 2016; Dingwall et al, 1991). Doctors began to get more and more involved in the recruitment of the nurses they wanted, rather than allowing the matrons or the sisters to dictate the nurses the doctors had. The advances of science and technology also imposed new and different needs on the type of nurses required (Glasgow, 2016).

Other factors such as the political and social reforms, especially, The Poor Law, began to affect the socio-cultural status of nursing and its leadership. Prior to the establishment of the National Health Services (NHS), many poor people could not afford doctors' and hospitals' fees, so, many people depended on the philanthropic goodwill of the rich. The Poor Law introduced the provision of asylums for the sick and disabled people. These asylums were overcrowded and in poor conditions and run by nurses. Many social reformers were critical of the state and the conditions in such institutions (Abel-Smith, 1960).

Other remote factor that affected the state of nursing in the UK was the French revolution. The French revolution led to the nationalisation of private hospitals, which meant large numbers of people were admitted to the newly nationalised hospitals. Unfortunately, there were no adequate provisions of doctors and other hospital workers as well as medications. These shortages led to mass death of people. But it brought an unexpected advantage in that doctors now had many corpses to use for their studies (Cunningham, 2002). Thus, the French revolution had a good side effect on doctors and the practice of medicine in the United Kingdom. Many doctors from the UK went to Paris to learn new practice of medicine from the experience and knowledge gained from dead bodies. Obviously, this had an impact on nursing and its leadership in the UK, as well.

3. NURSING LEADERSHIP BEFORE THE INTRODUCTION OF THE NHS

Prior to the second half of the nineteenth century, nurse leadership was mainly provided by the sisters (Wildman et al, 2009). For example, The Saint John's House Sisterhood, founded in 1848, was given responsibility for managing the nursing duties at St Thomas' Hospital in

1856 and Charing Cross Hospital in 1866. Similarly, All Saints' Sisterhood was employed to run the nursing services at the University College Hospital in 1862 (Helmstadter, 1994). Although, there were matrons in hospitals, most of them tended to be confined to purely administrative and house duties rather than clinical roles (Wildman et al, 2009). Nevertheless, some were actually former nurses who had risen to the position of a matron and so were able to perform clinical supervisory roles.

The Nightingale model of hospital manager was that each hospital should have a senior female person (Matron) in charge of the nurses. It is believed that Nightingale sought to take control of nurses out of the hands of the doctors and place it in the hands of the matrons (Helmstadter, 2008). The proposition did not go well everywhere, especially with the doctors (Abel-Smith, 1960). But, despite the initial objections, however, by the end of the nineteenth century, the matron had become a very important figure in hospitals in the UK (Wildman et al, 2009).

4. NURSING LEADERSHIP AFTER THE INTRODUCTION OF THE NHS

The NHS, which promises health for all from cradle to grave, free at the point and time of need, has been a huge success (Thomas & Richardson, 2016; Klein, 1998). The philanthropic approach to nursing training and provision of nursing services had gone. Doctors had started to get involved in determining what type of nurses they needed and the type of training they required of them. In addition, some were directly involved in the recruitment and selection of nurses. This might be seen as an erosion of the powers of the sisters and matrons.

Perhaps, the greatest change to nursing and its leadership came about after the Griffiths' Report of 1983 (Griffiths, 1983). There have been many proposals by the Conservative as well as New Labour Government (of Tony Blair/Gordon Brown, 1997-2010) since then. Two of the changes that have been introduced: are the Clinical Governance and the creation of The Modern Matrons post.

5. CLINICAL GOVERNANCE & MODERN MATRON

Clinical governance, which was introduced in 1998 (Department of Health 1998, Harvey, 1998) is a new way of working that affects all nurses working in any healthcare setting, especially the NHS. The government has defined clinical governance as a framework through which NHS organisations are accountable for continuously improving the quality of their services and safeguarding standards of care, by creating an environment in which excellence in clinical care will flourish (Harvey 1998). The activities that highlight it are clinical audit, risk management, evidence-based practice, user involvement, clinical supervision, clinical leadership, continuing professional education, management of inadequate performance, reflective practice, team building and peer review (Valentine and Smith 2000, Harvey, 1998). At the heart of Clinical Governance are the Senior Nurses or Nurse Managers, who are charged with the responsibility of making it work in their wards.

The Modern Matron was re-instituted in 2000, according to the government's White Paper, NHS Plan (DOH 2000). The White Paper described the creation of the post of a Modern Matron, a person with strong clinical leadership with clear authority at ward level (Hewison, 2001). The remit of her power and work was reiterated in April 2001 (NHS Executive, 2001).

It was envisaged that by the year 2004, there would be up to 2000 such officers (Hewison, 2001). According to the government, this development was prompted by public demand arising from the public consultation the government had carried out. That gives a brief history of nursing in the UK

6. NURSING LEADERSHIP AND NURSING RESEARCH, EDUCATION AND TRAINING IN THE UK

Since the 1980s, following the Griffith's Report of 1983, the importance of nursing leadership within the NHS was highly emphasized (Storey, 2016; DOH, 2000), especially by that statement in the report 'if Florence Nightingale was here, she will ask for the nurse managers' (Griffiths, 1983). The most recent and perhaps the most important change to nursing leadership is Clinical Governance, as briefly mentioned above.

Nurses and their leaders are directly charged with providing care, improving the quality of that care as well as safeguarding the standards of care. Because of these changes, '*nursing is professionalising fast*' (Moiden, 2002, p24), especially with all nursing training now transferred to the Universities. Many roles and positions have been created over the last sixteen years or so, that have enhanced the political, academic, executive and clinical status, and hence, the professional status of nurses. By 2004, over 1000 nurse consultants were to be appointed by the NHS to work alongside hospital doctors to draw up referral and clinical protocols (Moiden, 2002). There are many academic nurses as well as nurse professors in the universities now. Some nurses now occupy executive and political positions, all of which have helped both the professionalization and the professional status of nurses.

However, nursing research in England and the UK as a whole is still very much in its infancy and a number of reasons can be advanced for this. According to Gill (2004), some of the reasons are: lack of adequate research-active staff, nursing research lacks purely dedicated funding within the academic institutions, there is a lack of, or a poorly developed culture of research among the nurses academic staff, as well as a competing demand on nurse academic staff.

Prior to Edinburgh University starting degree courses, nursing training was mainly confined to the hospitals. It was only in the 1970s that University of Manchester appointed the first professor of nursing in the UK. It is therefore not surprising that the Nursing Departments of most Universities in the UK have not done very well in the 5-yearly Research Assessment Exercise (RAE) of UK universities (Gill, 2004). The RAE has now been replaced by another body called the Research Excellence Framework (REF). Their most recent assessment took place in 2014.

In order for nursing research to develop and mature, a number of issues have to be addressed, as a matter of urgency. From the ongoing discussion, it is very clear that nursing in England and the UK has come a long way. However, much more still needs to be done to enhance the professional image of nursing and for nursing to be able to hold its head up high in academic circles. Two of the issues that need to be addressed will be identified here, with suggestions on what could be done.

First, is the educational standard of those to be admitted to the register of nurses and midwives, and, linked to that is the research development among nurse practitioners.

- (i) It is gratifying to note that nursing training in England is now (from 2013) through a degree route. It is suggested that those who pass through the degree route are more likely to be given basic training on how to carry out research. And the tendency would be that some of them might be interested in taking up postgraduate studies in their profession. (Reference is made to England here as there are variations in training routes in the other home nations of UK- Northern Ireland, Wales and Scotland)

It is also suggested that the academic standards of those to be admitted to nursing training in the universities need to be raised to be at par with other university courses. The current five GCSEs will not help the image of nursing. It has been suggested that Oxford and Cambridge do not engage in nursing training for this reason. Black (2005) is of the opinion that improved nursing leadership and opportunities can be enhanced through education and training.

In this highly complex and advanced technologies, only highly educated and intelligent nurses will be able to cope with the healthcare demands and practice of medicine in the twenty first century.

Australia now requires a bachelor's degree for nursing registration. Some countries in Europe such as Norway and Spain only admit those with degrees into the nursing profession (Aiken et al, 2014). Scotland and Wales are also moving towards making a Bachelor's degree the minimum entry qualification to the profession (Shields & Watson, 2007). In the USA, about 80% of the nurses there have a minimum of Bachelor's degree, compared with 28% in England (Aiken et al 2014). In fact, most states in the USA will only allow those with a degree on their register (Shields & Watson, 2007).

The above issue is well summarised by Shields & Watson (2007, p72) who said that most of the submissions to two of the British Journals of Nursing are from overseas. A similar point was also voiced by the Higher Education Policy Institute.

- (ii) The second area which Nurses leadership need to address is the public image of nursing (see Thomas & Richardson, 2016; Gillett, 2012). Thomas & Richardson (2016) and Gillett (2012) have synthesized relevant newspaper articles over a couple of decades highlighting public perceptions of nursing as portrayed by the newspapers, most of which were negative. They, however, defended nursing and highlighted the good and positive works being done by nurses all over the UK. Aiken and her colleagues (Aiken et al, 2014) have also addressed this issue brilliantly. Aiken et al (2014), in a comparative study of 12 European countries found that nurses in England are not uncaring as portrayed by the media and the public, rather, they are unable to adequately fulfil their nursing role due to lack of resources. They identify burn-out among nurses in England to be one of the worst among the 12 countries studied. Their findings also reported that inadequate resources is affecting nurses in the performance of their duties effectively.

It is to be noted however, that recent reports about the impact of the Modern Matrons give a favourable outlook of the importance of this post, especially from the patients' perspective. More needs to be done, though, as White (2012) puts it, nurse managers and directors need to develop their political and lobbying skills in order to enhance their status in the corridors of

power and influence strategic national decisions that will affect their profession and their staff (Gillett, 2012). That will also affect and influence public perception of nurses and the important contribution they are making to the health of the population.

In this time of financial crisis and cutbacks, the nurses and their managers are between the 'devil and a hard rock' in terms of discharging their duties of care effectively. Thus, it will take higher and better negotiating skills of the nurse managers and directors to be able to influence strategic decisions that will affect nursing and the care they provide, which ultimately will lead to a better public image of nurses and midwives.

7. CONCLUSION.

This brief analysis gives a hint of the problems facing nursing in the twenty first century UK and what nursing needs to do to enhance its leadership. Nursing is a noble profession and the face of any health care system. It thus behoves both the practitioners and the end-users of nursing service, that is, the public, including the media to help in maintaining and enhancing the image of nursing (Gillett, 2012). Some writers have suggested that medicine without nursing is not feasible (Shields & Watson, 2007; Black, 2005).

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A COMPARISON OF UK AND CHINESE HEALTH AND SAFETY CULTURE IN CONSTRUCTION

M. Liu and P. Farrell

School of Engineering, University of Bolton, Deane Road, Bolton. BL3 5AB, UK

Email: mless@bolton.ac.uk

Abstract: Whilst the UK has far too many accidents, fatalities and injuries in construction, its record is arguably as good as, or better than most other countries in the world. There are many examples of best practice in flagship projects, and there is a commitment to share this best practice throughout the industry. Statistics from the UK Health and Safety Executive have shown a reduction in accident data over the last decade. However, there remains much more work to be done. In 2015/16, there were 45 UK deaths in construction; it is doubtful that such a high figure would be tolerated in more sophisticated industries such as nuclear or aerospace. Reliable accident data in China is somewhat harder to establish, however it can be ascertained that there are more incidents per head of population than in the UK. In year 2000, there were 1,180 employee deaths in China; in 2011, this had reduced to 989 deaths. The Chinese economy, including its construction sector, continues to grow at rates far higher than in western countries. It is important that whilst China's construction industry grows, it simultaneously adopts as far as is possible, international best practice in health and safety. This research is founded on a literature review to compare accident data between the UK and China, supported by interviews with Chinese practitioners working in the UK. Differences between regulation and marketing of the industries are explored. This is the first exploratory paper in a full-time PhD.

Keywords: China, Culture, Health, Safety.

1. INTRODUCTION

As China has developed its primary economic model over the last 20 years, and as its industry has updated itself, there has been substantial economic and social reforms. Much more attention has been devoted to health and safety. Health and safety management is becoming more embedded as a kernel in public and academic research. Under these new circumstances, the government collaborates more closely with industry and research institutions, and interaction is promoted; meanwhile, new application of technology and creativity is being applied and there is evidence of greater political leadership by the government in this field. It is a fundamental premise of conventional welfare economics for public policy makers, that public decisions should, as far as possible, reflect the preferences of those who will be affected by them. However, both technical and artificially induced mistakes still occur in projects, especially, in the field of safety management and accident prevention. In comparison, there is evidence that the UK is leading international efforts in health and safety management, especially, in the areas of company and management culture (Swuste, P. et al., 2012). At present, many domestic construction safety regulators exist in China and cross-functional performance reduces regulatory efficiency significantly because of the lack of necessary mutual checks and balances between institutions (Wang, at al., 2016). The UK's Health and Safety Executive (HSE) implementation of the Construction Design and Management Regulations (CDM, 1994), and subsequent revisions, illustrates it has encouraged the 'the integration of health and safety into project management' (HSE, 2004).

Although, health and safety issues still present significant challenges to UK companies, many of these challenges are being addressed with the benefit government support.

This paper will give an overall review and analysis of Health and Safety management with comparison between China and UK, under the three following subject areas:

- Current status and background
- Health and safety management system
- Policy and culture

2. CURRENT STATUS AND BACKGROUND

2.1 The Background to Construction in China and the UK

Figure 1 illustrates growth in the Chinese construction market over the five-year period 2010/15. Chinese construction enterprises have grown from 80,000 to 100,000 between 2010 and 2015. In the same period, the number of all employers increased from 120,000 to 150,000 and the data of all new housing have grown from £10,000BN to £20,000BN. Between 1980 and 2015, Chinese construction enterprises have grown from 6,604 to 80,991; a growth rate of 1226%, and the number of employees increased from 6.48 million to 50.93 million; growth of 786%. Construction industry output value has increased in the same period from 28BN Yuan (circa £12.4BN), to 18,075 billion Yuan (£1,829BN), a growth rate of 14831% (National Bureau of Statistics of the People's Republic of China Yearbook, NBPRC, 2016).

Figure 2 shows that the UK construction industry has also developed rapidly in the recent years, though some would argue not rapidly enough. The data of all new housing have grown from £20.05BN to £29BN between 2010 and 2015. In the same period, the data of infrastructure have grown from £11BN to £21BN. From the 1950s to the 2000s, the number of people working in UK construction increased 20% to 1.3 million. Two main factors can offer explanations for the increase: one is welfare and the living environment, and the other is economic plural conditions. Welfare and favourable living environments in developed countries attract an enormous number of skilled migrants. Also, liberal economic conditions are favourable to those job seekers from different countries. In the past 15 years, the UK construction industry also showed a gradual upward trend; the output value of the construction industry has an average annual growth rate of about 2% (Office for National Statistics, ONS, 2016).

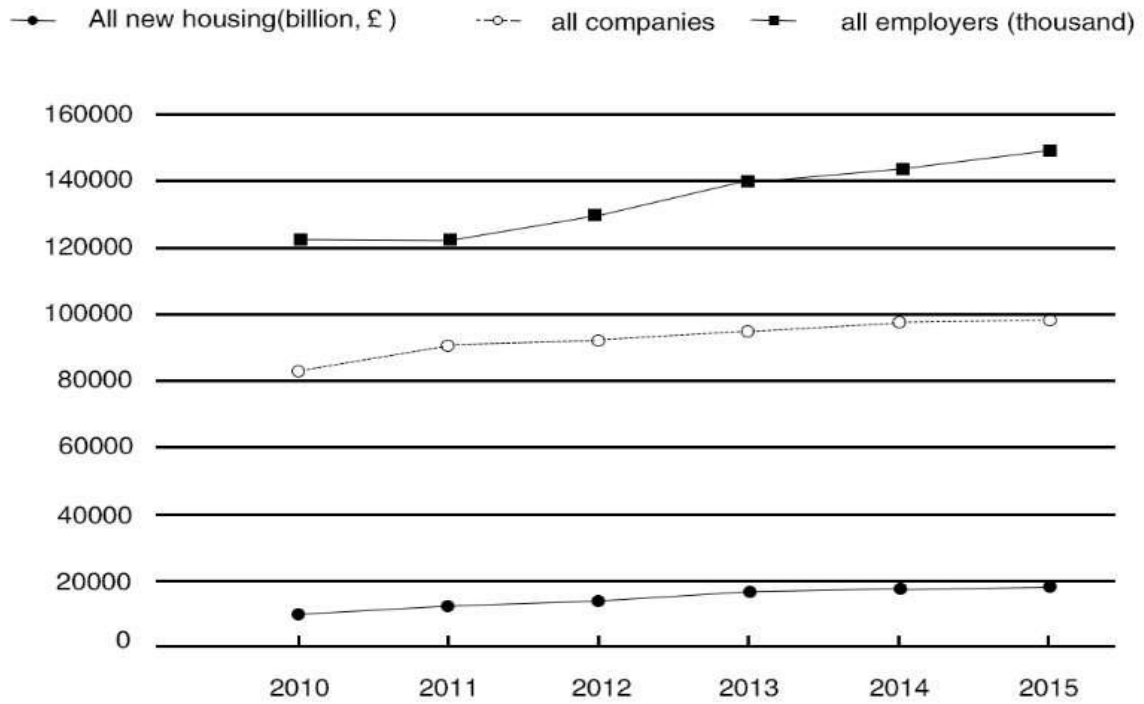


Figure 1: Chinese construction marketing growth 2010/15. Source: National Bureau of Statistics of China, NBS 2016.

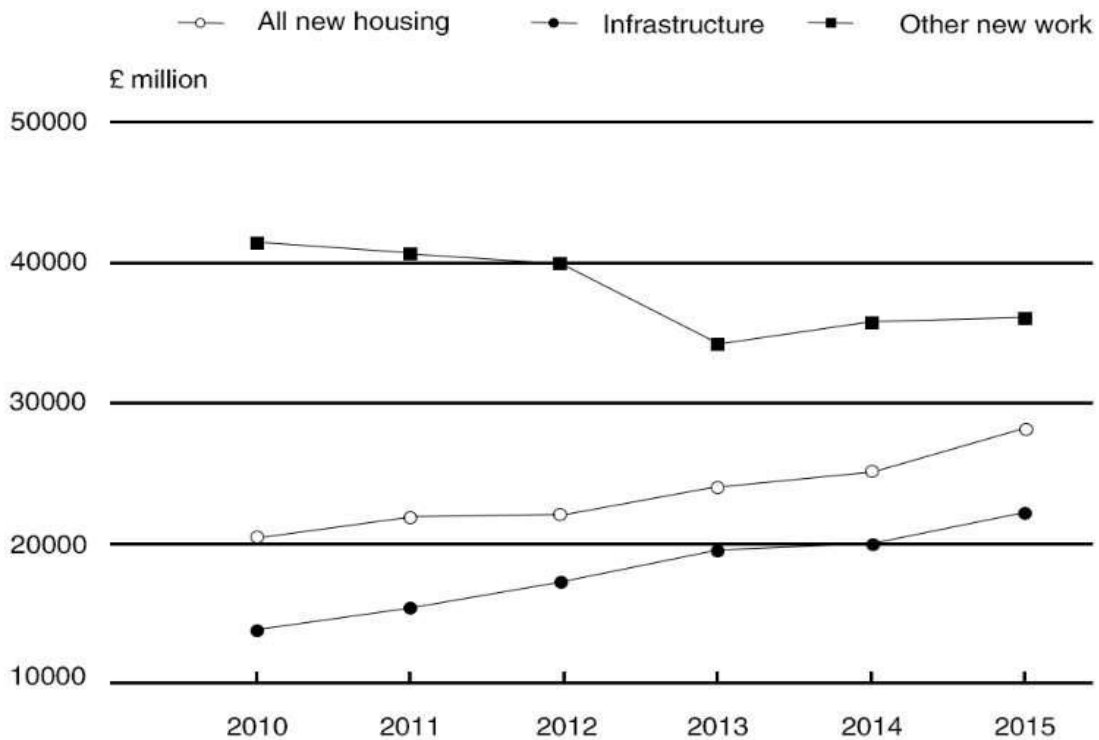


Figure 2: Components of all new work, seasonally adjusted chained volume measure £ million. Source: Construction: Output & Employment - Office for National Statistics, ONS, 2016

2.2 Current Status

The salient discrepancy between China and UK construction industries lies in their political systems and methods used to lead innovation, which leads to different attitudes towards health and safety. China has undergone progressive development and improvement in standardising processes in construction health and safety. Throughout its history, China has had relatively long processes to develop projects from inception to completion. In comparison, construction safety and health in Britain has been driven by a modernised civilisation, and avoids for example social problems that can be caused by long working hours for construction workers. Trade unions in the UK have played a significant role in promoting health and safety, and the Health and Safety at Work Act (H&SWA, 1974) became a watershed in establishing safer places of work. The present study discusses the differences between China and Britain in terms of the construction management, and strength of health and safety culture on construction projects.

3. HEALTH AND SAFETY MANAGEMENT SYSTEMS

3.1 Health and Safety Management Systems in China

The Chinese government manages safety and health by appointing a series of government agencies, as illustrated in Figure 3. It is through government units and the establishment of the corresponding industry rules, that health and safety is managed. Among them, the uppermost institutions are State Administration Work Safety of China (SAWS) and State Administration of Coal Mine Safety (SACMS) under which there are many local subordinate organisations. The functions of local organisations are to ensure industry approaches to safety are compliant with legislation and regulation, to report accidents, and maintain employee rights (Prevention and Control of Occupational Diseases Department, PCOD, 2014)

Alongside local organisations, SAWS also have support organisations such as the China Academy of Safety Sciences and Technology (CASST) and the State Occupational Safety and Health Association (SOSHA). The roles of these branch organisations include: technological support to SAWS, promoting the development of safety science and technology, health and safety education and trade, and providing services to enterprises related to safety technology, and information management.

CASST is a research institute covering the areas of major accident prevention, major hazard identification, assessment and monitoring, risk assessment and management, building major accident and emergency systems and emergency planning, developing safety and hygiene engineering technology, work safety inspection and management systems, and basic theory of work safety and work safety economics (The People's Republic of China on Workers Safety, 2014).

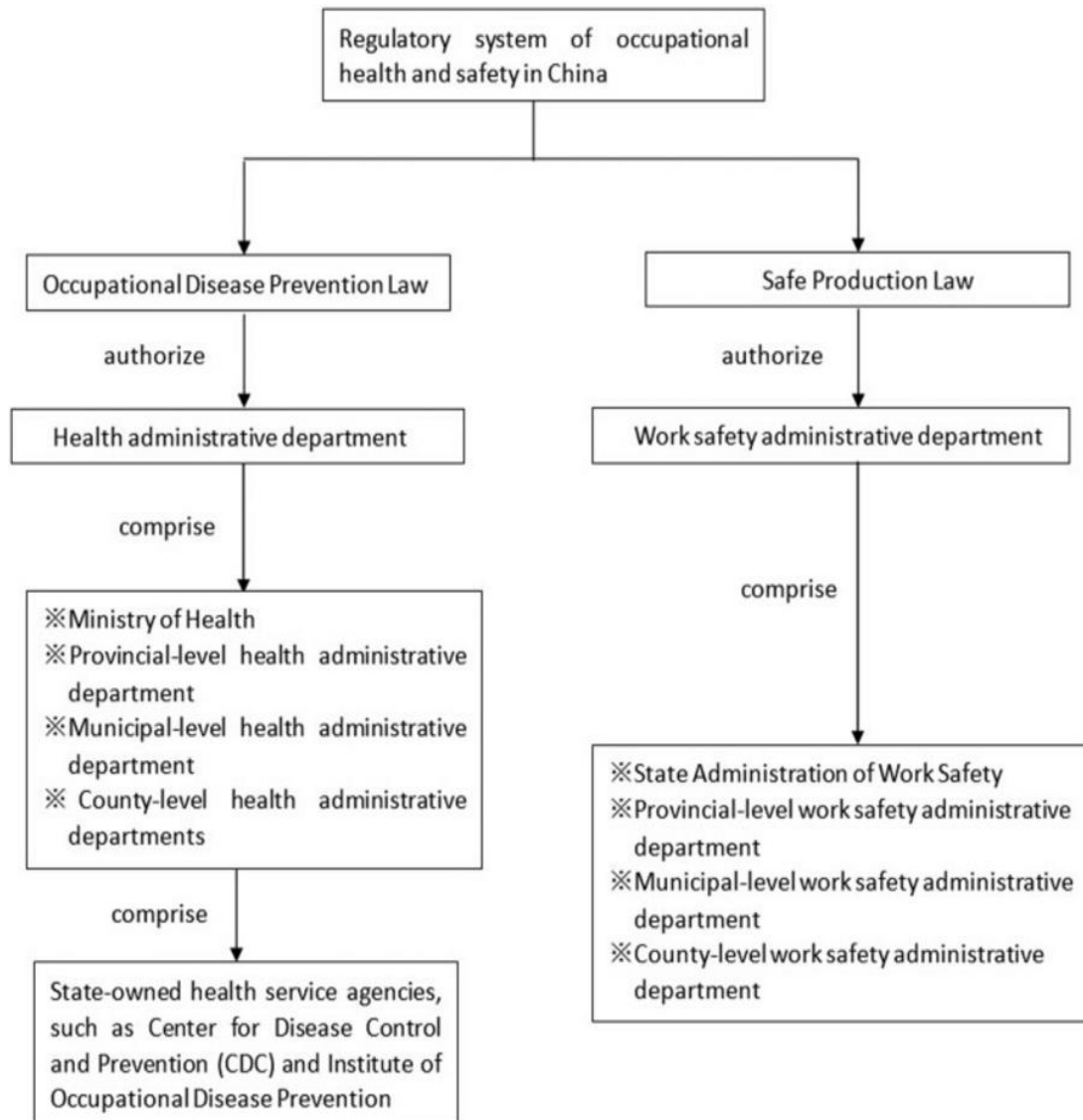


Figure 3: China's regulatory system of occupational health and safety. Source: Regulatory system reform of occupational health and safety in China, China safety, 2015.

3.2 Health and Safety Management Systems in the UK

Figure 4 illustrates how management processes are implemented in the UK to ensure compliance with Health and Safety Executive (HSE) requirements and the Construction Design and Management Regulations (CDM, 2015). CDM is intended to 'encourage the integration of health and safety into project management'.

The UK concentrates its efforts in three areas, to include compliance with rule of law, industry general guidelines, and specialist expertise. The UK aims to reduce as much as possible risks to health and safety in construction due to the omission or lack of construction technology management best practices. Great care is taken in the assessment of occupational hazards, as well as the assurance of occupational health and safety in the workplace. It has been estimated that one third of occupational deaths or injuries in the UK occurs on construction sites. Internationally, many more violations of health and safety regulations take place in the construction sector than in other industries (Naujalis, 2009; Mitropoulos and Memarian,

2012). There is extensive scientific research and many legal instruments that have concentrated on solutions to health and safety at work problems. Mitropoulos and Memarian (2012) emphasised the key role group work plays in preventing accidents and injuries to construction workers. Jacinto and Silva's study (2010) analysed different types of occupational accidents and put forward strategies for improving safety. Sustained commitment to robust systems of management of construction health and safety, plays a vital role in reducing the number of accidents, and it is important to continually raise the awareness of practitioners, tradespeople, employers, designers, contractors and others in the supply chain.

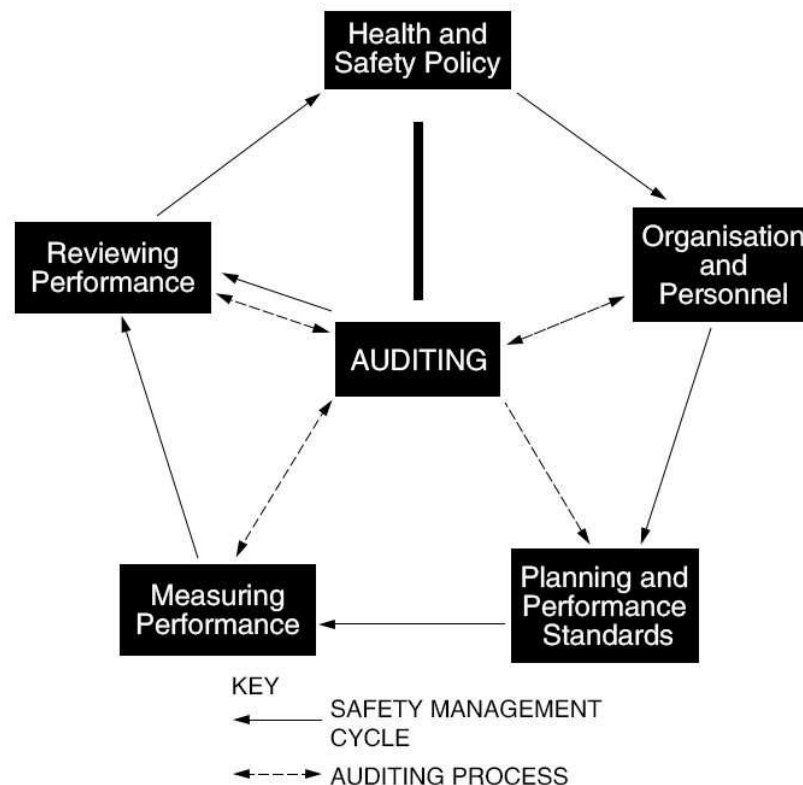


Figure 4: HSE management how to work in UK, source: University of Nottingham (UoN, 2017)

4. POLICY AND CULTURE

Political institutions in China and the UK are different, and it follows that development of policy and engrained cultures are similarly radically unlike. UK policy can be affected by market economies. To a certain extent, there are strict requirements in ensuring there is compliance with cost and budget targets. UK health and safety management systems take cognisance of government policy and the views of trade unions. However, the Chinese government is still gradually introducing different management patterns within the framework of economic reform that is being implemented. Government is the main body that's generates guidance and exercises control of policy.

Clear management objectives are put forward in the UK by the Health and Safety Executive (HSE). Policy emphasises the protection of people, ensuring health, safety and welfare of

occupational workers, and protecting public health and safety that may be affected by production. In contrast, the goal of Chinese laws and regulations are difficult to define and are very vague. Health and safety laws and regulations in construction are imperfect. For example, "safety production law" merely aims to strengthen supervision and administration of production safety, prevent and reduce production safety accidents, ensure the security of people's lives and property, and promote economic development (Chinese Centre for Disease Control and Prevention, ChinaCDC, 2017). Included in construction laws and other relevant regulations, are evasive requirements that contractors should pay for and take responsibility for the health, safety and environment on projects. Also, government implementation of policy is not well grounded in research that is relevant and applicable to construction projects. Construction needs to meet the interests and expectations of project stakeholders and the requirements of society, and respect its social, humanitarian and historical responsibilities. Health and safety management objectives require that construction should adapt to social developments and should contribute to improving the ecological environment and saving energy. But on many large projects in China, implementation of scientific research and feasibility studies are often hampered by burdensome administrative procedures, which leads to situations where forecast costs are too high and short cuts are taken that consume excessive natural and social resources and cause irreversible damage to the urban ecology and landscape. In health and safety management systems, the UK government mainly plays a surveillance role and has oversight through the HSE and its legal frameworks. The UK attaches significant importance to statistical monitoring of performance, and key performance indicators. Large fines are imposed on companies and custodial sentences imposed on persons responsible for health and safety breaches, particularly where accidents or incidents occur. The UK will also punish employers who do not maintain standards, and restrict the ability of directors to practice. However, the monitoring and implementation of health and safety law in China is arguably ambiguous and not robust. Companies and individuals who are non-compliant with health and safety procedures are often not held to account. Knowing this, companies take inappropriate risks and accidents occur. Liu and Cheng (2014) argue that power and responsibility between government departments are chaotic, which brings about mis-alignment between power and responsibility. A phenomenon of administration not according to the law appears to exist, and there is often inappropriate administrative intervention and inspection instead of concentration on best practice in construction management.

5. RESEARCH METHODOLOGY

To support data gained from the literature, interviews were held with 15 Chinese practitioners working in the UK construction industry; their job roles included technical project managers, construction managers, a project director, and a professional translator / archivist. Two practitioners were based in London and the other thirteen in north-west England, all on major projects with large Chinese contractors. The sample selection was one of convenience, since the lead author was able to get easy access. Care was taken to comply with ethical protocols. The interviews were conducted in Chinese, with field notes taken. Translation into English was subsequently undertaken to support sorting of data for interpretation. Seven of the practitioners had a bachelor's degree or above, whilst the other eight also have post-graduate qualifications.

Participants stated Chinese companies are keen to ensure they comply with UK legislation, and respect the work of trade unions. In comparison to China, where they may be a short-

comings in safety management, that is not the case in the UK. Whilst working in the UK, Chinese companies ensure they record carefully operational data regarding all relevant business practices, including health and safety; perhaps that is not always the case in China?

It was noted that in some Chinese companies in the UK, operatives work undesirably long hours each day, though that is more common in China. Operatives in China want to work long hours to maximise their income, and this is supported by employers who seek to complete projects as quickly as possible. Productivity is lower than it should be in the UK, since Chinese construction management teams need to spend time learning UK systems and regulations; consequently, delays can occur. It was recognized that UK construction uses a higher proportion of prefabricated techniques than appears to be the case in China, but that the UK appears to suffer more problems associated with weather conditions. Anecdotally, participants reported that operatives in China have a higher age profile. It may often be the case that in China, operatives need temporary overnight accommodation on site.

6. CONCLUSIONS

In general, the UK's building safety and health management system is fundamentally different to that of China. UK development is supported by technology and awareness of progress is sensitive to timely improvement. There are substantial opportunities for Chinese health and safety in construction to improve, and this can be supported by comparing processes with international best standards, including those in the UK.

Traditional Chinese thoughts and cultures need to change. Relevant laws and regulations should be up-dated to ensure there is clarity about the responsibilities of employers, designers and contractors, and ensure there is full consideration about the influence of health and safety on employees, members of the public and the environment. All participants in construction need to be involved in HSE management, from inception through to demolition and recycle. The Chinese government should implement fully its current laws and regulations for developing health and safety management systems, and spare no efforts to monitor and manage market practices which fall short of acceptable standards.

To achieve full control and to identify dangers, including those that arise from environmental failures, the Chinese government should promote scientific and management research, and ensure early warning management systems are used to identify dangerous situations. There seems to be inadequate implementation of economic and financial tools to improve the level of health and safety compliance. Insurance systems do not provide sufficiently well for those who suffer occupational injuries, and fines issued to companies that fail to comply with legislation do not seem to act as a deterrent to unsafe practice. There appears to be many instances of best practice law and policy formulation, from which Chinese government can learn from the UK. China ought to take active measures to impose sanctions on those responsible for accidents, and to ensure there is appropriate compensation through insurance schemes for victims and their families. Sanctions should include criminal proceedings. The market will decide that those companies with good accident records will benefit through lower insurance premiums.

Chinese companies do not seem to invest sufficiently in health and safety education and training, and to the extent that some training is provided, it is not wide spread and the quality

is arguably questionable. There is an urgent need to strengthen the skills and awareness of participants in construction through education and training.

In summary, there appears to be a culture of narrow thinking in Chinese management of health and safety, and that needs to change radically and quickly. Better systems are needed for risk identification and evaluation, and measurement methods or key performance indicators should be considered for implementation. Clear safeguards need to be implemented for employees and members of the public; legislation and insurance schemes need to be reviewed.

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TECHNICAL AND VOCATIONAL SKILLS GAP IN THE NIGERIAN CONSTRUCTION INDUSTRY: A LITERATURE REVIEW

A. O. Olusola, J. Lamond and P. Manu

Department of Architecture and Built Environment, University of the West of England, BS 16 1QY, United Kingdom.

Emails: Olukayode2.awonuga@live.uwe.ac.uk

Abstract: Nigeria requires its efficient and capable skilled workforce to manage the construction industry. The workforce comprises the engineers, technicians and the craftsmen from Nigerian universities, polytechnics and technical colleges. The importance of the skilled workforce cannot be overemphasized as it contributes immensely to the social and economic development of the country and its contribution to the national gross profit. The aim of this study is to examine the issue of technical and vocational skills gap within the Nigerian construction industry through a critique of literature relating to construction skills and education. The review reveals that the potential factors contributing to the technical and vocational (T&V) skills gap in the Nigerian construction industry include: outdated educational facilities; inadequate educational materials, tools and equipment among others. Drawing on this insight, the study concludes that further research is needed to empirically diagnose the skills gap in the construction industry.

Keywords: Nigerian construction industry, skills, technical and vocational education.

1. INTRODUCTION

Nigeria is a resource rich and fast growing economy with large demand for built facilities. Therefore the country requires a highly skilled, capable, strong and efficient workforce to manage the construction industry. The skilled workforce that should form the backbone of the construction industry is comprised of engineers, technicians and craft-workers. The importance of the skilled workforce cannot be over-emphasized as a skilled workforce in the construction industry contributes immensely to the social and economic development of a country (Ogwo and Oranu, 2006; Megudu *et al.*, 2011). Technical and Vocational Educational Training (TVET) has been identified by the Federal government of Nigeria as a significant tool that can help improve the lack of technical knowhow in the Nigerian construction industry. This is due to the important contributory aspect of education that could contribute to social and economic development through the output of its category of its products in ensuring adequate supply of a skilled labour force. According to Ogwo and Oranu, (2006), TVET is a branch of education offered presently in Nigeria education system. It was created to provide opportunities for students, particularly those who have a tendency to tilt towards studying science and technology programmes, to train to meet the manpower needs of industry (FRN, 2007).

However, despite the high demand for skilled workers, it has been observed that technical college graduates suffer high unemployment due to their failure to possess the required and appropriate skills needed for employment in the industries (Ogwo and Oranu, 2006). Employers from the construction industry in Nigeria have complained that TVE graduates do not possess the required and adequate skills for employment and that they lack confidence in carrying out their duties and responsibilities (Oni, 2007). Oni (2007) has attributed this to the

fact that the educational facilities available in technical colleges are outdated while modern ones are lacking and that formal training programmes have been inappropriate in content and inadequate in quality. This is in line with observation by Abdel-wahab *et al.*(2008),that the prevalent lack of skills affects productivity.

Furthermore, it has been observed that the level of technological advancement has increased in the area of tools and equipment used by the construction industry thereby calling for the industry workforce to update their skills to meet the current skills required globally (Crosthwaite, 2000). In more technical areas, equipment is becoming ever more sophisticated thereby necessitating training in the use of tools and equipments. The technological advancement equally calls for up skilling and multi skilling in every area of construction techniques (Crosthwaite, 2000). Nigeria lags behind in updating its curriculum to suit these new industry need in terms of skill acquisition. Although skill acquisition programme is organized with the intention of improving the performance of the skilled work force but it has never yielded a positive result (Olaitan *et al.*, 1996 quoted in Oketch, 2007). Crosthwaite (2000) has stressed the benefits of investing in the construction skilled workforce by training them to adapt to new technology and construction techniques in other to bridge the skills gap that is prevalent.

1.1 Skill and Skills gap in the construction industry

Construction skills and training needs are ever changing with the introduction of new business processes, different forms of organizing production and technical innovation which require the construction workforce to be more highly skilled in their various areas of expertise (Spenner, 1983; Mackenzie *et al.*, 2000; Forde and MacKenzie, 2004). Any definition of skill according to labour scholars must consist of task complexity or variety and worker autonomy (Spenner, 1983; Olaitan *et al.*, 2006). It is equally an ability to perform a productive task at a certain level of competence. Where a skill is associated with a particular task, a person who does not possess such a skill is unlikely to be able to carry out this task or will be less productive than somebody who possesses the skill. Skills are often associated with qualifications (Mawer& Jackson, 2005) and acquisition through formal education and training which is adequate in quality and quantity. Vocational technical education according to UNESCO, (1997) is “those aspects of the educational process involving, in addition to general education, the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupation in various sectors of economic and social life.” However, it is important to note that TVET is not only about knowing how to do things but also understanding why things are done in a particular way(Oketch, 2007).TVET is different from just teaching domain specific skills but includes general skills and hands on practices which make it different from other forms of training. The employers in the construction industry are looking for the skilled workforce with right employability skills (Crowson *et al.*, 2000) and qualities so as to contribute to the development and success of the industry. Skills identified by the construction industry to be of importance include, academic or cognitive skills, generic skills, technical or vocational skills and work related attitudes or soft skills (Stasz, 2001).

Academic or Cognitive Skills: These are basic academic skills needed to support learning in different disciplines such as English, mathematics, science and so on. These subjects are learned in school and it should be able to be transferable to applications where needed, they are assessed by the use of standardized test.

Generic Skills: These are combination of skills that deals with problem solving, communications, or team work they are equally transferable across work settings. Generic skills have meaning in different work context. (Stasz, 2001).

Technical Skills: These are specific skills for use in an occupation and which include references to academic skills (e.g., Physics needed by Electricians) or having knowledge about tools equipment's and facilities (e.g., operation of a switch gear). They are always coded in job description and they are measured using the standardized assessment.

Soft- Skills: There is no specific definition to it as there is no way to conceptualize it. It could be referred to such construct as motivation and dispositions. It could be accessed through self-report questionnaires but are equally judged through personal impression.

Besides these skills, construction graduates are required to have three essential attributes (Love et al., 2001; Ogwo and Oranu 2006). First, they are to have practical experience so that they are thoroughly familiar with the workings and intricacies of the industry. Secondly they are to be familiar with tools and techniques for planning, and then have the personality and insight that will enable them to work harmoniously with other people, often under very strained and trying periods. Graduates must know and acknowledge the reality that they cannot achieve everything on their own efforts alone. Additionally, they thus, need to be able to work with and through people to perform their duties. The construction skill workers are required and supposed to possess particular range of skills to include personal, business, technical operational levels and employability skills meant to assist in their daily activities at work (Oranu & Ogwo 2006; Stasz, 2001).

Employability skills: These are skills necessary for getting on, keeping and being successful in one's job. These are the skills used in making critical decisions and attitudes that enable employees to get along with their colleagues, solve problems, develop respect and ultimately become strong representative of an organization. These skills are usually lacking in graduates that are just out of school and even those already in employment. Other skills needed for employability includes: Interpersonal skills, critical thinking skills, communication skills, management skills among others. Graduates are expected to be active and able to solve problems in a distinctive way these are the abilities that employers look for when recruiting technical college graduates (Cranmer, 2006). In general, employers look for graduates with communication skills, empathy, motivation, decision making abilities, planning abilities and improvisation abilities (Bagshaw, 1996).

The sudden shift in skill requirements in the modern economy has significant implication for education and training. This is partly due to widespread agreement that more education and training is good for the modern economy. The main question for policy makers is how to change the education and training system to meet these demands most efficiently (Green, 1999) to prevent skills gap.

Most of the developed and developing countries have been experiencing skills gap as perceived by the employers (CIOB, 2009). Skill gap in industry are identified as lack of qualified trained persons from the perspective of the employer. They could be due to inadequacy in general education levels or due to inadequacy of technical skills.

Skill gap according to (ASTD, 2012) is "the significant gap between organisation current capabilities and the skills it needs to achieve its goals". It is the point at which an organisation

can no longer execute its strategies, fulfil its mission, grow, or change because it cannot fill critical jobs with employees who have the right knowledge, skills and abilities. This existence of a skills gap is said to be an indicator of negligence in area of education and training (Chan & Dainty 2007; Gann & Senker, 1998). The relevant curricula and the mode of teaching should be critically looked into in order to correct the abnormalities there-in.

Manson *et al.* (2009) conclude that, based on employers feedback from the construction industry, skills gap are prominent within the following skills, generic skills, numeracy, literacy, personal skills, IT skills and vocational and job specific skills. These skills are required for employment. General education comprising the generic skills has been embedded into the curriculum of TVET both in the developed and developing countries in order to serve as bases for training. The in-ability of technical college students in Nigeria in area of science, technology, engineering and maths (STEM) which are coined under general education in the school curriculum (FRN, 2004), has been a major problem. The in-ability of students to comprehend and apply those subjects has created a skills gap among the workforce.

1.2 Evidence of Skills gap in Nigeria

Studies in various developed as well as developing countries have shown that a skills gap exists or is prevalent among the skilled workforce in the construction industry (Dainty *et al.*, 2004; Manson *et al.*, 2002; UNESCO, 2012). A chronic misalignment of the education system to the needs of the labour market is a global problem, UNESCO (2012) reported that there is skills gap throughout the world. The skills gap crisis in the construction industry is not peculiar to Nigeria, Hass *et al.*, (2001) record that USA is facing a long term labour shortage and skills gap. Mackenzie *et al.*, (2000) Dainty *et al.* (2005) and Agapiou *et al.*, (1995) each reported on the skills shortage and skills gap in the UK.

In Nigeria, the skills gap in relation to skilled workforce in construction industry is under explored in research. Employers realised that there are also areas of skill deficiencies within the skilled workforce. These deficiencies are at various levels, though more so in the craft workers. Various reports and headlines have indicated the existence of skills gap and poor quality of craft workers in the Nigerian construction industry (Obiegbo, 2002; Olaitan *et al.*, 2006).

Previous research by Udofia, (2012) Ogwo and Oranu (2006) Okejiri, (2011) reveal evidences of skills gap in Nigeria that include the following: industry comments on lack of skills; importation of expatriates; and unemployment of technical graduates. These are discussed in further detail below

Insufficient skill: The construction industry in Nigeria has complained about the graduates of technical college who are the major skilled workforce of the industry not possessing the adequate practical and technical skills needed for employment (Awe, 2010; Ogwo and Oranu, 2006). The inadequate training received from the school and obsolete equipment has contributed to skills gap.

Importation of expatriates: Lack of insufficient skill on the part of the workforce in the Nigerian construction industry has prompted the Federal government of Nigeria to import expatriates from the developed countries to come and assist in construction works (The

Nigerian Punch, 2006). Such activity suggests that the local workforce is not competent enough to handle such big projects due to insufficient skill (Okejiri, 2011).

While the Nigerian government has made concerted efforts to enhance the quality of vocational technical education to prevent the existence of skills gap (FRN, 2007; Oni, 2007), educators, and the construction industry have agreed that a skills gap exists between the knowledge acquired and skills needed by the industries (Udofia, 2012; Ogwo and Oranu 2006; Okejiri, 2011). This skills gap therefore creates unemployment for technical college graduates.

Unemployment: Despite the large number of graduates of technical colleges in Nigeria and the availability of the construction work they remain unemployed due to the fact that they are found incompetent (Obiegbu, 2002; Olaitan et al., 2006). The graduates of technical colleges in Nigeria are found roaming about the street, mainly because the training acquired do not match the industry requirement. There are mismatches between skills developed by present public policies and those required to support structural change and employment in the labour market (Awe, 2007; Olaitan et al., 2006). According to Olaitan et al., (2006) technical college graduates are found deficient in practical and technical skills, while Awe, (2007), Udofia, (2012) reported that the graduates lack employability skills and also they are deficient in technical skills.

1.3 Factors causing Skills gap

Previous research by Obiegbu, (2002), Olaitan *et al.*, (2006) and others reveal a number of factors that combine to induce construction skills gap to include: demand for multi-skill approach, demand for new skills, lack of educational training, rapid change in technology and inappropriate skills and inadequate training. These are discussed below.

Demand for multi-skill approach: The single skill approach is common in Nigeria, where workers master one specific craft trade, is said to be becoming increasingly inappropriate and has given rise to industry fragmentation (Arhani et al., 2003). It is also among the factors said to be causing skills gap. Conversely, multi skilling where a worker is able to perform several trades, and up skilling is presently adopted and adapted into the curriculum content during training programmes in the developed countries. Both approaches have their strength and weaknesses. Investigations in this area are still sparse in Nigeria (Obiegbu, 2002; Olaitan *et al.*, 2006; Murray et al., 2002).

However skilled workforce in any construction trade arguably need to be multi-skilled to enable them to deal with the variety of equipments in use in construction industry (Ness, 2009).

Demand for new skills: Due to advancement in Science and technology the level of skill required by the industry is increasing thereby calling for new skills and, skills development is required of the skilled workforce (Mackenzie et al., 2000; Cordery, 2007). Introduction of new technology has greatly affected the performance of the craft workers due to the out of date training they had previously acquired coupled with a sizeable number of generic technologies that are affecting the type and number of construction skills required as previously mentioned.

Lack of Educational Training: The lack of educational training programmes that are appropriate in curriculum content and adequate in quality facilities meant for training

(Oketch, 2007; Awe, 2007; Olaitan *et al.*, 2006) has contributed greatly to skills gap in Nigeria. Inappropriate skills and inadequate training from non-experts to the craft trainees (Oketch, 2007; Olaitan *et al.*, 2006) has contributed greatly to skills gap challenges in the construction industry. In that vein Awe (2007) and Steedman (1996) referred to it as negligence in area of education and training.

In general, the quality and training of technical education in imparting skill acquisition is low, with undue emphasis on theory and certification rather than on practical skills acquisition. Most technical education departments in Nigeria do not have a well-structured and equipped laboratories for training. The existing laboratories are out of date and even stocked with grossly inadequate tools and equipment's for training (Awe, 2007).

Changes in the nature of work due to technological innovation have created demands for new skills, and education and training policies to enhance skill development (Awe, 2007; Oketch, 2007; Mackenzie *et al.*, 2000; Forde & Mackenzie, 2004).

Rapid change in technology: The industry all over the globe is experiencing rapid changes in technology. The reason is not far-fetched because of the computer age which has made it compulsory for the industry to meet changing situations. Despite this change most industries and schools in Nigeria are yet to adapt to this trend and make it available for training. This however, has great constraints and influence on the workforce (Ede, 2010; Femi, 2014). This calls for demand of new skills in the craft workforce.

Inappropriate skills and inadequate training: The lack of inadequate training and transfer of inappropriate skill has contributed to part of causes of skills gap, coupled with textbooks that are out of date which the instructors use in transferring and imparting negative training to students (Udofia *et al.*, 2012)

2. IMPLICATIONS FOR FURTHER RESEARCH TO UNDERSTAND THE SKILLS GAP IN THE NIGERIAN CONSTRUCTION INDUSTRY

The review of the literature has shown the potential factor contributing to the technical and vocational (T&V) skills gap in the Nigerian construction industry. Based on this insight the implications for further research are considered in this section.

Presently, in the Nigerian construction sector, the issue of skills gap among the craft workers are increasingly becoming common and this can be linked to the need to meet the huge housing and infrastructure deficits within the country (Awe 2007; Awe *et al.*, 2010; Ayedun *et al.*, 2011).

It is thus important that for the local Nigerian context, further research work is undertaken to elicit other skills gap issues that are not apparent in the extant literature and also to devise commensurate adequate measures towards the development of a more holistic skills gap guidance.

The further research work is expected to be addressed by five main steps as part of an on-going PhD study:

- 1 To develop a framework for the measurement of skills gap in industry.

A framework that would enable a thorough diagnosis of the prevailing skills gaps within the Nigeria construction sector would be developed through a critical analyses of approached that have been used within the extant literature for skills gap assessment.

2 To design a framework to access the curriculum of TVE with a view to map the curriculum with the gap.

Based on the literature review the framework will be designed to examine areas of skill need in the industry. A framework showing the details of the skills to be learnt according to the curriculum specified for the craft men will be critically assessed to see whether the curriculum of TVE constitute the skills needed by the industry.

3. To collect and analyse data.

Data would be collected through survey research administering questionnaire technique on the respondent, and focus group interview with the stakeholders and other respondents. Analysis will be carried out via SPSS software version 24 analytical tool and qualitative approach to understand the intervention needed to address the skills gap. To understand the nature of the collected, several descriptive statistics including distributions, measures of central tendency such as means, medians and modes, and measures of dispersion such as standard deviation will be employed. The focus group interview will be analysed using thematic content analysis. The analysis will follow the five main steps as designed by (Creswell, 2009). 1) Transcribing of the audio discussion (i.e verbatim transcription), 2) Organising and preparing the transcripts 3), Iterative re-reading of the transcripts, 4) Coding of the transcripts; and 5) Generating themes and sub themes.

4 To validate findings

The result from this research will be validated from stakeholder's perspectives. The stakeholders would evaluate the utility and sustainability of both the measuring and mapping framework to ascertain that the findings truly represent the phenomenon claiming to measure and map out in the research. The extent to which the research findings and hence the insight given by the recommended frameworks can be trusted however relies on the process of validation process that will be undertaking in respect of this research. The research will under-go both internal and external validity. The four questions relating to four areas of validity will be addressed as these are 1) Are the constructs valid? 2) Are the statistical conclusions valid? 3) Does the research demonstrate internal validity? 4) Does the research demonstrate external validity?

5 Finally conclusions and recommendations will be drawn to address the important gaps within the technical grades in the construction industry.

8. CONCLUSIONS

The literature has revealed that Vocational and technical education needs to be subjected to change and reform of its curriculum in order to improve the performance of its graduates. Recent reports show low levels of training among craft workers in the Nigerian construction sector, and a decline in construction training relative to developed countries.

There are reports of skills gaps across the different categories of skills this leads to unemployed technical graduates as well as unfilled skilled positions. Although the specifics of the skills gap have not yet been fully explored, some factors such as inadequacy of the curriculum and facilities in the education sector could be at play.

Therefore the skills gap needs to be examined in the light of TVET curriculum and training. There is the need to understand both the nature and extent/size of the skills gap in different categories of trades in order to design better training and programs. Further research intended to address this need has been proposed and the key steps involved also outlined.

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EDUCATION MISMATCH OF UNIVERSITY GRADUATES WITH LABOUR MARKET REQUIREMENT IN LIBYA CONSTRUCTION SECTOR

A. Osman and D. Baldry

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: a.osman1@edu.salford.ac.uk

Abstract: The consideration of the investment of human capital is the most important issue in many different countries especially in developing countries which have high and medium income, for example, Libya. Investment in education is one of the components that lead to creating a strong environment business as it produces highly qualified graduates to enter the labour market. However, the graduates may be facing education mismatch for the types of employment that they gain. The aim of this research is to study impacts of education mismatch in the Libyan labour market and identify if there is match or mismatch between educations level with labour market required. Moreover, provide an initial estimate of Libya's labour market. This research will identify the determinants of education mismatch for graduates in Libya and the effect on the performance of their job and the performance of the organisations. This research will also investigate the effect of education mismatch on the job satisfaction, particularly in the construction sector in Libya. The sample will be about construction engineering graduates from different Universities in Libya, whereas the data used for this paper is the published data from Bureau of Statistics and Census, General information authority in Libya. This paper will discuss the lessons that can be learnt from the measurement of education mismatch of graduates from construction engineering in developing countries recently or currently to overcome challenges of the labour market.

Keywords: Human Capital, Labour Market, Education Mismatch, Construction Sector, Libya.

1. INTRODUCTION

Investment in education, particularly higher education, has been observed as dynamic for improving an individual's productivity and employability (Becker, 1975). This, in turn, will raise individual income and social status (Teichler, 2002). The perceived benefits of higher education have convinced many students in Libya to pursue their studies beyond the secondary school level, leading to a growing request for tertiary education. The challenge for different countries is to ensure this educational investment remains a dynamic and not disruptive force by matching the individual's job with their educational level.

Understanding the relationship between education and labour markets is significant not only to graduates but also to educators, economists, and policymakers. There is no doubt that the quality of education and the number of years of education has a great impact on the future career of a person. The risk of being unemployed or even employed in a job that does not match one's education, especially after long years of education, has both negative economic and social consequences on graduates and their societies.

Matching between an individual's employment and his/her education is important to realise the human capital stock of the workforce in the most efficient way. The existence of education-occupation mismatches has negative effects on the economy (McGuinness, 2006).

On the institution level, Tsang (1987) studied the effect of educational mismatch on labour productivity and found that overeducated employees have negative effects on output. On the individual level, overeducated employees are not utilising their full investment in human capital and researchers have found that they tend to receive lower returns compared to those who are sufficiently matched (Hartog, 2000).

The meaning of education mismatch refers to whether the individual has a level of education that is above or below the required level of education to proceed in a certain career (Hartog, 2000). Freeman (1976), in his book “the Overeducated American”, was the first to discuss the educational mismatch phenomenon. This book concluded that the decline of returns to education among new entrants to the labour market is due to the fact that the supply of graduates is higher than the demand for them in the labour market.

Currently, there exists a substantial number of researchers that explore the returns on educational mismatch. Most of these researchers, however, focus on developed countries. Few researchers have explored this field in developing countries, such as the research done by Quinn & Rubb (2004) on Mexico and Abbas (2008) on Pakistan.

This research will seek to ascertain the educational mismatch among Libyan graduates in the construction sector. The research will investigate its determinants, and its potential effects on the individual wages, job satisfaction, and job-search behaviour. The data for the research will be collected by using a questionnaire, which will be completed by the University graduates who have been employed in the construction sector between 3-5 years after graduation. Hence, the research will contribute to the existing literature by providing empirical evidence on the incidence, determinants, and the effects of a mismatch in the supply of University Graduates with labour market requirements in the construction sector in Libya.

Figure 1 shows University graduates destination after graduation. They might face four possible options, which are: they will get a job that matched with their qualifications or mismatched or they will be unemployed or they may seek employment overseas.

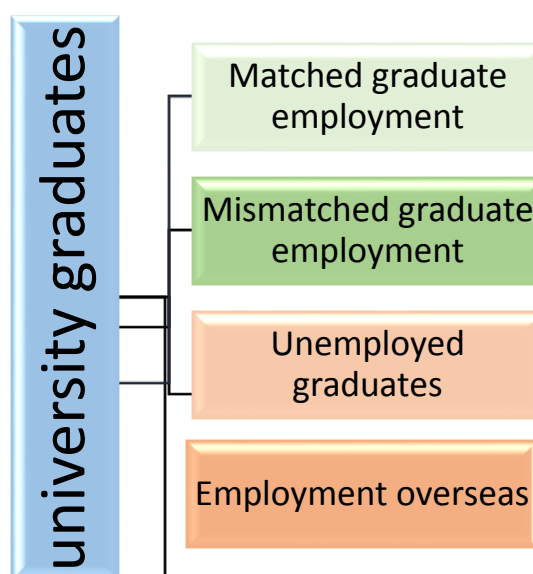


Figure 1: University Graduates Employment Destination

2. RESEARCH BACKGROUND AND MOTIVATION

There was growth in the number of higher education organisations in Libya from two in 1975 to 76 universities and technical and vocational organisations by the year 2015 (Libyan Organization of Policies & Strategies, 2016). As a result, the number of students and graduates has increased too. Based on the data from Ministry of Higher Education of Libya (2016), the number of graduates from Libyan universities increased from 36,855 during the academic year 2009-2010 to 48,095 during the academic year 2014-2015. Also, 45% of the labour force are from higher Education Level in Libya (World Bank, 2015).

Potentially outdated curricula and a lack of coordination between educational organisations and the requirements of the labour market are liable to lead to a sense of frustration among graduates at mismatched educational outcomes which could create a sense of resignation or cynicism and have a damaging effect on economic and social cohesion. However, it is unclear if such a highly educated workforce is required in Libya. This might put some graduates in a position. Where they might have an educational mismatch for their job. A study by World Bank (2015) argued that the average educational achievement of the workforce has increased, there is a suggestion that the occupational structure of the labour market does not have the capacity to absorb the increased number of educated workers into traditional graduate occupations. These arguments suggested that the expansion of the supply highly skilled workers, given the slower growth of demand for the same, might potentially impact unfavourably on the individual as well as the economy, at least in the short run (Duncan & Hoffman, 1981). Moreover, the detrimental effects of educational mismatch have the potential to persist even in the long run (Hartog, 2000).

Based on the above, university graduates in Libya might be not matched with labour market requirements. Studies in different countries have indicated that there is an impact on wages when there is a mismatch with Labour market. Many graduates are employed in jobs for which a degree is not required, and in which the skills they learned in higher education are not being fully used. The challenges facing the labour market in Libya is the lack of coordination between educational organisations output and the requirements of the labour market (World Bank 2015).

3. SCOPE OF THE RESEARCH

This paper will focus on the educational mismatch of the University Graduates with Labour Market Requirement in Construction Sector in Libya. The former is defined as an employee who has attended a level of education that is higher than what is required for the position he or she occupies (McGuinness, 2006). The latter describes the extent to which employees are not able to utilise all their skills and knowledge in their current occupation and where they have more skills than is required for their current position (Mavromaras, McGuinness, & Fok, 2009). The limited literature has documented the incidence of educational mismatch in North Africa countries such as Libya (Bedir 2014; Nadia 2014; Angel-Urdinola & Semlali 2010).

A large number of studies on educational mismatch has focused on developed countries and in particular the UK, U.S., Australia, the Netherlands, and Spain (McGuinness, 2006). Apart from Quinn & Rubb (2006) who focus on Mexico, there is a scarcity of literature investigating this issue from the perspective of developing countries. The reviews of the mismatch literature by Hartog (2000), Sloane (2003), McGuinness (2006) and Leuven & Oosterbeek (2011) make very little or no mention of matching in low or middle-income

labour markets. The main explanation revolves around the paucity of data in developing countries.

The scope of this study addresses Libya as a developing country with median income, to investigate the determinants and causes of educational mismatch of university graduates outcomes in the labour market. This research will concentrate on graduates from universities in Libya, who have worked in the construction sector recently between 3-5 years after their graduation, which is the years between 2011-2015, because of changes in the labour market and the structure of the economy in general, particularly in sectors with a high job-creating potential in Libya, such as construction. (Abuhadra & Ajaali, 2014).

4. AIM, OBJECTIVES

4.1 Aim

The aim of this research is to investigate the incidence and the effects of educational mismatch of the university graduates in Libyan construction labour market.

The Libyan construction sector contributes 5.2 per cent of the Libyan Gross Domestic Product (GDP), and it employs around 3.2 per cent of the total workforce. However, in spite of the huge investments in construction activities over the past four decades, the Libyan construction industry is an under-researched and underdeveloped area.

4.2 Objectives

- To ascertain the level of Education of graduates from universities who recently or are currently working in the construction sector.
- To establish the nature and the determinants of Educational mismatch of graduates.
- To examine the effects of Education mismatch on individuals income, career prospects, workplace satisfaction and behaviour.

5. LITERATURE REVIEW

5.1 Definition of Educational Mismatch

Educational Mismatch describes the condition where a graduate is vocationally or academically overeducated or undereducated to perform what the job requires (Sicherman, 1991). There are two fundamental types of education-related job mismatches; horizontal mismatch and vertical mismatch. A horizontal mismatch refers to a situation where the scope of a graduate's degree study is unsuitable for the job position even though the qualification level is suitable (Robst, 2008). On the other hand, a vertical mismatch occurs when the required level of education for a specific job is different from the actual level of education of the worker (Bejaković & Mrnjavac, 2014).

5.2 Measurements of Educational Mismatch

Educational Mismatch is measured by comparing a person's current education with the required education for a specific role. Whereas measuring current educational attainment is relatively simple, obtaining information on the required education level is more difficult (Dolton & Silles, 2008). There are three approaches where can be used to measure the required education which are subjective, objective and statistical methods.

Subjective method [SM], is defined as the Employee's Self-assessment [EA]. It is based on employee's own valuation of the level of education required to perform their job (Hartog, 2000). It is, therefore, considered extremely subjective as it depends on the employees' perceptions. This method has been used by Duncan & Hoffman (1981) and Sichernan (1991) and more, see table (2). In this approach, employees are asked about their perception of the required level to do their work and then the difference between their current level of education and the required level which will locate whether the employee is over/under-educated. Many studies based on this method have used different questions to inquire about employees' views. For instance, Duncan & Hoffman (1981) asked the following question: *how much formal education is required to get a job like yours?*. Another study by Alba-Ramirez (1993) asked this question: *what kind of education does a person need in order to perform your job?* By looking to these two questions, one can conclude that the first question focuses on recruitment standards while the second question focuses on the requirements for career performance. This means that the same person can give different answers to different questions which make the use of this method questionable at times, which is the negative aspect of this model. The positive aspect of this method is that it provides up to date information about current education requirements. A respondent will be classified as over-educated if his/her real education is greater than that required education for the career. Undereducated employees are defined as having education level less than their work requirement. As a result, a well-matched employee is defined as someone whose employment level requirement is in line with his/her education level background (Zakariya, 2013).

Objective method [OM], it is defined as the job analysis [JA] method. It uses the information given by professional analysts related to the qualifications required for a career [external assessment measure]. Probably, the most famous source of such information is the Dictionary of Occupational Titles [DOT] in the US and the Standard Occupational Classification System in the UK. It is used to measure educational mismatch by comparing current education with the model requirements for a given career. If a person's current level of education is higher than what is determined by an occupational job analysis for a given job, then he/she is considered as over-educated. However, if the level of education are lower than what the work requires, then the employee is considered under-educated. One of the criticisms of this model is that having the same job title does not necessarily mean that employees are doing the same tasks and they may even require a different group of experiences and different level of education (McGuinness & Bennett, 2007).

Realised Matches method [RM], is defined as the statistical method and can be estimated using two approaches the mean and the mode. The mean approach is the required amount of education for an employee as concluded from the mean years of completed studying of all employees occupancy within the same career (Verdugo & Verdugo, 1988). Employees are then classified as over-educated or under-educated if their educational level holding is more than one standard deviation above or below their careers mean educational level. Those employees with a number of years of education, which is classified within one plus or less

standard deviation of the mean, are deemed to be well matched (Zakariya, 2012). The mode approach was used by Cohn & Khan (1995) and Kiker et al (1997). who used the mode of the level of schooling instead of the mean. It also does not consider standard deviations. Employees who are above the mode value are considered over-educated while those below the mode value are considered under-educated they equal the mode value, then they are well matched. This method considers the current educational level of employees in any career as determined by hiring standards and labour market conditions rather than the job requirements itself (Hartog, 2000).

5.3 Empirical Evidence of Educational Mismatch

Table: 2 Empirical Evidence of educational mismatch

| | | | | |
|--------------------------|-----------|--|---|---|
| Developed countries | US | Duncan & Hoffman (1981) Subjective | Rumberger (1987) Subjective | Verdugo & Verdugo (1989) Objective |
| | UK | Groot & Brink (1997) 3 different models | Alpin, Shackleton & Walsh (1998) Objective & Subjective | Dolton & Vignoles (2000) Subjective |
| | Portugal | Kiker, Santos & De Oliveira, (1997) 3 different models | | |
| | Canada | Vahey (2000) Subjective | | |
| | Australia | Voon & Miller (2005) Realised matching method (statistical method) | | |
| | Poland | Kiersztyn (2013) Objective | | |
| Less developed countries | Mexico | Quinn & Rubb (2006) Realised matching method (statistical method) | | |
| | Pakistan | Abbas (2008) Realised matching method (statistical method) | | |
| | Tunisia | Nadia Zrelli Ben Hamida (2014) Subjective | | |
| | Egypt | Nada Bedir (2014) Realised matching method (statistical method) | | |

6. METHODOLOGY

The literature applies three different approaches to explain educational mismatch: Worker's Self-assessment [WA], job analysis [JA] and Realised matches method [RM]. This study will use evidence from Libya, in which will be using the approach of self-assessment [WA] of graduates employees. Since this approach is intended to understand and measure the occurrence of the phenomenon of educational mismatch and its effects on career progression.

This research will use a quantitative method. “Quantitative research is Explaining phenomena by collecting numerical data that are analysed using mathematically based methods in particular statistics” (Muijs 2004, p3). Quantitative research is particularly suited to discover the state of something, also to explain phenomena.

The secondary data collection will largely focus on the datasets of the graduates, who are working in construction sector recently or currently in Libya, a country in which the state controls such sectors as the ministry of higher education, the ministry of labour and bureau of statistics & census in Libya.

The primary data collection would be via questionnaire. All of the respondents will be contacted through their organisations to obtain their approval to participate in the study. Once they agreed, the questionnaires will be sent to their contact addresses.

After the process of data collection and statistical analysis, the impact of educational mismatch on individual wages will be estimated by using econometrics model.

The research will depend on official data from the office of the information and documentation at the Ministry of Higher Education and the Ministry of Labour and data from the official organisations in Libya such as the (General Information Authority) and (Bureau of Statistics and Census) to determine the numbers and information about the graduates who recently worked in construction sector.

Stratified Random Sample is applied in this research to different faculties graduates in different universities in Libya. It will be useful if the researcher wishes to be able to make generalisations because it seeks representation of the wider population (Cohen et al. 2005). The graduates will be requested to complete an online questionnaire by sending the link to their contact addresses. Some hard copy questionnaires will be distributed to those who can not fill the questionnaire online.

The survey will present a rich source of information regarding Libyan university graduates and link their experience in the labour market. In particular, the survey will contain relevant data about the individual graduates personal, employment and education characteristics, marital status and other socioeconomic indicators, which are all are important determinants of labour market outcomes As these factors are potentially strong predictors of an individual’s participation, attachment, and performance in the labour market, priority should be given to the careful and considered procurement of this information.

Although sampling methods in the social and behavioural sciences are often separated into two groups [probability, purposive], there are actually four broad types as shown in Figure[2].

Probability sampling methods are primarily used in quantitative research. Tashakkori & Teddlie stated that “selecting a relatively large number of units from a population, or from specific subgroups [strata] of a population, in a random manner where the probability of inclusion for every member of the population is determinable” (Tashakkori & Teddlie 2003,p713). Probability samples aim to reach representativeness, which is the degree to which the sample accurately represents the whole population.

7. CONTRIBUTION TO KNOWLEDGE

This research will highlight the phenomenon of the lack of coordination between higher education outcomes and the requirements of the labour market which results in mismatches in the level of education and skilled with the labour market requirements. This research will seek to clarify empirical evidence to know the causes of this phenomenon in Libya as a developing country and to reach solutions that help decision-makers at the state level and educational organisations in Libya to reduce the size of the gap. The research will seek to determine the effects of this phenomenon on career prospects and job satisfaction for individuals.

8. CONCLUSIONS

The paper theoretically investigated the determinants and how to measure of the education mismatch phenomenon, using the self-assessment of graduates, who recently working in Construction Sector to determine the education mismatch with labour market requirements. In addition, it is possible to estimate the impact of this phenomenon on wages and job performance.

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THE IMPACT OF NATIONAL CULTURE ON DISPUTE RESOLUTION: A LITERATURE REVIEW IN THE CONTEXT OF STATUTORY ADJUDICATION IN THE CONSTRUCTION INDUSTRY

F. Aminuddin and P. Chynoweth

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: f.a.b.aminuddin@edu.salford.ac.uk

Abstract: The role of culture is important in shaping conflict management and dispute resolution. As a result, a core question for the field of dispute resolution is the degree to which the cultural values of people within a particular society lead certain forms of dispute resolution to be more or less effective than others. The current study posits that for imported foreign legislation to be effectively exercised in a different local setting, local culture and the variety of conflict management styles ordinarily used within the receiving society need to be taken into account. This paper explores the complex and multidimensional question of how national culture affects dispute resolution styles from the unique perspective of statutory adjudication within the construction industry. Hence, the paper presents initial work, in a research project using a Malaysian case study to assess the viability of implementing a western-style statutory adjudication regime in an Asian construction industry setting. It reviews key literature in relevant fields to assist in the development of a theoretical framework to guide the study's ensuing empirical investigations into the question of why parties in the Malaysian construction industry might choose to employ adjudication to resolve their dispute.

Keywords: Adjudication, conflict management, dispute resolution, national culture

1. INTRODUCTION

In an ideal world, there would be no conflicts and disputes in a perfect construction project. There would be perfect communication, perfect mutual understanding and perfect harmony between individuals engaged in the project decision-making process (Cheung, 2014). Nevertheless, in reality, these factors are susceptible to disagreement and differing interests that, unless managed and resolved, will escalate into disputes. The severity of this phenomenon has the potential to turn an otherwise a successful project into an unsuccessful one. Construction activity is a complicated process involving many disciplines with a diverse set of skills (Kangari, 1995) where by its very nature, problems are bound to arise in the undertaking such a complex tasks due to widely differing values and goals among project participants. There is a pressing demand for an initiative to sustain and maintain the industry's positive and impressive growth. Devastating scenes such as late and non-payment were widely recognised as a rampant, common and boundless problem in the construction industry and persisted in one project after another regardless of whether it is a public or private contract (Danuri et al., 2006).

The Malaysian Government has long recognized problems facing parties to construction contracts in securing regular and timely payment that impacts cash flow project implementation. In ensuring the impressive growth of the industry, Malaysia has extended its purview to look to the Western world in order to seek better ways to tackle the default system of dispute resolution for payment problems within the construction industry that were not working well. According to the Construction Industry and Development Board (CIDB),

under those circumstances, the landscape of the Malaysian construction industry does need altering for the better. Hence, CIDB has been mandated to shoulder the task in drafting Malaysia's own legislation of the Construction Industry Payment and Adjudication Act (CIPAA) development.

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The paper outlines an early work of a research project of a single case study of the Malaysian adjudication regime to assess the viability of the implementation of a western-style statutory regime in an Asian construction industry setting. It sets to review some of the key literature in the fields of national culture, dispute resolution, and conflict management style to develop a theoretical framework that will guide the study's to pursue an empirical investigation on the issue of employment of adjudication as a method to resolve payment dispute

2. NATIONAL CULTURE

In the past, there was a strong belief that human nature was universal. However, it has been claimed that globalisation has led to an increased emphasis on cultural diversity and its influences on personal, social and organisational practice in many ways (Kaushal and Kwantes, 2006). Globalization is argued led to Westernization of people in Eastern cultures that drive homogenization (Laugani, 2006). Stiglitz (2002) opines that in the long-run, globalisation and homogenization will have a devastating effect on developing countries and it will result in the erosion of their cultural traditions.

Culture as a concept is complicated to define. Authors who have written on this topic in some ways deal with the definition of culture differently. Hofstede (1984) defines culture as the collective mental programming of the people in an environment. Culture is not a characteristic of individuals, but it encompasses many people who were conditioned by the same education and life experience. Hence, in more practical terms, culture refers to the collective mental programming that the people of a group, tribe, a geographical region, or even a nation have in common, and the programming is different from one to another.

The concept of national culture has suffered from vagueness, and there has been little consensus on what represents the national culture. Since culture is an intangible concept, a growing stream of cross-culture research described the necessity to develop a means of making it more concrete. Thus, scholars identified and categorised culture in the form of a structure called culture dimensions. We can use these categories to differentiate one culture from another. The term national culture dimensions have been originally defined as categories that organise data culturally (Hoft, 2003). It has been used to map culture differences regarding values and practices embraced by an organisation (Ankrah and

Langford, 2005; Liu et al., 2006). The notion of national culture dimensions originated in cross-cultural communication research done by Hall et al. in the 1950s. Since then, a number of models and dimensions of national culture have been established.

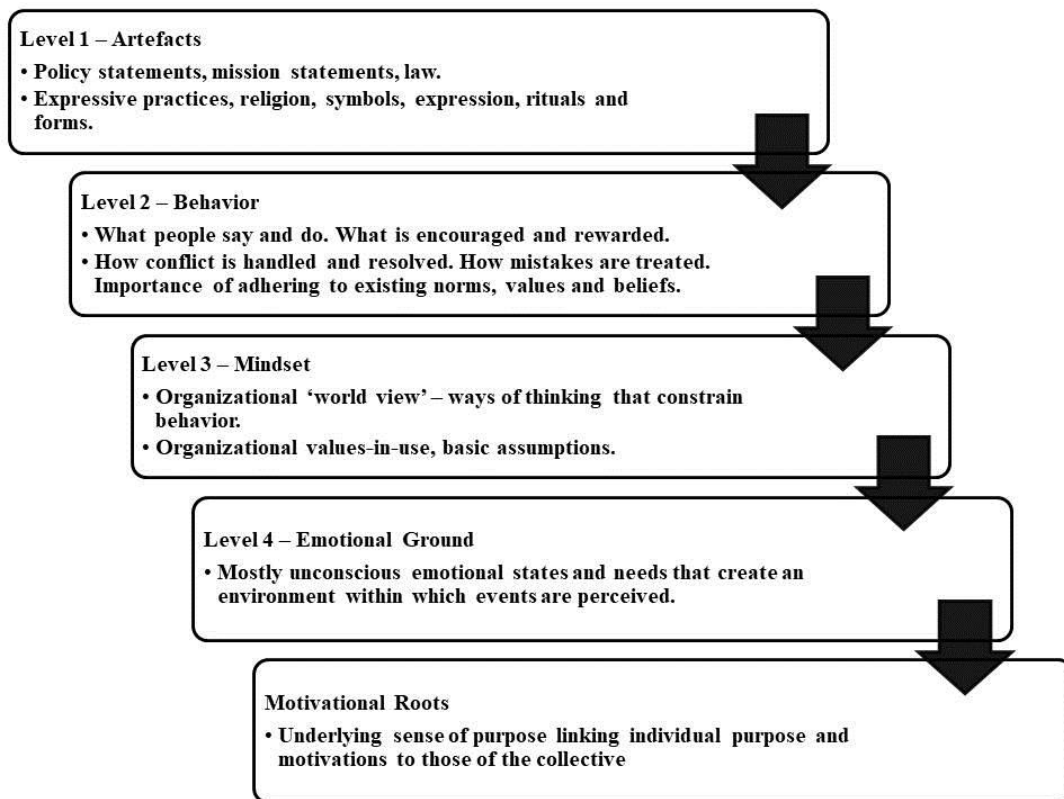


Figure 1: Five core levels of culture

Source: Hawkins, P. (1997). Book Review: Organizational Culture: Sailing Between Evangelism and Complexity. Human Relations, 50(4), 417-440. p. 7.

The reorientation of culture by Avruch (1998) supports the view that individuals embody multiple cultures that are always in the case of psychology and socially distributed. Thus, the study proposes that defining certain culture dimension does not mean every individual who falls in the same groupings of a nation has the same dimensions. As depicted in Figure 1, the argument advanced here addresses the motivational roots of behaviours that are grounded in individuals' unconscious desires to create an environment which can be regarded as meaningful.

The score obtained by Malaysia on each dimension of Hofstede's national culture values out of 120 scores is discussed in this paragraph. Malaysia scores very high on power distance dimension (100 scores), meaning that the society accepts a hierarchical order in which everybody has a place, and it needs no further justification, and the ideal boss is a kind autocrat. Challenges to leadership are not well-received. With a score 26, Malaysia is a very collectivistic society. Loyalty in a collectivist culture is vital and overrides most other societal rules and regulations. Such a society fosters strong relationships where everyone takes responsibility for fellow members of their group. Although scoring 50, Malaysia still can be considered a masculine society which is a success-driven society. Conflicts are resolved by fighting them out. Malaysia scores 36 in uncertainty avoidance dimension and thus, has a low preference for avoiding uncertainty. Low uncertainty avoidance index societies maintain a more relaxed attitude in which practice counts more than principles and deviance from the

norm is more easily tolerated. Rules should be no more than are necessary and if they are ambiguous and do not work, they should be abolished or changed.

Hofstede's dimensional model of national cultures values has been applied to various areas of differences of the concepts of self, personality and identity, which in turn explain variations in conflict resolution strategy. The increasing amount of study in industry-specific and culture-specific themes indicates the importance of understanding culture in ADR arena. However, there is an extreme dearth of literature sources on the discussion of the Hofstede's national culture theory within the context of the relations between the Malaysian national culture and conflict resolution. Attempts have been made to predict what conflict management styles suit a certain culture of society. For example, collectivism/individualism has been vastly utilised by researchers in explaining differences in the interpersonal behaviour in conflict management field. Summarizing the findings from the literature, it is found that individualist society tends to adopt more confrontational nature in resolving disputes while collectivism society tends to adopt a less confrontational method in resolving disputes.

An inference suggested from these findings is that, since Malaysia, according to Hofstede's dimensional model of national culture, is a very collectivistic country, a less confrontational method of dispute resolution is viewed as the most appropriate way that best suited with the culture the Malaysian of society.

Although the above submission may be true, the study opines that Hofstede's theory of national culture should not be taken lightly to fit in whatever form of cultural labelling without taking account many other "situational" factors associating to the decision to adopt certain conflict styles. Thus, this study seeks to explore what the real truth is surrounding the rapidly changing of the Malaysian dispute resolution landscape in the construction industry. To achieve this, the study chooses to see from the perspective of conflict goals of the disputants to help for a better understanding on how national culture characterises a particular society's conflict management styles.

3. THE EFFECTS OF NATIONAL CULTURE ON THE CHOICE OF CONFLICT MANAGEMENT STYLES

In recent years, there has been recognition of the relationship between conflict management styles with national culture. A substantial body of literature which relate national culture issues to the construction industry, especially in the field of construction management, has recognised the need to have a full appreciation of the influences that national culture has on their functioning in conflict management and dispute resolution measures are to be effective and worthwhile. Previous studies also demonstrated the influence of national culture on conflict management and dispute behaviours (Swierczek, 1994; Morris et al., 1998; Tsai and Chi, 2009; Gad and Shane, 2011). The studies found significant contrasting patterns that have been observed repeatedly of how international construction professionals behave differently in their styles of managing conflicts and resolving disputes.

Hence, conflict management and dispute resolution processes are greatly influenced by cultural characteristics. As a matter of fact, disputes and conflicts which occur within the framework of a culture's institutions need that particular culture to provide a clear context of what dispute resolution methods (Tsai and Chi, 2009) best suit their way of life. The

consequences of the three central cultural ingredients – beliefs, values and norms influence the members of the community to behave and act in ways considered acceptable by other members of the group (Rashid and Ho, 2003) but may be unsuitable and unacceptable to members of a different group.

4. WESTERN VERSUS EASTERN CULTURE IN CONFLICT MANAGEMENT AND DISPUTE RESOLUTION

Many studies have investigated so-called “East-West differences” by comparing construction professionals from the United Kingdom and the United States of America to a matched group in an Asian society (Morris et al., 1998). The study by Chan and Tse (2003) yields some interesting key observations about the issue of cultural clashes between the Western and Eastern styles of tackling disputes in international construction projects. The interpretation of the study shows that there was a stronger indication that the Asians prefer informal methods for resolving contract disputes in international projects in comparison with the Westerners. Importantly, the study provides a good indication that cultural clash is one of the most crucial factors contributing to disputes in international projects.

Hofstede indicated that collectivism/individualism was the major construct between the Eastern and Western societies. In general, Asian people measure high on collectivism as they emphasise cooperation, interdependence, and harmony (Johnny et al., 2010). They are more concerned with the consequences of their behaviours on their in-group members and are more likely to sacrifice personal interest for the attainment of collective interest (Hofstede, 1984; and Chan and Goto, 2003). Contrast with individualism; the culture characteristic are in which they have a higher sense of personal identity, striving to be one’s true self, have an internal locus of control and principled moral reasoning (Waterman, 1984). As a result, there are fundamental differences between a society’s cultural background that determine their perception and reaction to dispute, as well as the coping mechanism employed by project parties in a construction contract. Conflict management styles considered as adversarial in non-western societies may not perceive similarly in western societies and vice versa. Management of conflict and dispute resolution between two cultures can also differ.

In their study investigating how ethnic differences between the Korean and American employee, Lee and Rogan (1991) found that in organisational conflict management behaviours, Koreans are extensive user of solution-oriented strategies, while Americans prefer to use either confrontational and control strategies in dealing with organisational conflicts. Moreover, findings also indicate that Koreans are more sensitive in exercising power when facing conflicts with subordinates in the organisation.

In a different study, Morris et al., (1998) found that a problem in joint ventures between U.S. and Asian firms is that cultural differences impede the smooth resolution of conflicts between managers. In a survey of young managers in the U.S, China, Philippines, and India, they found support for two hypotheses about cultural difference in conflict management style and cultural values that account for these differences. First, Chinese managers rely more on an avoiding style because of their relatively high value on conformity and tradition. U.S. managers rely more on a competing style because of their relatively high value on individual achievement.

Interestingly, Cai and Fink (2002) in a more latest study investigating the fundamental beliefs regarding cross-cultural differences in conflict styles consisted of graduate students from 31 different countries residing in the U.S. found that assumptions regarding the relationship of culture to conflict style preferences may not be true. Individualists do not differ from collectivists in their preferences for the dominating style. This finding strengthens the study's verdict that the interpretation of conflict styles across culture is more complex than we believed.

5. SECURITY OF PAYMENT REGIME AND ADJUDICATION ACT

Considering payment disputes in construction are rampant and often complex, industry players and professional bodies recognised the necessity for the matter to resolve promptly. Numbers of developed Western countries have adopted a sort of industry-specific legislation with the aim to resolve cash flow related problems and improve the efficiency of dispute resolution within the construction industry. Such legislation was considered necessary to protect the parties who are susceptible to cash flow related problems especially the contractors, subcontractors, consultants, and suppliers who are normally payees in the industry (Munaaim, 2012). Industry-specific security of payment legislation reportedly has improved payment practice has therefore been introduced to increasing numbers of countries (Gould & Linneman, 2008; Brand & Davenport, 2012; Teo, 2008).

The legislation provides new statutory rights to payment, added to existing contractual rights, together with a mechanism to determine some or all of the rights of parties to construction contracts via adjudication (Munaaim, 2010). Available and linked to the security of payment regime are further remedies for the unpaid party to employ the adjudication procedure if the payment provisions stipulated in the contract are not complied with, or the options to resolve the payment dispute in an adjudication to obtain a decision of that are not available.

The UK became the first country in the world to enact this kind of legislation under the Housing Grants, Construction and Regeneration Act (HGCRA) 1996. It is one of the most important pieces of legislation that the construction industry has ever been obliged to understand. The introduction of adjudication is a revolutionary step taken to introduce a mandatory regime, which, with some categories of exceptions, will apply to all construction contracts. Adjudication was enacted as a medium of improving payment practice in the UK. It is a statutory right that can be enforced unilaterally at any time during construction contract and provides a quick resolution and an inexpensive alternative compared to arbitration and litigation.

Construction adjudication produces a decision that is temporarily binding until disputes are resolved, and the decisions are overturned by arbitration, litigation, or agreement. Not long after the "success" of adjudication in the UK (Gaitskell, 2007), some Western countries such as Australia, New Zealand and soon, Ireland, have introduced and enforced a similar kind of jurisdiction.

Now with the globalisation as the background, Western civilisation especially the Anglo-Saxons, holding the influential position, is spreading its influence in every part of the world, including South East Asia. The pace of implementing adjudication is growing substantially. In this way, there is a common platform for the discussion in South Asian countries to adopt

the same idea of introducing a quick and rough justice for payment problem in their construction industry.

6. STATUTORY ADJUDICATION: THE MALAYSIAN CONSTRUCTION INDUSTRY ADJUDICATION AND PAYMENT ACT (CIPAA) 2012

As discussed earlier, the payment scenario in Malaysia is no different. An empirical investigation conducted by the Masters Builders Association Malaysia (MBAM) with the CIDB and the University Malaya (UM) in 2006 on payment problems shows that payment delays and payment defaults are serious. It also extends the findings to predict an estimate of delayed and non-payment amounts based on a sample of industry players on the amount of unpaid work from the year 2000 and 2006. Roughly, the projected estimated figures are billions of Ringgit. The survey has confirmed the harsh reality of payment default to be a major problem and to be the biggest barrier from improvement and changes to a modernization of the industry (Ameer Ali, 2006 and Fong, 2007).

With the aim to improve payment practice and dispute resolution in Malaysia, the Construction Industry Payment and Adjudication Act 2012 (CIPAA) has officially come into operation. The Kuala Lumpur Regional Centre for Arbitration (KLRCA) has been named as the authorized nominating body to perform various functions including appointing, administrative and training authority for statutory adjudication under CIPAA (Rajoo, 2014). The relatively new Malaysia adjudication legislation has unique features that claimed to have taken into account cultural differences as well as different construction industry customs and practices (Lawless, 2012). By looking at the law itself, the aim of CIPAA is described as:

An Act to facilitate regular and timely payment, to provide a mechanism for speedy dispute resolution through adjudication, to provide remedies for recover of payment in the construction industry and to provide for connected and incidental matters.

KLRCA defines adjudication as a summary procedure of legislative intervention for dispute resolution under a construction contract. It allows the party who is owed monies (“the claimant”) under a construction contract to have the disputes resolved with the non-paying party (“the respondent”) in a quick and cheap manner. Disputes which are referred to adjudication under the CIPAA relate to payment for work done and services rendered under the express terms of a construction contract. Adjudication is a mandatory statutory process that does not require an agreement between the parties of the contract and it prevails over any contractual agreement to the contrary between the parties.

7. THE MALAYSIAN CULTURE AND CONFLICT RESOLUTION

Malaysia is a plural, but largely segregated society and its shareholding structure reflect this feature. An examination as to cultural preferences of dispute resolution should take this into account. Scholars have made some generalisations as to conflict mediation in Eastern societies, but no specific studies have been made about stakeholders’ dispute in resolution in Malaysian companies (Augsburger, 1992; Lederach, 1995 and Karim, 1990). However, Wall and Callister (1999) indicate the plausibility that ‘the Chinese would be more receptive to assertive mediation’ while the Malays ‘would be more comfortable with an informal listening, opinion gathering and discussion approach’.

It was also said that the Chinese have a general aversion towards the judicial system a forum for dispute settlement, which is historical baggage from the period they were discouraged from seeking settlement by way of litigation. Therefore, the existing social institution played a far more active role to help resolve disputes (Goh, 2016). Hooker (2002) noted that in pre-independent Malaya, no commercial disputes were ever brought to the colonial courts for adjudication based on Chinese customs. Culture and history may well be the cause of this, even today, from the frequency of shareholders' litigation, it would appear that there is still an aversion towards the formal judicial system to solve disputes.

The above submission seems to suggest that in resolving a dispute, the Malaysian society tends to incline towards amicable settlement via negotiation and mediation. However, following the rapid change of construction dispute landscape and increasing complexity of construction projects in a developing country like Malaysia, to what extent this practice is applicable to the local construction industry?

8. THE INFLUENCE OF NATIONAL CULTURE ON THE INTRODUCTION AND THE IMPLEMENTATION OF STATUTORY ADJUDICATION IN MALAYSIA: A RESEARCH PROPOSAL

Following the well-publicised concerns that no assumption is made that the Western model is generalizable to all cultures, coupled with the topical phenomenon that; (1) Malaysia is a newcomer, being the second country in Asia after Singapore to enforce statutory adjudication at its national level; (2) the distinct feature of adjudication practice that requires the parties to be competitive and confrontational in nature that may go against the custom values of the Malaysian; and (3) adjudication, like litigation and arbitration provides a win-lose, rough justice solution that potentially may tarnish a harmony working environment between the construction parties of the Malaysian community; there is an emergence of an apparent questions of cultural "suitability" and "acceptability" of adjudication under CIPAA, being another form of dispute resolution mechanism drawn from foreign management system into domestic settings. Is the adjudication system, largely developed in Western culture, applicable elsewhere?

Having arrived at the research problem through the literature, informal consensus was obtained by the practitioners of adjudication in the Malaysian construction industry to determine whether these experts had noticed the influence of national culture characteristics on the implementation of adjudication, if so, whether national culture was perceived to be problematic in the implementing a successful adjudication system in Malaysia.

It was also loosely evident that some adjudicators have less confidence that adjudication will achieve the same level of satisfaction as practised in the UK. The submission is based on the opinion that adjudication may help to boost the payment default issue in the industry but it may go against the custom of the local industry players. Some claim that payment culture in the Malaysian construction industry experiences no significant changes after the introduction of CIPAA. In Malaysia, the Act is relatively new, but if observed from the cultural perspective, a sound scientific analysis is worth to be placed on the national cultural characteristic issue to the implementation of adjudication in Malaysia.

It is further claimed that Malaysian working culture is much different from that Western societies. This is because, looking at the social scenario, due to the shared working-values of

the Malaysians, the industry is autonomously run and where decisions of the people in the industry are dictated by political and social influences. Hence, if adjudication is to be totally implemented in Malaysia, a further closer look must be placed upon the local custom of the industry. CIPAA must not be a copy or a duplicate of a system from the Western jurisdictions.

The body of literature hints that the construction industry tends to overlook the potentials of human-related “soft” factors or behavioural aspects of the conflict management in improving dispute resolution processes. For example, York’s (1996) model helped the construction stakeholders to select the best resolution strategy based on predominantly “hard” factors that are mainly concerns with time cost, degree of control by parties and flexibility. Brown and Marriott (1999) found that, amongst others, factors such as confidentiality, remedies, enforceability, degree of formality and type of contract are the key selection factors adopted for mapping a dispute resolution method. However, David (1998) and Cheung and Suen (2001) recognized the importance of human nature in dispute resolution, expanded the selection factors by adding factors like cultural factors, preservation of business relationships and relationships between parties as the project key success factor.

Malaysia’s exposure to Western ways has resulted in adopting western management and technology. Mendoza (1991) points out that: “When we in Asia adopted Western management technology, we swallowed it, whole hog. We bought it lock, stock and barrel, its principles, its legal under-pinning, its underlying assumptions; no exceptions, no returns no refunds. We have spent the last four decades trying to fit into the well-rounded Asian souls and sensibilities into the square hole of the Western mind. And it has been a clumsy fit”.

These are some of the many views suggesting that Malaysia may faces difficulties with the adoption of foreign practices; to a certain extent they seem to be unsuitable to the local environments. At the same time, these also reflect the need to engineer its own practices. One of the basic challenges in a developing country face is to find and identify those parts of their own tradition, history and culture that can be used as management building blocks.

Familiarization with foreign legal systems increases opportunities to borrow ideas from them. However, what is the likelihood of viability of applying these ideas and what will be the social cost? The very core issue addressed in this paper is the degree to which cultural values shape the viability of dispute resolution mechanism in construction industry. Using this scholarship, this study argues that cultural differences present formidable barriers that should not be ignored in analysing emulation of legislation.

9. CONCLUSION

This paper has noted that the literature clearly suggests that cultural factors are significant dominant of the viability of particular dispute resolution methods. Specifically, it shows that culture is not a character of individuals, but rather a character of a group of people that subject to the same experience in an environment. Cultural variables can predict some aspect of conflict resolution practices. It is found that confrontational methods were more preferable by individualist society compared to collective society that may choose a less controlling method in resolving dispute. Hence, conflict management styles are greatly influenced by cultural characteristic.

The paper has described the conflict resolution strategy from national culture perspective base by reference to the Hofstede's theory of national culture which incorporates especially from individualism/collectivism theme. It has demonstrated how this knowledge base incorporates a number of areas of differences of the concepts of self, personality and identity which in turn indicate the importance of culture-specific themes in understanding the viability of an ADR within a specific country.

According to this view the recent introduction of the western-style statutory adjudication regime in Malaysia might be considered to be a poor cultural fit. This provides the inspiration for the current study which will explore the complexity of the relationship between national culture, conflict management styles and the dispute resolution processes. A theoretical framework will be developed for the study based on the dimensions of national cultural variations reviewed here as well as further theoretical work which has also been undertaken on styles of conflict management.

The study will then apply this understanding to the empirical world to investigate the appropriateness for the implementation of adjudication as a mechanism for construction dispute resolution in the context of the Malaysian culture and to understand why Malaysian construction players, contrary to collectivistic practice, choose to employ a confrontational mechanism like adjudication to resolve their dispute.

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PROPERTY AND PROJECT MANAGEMENT

THE NOMENCLATURE OF GEOTECHNICAL ERROR TRAPS AS A THEORETICAL FRAMEWORK FOR ASSESSING FINANCIAL RISK IN TRANSPORTATION INFRASTRUCTURE PROJECTS

A. Amadi¹ and T. Omotayo²

¹*School of the Built Environment, University of Salford, Salford M5 4WT, UK*

²*Robert Gordon University, UK*

Email: amadi@lote@yahoo.com

Abstract: Engineering and re-engineering issues related to ground conditions, have been consistently discussed in the technical press, as the cause of significant cost and time overruns in highway projects located in different parts of the world. The literature continues to report statistics of widely publicized projects which have significantly exceeded their initial budget due to geotechnical uncertainties. Despite these widely-publicized case histories, there is a discernible gap in the scholarly literature on studies that have analyzed in-depth, the fundamental geotechnical drivers in practice, which represent the underlying error traps creating a propensity for highway projects to run over budget. In view of the calls for construction industry researchers to shape tomorrow's built environment, this study analyses and synthesizes the nomenclature of geotechnical error traps, as a theoretical framework for assessing financial risk due to inadequate geotechnical risk containment. The study findings reveal arguments and widely contested issues in geotechnical practice, which to various degrees, can have significant financial impact on project completion cost in highway projects. This study thus provides clients for road projects (highway agencies), who constitute the primary target audience, with the necessary theoretical perspective necessary to understand the various trajectory through which geotechnical risk can trigger inefficiency and wastage of financial resources on transportation infrastructure projects.

Keywords: Cost Overruns, Error Traps, Geotechnical, Risk.

1. INTRODUCTION

Ground conditions have been repeatedly asserted to account for a huge percentage of the technical risk posed to highway development, due to its complex interfaces with the design and construction of transportation projects. Several publications (Peacock, and Whyte, 1992; Alhalaby and Whyte, 1994; Whitman, 2000; Clayton, 2001; Venmans, 2006) have identified ground conditions, and the relatively high level of uncertainty associated with it, as one of the most fundamental technical explanations of cost overruns in highway projects. Engineering and re-engineering issues related to ground conditions have been consistently discussed in the technical press, as the cause of significant overruns in highway projects located in different parts of the world, with huge economic implications (NEDO, 1983, 1988; NAO, 1994; ICE, 2001; Alavi and Tavares, 2009; DETR, 2014).

In 1990, an analysis of 67 highway contracts in the UK, revealed an average cost overrun value of 28%, 17 of which showed 44% cost increases due to earthworks and unforeseen ground conditions (ICE, 1991). The National Audit Office (1994) also reported 210 cases of premature failures, worth about £260 million, due to inadequate ground investigations. The National Audit Office (2001) further revealed that 70% of public sector projects experienced delays, with 73% over budget, in the face of dwindling investment in ground investigations.

The New Civil Engineer (2011), reported an audit of geotechnical failures, in the Netherlands, which were estimated as costing between 5% and 13% of annual expenditure (€70bn/£61b).

Significant cost overruns of up to £516 million were revealed by, the Department of the Environment, Transport and the Regions (DETR, 2014), in the seven largest road projects executed, due to unforeseen ground conditions, accounting for a 63% increase above budgeted funds. Of the seven projects, the M60 Manchester ring road incurred the highest cost overrun of £184 million, because unforeseen ground conditions amounting from delays of 35 to 46 weeks, and claims worth £30 million. Five of the schemes included within the DETR analysis were also revealed to be between one to five years behind schedule.

The Hallandsås Tunnel Project, Sweden, designed for the construction of two 8.6 km long railway tunnels at an initial budgeted cost of £440 million in 1992, escalated to £840 million in 2008, due to unforeseen ground and water conditions (Creedy, 2006). The project was abandoned at 3 km (30%) completion in 1995, resumed in 1996, discontinued in 1997, and resumed in 2004, after seven years. Work progress in as at 2009, was measured to at 59% completion, with final completion in 2015, as reported in the technical press (IRJ, 2015). Also, the critical factor cited as responsible for the controversial £900m cost overrun reported in the Big Dig, United States Boston Artery project, were technical issues due to unforeseen ground conditions compounded by high water table two to three meters below the surface which was discovered during construction (Creedy, 2006).

As noted from the different popularly cited statistics and case histories, ground conditions constitute a major risk factor that can ultimately determine the successful performance of a contract. The study thus explores the nature of geotechnical risk factors at the pre-contract phase of highway projects, leading to cost overruns at the post contract phase. As Sower (1993:238) asserts: “*Ground-related problems often originate in an earlier phase than the phase in which they occur...out of 500 failures evaluated, 58% originated in design, and manifested in construction*”. The study thus provides a kaleidoscopic view of the various routes to managing risks due to the ground, at the preconstruction phases of highway projects, and how a lack thereof, can culminate to determine the trend of high cost overruns in highway projects.

2. CONCEPTUAL FRAMEWORK

Love *et al.* (2012) suggests the unintentional triggering of ‘Latent Pathogens’, which lay dormant in the complex interactive processes of infrastructure projects, counterfactually trigger cost overruns. Pathogens as defined by the authors represent “*the latent conditions that lay dormant within a system until an error comes to light*” (Love *et al.*, 2012:3). Such pathogens may thus be considered part and parcel of the everyday functioning in an organization, because they have been in existence over a considerable period. But such practices negate or significantly deviate from best practice, setting off an additive chain of concomitant errors which creates significant ‘error traps’ leading to cost overruns. Morris (1990:154) was of the view that inadequate technical preparation at the front-end of projects often characterised publicly funded projects and accounted for budget overruns in infrastructure projects, stating: “... *Appraisal ... is very often is devoid of meaning when the emphasis is only on the form of the project proposal rather than on its content.* While,

Johansson (2015) was of the view that managing multidimensional uncertainties within limited time, and cost constraints often trigger cost overruns in infrastructure projects.

Although these narratives provide theoretical platforms for understanding financial risk due to shortcomings in organizational practices in infrastructure projects, they are not specific to geotechnical risks in highway projects. As the ICE (2001) underscores, irrespective of projects details, ground condition is a factor to be contended with in highway projects, due to the more complex interfaces of transportation projects with the ground. The objective of this study therefore is to analyze the chain of concomitant geotechnical error traps that can counterfactually culminate in significant cost overruns in highway projects.

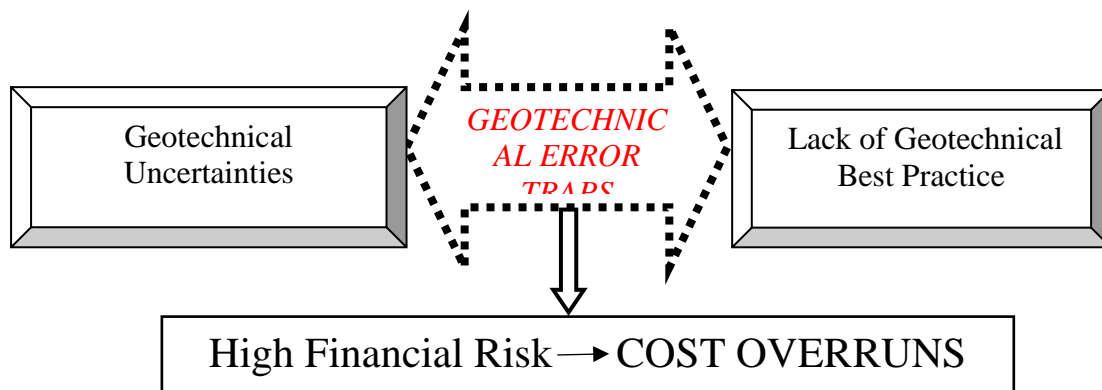


Figure 1: Conceptual Approach to the Study

Following the conceptual framework in Figure 1, the study examines the dictates of geotechnical best practice in the distinct project phases, as a basis to synthesize a theoretical framework for assessing financial risk due to geotechnical uncertainties in highway projects.

3. METHOD OF STUDY

The study reviews the relevant literature related to cost overruns in highway projects, triggered due to mismanaged geotechnical risks. This is with a view to deduce shortcomings which can portend error traps in the practices of highway organisations. The study explicitly illuminates geotechnical best practices at the: conceptual costing phase; design preparation phase; as well as at the contractual phase during bidding, tender documentation, and contractor selection. The study deduces gaps in knowledge, suspected as prevailing in the professional practices of highway agencies, by critically analysing current arguments and divergence between industry practices, as a basis of synthesizing a theoretical perspective for evaluating financial risk triggered by geotechnical uncertainties. Due to the practice based nature of the research, related articles from the technical press evident in publications by international professional bodies, recognised standards of best practice, research institutes and highway agencies are used to support the bulk of scholarly literature.

4. GEOTECHNICAL ERROR TRAPS IN PROJECT PHASES

4.1 Geotechnical Error Traps at the Conceptual Estimate Phase

A conceptual estimate is an estimate prepared at the phase of highway development, whereby only a general idea exists about what the project will entail (Lowe *et al.*, 2006). Various terminologies have been used to label this estimate in a project. Typically, such terms as

'early stage estimates', 'initial estimates', 'top-down estimates', 'preliminary estimates' and 'investment estimates' are used in the literature to label this point of initial arbitrariness in project details and definition (Chou, 2005; Tan and Wakmasha, 2010; Asmar *et al.*, 2011). Despite these different terminologies, the initial point of estimation, for any project is the planning stage, during which a business case is identified, and investment decision-to-build, must be made.

It has been opined that highway projects have historically experienced significant cost overruns, often rooted at the point of the decision-to-build (Cantarelli *et al.*, 2010). To circumvent the occurrence of cost overruns, the estimating methodology used to project budgetary outlay at the conceptual phase, will need to yield estimates that closely approximate final costs (Tan and Wakmasha, 2010). The current practices of highway agencies, reveal varied methodologies of approximating conceptual estimates (Chou, 2005; Alavi and Tavares, 2009). Different agencies have used differing approaches at the preliminary phase to project budget estimates (Alavi and Tavares, 2009: 10). The literature however shows a predominance of methods, conventionally associated with the early stage estimation practices of highway agencies (Chou, 2005). From the analysis of the costing practices of several highway agencies, the author revealed a commonality of conceptual costing practices based on historical cost/mile averages. Also apparent is the fact that none of the methodologies can be identified as having any form of systematic geotechnical input, as unique characteristics such as potential variability in ground conditions are not accounted for (Romero and Stolz, 2009). With a high element of subjectivity required on the part of estimators in deducing to the level of ground similarity with past project. As Turouchy *et al.* (2001) expounded, these methods often based on cost per-mile tables, usually have adjustment made for project specific incidentals, using informal engineering judgment. Methods based on the estimation of "rough" quantities for all major items, basically apply the generic LWD (length, width, depth) method which involves estimating pavement volume, and then adding costs for other items. The LWD method however does not accommodate the possible variability in cross sectional details along the proposed route, with lump sum contingency allocations used to cover for geotechnical uncertainties. It can thus be discerned that the technique of 'lane mile extrapolation' typically used by most highway agencies, may not necessarily account for the true conditions of site.

Although, it may be argued that no certainty can be achieved in predicting ground conditions for highway projects, at the conceptual phase, Turouchy *et al.* (2001) however reported that a fair attempt to account for ground conditions was observed in the Tennessee Department of Transport, (TnDOT). The TnDOT undergo a more rigorous process, where cost estimates are developed after carrying out comprehensive desk studies, supplemented with the use of aerial photography and topographic sheets, with further preliminary site reconnaissance. This is reproduced in a CAD drawing system scaled plan sheet, where a rough layout of the road is produced, based on which the road centre line is drawn to envision the typical section for subsequent detailed measurement to generate quantities for 20 major cost items. Turouchy *et al.* (2001) further reported that most of the DOTs surveyed revealed that the pavement cost, represented the most difficult cost item to estimate and often accounted for the largest deviations from detailed design estimate and final cost. This contrast with few states DOTs such as Tennessee that dedicate a relatively large amount of financial and human resources to preliminary engineering, and have very low deviations from their initial cost estimates.

Despite this technical shortcoming noted, as the literature continues to report, several highway agencies deploying qualitative methods of conceptual estimating due to the speed

and ease of its applicability (Chou, 2010). Romero and Stolz (2009:186) thus assert that this practice, evident within highway agencies, will amount to producing no more than just a guesstimate, stating:

“Reliance on historical cost per mile data are not well suited for feasibility studies, because not only do construction costs vary widely because of subsurface, geographic, and other project-specific parameters, but also because such construction costs are not generally available in cost databases... This could result in significant budgetary shortfalls as projects progress through the developmental phases of planning and design to construction”.

4.2 Geotechnical Error Traps at the Detailed Design Estimate Phase

Detailed estimates are prepared at later stages of projects, often before the contractual phase, when all project details and cost data previously not adequately defined at the conceptual stage are available. Turouchy *et al.* (2001) opined that each successive phase of the project life cycle is more influential as the focus narrows on the amount each project will cost with a corresponding reduction in contingency allowance. Schexnayder *et al.* (2003) thus stated that subsequent estimates are made throughout project design as continuing checks on cost expectations, and the confidence intervals decline to where the final definitive estimate is expected to be very close (plus or minus 5 per cent) to actual project costs and that the estimates are symmetrically distributed around the actual costs.

Detailed design estimates are typically prepared by breaking down work into the lowest level of detail, (Level 4 Rate Build-up of the WBS) that comprehensively captures all cost components, before a contract is awarded and construction commences (DOE, 2011)). Detailed design estimates ideally should cater for all major cost contributors and financial risk factors in the project (GAO, 2009). It is thus a basic underlying assumption that the cost estimate prepared by clients at the detailed design phase is an accurate predictor for future costs of a project, having taking into consideration, condition of the ground at the proposed site. It is therefore logical that at this point of detailed estimating, that the cost implication of ground related risk in projects, recognized by the institution of Civil Engineers (1991), to be a major cost driver in transportation projects, has been adequately established. Consequently, it can be deduced that defining the geotechnical properties of the ground, in sufficient detail and accuracy, is of vital importance in the preparation of detailed design estimates, as unanticipated poor sub-grade can undermine the overall financial performance of a highway project.

Accordingly, a site investigation should attempt to foresee and provide against technical and financial difficulties that may arise during construction because of ground and/or other local conditions (Ashton, 1997). A site investigation as stipulated by best practice should consist of three stages, namely a desk study, a preliminary reconnaissance and a site exploration. Bell (2007:231) stated that a desk study is undertaken to make an initial assessment of the ground and to identify, if possible, any potential geotechnical problems. The preliminary reconnaissance involves a walk over the site and its surrounds based on visual inspection. This is because geotechnical uncertainty is always high before a comprehensive site investigation is completed (Ashton and Gidado, 2001). The aim of a detailed ground exploration is to try to determine and thereby understand the nature of the ground conditions on site and those of its surroundings (Clayton *et al.*, 1996).

The ICE (1999) thus emphasized that a desk study and preliminary reconnaissance should not be regarded as an alternative to detailed ground exploration. Clayton *et al.* (1995:38) contradicts this stance by opining that:

“The desk study and walk-over survey are the two essential components of ground investigations. Other parts (such as boring, drilling, and testing) may sometimes be omitted, but these parts of site investigation must always be carried out”.

These contradictory stances in the literature may thus imply that the phase of detailed ground investigation may be overlooked, leading to monumental cost-overruns that could have been prevented (Institution of Civil Engineers, 1999). As the literature shows, expenditure on ground investigation is often accorded a low priority (ICE, 1991; Paul *et al.*, 2002; Albatal *et al.*, 2010). Typically, several authors including Clayton, 2001; Paul *et al.*, 2002 and Albatal *et al.*, 2010 have noted that the cost of site investigations in relation to the total project cost is small. Typical values of 0.20 to 1.50 per cent of total project cost were revealed by Albatal *et al.* (2010). Clayton (2001) found a direct positive relationship between expenditure on site investigations and the level of cost overruns experienced in projects. As Cathie (2000:1) asserts: *“Spending money on geotechnical investigations and engineering is like a good insurance policy”.*

4.3 Geotechnical Error Traps at the Tendering Phase

The contractual provision made for the allocation of geotechnical risk, is the key feature of highway contracts around which hinges the magnitude of risks borne by both parties to a contract (Moleenar *et al.*, 2006). This is because, the tender price forwarded by contractors in bidding for highway contracts, is fundamentally determined by the level of ‘knowns’ about a project (Moleenar *et al.*, 2006). The literature establishes the importance of making fully known, the level and types of risks associated with any project, so that inconsistencies in computing tender figures do not arise (DRMB, 2006; Moleenar *et al.*, 2006). As Moleenar *et al.* (2006:31) asserts:

“The contract is a vehicle for risk allocation ... it defines the roles and responsibilities for risks. Risk allocation in any contract affects cost, time, quality, and the potential for disputes, delays, and claims.

Moleenar *et al.* (2006) further argued that clients, are in the best position to assume responsibility for ground related risks, as indicated in Table 1.

*Table 1: Risk Allocation Matrix for Highway Projects
(Source: Moleenar et al., 2006)*

| Risk | Party recommended to assume risk | Medium of Risk Management |
|-------------------------|--|--|
| Site access | Owner | Advanced Planning |
| Methods of construction | Contractor | Specific Contract Clause |
| Site conditions | Owner | Geotechnical Investigation Reports; Contract Clauses. |
| Weather/Acts of God | Shared (Owner assumes delay risk; contractor assumes financial risk). | Contract Clause |

As Table 1 shows Ground Investigation Reports and the various contractual clauses, serve as risk allocation measures. The inclusion of a 'Ground Investigation Report, and a 'Differing Site Conditions (DSC) clause', implies that, in the event of encountering a subsurface condition different from that which was indicated, the owner bears the additional cost for executing the work under such conditions (O' Toole, 2006). The efficacy of these measures serve to optimally allocate geotechnical risk and therefore avoid costly disputes.

The literature however indicates a divergence between industry practices, as some highway agencies try to transfer the risk associated with the ground conditions to contractors in their misguided notion of ensuring certainty of final outturn cost (Chan and Au, 2007). Contractors thus must rely on guesswork to project estimates, which are forwarded in bids, risking potentially undetected ground conditions. Several authors (Tah *et al.*, 1994) thus advocate for the optimal allocation of geotechnical risks in traditionally procured contracts, as this a major factor which is considered by contractors in setting price margins. As Romero and Stolz (2009:8) opines: "*The types of risk allocation measures, or the lack thereof, have a profound influence on a contractor's decision whether to bid for a project and the amount of contingency placed in a bid for risk*".

Where ground investigation reports and DSC clauses are included, the literature evidences a significant reduction in the level of bids received (O' Toole, 2006; Romero and Stolz, 2009; Wong, 2012). This reduction in the level of bids received by clients, was attributed to the reduction in the level of risk borne by the contractors relating to ground conditions, and therefore the level of contingency that is included in the bids tendered. Geddes (1985:2) remarking on this stated that:

"Although including ground investigation reports, and as such adding a differing site condition clause to a construction contract, introduces some uncertainty for an owner regarding the ultimate cost of a project. This uncertainty, however, may be offset by lower bids from contractors who will not have to account for unknown conditions by including contingencies in their bids".

A note of caution is, however, sounded by O' Toole (2006), who raises valid concerns about the accuracy and representativeness of ground investigation reports, suggesting that where incomplete or inaccurate reports are used as a basis of financial and risk assessments by contractors, the client faces significant financial risk due to contractual change events resulting from report inaccuracies. Supporting this view, Wong (2010) identified two common arguments often raised by contractors when faced with the unforeseen ground conditions during the progress of works. Firstly, whether a ground investigation report was included as part of the contract documentation, and secondly whether the report provided, was truly representative of the physical conditions of site.

In the event that a ground investigation report was included as part of the contract, and was subsequently found not to be representative of the ground conditions experienced during construction, this can provide sufficient basis for claims and variations to arise in a contract. Thus, case law related to construction projects, is rife with cases where the core argument revolves around the issue of non-representative ground investigation reports. For example, the landmark case of *E. H. Morrill Co. versus. State of California*, is both a classic example of one such dispute, and the underpinning case law used by contractors wishing to challenge the employer's ground investigation report. The client in this case had tried to avoid the liability for unknown or unforeseen site conditions by incorporating '*Disclaimers and*

Exculpatory Clauses’, which as the literature shows, do not often hold up to detailed legal scrutiny in the final judgement (O’Toole, 2006). Clients would thus only have to resort to the use of DSC clauses, which would mean paying for those conditions that could not have been revealed in detailed investigations, archetypally expressed in the form of ‘*Unforeseen Ground Conditions*’ or a type-1 DSC (ICE, 1991).

Different internationally recognised standard forms of contracts and regulations have various adaptations of a DSC clause: The ICE form of engineering contracts; The FIDIC Red and Yellow Books, The American Federal Acquisition Regulations. Even the most recent, newly released version of the Engineers’ Joint Contract Documents Committee contracts prepared as a joint document between The American Council of Engineering Companies (ACEC), The National Society of Professional Engineers (NSPE) and The American Society of Civil Engineers Institute (ASCE), contains adaptations of the differing site condition clause. The 7th Edition of the ICE Standard Form of Engineering Contract: Clauses 11 and 12, later replaced by the suite of New Engineering Contract (NEC) forms, focuses on the theme of managing ground risks. The ICE Form of contract was intended to rationally share the risk on ground conditions between the employer and the contractor, as a basis of fostering adequate management of ground risks in engineering and construction contracts (Wong, 2012). The FIDIC Red Book (1999) focuses on client designed projects, while the FIDIC Yellow Book (1999) focuses on contractor designed projects. Clause Clause 4.10 -12, of the FIDIC Red Book, centers on three main themes: Information on sub-surface conditions and inspection of site; Interpretation by the contractor; and physical conditions revealed during contract execution (Wong 2012).

However, some other forms of contracts used in different countries adopt common law position. Typical wordings contained in JCT forms of contract used by the Nigerian Federal Government, states:

“...the Contractor shall be deemed to have visited the site and satisfied himself that he has allowed in his price for everything necessary for the completion of the Works”.

Similarly, Clause 13(1) of the Hong Kong Government General Conditions of Contract (GCC) for civil engineering or building works states:

“The Contractor shall be deemed to have examined and inspected the Site and its surroundings and to have satisfied himself, before submitting his Tender... as regards the nature of the ground and sub-soil, the form and nature of the Site... the nature of the work and materials necessary for the execution of the Works... and generally to have obtained his own information on all matters affecting his Tender and the execution of the Works.”

Others, even within the jurisdiction of the countries which adopt the requirement of differing Site Condition clauses, have resorted to including ‘Site Inspection Clauses’ stipulating that contractors carry out all requisite inspections. Remarking on this scenario, as a financial gamble by clients, Chan and Au (2007:3) opined that:

“The owner risks tragedy, first, from cost-cutting measures the contractor will take if it hits unforeseen conditions, and then, from fighting contractor claims and picking up the pieces if the contractor abandons the project or goes bankrupt”.

Lack of geotechnical risk allocation measures by highway agencies in contract documentation, during bid solicitation therefore constitutes significant financial risks in highway projects, which often plays out to trigger cost overruns.

4.4 Geotechnical Error Traps at Contractor Selection Phase

A key underlying feature, implicit in the successful execution of a highway contract, is the efficiency of the contractor. The selection of a contractor has thus been emphasized in the literature (Holt *et al.*, 1995; Crowley and Hancher, 1995), as a risk variable to which utmost consideration should be given during the procurement phase, as it has significant connotation to undermine meeting project performance objectives of cost, quality and time. Holt *et al.* (1995) thus distinguished between the lowest initial bid and the most competitive/viable price for a project under an existing investment climate. This is against the misguided notion of clients often opting to award contracts on a lowest bidder basis, at the risk of incurring huge cost overruns due to contractor’s incompetence (Crowley and Hancher, 1995). The need for an informed unbiased appraisal of contractors’ technical capabilities relative to bid price has thus resulted in the development of multi-parameter quantitative models for contractor selection (Gransberg and Gad, 2014). The authors asserted that comprehensive quantitative approaches to contractor selection require the assignment of relative weighting of critical geotechnical factors, aggregated in deciding on the winning bid. Gransberg and Gad (2014:967) further stated:

Gransberg and Gad (2014) further explained that in the United States, during this phase, the inclusion criteria of the project RFQ or RFP, is however established based on state laws or published DB procurement guides of the highway agency, and not just on a project specific basis. The findings of Gransberg and Gad (2014) study revealed the various approaches adopted by US highway agencies, in DB projects. These are shown in Table 2.

Table 2: Geotechnical Approaches in DB Contractor Selection
Source: Gransberg and Gad (2014)

| Highway Agency | Approach |
|-----------------------|---|
| Minnesota DOT | Higher scoring weights Bonus scoring for exceeding minimum requirements; |
| UDOT | Heavier emphasis on the technical aspects via a 50/50 cost/technical weighting. |
| Delaware | Submission of a narrative outlining the various geotechnical risks and proposed method of construction |
| Maine DOT | Superior scores in geotechnical category |
| Minnesota | 5-year warranty for geotechnical failure on a pass/fail basis |
| Florida | 20 points awarded for quality of design and ground Investigations plan and minimization of design changes |

As can be discerned from the various methods adopted by highway agencies, geotechnical input is ensured either based on the weightings or extra scores in the technical proposal, Minimal geotechnical requirements relative to other factors may however be necessitated under routine construction work in better ground conditions, with higher requirements in more complex projects or in adverse difficult ground conditions. Subjectivity in the process of contractor selection is therefore eliminated by the explicitness of the procedure. Lack of a comprehensive qualitative/quantitative mechanism deployed to ensure that geotechnical requirements are incorporated into contractor selection decision, therefore represents another

potential geotechnical error trap at the contractual phase of highway projects, which can trigger calamitous financial consequences on projects.

5. DISCUSSION

The study has revealed various error traps through which geotechnical risk manifests at the conceptual, detailed design, and contractual phases of transportation projects.

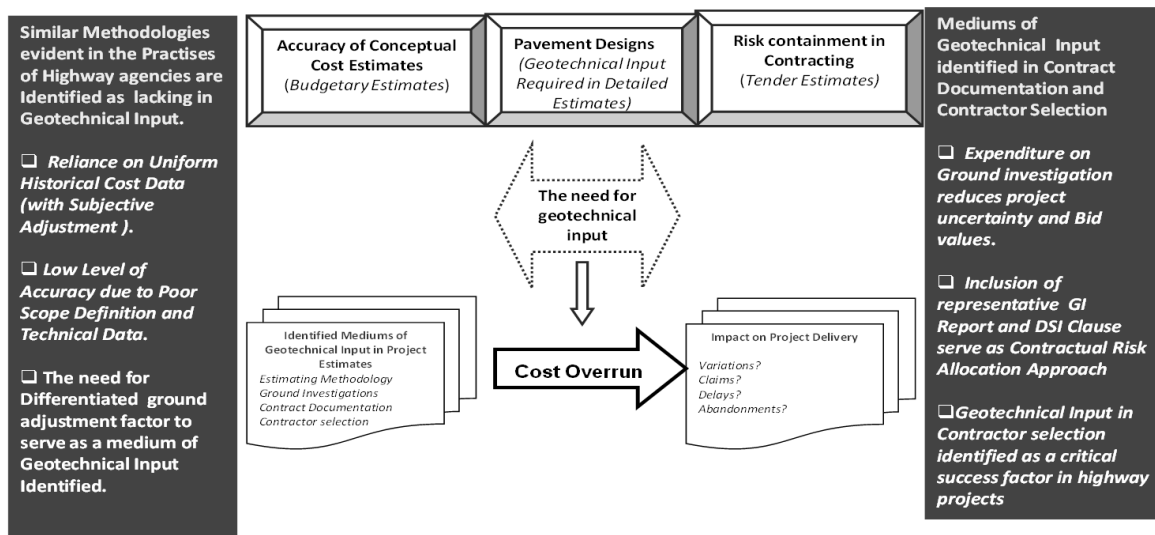


Figure 2: Theoretical Framework for Assessing Financial Risks due to Geotechnical Uncertainties

As Figure 2 illustrates, there are still ongoing divergence in the practices of highway organisations, relating to:

- The methodologies deployed for conceptual cost estimating, to enable the use of more deterministic costing methods that better reflect heterogenous ground conditions;
- The adequacy of ground investigations carried out with calls for sufficient expenditure to be devoted to carrying out more rigorous preliminary exploration.
- whether there is need to incorporate Ground Investigation Reports (GIR) and by implication Differing Site Condition (DSC) clauses in engineering contracts, as a mechanism of geotechnical risk containment;
- The incorporation of comprehensive multi-dimensional algorithm during contractor selection, that incorporates specifically tailored geotechnical factor weightings

These gaps in practice identified can therefore serve as a logical theoretical perspective, for assessing financial risk due to ground conditions in highway projects.

6. CONCLUSION

This study has shown how widely contested issues in geotechnical practice, implying poor financial risk containment may still currently be on going to various degrees on highway

organizations, and can have significant financial impact on project completion cost. The dynamics of geotechnical risk aversion has thus been shown to have important implications for the accuracy of the project's final outturn cost. This study has provided clients for road projects (highway agencies), and who therefore constitute the primary target audience, with the necessary theoretical perspective necessary to understand the various trajectory through which geotechnical risk can trigger inefficiency and wastage of financial resources on transportation infrastructure projects.

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EXAMINING AND MAPPING THE BIDDING PROCESS OF IRAQI QUASI-GOVERNMENTAL CONSTRUCTION COMPANIES

T. Al-Obaidi and A. Higham

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: t.ameen@edu.salford.ac.uk

Abstract: Business Processes (BP) have been recognised by business leaders and academics as the core of organisations. Thus, organisations, in order to survive and succeed in a turbulent competitive business environment, are required to focus mainly on improving their business processes. Business process management (BPM) is a comprehensive and wide used approach to increase BP's principles into an organisation. With the aim to improve the overall performance of Iraqi Quasi Governmental Construction Companies (IQGCCs) by employing the BPM approach. This research, particularly, focuses on examining and mapping the current bidding practice within three of Iraqi QGCCs. Required data were collected by conducting semi-structured interviews with engineers, and managers from different organisational levels and supported by focus groups to validate the mapped process. The research highlighted a number of challenges facing the current bidding process resulting mainly from limited authority provided to the regional level and the functional hierarchy management system adopted by these companies. As a result, more studies to streamline and improve the current bidding process's efficiency are extremely needed.

Keywords: bidding, business process, IraqiQGCC, process mapping.

1. INTRODUCTION

Rising the globalisation, liberalisation of international trade and rapid technological development over the last two decades have put the business environment under fast dynamic change (Shtub and Karni, 2010). The question of how some organisations have managed to survive and grow under such environment, has attracted wide interest amongst management practitioners and researchers. Seminal researchers such as Porter (1985), Hammer and Champy (1993) and Harmon (2003) argue organisations can survive, succeed and enhance their overall performance through focusing on improving their business processes (BP).

In the same vein, the Iraqi business environment, after the 2003 conflict have been subject to profound change influenced by the radical changes to Iraq's political, and economic systems. These changes have put Iraqi Quasi Governmental Construction Companies (IQGCCs) into direct competition with the private sector. Ending the monopoly IQGCCs had over most publicly funded construction contracts, an arrangement that lasted for decades and prevented these businesses adopting the free market models seen in other quasi governmental bodies in other countries such as the UK. Consequently IQGCCs have struggled to both win contracts and generate profit in this competitive market. Resulting in wide criticism of these companies inability to improve their poor performance, low productivity and high level of inefficiency (Filaih, 2013). As a result change is urgently needed to enhance the competitiveness and profitability of these organisations. Such improvements, Brocke and Rosemann (2015) espouse can be achieved by implementing Business Process Management (BPM) to enhance and improve the internal processes and therefore the business efficiency. Nevertheless, a prerequisite for performing any dramatic performance improvement using BPM, is to have a

clear understanding of the organisation's core business processes, however, very little is known about how these IQGCC organisations operate, there are no existing process maps or indeed directives on how processes such be undertaken.

Forming part of a wider doctoral research study seeking to develop a transformational organisational framework to improve the performance of IQGCCs funded by the Iraqi government, the research reported in this paper resolved to establish how IQGCC business operate by examining and mapping the current "as-is" processes (Weske, 2012) adopted during the bidding phase of the project lifecycle assuming a traditional procurement model (the dominant form of procurement in Iraq).

The research concluded that the current bidding process faces numerous challenges related mainly to two factors: authority and management. As a result, the authors conclude that there is an urgent need for more research aimed at assisting the Iraqi government and the IQGCCs to improve their efficiencies, process and ultimately their overall performance and competitiveness.

2. LITRATURE REVIEW

2.1 Business Process (BP) Definition and Elements

The word 'process' is still ambiguous, and might be interpreted as different things by different people based on the field, market, and function in which they are working for (Palmberg, 2009). Consequently, different definitions have originated from different areas of study. Yet most of these definition compose rather similar concepts and elements to describe business processes which Looy *et al.* (2011) opines could be summarised into seven elements: The span of time and space; having a purpose or value for customers; inputs and outputs; a group of clearly defined and interrelated activities; horizontal or cross functional; using resources; and repeatability (Hammer and Champy, 1993; Palmberg, 2009; Looy *et al.*, 2011). Such elements give a business process the transformative feature proposed in the seminal work of Michael Porter (1985). Porter advanced the theory that an organisation has a chain of activities that add value to an input (raw material) in order to transform it into an output (product) that meets the needs of their customers. Anything not directly adding value in this process can therefore be eliminated, reduced or outsourced to reduce cost. In fact, the transformative view tends to deal with tangible things such as those found in the manufacturing and construction sectors. This view of looking at business process has been successfully applied in manufacturing field and was advocated in Egan's (1998) seminal review of UK construction to improve its performance (Cooper *et al.*, 2005).

2.2 The Importance of Business Process

Adopting a business process prospective has become a mandatory requirement for any organisation striving to excel (Looy *et al.*, 2011). Baloh *et al.* (2008) considers focusing on BP as a best practice management paradigm correlated to organisational performance results. Empirical studies have demonstrated the strategic value of adopting a process based model within organisations to enhance efficiency and competitiveness. Lockamy and McCormack (2004) identified that companies which establish strong guidance for their business processes typically reach higher levels of performance and provide an enhanced work environment with higher levels of cooperation and less conflict. Similarly Kohlbacher (2010) uncovered that BP is positively associated with customer satisfaction, product quality, delivery and time-to-

market speed. Leading Bronzo *et al.*, (2013) to stress that concentrating on improving BP can significantly enhance value creation and drive a company to both higher performance and a more sustainable competitive advantage.

Several approaches have been suggested to implement BP principles, these include: Total Quality Management (TQM), Business Process Reengineering (BPR), Six Sigma, and Continuous Process Improvement (Armistead and Machine, 1997) and Business Process Management (BPM). However, Rohloff (2009) opines that of these approaches, BPM is the most comprehensive, well-known, and widely used.

2.3 Business Process Management (BPM)

BPM is defined by Brocke and Rosemann (2015, p ix) as "*A comprehensive consolidation of disciplines sharing the belief that a process-centred approach leads to substantial improvements in both performance and compliance of a system*". BPM incorporates many aspects of other approaches, such as TQM, BPR, and lean six sigma (Rohloff, 2009). It is a collection of principles, methods, and techniques to analyse, redesign, implementation, and monitor BP through a reputable life cycle (Dumas *et al.*, 2013).

BPM enables the BP to be streamlined, and redundancies to be eliminated through managing it on an ongoing and continuous improving basis. Rather than as the one-off radical change proposed by other techniques such as BPR (Armistead and Machin, 1997). Moreover, BPM is based on the principle of building on and transferring for what already existed and not starting from scratch again as proposed by BPR. Hence BPM presents an organisation with significantly less risk, and more importantly less up front expenditure (Krafzig *et al.*, 2005; Swetaanand, 2011). The other benefits of implementing BPM, identified by Bai and Sarkis (2013) include the ability to accelerate organisational processes, reduce resource requirements, and boost productivity and efficiency, whilst enhancing competitive advantage. Yet, O'Reilly and Tushman (2016) claim that adopting a stringent system of BPM can harm a firm business since such system would limit innovations to only incremental. Resulting in undermining the firm ability to produce radical innovation during periods of rapid change.

Although the aforementioned downside of BPM, which is seen as an implementation issue, the wide benefits that can be obtained by employing BPM have been attractive many organisations worldwide to implement this approach to enhance their organisational performance (Tang *et al.*, 2013). Add to that, the construction industry, as a whole, is characterised by the lack of innovation in comparison to other industries such as manufacturing and software (Koskela and Vrijhoef 2000; Taylor and Levitt 2005; Wang and Du, 2015). Therefore, such disadvantage in BPM may not significantly impact on construction companies that employ this approach. As a result of the literature review, it was determined that the implementation of BPM underpinned by the theoretical framework developed by Porter (1985) will provide a suitable basis from which the researchers can develop a transformational framework for IQGCCs to enhance their competitiveness.

2.4 Documentation and Mapping "As Is" Business Processes

Process mapping is a simple tool used to facilitate understanding the activities and tasks involved in a business process by means of displaying these activities, their inputs,

sequences, performers and related outputs in a visual format (Stolzer *et al.*, 2011). It can be considered as the most significant activity in the process analysis and evaluation. According to Lee *et al.* (2007) construction organisations may seek to document and map existing processes in order to improve their business process performance in a dynamic market. Enabling construction companies to concentrate on value creation, waste elimination and improved efficiency.

Several techniques have been developed to facilitate mapping processes and structuring the information including: Business Process Model and Notation (BPMN), Data Flow Diagram (DFD), and Integration DEFinition Modelling (IDEF). Selecting the most appropriate technique is mainly dependent on the purpose of modelling, system being modelled, modeller experience, availability of supporting software, and time constraint (Aguilar-Saven, 2004). Koskela (1995) argues that modelling tools used to model a construction process should be: 1) Breadth enough to cover a wide range of various processes and their interaction, and 2) Depth enough to include all important basic constructs, such as process flows, inputs and outputs, participants, etc. Simultaneously, they should also be easy to use and understandable by all people engaged in designing and implementing processes (Sweet and Schneier, 2013).

Indeed, the key purpose of mapping the current operational processes of IQGCCs is to capture (as-is) processes and identify their main problematic points with the aim of refining them. IDEFØ is one of the most widespread use techniques in practice to describe (as-is) processes with the purpose of developing revised (to-be) processes (Aguilar-Saven, 2004). It is characterised by being well structured and quite easy to use and understandable by stakeholders in comparison to other mapping techniques such as BPMN. Moreover, IDEFØ is a widely accepted and used technique in modelling the construction processes (Koskela, 1995; Cooper *et al.*, 2005). According to Kagioglou *et al.* (2000) this technique used in developing the Generic Design and Construction Process Protocol (GDCPP). Yong-qiang *et al.* (2008) also used it to develop an integrated information management system for construction projects. Ekung *et al.* (2014) also employed it to map the operational processes of heavy engineering projects in Najeria. Additionally, the researcher experience to deal with IDEFØ and the software programme that supports it, is much better than dealing with other modelling tools. Accordingly, the IDEF0 process modelling technique has been selected as a key tool to map "as-is" operational processes of IQGCCs.

IDEFØ models are built on a basic idea of hierarchically structured analysis and designed to support decomposition feature. A typical diagram of IDEFØ consists of a number of boxes surrounded by arrows. Each box has a name and represent a function which can be an activity, process, action or transformation. While, arrows represent the inputs, outputs, control and mechanism of the process (Aouad *et al.*, 2013; Oakland, 2014). Figure 1 below illustrates a typical function in the IDEFØ diagram.

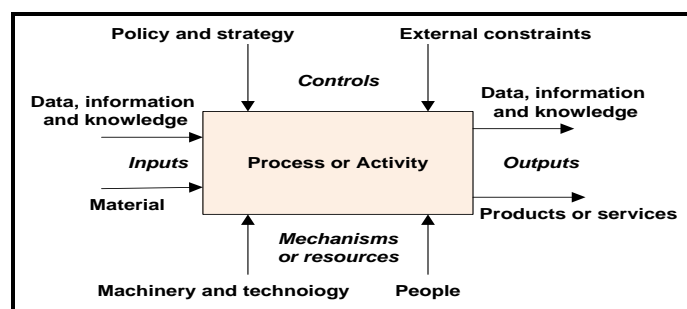


Figure 1: IDEFØ model language (Oakland, 2014)

3. RESEARCH METHODOLOGY

This research focuses upon examining and mapping the current bidding process adopted by IQGCCs under the traditional procurement. Three Iraqi QGCCs were sought to be involved in this research as case studies. All the selected companies are owned by the Iraqi Ministry of Construction and Housing and considered as large companies. With a headquarter established in the Iraq's capital (Baghdad), each of these companies runs construction projects across the country through a number of regional offices distributed in several provinces. Table 1 below provides some details concerning these companies.

Table 1: Case studies details

| Company Name | Company specialization | Number of employees | Number of regional offices | Company's status |
|---------------------|-------------------------------|----------------------------|-----------------------------------|-------------------------|
| C1 | Roads & Bridges | 2042 | 10 | Money-losing company |
| C2 | Multidisciplinary Engineering | 2218 | 13 | Money-losing company |
| C3 | Building & Bridges | 1306 | 9 | Money-losing company |

The research started by carrying out an extensive literature review with the aim of establishing a better understanding regarding the best practice bidding process adopted worldwide. As a result, best practice bidding process map has been generated to be a benchmark to facilitate mapping and analysing the "as is" bidding process implemented by IQGCCs. Then, six to eight semi-structured interviews, from different organisational level, were conducted within each case study. In total, the number of personnel interviewed was nineteen. All the respondents were engineers, engaged directly or indirectly in the bidding process and each possessing in excess of ten years with his/her company. The interviews were conducted in Arabic, on face to face basis, and in the respondents' offices. Each interview lasted around one hour and all the responses were recorded and then transcribed within two to three days of the interview before starting the initial mapping. During the initial mapping, there were numerous instances in which the researcher had to further clarify and discuss with the interviewees regarding specific issues popped to the surface while mapping. As a result, a bidding process map was generated for each case study by using IDEF0 technique. Thereafter, a focus group was conducted within each case study to validate and ensure that the process was correctly mapped and reflecting the company practice. Each focus group involved five participants of the population of engineers who had previously interviewed. Based on the views generated through the focus group, a number of amendments were conducted to produce the final map. Accordingly, three maps for the bidding process have been generated. However, the comparison among them has shown that all companies adopt almost the same processes. For this reason, in addition to the space constraints to describe all the cases here, one case has been elected as an example representing all the three cases.

4. FINDINGS FROM THE PILOT CASE STUDY

4.1 Company Background

The company under study is a general construction company established in the late 1970's with a capital of \$ 1,205,286. The company's business operation covers a wide scope of projects, including designing and/or constructing housing complexes; bridges and roads; water treatment and sewage plants; electrical power towers and stations. The company total

number of employees is 2218, with 97.7% of them are permanent official governmental employees.

The company's organisational structure, illustrated in figure 2, shows how the company is designed based on a traditional hierarchical structure, in which the works are divided on different departments and sub-departments (divisions) within the company.

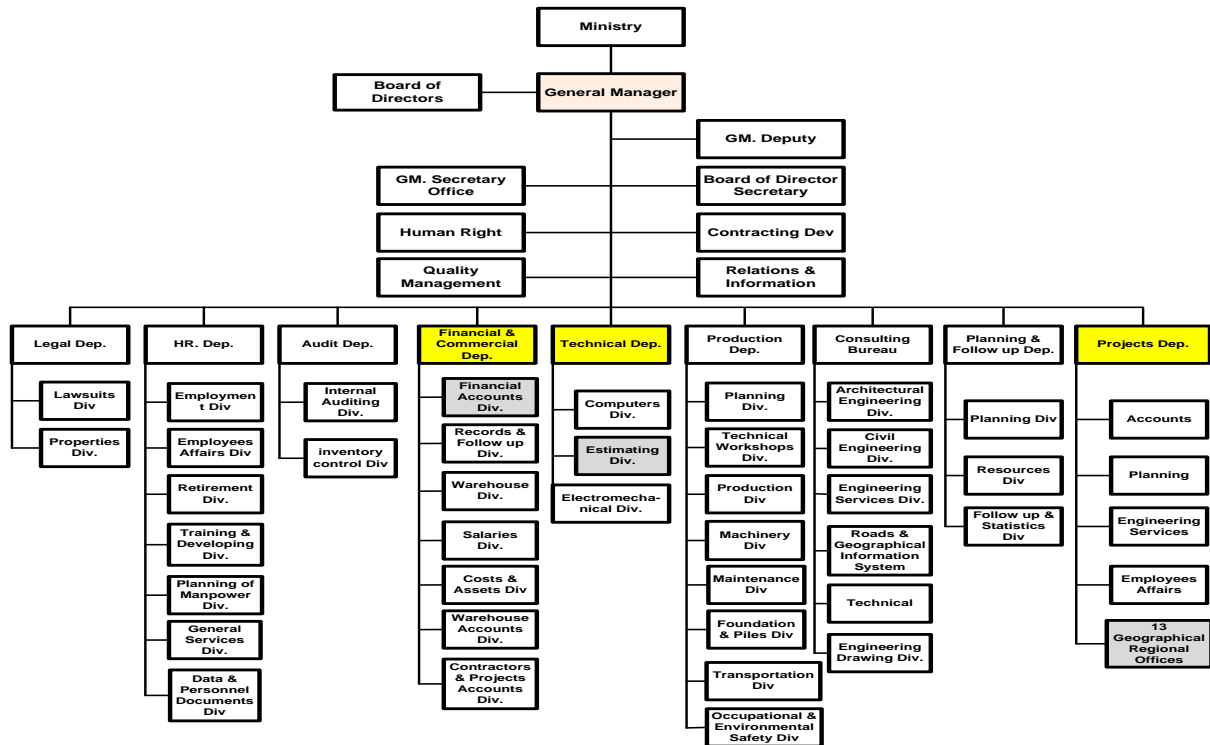


Figure 2: Organisational structure

The company also runs thirteen regional offices spread over various provinces and directly linked to the projects department in the corporate headquarters, to execute the company's projects each according to its respective geographic area. Each office is headed by a regional manager and divided into functions which typically include: planning and follow up; estimating; administration; engineering; warehouse and accounting.

Over the last decade, the company has completed nearly 200 projects with a total value of \$650 million. Reviewing the financial statements, however, reveals that the company has lost up to \$20 million. Moreover, it has been noted that most of the company's projects are not completed within the stipulated contractual durations. As a result, it is common for the value of Liquidated damage to equal or even exceed the upper limit allowed for damages, which is usually 10% of the contract value.

4.2 Company's Core Business Processes

Figure 3 illustrates the four main components of the operational process adopted by the company for projects procured using a traditional contract. A1 - Bidding Process, the scope of this research, is typically triggered by the company need for additional work and receiving or observing an advertisement for expressions of interest. The Bidding process, ends when the firm submitting the bid package to a client. However, in order to develop a

comprehensive understanding of current bid practice, it was important to capture the various sub-processes involved in the company's bidding process, the stakeholders responsible for performing those processes, the main inputs and outputs, information required, and finally to identify who is responsible for making the final decision to bid and when. Consequently, another level of decomposition of the bidding process is necessarily required. Figure 4 shows the decomposition of process A1 into 10 sub-processes A1-1 to A1-10.

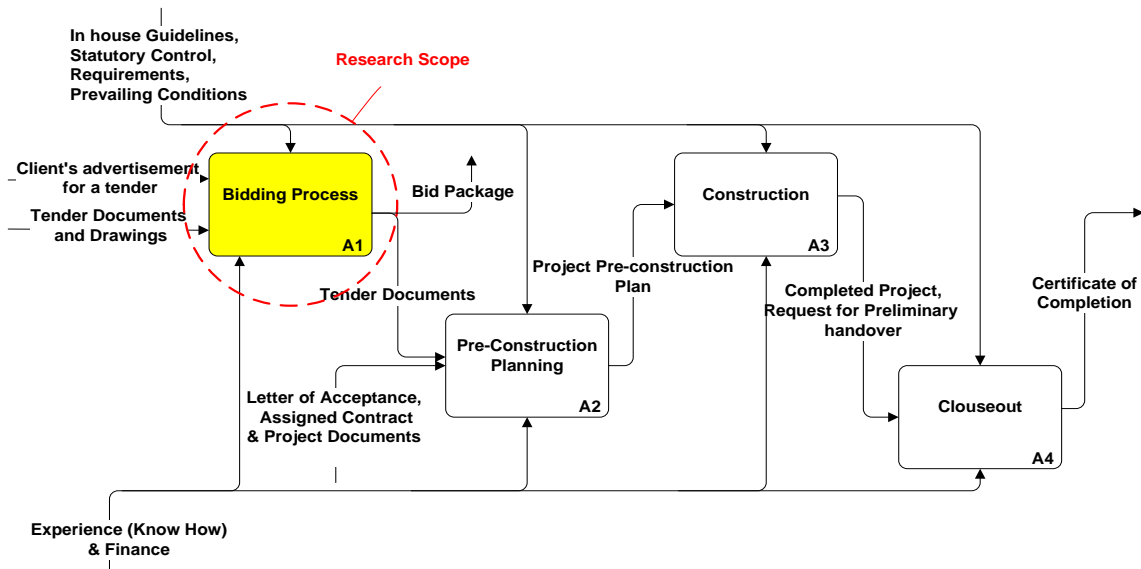


Figure 3: IDEF0 Level 1 the company operational process

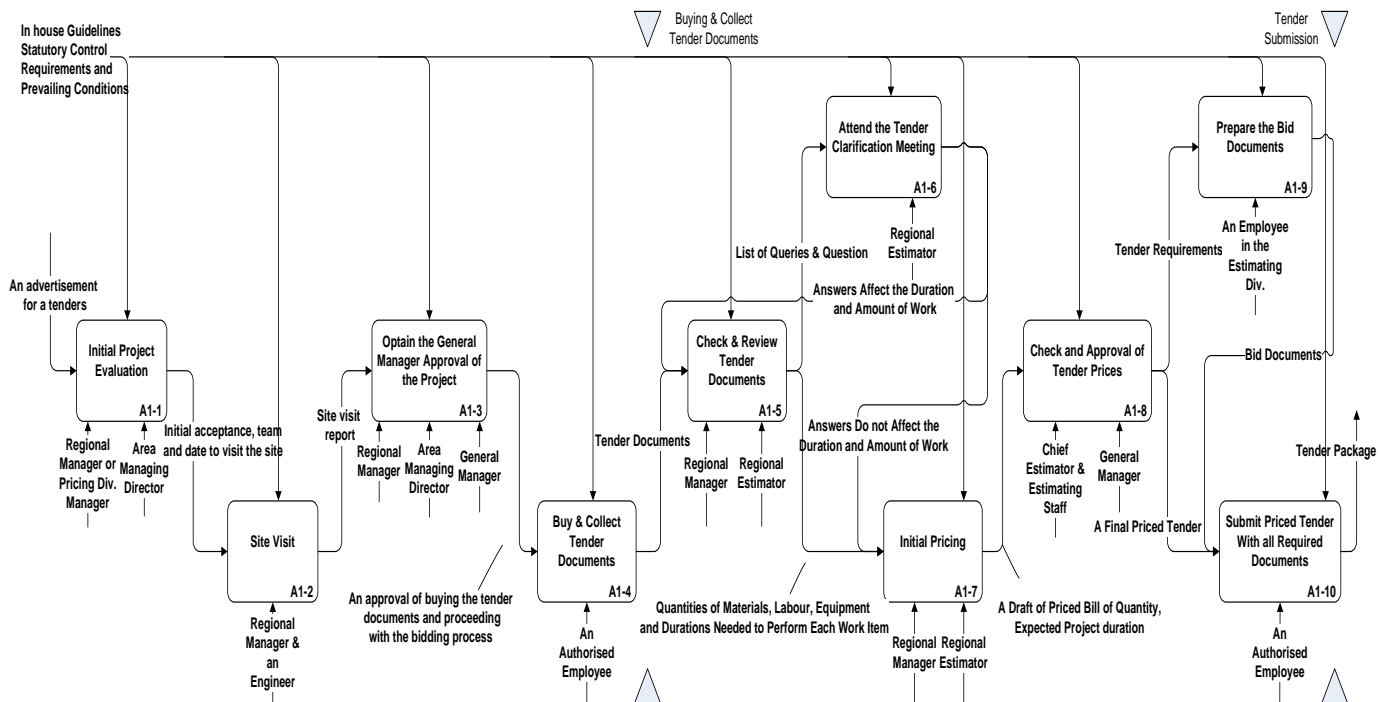


Figure 4: IDEF0 Level 2 the company bidding sub-processes

5. CHALLENGES TO THE BIDDING PROCESSES

In order to streamline the whole bidding process and bring it in line with the best practice benchmark, *The Code of Estimating Practice* (CIOB) (2009), the barriers and problematic points needed to be identified and solutions proposed. Several challenges associated with the current bidding practice have been identified as highlighted below.

5.1 Inefficient mechanism in developing bid/ no bid decision

During the A1-3 process a decision is made by the GM whether to bid for the project, and therefore to purchase the contract documents or not. This decision is similar to the bid/no bid decision in the best practice guidance. However, it is generally based on information derived from the advertisement for a tender and a subsequent site visit. However, such limited information is seldom enough to develop an accurate decision. The organisation really needs to evaluate the risks and opportunities embedded in the tender documents, such as: terms and conditions of the contract; details and complexity of the work; the tender documentation quality etc. The Code of Estimating Practice (CIOB, 2009) emphasises that the decision to bid or not should be made based on an appropriate risk analysis report, and the standpoints of other senior management members, this is currently not been implemented by IQGCCs. Accordingly, it could be argued that the absence of an appropriate risk analysis report is negatively affecting decision making by allowing more room for the GM to fully evaluate the risk and opportunity profile of the project.

At the root of this problem are two fundamental issues with the operation of the IQGCCs: Firstly, the lack of authority given to the regional managers, which does not allow them to buy tender documents without obtaining the GM's approval, despite the minimal outlay compared to the costs of developing the bid. As the regional manager espoused: "*we are not authorised to pay the tender fees and charges without getting the general manager's acceptance of payment*" (Regional Manager). Restricting the permission to buy the tender documents to the GM, is clearly not adding value to the process. Rather, it can be time and cost consuming. Given written approval is usually needed, which is then issued to the organisations accountant who subsequently issues a cheque for the purchase of the tender document. Obtaining this approval generally takes between two and four working days and needs an authorised employee to both deliver the formal written request and bring the acceptance back.

Secondly: the excessive auditing and inspection actions, imposed by different internal and external governmental bodies, such as: Internal Auditing; Inspector General Office; and Commission of Integrity, usually prevent the estimating team from stopping the bidding operation after paying for the tender documents no matter how bad the risk profile for the project. Therefore, it seems to be a hard gate in this stage. This problem is reported by one of the firm's estimators who stated "*After buying the contract documents, we have to proceed with the tender process and submit our bid package, otherwise, we might be questioned by the internal auditing in the company and/or the inspector general office in the ministry*" (Estimator).

5.2 Exaggerated administrative procedures, red tape, and departmentalization.

The exaggerated administrative procedures and red tape exercised by all the company departments, including the finance department is another problem hinders the company's bid business operations. Leading an engineer to argue *"Although, we have obtained an approval of buying a tender for over a week, we are still waiting the financial department to sending us the tender fees... fatal routine as well as, unawareness some of financial department staff of the importance of such issues are always the main reasons for this delay"* (Engineer). This viewpoint identifies another important problem, the staff's lack of understanding. From the interviews it appears those employed by the company do not understand the core business process and its importance to the success of the organisation. This is due to the company' structure, which is based on hierarchy and traditional functions. Which ultimately prevents employees seeing and understanding how the organisation operates beyond the boundaries of their department.

5.3 Workflow bottleneck, task duplication and work quality

As illustrated in figure 4 before submission all tenders must pass through the process A1-8 in order to check the accuracy of pricing and its computation. This process is executed by the estimating division in the headquarters. Reviewing the records of organisation revealed the company submitted 1,144 tenders between January 2008 and December 2013. Suggesting the company, on average, submitted 1 tender every 1.2 working days. Considering the high number of tenders that needed to be checked and amended by one division, whose personnel also undertook other duties such as checking and reviewing the feasibility study plans for awarded projects; opened and analysed in-house submitted tenders, attended tender committees was an impossible task. Added to this the need to avoid both mistakes and delays whilst completing the manually suggests some inaccurate or incorrect tenders were likely submitted to clients. This issue was raised during several interviews, this quote for the Deputy Regional Manager provides a useful summary of the main argument: *"Sometimes certain mistakes could occur in pricing, but as you may know, due to the excessive workload and time constraint on estimating division some of them might not be caught. I do remember this happened with two of our projects"* (DRM). In the same context, one of the project managers interviews, suggested that by having this robust validation process, estimators, under pressure to bid for high volumes of work would be less meticulous when developing their estimates as they knew the work will be checked and amended later before being ratified. *"Sometimes, I say to Mr. X, please just finish this report slapdash and send it, it will be reviewed and checked further by the corporate staff, and if they have any problem, they will contact us"* (Project Manager).

As a result, the process A1-8 duplicates earlier work and creates a bottleneck in the bidding process that leads to reduced quality and efficiency. Moreover, it was noted that there is no a clear mechanism in place to decide on the desired mark-up and settle the final bid price. Most of the interviewees explained that the mark-up is semi fixed for all projects and is equivalent to 20% of forecast project cost. Whilst, the GM's final approval of tender price is just a routine procedure to satisfy the GM himself and to formalize the tender. *"We usually add 20% of the project cost as a mark-up. This ratio is recommended by our Ministry"* (Bid Manager). Of more concern is that a senior manager within the organisation clearly did not understand the organisations estimating process or mark up on the base forecasted cost, opining that *"the*

final tender price is usually determined by the estimating division, whereas the GM's role is just to ratify on that price" (Senior Manager).

6. DISCUSSION

It is clear based on what has been discussed in the preceding section that the most challenges and problematic points facing the bidding process adopted by IQGCCs relate to two main factors: Management system employed and Authority distribution in the organisation. These factors are generally interrelated and collectively influence the efficiency and quality of the process.

Management: mapping the current practice of IQGCCs revealed that these companies are operated through a traditional functional management system dominated by hierarchy, centralised control, and bureaucracy. Adopting such approach has helped develop a fertile environment that brought about notable delays, increase in the business cost, and reduction of quality. That was particularly because the current adopted management approach worked on dividing the various bidding process activities horizontally on several functional units, and vertically on different management layers. Where, each unit executed its respective tasks and sent it to the next one. Every unit is responsible only for its own task, whereas in this picture the responsible and accountable for the entire process is absent. Accordingly, the cohesion, coordination and integration of work, whether between the regional offices and the corporate departments/ divisions, or among the different departments/division themselves was inferior, and always governed by formal and statutory procedures. This is aligned with the view of Sungau *et al.* (2013), who report that a traditional functional approach may facilitate the local optimisation, but it often leads to negatively affect the overall performance. Because each functional unit in the organisation develops its own objectives and means of performing its businesses, regardless the overall organisational goals and objectives. Thus, different goals, interests and background of the people of these functional units usually creates barriers between them, which lead to problems in communication and inefficient coordination in handovers between functions (Shtub and Karni, 2010). They prevent employees in the different departments from viewing their firm's common processes and understanding their roles within those processes and how they are associated in achieving the company objectives (Skrinjar *et al.*, 2010).

It is also argued that companies with a corporate staff have a tendency towards auditing more than supporting the business units, ending with unnecessary bureaucracy, barring decision making and increasing cost (Pigorini *et al.*, 2006). This has been empirically proven by the findings of this research, where it found that the, exaggerated auditing and inspection actions imposed from the corporates staff and other governmental bodies, have been one of the major obstacles to the work efficiency of IQGCCs. These auditing actions together with the excessive administrative procedures advocated by the traditional management system helped to create a working environment dominated by bureaucracy, administrative routine, red tape, and inflexibility.

Authority: analysis of the current bidding practice revealed that IQGCCs are managed by a very centralised control system where the General Managers have the ultimate sanctioning and veto powers on almost all the decisions. As illustrated in figure 4, two out of ten key steps within the bidding process were found have to be ratified and approved by the GM before allowing them to proceed further. That was usually carried out through signing up the

relevant formal letters. Considering the organisational hierarchy, obtaining an approval, such as buying a tender document, was required to verify its related request at each management level, till it reaches to the highest one represented by the GM. This has led to generating workflow bottlenecks, duplication of tasks, time delay, reduction the quality of work, and increasing the costs and mistakes. According to Graetz and Smith, (2009) centralised bureaucratic system has become an old and unable to cope with the challenges and continues changes in the new business environment, as those facing IQGCCs nowadays. This view is further supported by Banner and Gagné (1995) who assert that the slow-moving traditional bureaucratic system is seemingly more outdated than ever before. Since, by the time a major decision goes all the way up through several management layers in the hierarchy for the review and implementation, the organisation can be too late in response to major environmental changes. In this context, a study conducted by Wang and Du (2015) uncovered that construction contracting companies can only achieve the best performance when the appropriate balance in authority distribution between the various management layers. Yet, shifting the powers to low-level managers should be combined by providing them with sufficient information and knowledge that enabling them of making their decisions efficiently.

Based on what is discussed here, it is very clear that there is a need for improvement the current bidding process adopted by IQGCCs in order to enhance their performance.

7. CONCLUSIONS

The study has produced a visual map of the current bidding practice adopted by Iraqi Quasi Government Construction Companies (IQGCCs) that clearly shows how the current bidding process flows, its main activities, people involved in carrying out those activities, and the key decisions and gates. The research has also identified a number of challenges and problematic points which have adversely affected the efficient functioning and quality of tender operations. Inefficient mechanisms in developing the key decisions, exaggerated administrative procedures and red tape, in addition to the workflow bottleneck and task duplication are the main challenges that facing IQGCCs in their bidding process. These problems were generally related to two main factors, namely: Authority; and Management. It has been noted, that in spite of the major part of the bidding process was performed at the regional level, yet they do not have enough authority required to streamline their work. All the authorities are held by the senior management level, whilst the final say and approval regarding most issues are always grasped by the General Managers. Managing the companies on a functional hierarchical structure base, from the other side, also led to reduce the efficiency of the process through creating a working environment dominated by bureaucracy, administrative routine, and inflexibility. As a result, further research on how to streamline and refine the current bidding is required in order to enhance the organisational competitive advantage and overall performance.

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THREE PERSPECTIVES OF PUBLIC SECTOR CONSTRUCTION PROJECT CULTURE: AN EXPLORATORY CASE STUDY IN SRI LANKA

A. Samaraweera¹, S. Senaratne² and Y.G. Sandanayake¹

¹ Department of Building Economics, University of Moratuwa, Moratuwa, 10400, Sri Lanka

² School of Computing, Engineering, and Mathematics, Western Sydney University, Australia

Email: aparna.samaraweera@gmail.com

Abstract: Among different cultural manifestations, basic assumptions better explain a cultural context. Further, more insight into the basic assumptions of cultural context could be reached through a single study including the three perspectives of culture such as; integration, differentiation and fragmentation, which is not popular in construction research arena. Thus, the aim of this study is to explore the project culture in public sector construction context using underlying basic assumptions of the project participants. The aim was approached through an exploratory single case study of a public sector building construction project, procured in traditional procurement method. Data was collected through nine semi-structured interviews, observations of two progress review meetings and a documentary survey. Findings include elaboration of the underlying basic assumptions of the construction project culture in three perspectives of culture. Integration perspective revealed the basic assumptions collectively held by project participants such as: client being the most powerful team member carrying uncertain decisions; rare appreciations among members; rewarding for conformance to the contract, and contractor lacking trust on client and contractor. Differentiation perspective revealed existence of strong sub-cultural groups as contractor, consultant and client. Sub-cultural basic assumptions included; contractor being profit motive, consultant favouring the client beyond the required impartial role and client assuming a dominant role within the team. Fragmentation perspective revealed several ambiguous situations going against the integrated and differentiated basic assumptions.

Keywords: Basic assumptions, Construction project culture, Differentiation, Fragmentation, Integration.

1. BACKGROUND

‘Culture’ is defined as a set of learned customs, values, attitudes and meanings that are ‘shared’ by the members of a group and hence, culture is often one of the primary ways to differentiate one group from another (Duarte and Snyder, 1999). Similarly, Hofstede (1980) too interprets culture as a shared phenomenon among the human group, but culture is manifested as mere values. Among different popular attempts, many researchers interpret construction project culture too from the shared point of view (see Zuo, 2008; Thomas *et al.*, 2002; Ankrah *et al.*, 2009). Zuo (2008) elaborates that project culture in relational type of contracts are of integrative, cooperative, goal-oriented, people-oriented and flexible type of a shared culture. The theoretical framework brought in by Kumaraswamy *et al.* (2002) is popular for elaborating construction project culture with a differentiated perspective; highlighting the existence of sub-cultural groups in a construction project context.

Nonetheless, Martin (2004) disagrees with the definition of culture as a “shared” phenomenon among the members of the organisation. As Martin (2004) argues, all of these cultural manifestations are interpreted, evaluated, and enacted in varying ways because

cultural members have differing interests, experiences, responsibilities and values. Thus, Martin (2002) describes that culture consists of the patterns of meanings that link the cultural manifestations together, sometimes in harmony (integrated perspective), sometimes in bitter conflicts between groups (differentiated perspective), and sometimes in webs of ambiguity, paradox, and contradiction (fragmented perspective). For these reasons, it is much too simple to define culture in unifying, harmonious terms, for example, in terms of values that are espoused by management and apparently shared by most employees. However, Gajendran *et al.* (2012) state that no popular study found in extant literature of construction research arena, trying to understand culture with a fragmentation perspective of Martin (2004), but such a research would be a worthy attempt to explore deep into the construction project culture.

Cicmil and Gaggiotti (2014) state that project culture is overlooked as a slippery concept since it is really a context dependent, social relational practices. Schein (2009) too agrees with a shared culture, but argues that it is the underlying basic assumptions among all the cultural manifestations that demonstrate the real essence of culture. Duarte and Snyder (1999) view culture as hidden 'scripts' that people use to guide their behaviours, where these scripts are created by repeated interactions between members of the group that create them. Overtime, they become second nature and serve as shortcuts for guiding actions and making decisions. These hidden scripts have a similar meaning to the basic assumptions of Schein (2009). In addition, Hofstede (1980) also refers these underlying assumptions as 'taken for granted values'. Thus, this research aims to explore patterns of underlying basic assumptions of the construction project culture in Sri Lanka using the three perspectives (integration, differentiation, fragmentation) of culture.

2. THREE PERSPECTIVES IN CULTURAL ANALYSIS

Martin (2002) conceptualises culture from three different perspectives; integration, differentiation, and fragmentation. These perspectives are complementary, in that each allows the researcher to investigate the blind spots inherent in the others (Kappos and Rivard, 2007).

Integration refers to interpretations that lead to consensus across the whole group. No ambiguity exists in interpretations of the manifestations by any member and interpretations are clear to all members (Martin 2002). Thomas *et al.* (2002) point out that 'clan type' of a shared project culture brings in better quality outcomes in a construction project and 'market type' of a shared project culture brings in weaker quality outcomes. Richter and Koch (2004) carried out a case study related to a Danish manufacturing company to understand the safety culture. They made conclusions that integration of safety cultural aspects were relatively weaker compared to differentiation and fragmentation. They identified three strong sub-cultures, which they named as; 'Production', 'Welfare' and 'Mater' and observed integrated safety cultural beliefs among some sub-cultures; such as non-acceptance of safety related risks was common for 'Welfare' and 'Mater' sub-cultures. Case studies of three retailing organisations done by Harris and Ogbonna (1998) found that each of Martin's (2002) three perspectives corresponded to different hierarchical positions. Accordingly, head office personnel revealed that they tended to adopt an integration perspective on organisational culture, i.e. culture was viewed in terms of consensus and consistency and cultural deviation was considered unwelcome.

Differentiation does not assume a shared culture. This perspective assumes that consensus on cultural manifestations exist only at sub-cultural level. According to this perspective,

ambiguities are identified among the sub-cultures, which help defining the group boundaries between the sub-cultures. (Martin 2002). The case study of three retailing organisations by Harris and Ogbonna (1998) revealed that store managers commonly adopted a differentiation perspective on organisational culture, i.e. store managers viewed culture as dichotomous, inconsistent and characterised by subcultural consensus. Kumaraswamy *et al.* (2002) have attempted to define construction project culture by looking at the impacts from different sub-cultures. They identified 'organisational', 'professional', 'operational' and 'individualistic' sub-cultures as the principal elements that come together to evolve the culture within a construction project. Ankrah and Langford (2005) and Rameezdeen and Gunarathna (2003) bring in empirical evidences for existence of strong sub-cultures as contractor and consultant in construction project context. Further, Zuo (2008) highlights the impact of client as a dominant member in a construction project cultural context.

Fragmentation assumes that ambiguous interpretations of manifestations by members in a cultural context are inevitable. Both integration and fragmentation perspectives try to minimize the experience of ambiguity. These ambiguous interpretations should not be ignored or attributed to differences between sub-cultural groups. Ambiguous interpretations of manifestations bring in paradoxical or ironic actions and reactions. Such interpretations do not suggest any clear cultural or sub-cultural boundaries and produce a fragmented view of the manifestations. Thus, the members of an organisation interpret the manifestations in a number of different ways, without demonstrating any consensus, consistency, or clarity (Martin 2002). Richter and Koch (2004) describe that such ambiguities in a cultural context can be found in terms of ambiguities of: intentions, understandings, history and organisation. The case study of three retailing organisations by Harris and Ogbonna (1998) described that shop floor workers exhibited a fragmented organisational culture, where the views of shop floor workers tended to focus on the ambiguity, fluidity and complexity of organisational culture. Gajendran *et al.* (2012) describe that construction project organisations are paradoxical and contradictory, generating ambiguity and leading to conflicts by nature. Thus, eliminating the study of fragmentation in a construction project cultural study could be misleading the real picture of culture.

In overall, Martin (2004) suggests that using all three perspectives together in one study brings valuable insights of the cultural context and avoid the theoretical blind spots of single-perspective. Elaborating on a framework for understanding cultural philosophical positions for analysing construction project culture, Gajendran *et al.* (2012) indicate the importance of following a construction project cultural research as a hybrid function/non-functional cultural analysis, which includes three cultural perspective of integration, differentiation and fragmentation.

In addition, there are number of empirical evidence for cultural differences between public and sectors. Nutt (2005) explains that the main reason for such cultural differences between private and public resides with the purpose or objective of organisation. According to Nutt's (2005) explanations, objective of private sector is to create wealth for shareholders, while public sector intends to provide a service to fulfil a public need. Harrison and Baird (2015) carried out a research on identifying the organisational culture of public sector organisations in Australia. They conclude that local councils in Australia have matched the private sector organisations but, government departments and agencies are lagging behind private sector in terms of the cultural factors such as; outcome orientation and innovation. Therefore, there is a need to explore patterns of underlying basic assumptions of the public sector construction

project culture in Sri Lanka; using the three perspectives (integration, differentiation and fragmentation) of culture.

In view of the facts cited above, a research framework could be brought in for studying the construction project culture using the three perspectives in cultural analysis (see Figure 1). Accordingly, within a construction project cultural context, integration perspective includes the cultural manifestations agreed by all the members of the construction project team. Further, differentiation perspective is valid for manifestations agreed within a given sub-cultural territory. A construction project can be consisted of client, contractor and consultant sub-cultures. Moreover, fragmentation perspective is valid for the contrasting cultural manifestations without indicating clear consensus on intentions, understandings, history and organisation within the total project cultural territory.

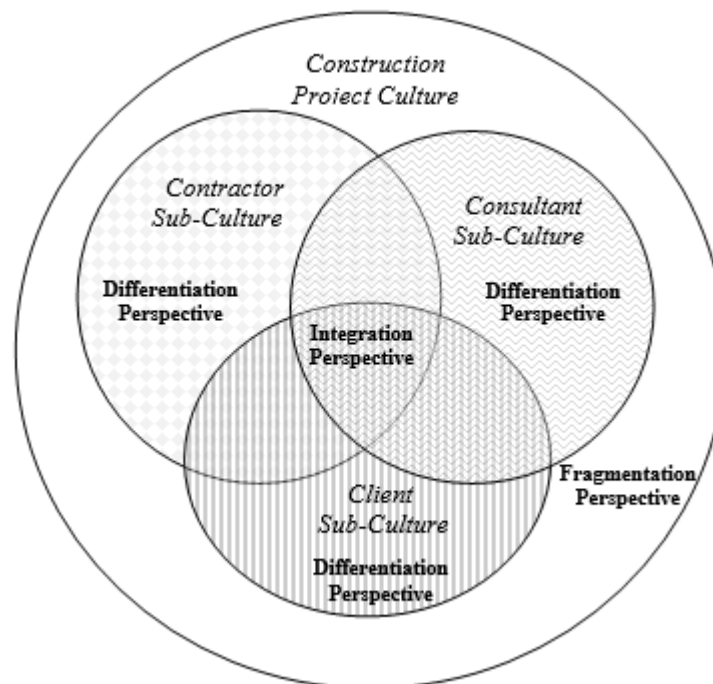


Figure 1 – Three-Perspectives of Construction Project Culture

3. METAPHORIC ANALYSIS OF CULTURE

Underlying assumptions or otherwise called ‘taken for granted values’ are considered as the core of the culture or the essence of the culture (Schein, 1984). Schein (1983, 1984) explains basic assumptions as mostly unconscious and are taught to new members as a reality and as the correct way to view things. Kluckhohn and Strodtbeck (1961) advise that basic assumptions of an individual or a group do not comprise an exhaustive list. They suggest six basic types of problems to be solved by every society, which give rise to the basic assumptions. These include the followings:

- (1) What is the nature of human beings: are they good, evil or neutral?
- (2) What is our relationship to nature: are we subjugated to nature, in harmony with nature, or do we have mastery over it?

- (3) What is our relationship to other human beings: is it lineal (ordered position within groups), collateral (primacy given to goals and welfare of groups), or individualistic (primacy given to the individual)?
- (4) What is our primary mode of activity (motive for behaving): is our basic orientation one of being-in-becoming, doing or reflecting?
- (5) How do we view time: do we focus on the past, present, or future?
- (6) How do we think about space: is it public, private, or mixed?

Schein (1983, 2009) and Hills (2002) too add some more such problems to be solved by the individuals in a cultural context, which give rise to basic assumptions as follows:

- (7) What is the correct way for humans to behave (the nature of human activity): is it being dominant/pro-active, harmonizing, passive/fatalistic?
- (8) How do we define what is true and what is not true (the nature of reality and truth): by pragmatic test, reliance on wisdom, or social consensus?
- (9) Is the group best off if it is highly diverse or if it is highly homogeneous? (homogeneity vs. diversity)
- (10) Should individuals in a group be encouraged to innovate or conform? (homogeneity vs. diversity)
- (11) Do we tend to believe in fate/god or not? (unknowable and uncontrollable)
- (12) How should society distribute roles, power and responsibility between the genders: only to male, females, or both? (gender)

Elaborating the importance of studying the underlying basic assumptions of a cultural context, Hills (2002) describes how a Native American small tribe survived by understanding the basic assumption of the culture of majority. This is because, basic assumptions unveiled the differences between the cultural groups on how they perceived the nature of human nature, human activities, human relationships, nature of reality and truth and so on. Accordingly, behaviours and values of each cultural group would depend on the same. Such knowledge is helpful for creating win-win situations during negotiations as each party understand each other. In addition, Schein (1983, 1984) explains how the knowledge on basic assumptions could be used during change initiatives within an organisation. Hence, it is apparent that understanding culture through underlying assumptions rather than elaborating merely through artefacts, behavioural features and values give valuable insights into the culture. An attempt to understand such basic assumptions of a construction project could bring in advantages during change initiatives and negotiations with external parties.

Moreover, Schein (1984) explains that patterns of basic assumptions of organisational culture are realised through the attempt of the group of people in coping with the problems of internal integration (those that deal with the group's ability to function as a group) and external adaptation. (those that deal with the group's basic survival). Problems of external adaptation and survival include; Strategy, Goals, Means of accomplishing goals, Measuring performance and Corrections. Problems of internal integration include; Language, Boundaries, Power and status, Intimacy, Rewards and Punishments and Ideology (Schein, 1983). Ankrah *et al.* (2009) explain that 'projects' hold characteristics similar to 'organisations' but, one-off nature of projects become the significant difference. Thus, it can be argued that the project culture is also emerged in the attempt to survive from the aforementioned internal integration and external adaptation problems. To unveil the underlying basic assumptions, it is necessary to go down the list of issues (internal integration and external adaptation problems) and ask how the group views itself in relation to each of

them: what is the core mission, goals, the ways to accomplish those goals, the measurement systems and procedures used, the way actions are remedied, particular jargons and meaning systems, the authority system, peer system, reward system, and ideology (Schein, 1983). Such an effort gives rise to the deeper level of assumptions, which ties together the various solutions to the various problems as indicated by, Kluckhohn and Strodtbeck (1961), Schein (1983, 2009) and Hills (2002) in the list previously discussed.

4. METHODOLOGY

The best choice of a research philosophy depends on the type of research question the researcher tries to find answers to (Saunders *et al.*, 2009). The research question of this study is; “How do patterns of underlying basic assumptions of a public sector construction project exist?” Considering the research question to be answered, ‘Interpretivism’ (Creswell, 2009) is selected as the research philosophy. This research question is more in line with the belief that culture is the forms and practices of unconscious processes of construction project team members. This is because, patterns of basic assumptions are unconscious or psychological processes of human mind. Thus, this research tends to consider culture as a root metaphor with ‘ontological assumption’ (Creswell, 2009) that reality as a social construction. Therefore, subjective qualitative means of knowledge creating is expected with thick descriptions with the ‘axiology’ (Saunders *et al.*, 2009) of more value input from researcher on the research process. This leads to the ‘epistemology’ (Saunders *et al.*, 2009) of understanding how the social reality about project culture is being created.

According to Yin (2009), ‘how’ type of research questions support case study research strategies. Thus, considering the depth of analysis required and the requirement of contemporary data and events to be analysed, exploratory case study was selected as the research strategy. Single case study was chosen because the intention of the study was to develop propositions on basic assumptions of construction projects for further analysis. Thus, research would be extended by further replications in two more cases in future. In addition, the study was limited to a public sector construction project. Accordingly, a single case of a public sector building construction project (Project XYZ) in Sri Lanka, operated under the traditional procurement with measure and pay contract was chosen. ‘Construction project culture’ was the unit of analysis. Project team consisted of a powerful ministry in Sri Lanka as the client, a local semi-government consultancy firm and a local private contractor.

Data collection was done by conducting nine semi-structured interviews, observation of two progress review meetings and a documentary survey with two additional meeting minutes, which were not observed, construction contract document and consultancy agreement. Panel of interview consisted of three members from the Client’s representatives [Deputy Director (Corporate Management), Technical Officer (Maintenance), Procurement Assistant], three members from Consultant’s representatives (Project Manager, Project Architect, Project Quantity Surveyor) and three members from Contractor’s representatives (Construction Manager, Site Engineer, Project Quantity Surveyor). The interview guideline and the meeting observation guideline were consisted of questions related to internal integration and external adaptation problems as discussed in Section 3 to capture the basic assumptions of the project team in indirect terms. Data analysis was done by using code based content analysis.

5. CASE STUDY FINDINGS

Project XYZ was a building construction project to extend the existing ministry headquarters at city centre of Colombo. The construction contract sum of the project was Sri Lankan Rupees 1.13 Billion and 65% of the physical construction work was over by the time the case study was conducted. Integrated, differentiated and fragmented perspectives of the basic assumptions of the construction project culture in Project XYZ are presented within this section. The identified basic assumptions are grouped as per the various problems (*The nature of human nature, The organisation's relationship to its environment, The nature of human relationship, Motive for behaving, The nature of time, The nature of space, The nature of human activity, The nature of reality and truth, Homogeneity vs. diversity, Unknowable and uncontrollable, Gender*) indicated by Kluckhohn and Strodtbeck (1961), Schein (1983, 2009) and Hills (2002).

5.1 Integration Perspective of Basic Assumptions of Construction Project Culture

Integration perspective holds basic assumptions with a collective consensus across the project team consisting of Client, Consultant and Contractor. Such basic assumptions of Project XYZ included: Client was the most powerful member in the project team (*The nature of human relationships*); Contractor only believed formal instructions in black and white (*The nature of human nature*); decisions made by the public sector clients were uncertain (*Unknowable and uncontrollable*); not innovation, only conformance was practiced in public sector construction projects (*Homogeneity vs. diversity*); rare appreciations and constant highlighting of mistakes and punishments were available in construction projects (*The nature of human nature*). Thus, all members of Project XYZ assumed that they were in a cultural environment built upon Client's autocracy, lack of trust among members and minimal mutual appreciations. Further, they believed a working environment full of uncertainties thus, tried to conform to the contract to reduce risks.

In addition, there were basic assumptions, where consensus on those basic assumptions were available only among pairs of sub-cultural groups of Contractor, Consultant and Client. Contractor and Client both assumed that a strong project management was essential for project success (*The nature of human nature*) and continuing relationships was not a concern in a construction project (*The nature of time*). Consultant and Client together assumed that effectiveness and efficiency in communication resulted in, how much the red tape for fast communication was overcome within the process (*The nature of human relationships*); Client believed that continuous pressing could motivate the consultant and contractor (*The nature of human nature*); all genders were treated equally in construction projects (*Gender*), Contractor attempted to pass all responsibilities and blames to the consultant (*The nature of human activity*), Consultant held an importance in the project team as the technical advisor to the Client (*The nature of human relationships*), Client should be allowed to initiate variations (*Motive for behaving*). Further, Contractor and Consultant both assumed that Contractor tried to deliver the required quality in the project (*Motive for behaving*).

5.2 Differentiation Perspective of Construction Project Culture

Differentiation perspective identifies the existence of sub-cultural groups within the cultural context. Clear evidence for professional sub-cultural existence including; contractor's sub-

culture, consultant’s sub-culture and client’s sub-culture was available within the Project XYZ. According to the differentiated basic assumptions, Contractor lacked trust on other members of the team and basically profit motive. Consultant gave an attempt to win the client as they valued the long-term relationship with the client expecting to gain Client’s future projects. Client attempted to keep a proper control of project team members and portrayed as an aggressive member and very demanding.

Many conflicting behaviours, thoughts and intentions between the sub-cultural groups in Project XYZ could be better explained using the basic assumptions identified in Table 1. For example, Consultant complained over contractor’s behaviour of targeting for additional claims in most situations. As indicated by the differentiated basic assumptions, Contractor’s financial profitability was of an utmost importance to the contracting organisation. Thus, they believed that they should carry out any task within Project XYZ, if they were entitled for a payment only. Thus, being vigilant over any possible claim was natural for the Contractor. However, Consultant identified this as a disturbing behaviour giving a negative effect over trust for team work within Project XYZ. Thus, Consultant had tried their best to avoid any additional claims for the Contractor. Another example was; Contractor had a complaint that Consultant tended to favour the Client. They further complained that Consultant used to have tough control cost, deducting amounts in interim payment application to win the Client. This situation could be explained using the differentiated basic assumptions indicated in Table 1.

Table 1: Differentiated Basic Assumptions (DBA) of Contractor, Consultant and Client

| Contractor’s DBA | Consultant’s DBA | Client’s DBA |
|---|---|--|
| <i>a) The nature of human relationships</i> | | |
| 1. Consultant tried to win the client 2. Teamwork history was beneficial for project success | 1. Client depended on the consultant as the technical advisor 2. Perfect performance of individual roles would bring project success 3. Parallel project works at organisation hindered attending to all demands of a specific project 4. Client was the most important member in the team 5. Effectiveness and efficiency in communication resulted in, how much the red tape for fast communication was overcome within the process | 1. Contractor and consultant always tried to defend themselves by passing responsibilities to each other 2. Consultant was the most important member in the team 3. Effectiveness and efficiency in communication resulted in, how much the red tape for fast communication was overcome within the process 4. Consultant had the legitimate control of the project, but never used |
| <i>b) The nature of human nature</i> | | |

| | | |
|---|---|--|
| 3. A strong impartial project manager was essential to drive the project 4. Consultants were impractical in their decisions 5. Consultants were careless and lacked integration among designers | 6. Having a tough control on project cost induced the client's faith on consultant 7. Contractor targeted for additional claims in every situation 8. Client believed that continuous pressing could motivate the consultant and contractor | 5. The most effective way to get work done was through continuous monitoring and frequent pressurising 6. A strong project management was essential for project success |
| <i>c) The nature of human activity</i> | | |
| 6. The correct way of behaving was being reactive, not proactive | 9. Contractor attempted to pass all responsibilities and blames to the consultant 10. The control in a construction project was the contract | 7. Consultant was responsible for quality of the project |
| <i>d) The nature of time</i> | | |
| 7. Continuing relationships with client or consultant were not essential, only professional working relationships were adequate | 11. Continuing relationship was very much important with the client, but not with contractor | 8. Continuing relationships with contractor or consultant was not essential 9. Client was liable to make timely payments to the Contractor |
| <i>e) The organisation's relationship to its environment</i> | | |
| 8. Contractor should always be ready to have ultimate justice through Adjudication or Arbitration | 12. This client was a special client to the consultancy organisation | 10. Variations were not an issue, as long as project had enough funding |
| <i>f) The nature of reality and truth</i> | | |
| 09. Experience and level of authority were critical in decision making in construction 10. Understanding the construction sequence was critical for project success 11. Cause and effect governed every aspect in project context | 13. Difficult to convince the practical aspects of construction to the client 14. Client mainly tracked performance of the consultant through the open discussion at the progress review meeting | |
| <i>g) Homogeneity vs. diversity</i> | | |
| | | 11. Consultant and Contractor were bound to deliver what was agreed in the contract under any circumstances |
| <i>h) Motive for behaving</i> | | |

| | | |
|--|--|---|
| 12. Continuous improvement was a necessity 13. Profit making was the ultimate objective of the contractor 14. As finance was the ultimate concern, contractual entitlement for a payment was essential to carry out any work 15. Delivery of expected project quality was an organisational concern | 15. As client being the end user, satisfying the client's requirements should be a priority 16. Contractor tried to deliver the quality as expected by the consultant | 12. A construction project would never be a priority of a client's day-to-day work 13. Client learnt within the project life cycle, therefore should be allowed to initiate variations accordingly |
| <i>i) Gender</i> | | |
| 16. Females lacked practicality in work | 17. All genders were treated equally | 14. The ideal was to have a balance in genders |
| <i>j) Unknowable and uncontrollable</i> | | |
| 17. Ultimate responsibility of time, cost and quality of the project resided with the contractor 18. Contract was the biggest control and up-holder of justice in a construction project | | |

As indicated in Table 1, Consultant had the basic assumption that they had to have a continuing relationship with the Client to obtain potential future projects. In addition, this Client was a powerful government ministry in Sri Lanka, thus, treating them well was an organisational concern for the Consultant. Thus, Consultant had found means of winning the faith and trust of Client by having a proper control on cost of the Project XYZ.

5.3 Fragmented Perspective of Construction Project Culture of Project XYZ

Fragmented perspective revealed the ambiguities and paradoxes in basic assumptions. There were three such major fragmentations in the basic assumptions of the project team members which are described as follows:

a) Client was not much pleased with the Consultant's performance, nor valued long term relationships with the Consultant, but ultimately nominated the same Consultant for their upcoming project. Client complained that all delays occurred in Project XYZ was due to lack of a strong leadership and control by the Consultant and openly criticised the Project Manager. The sub-cultural assumptions of the Client included; "Consultant had the legitimate control of the project but never used" and "a strong project management was essential for project success". Further, Client firmly held the assumption that "continuing relationships with contractor and consultant was not an essential". More importantly, Client directly expressed the dissatisfactions to the Consultant and complained the higher authority levels of the Consultant in case of any underperformance. However, still Client wished to have the same Consultant for their upcoming project. The justification given by the Assistant Director

(Premises) was that this Consultant was known to them and more comfortable to work with them, but other members had no proper justification. As Consultant of Project XYZ was a semi-government organisation, there was no any hidden special benefit available for the Client's representatives for appointing the same Consultant or it was not a decision taken due to any influence of the higher authorities of the Client and there were some other government consultants readily available in the market for hiring for this project.

b) Consultant was very strict on monitoring, whether the Contractor was going inline with the contract and was strict on payments to the Contractor, but at the same time expected Contractor to work informally beyond the Contract. Strict basic assumptions of the Consultant included; "control in a construction project was the contract", "having a tough control on project cost induced the client's faith on consultant" and "perfect performance of individual roles would bring project success". Having such grounds, Consultant also held the contradictory assumption that "effectiveness and efficiency in communication resulted in, how much the red tape for fast communication was overcome within the process" and complained that Contractor believing only in formal written methods of communication as hindering the project progress. The project was lagging behind due to concurrent reasons of Client, Contractor and Consultant. Yet, Consultant had massive complaints that Contractor did not take necessary initiatives for acceleration such as; increasing the number of labourers, working both day and night shifts, working at least with 50% of workers during New Year Festive season. However, working night shifts was not stated within the contract and there were legal restrictions to work during night by local authorities due to possible disturbances to the dwellers around the area of construction. Further, when the Consultant was questioned on whether they were ready to pay any additional costs such as overtime for workers who worked night shifts, they refused such payments, indicating acceleration was required due to Contractor's own faults and Client was not entitled to pay any extra to the agreed contract sum. Whenever the Contractor put forward any additional claim, Consultant had looked down on it, holding the basic assumption that; "Contractor targeted for additional claims in every situation" and indicated it as a disturbing behaviour requiring the Consultant to be careful all the time to avoid such claims. Thus, Consultant requiring the Contractor to be less formal and treating them formally by themselves was ambiguous within the project culture.

c) Another fragmented behaviour was that Client aggressively demanded partial completion of the building on time, but awarded extension of time gradually, whenever Contractor failed to achieve the time target. Client strongly held the assumption that "Consultant and Contractor were bound to deliver what was agreed in the contract under any circumstances" and "Client was the most powerful member in the project team". By the time the case study was carried out, the project was still lagging behind time even after extending the date of completion for two times. Before awarding the second extension, Client had refused the second request for extension and demanded to handover the building. Chairman of the Contractor's organisation was summoned to the Client's office and complained about this and strongly indicated that they were expecting to blacklist the Contractor if failed to achieve the time target given. This was because, this Client was one of the powerful ministries in Sri Lanka. Further, Client had organised an opening ceremony believing that Contractor would hand over the building accordingly. However, Contractor had failed to do a partial completion and that had resulted in a huge disappointment of the Client. However, this issue had ended up awarding second extension of time and no Liquidated Damages were claimed from the Contractor. Nevertheless, Contractor was on the verge of failing to achieve the third extension of time as well. Client and Consultant both complained that the reasons for the third delay were solely due to Contractor's lapses such as; problems in material procurement

and labour scarcity, which was accepted by the Contractor too. Contractor had made some initiatives such as; installing temporary ceiling and glasses for windows until the materials got imported as per the exact specifications. Client's representatives mentioned that they would definitely refuse the third request for extension of time and claim Liquidated Damages from that point onwards. However, Consultant did not believe that Client would claim Liquidated Damages as usual. Consultant declared that the reason for this careless behaviour of Contractor was due to the lenient nature of the Client, where Client did not stick to the words on their power and punishments and Contractor had the habit of feeling complacent over the project matters. Project Manager had some presumption that Client became demanding when the higher authorities of Client organisation started pressurising the Client's representatives only.

6. CONCLUSIONS

This research was an attempt to explore the patterns of underlying basic assumptions of the public sector construction project culture using a hybrid of integration, differentiation and fragmentation perspectives of culture. Integration perspective identified that all project team members collectively assumed client as the most powerful member in the project team, whose decisions could be uncertain at times. Further, all members assumed that contractor lacked trust on other two sub-cultural groups (client, consultant) requiring formal instructions in black and white. They believed that conformance to the contract was rewarding and appreciations were very rare among members.

Differentiation perspective identified that there were strong professional sub-cultures existed as client, contractor and consultant. Differentiated basic assumptions identified for each sub-cultural group (contractor-consultant-client) are given in Table 1. Accordingly, contractor lacked trust on consultant and client, operated with profit motive and believed that practical working experience as essential for working for a construction project. Consultant was looking more into pleasing and fulfilling the client's requirements and valued maintaining a long term relationship with the client with the objective of receiving new projects from them. Client demonstrated an autocratic behaviour and assumed that project team should be under their proper control. These differentiated basic assumptions could be used to better explain several conflicting cognitions among the client, contractor and consultant.

The fragmentation perspective of public sector project culture of the selected case demonstrated three notable ambiguous, blind spots in cultural context, which couldnot be properly explained. The first ambiguity included; the Clients behaviour of nominating the same Consultant for their upcoming project even though Client was not satisfied with the performance of the Consultant or not valued maintaining a continuous, long term relationship with the Consultant. Second ambiguity included; the Consultant requiring the Contractor to be informal in their behaviour, considering such behaviour could be more effective and efficient, but at the same time treating the Contractor in a very formal and strict manner following the contract terms. Third ambiguity included; Client aggressively demanding on timely partial completions of the project by the Contractor but, when the Contractor failed to achieve the given targets, Client seemed to be accepting the Contractor's mistakes and treating very leniently.

Thus, describing the project culture only with the integration and differentiation perspectives by avoiding those ambiguities would have been misleading. This was because, culture did not

consist merely with commonly agreed manifestations at all times. Rather, portion of project culture consisted of a constant flux of commonly agreeing and disagreeing on certain manifestations. The output of this research would be useful for construction project participants to understand the cognitions behind the behaviours of public sector construction project team members. Further research includes, replication of these findings in some more similar cases for strong confirmation of the findings.

7. ACKNOWLEDGEMENT

The authors wish to thank the Association of Commonwealth Universities, United Kingdom for providing financial support to participate and present this paper in 13th International Postgraduate Research Conference of University of Salford, Manchester, United Kingdom.

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A THEORETICAL TRANSFORMATIONAL ORGANISATIONAL FRAMEWORK TO IMPROVE IRAQI QUASI-GOVENMENTAL CONSTRUCTION COMPANIES' PERFORMANCE

T. Al-Obaidi and A. Higham

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: t.ameen@edu.salford.ac.uk

Abstract: Over the last decade, Iraqi Quasi-Governmental Construction Companies (IQGCCs) have faced wide criticism due to their poor performance, low productivity and inability to generate profits. An earlier study conducted by the researcher has pinpointed a number of deficiencies in the current practices of these companies, resulting mainly from adopting a traditional management system dominated by hierarchical structures, centralised controls, and high levels of bureaucracy. Yet, both theoretical and empirical studies reveal that organisations can survive, succeed and enhance their overall performance through focusing on improving their business processes (BPs). This paper aims to synthesise a theoretical transformational organisational framework to address the challenges emanating from current practice within IQGCCs with the view of determining a step change improvement that could ultimately enhance their bottom line performance. Consequently the work proposes a theoretical framework that acts as a roadmap to streamline and implement continuous improvement within Iraqi QGCCs core business processes. The paper concludes by proposing further data collection to validate of the framework proposed in the context of IQGCCs.

Keywords: Business process, Construction companies, IQGCCs' Performance, Framework.

1. INTRODUCTION

Following the US led invasion in 2003, Iraq has been subject to radical change, especially, in its political and economic systems. This change has directly impacted upon the Iraqi business environment in general and Iraqi Quasi-Governmental Construction Companies (IQGCCs) in particular. Where, after decades of domination over most publicly funded construction contracts, these companies face fierce competition from in excess of 3,500 local and international private firms. As a result, IQGCCs have subsequently struggled to both win contracts and generate profit (Wing, 2009). Consequently the majority have incurred substantial financial losses becoming unsustainable burdens on the national budget (IPMO, 2015). This along with concern about the ongoing inability of these companies to improve their poor performance, low productivity and high levels of inefficiency has resulted in calls for the Iraqi government to radically reform or even close these loss-making businesses (Shikhely, 2007; IPMO, 2015).

Seminal researchers, including Porter (1985), McCormack (2007), and more recently Trkman *et al.* (2015) espouse that in today's turbulent and competitive business environment focusing on improving business process (BP) remains the most appropriate means by which organisations can survive, succeed and ultimately enhance their performance and competitive advantage. Egan (1998) in his report *Rethinking Construction* advocates adopting just such an approach as a route to improving low productivity, profitability, and quality within the UK construction industry. Consequently several plans and models such as RIBA plan of work, OGC gateway process, and the more academically robust Generic Design and Construction

Process Protocol have been proposed to streamline and improve the process of construction. Yet, most of these initiatives have been designed with a focus on the project rather than the businesses involved, as a result a strong emphasis is placed on the enhancement of the project processes typically from the client’s prospective or that of their professional team. As a result insufficient attention is placed on how the business processes (BPs) of the main contractor engaged under traditional procurement. Especially in a way that would allow the main contractor to positively contribute to formalising and developing approaches used to execute their projects (Serpell and Diaz, 2016). More over, the process frameworks identified above has been typically developed from the prospective of western developed nations, as such developing; post-conflict nations such as Iraq have been dis-regarded. It was therefore resolved to look at the applicability of these process frameworks in one such post-conflict country.

Forming part of an on-going doctoral study, aiming to develop a conceptual framework for the enhancement of business processes within existing IQGCCs in order to trigger a step change improvement in their performance. The first phase of this research revealed a number of challenges exist within the core BPs of these companies that prevent them from operating efficiently. Qualitative analysis revealed four fundamental factors that need to be overcome if performance is to be enhanced, these included: 1) government regulations imposed by government on IQGCCs; 2) management system adopted by these companies; 3) authority distribution; and finally 4) communication system. Consequently the research presented in this paper then from the second phase of the doctoral study proposes a transformational organisational framework that addresses the challenges existing in the IQGCCs current practices by providing a formal structure and systematic process through which these project delivery can be enhanced and business processes refined.

2. BACKGROUND ON BUSINESS PROCESS VIEW

2.1 Business Process BP

Existing literature includes a myriad of different definitions for a BP, yet when distilled to their principal features the majority of these definitions include the same series of key elements. As summarised by Palmberg (2009) and illustrated in figure 1, these include: an input (need), a horizontal sequence of repeatable activities, the resources needed by the production process and ultimately an output (result). These features are further encapsulated in Looy’s *et al.* (2011:1124) definition of a business process, namely as a: "*repeatable set of coherent activities, triggered by a business event and performed by people and / or machines, within or among organisations, for jointly realising business goals and in favour of internal and / or external customers*".

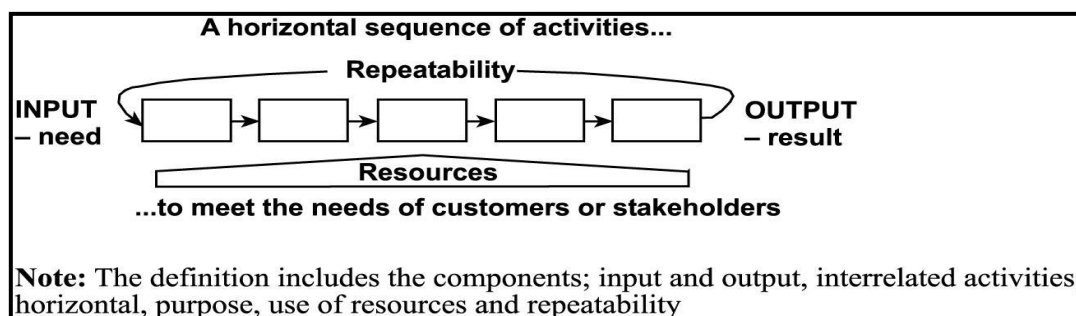


Figure (1), Business process components (Palmberg, 2009, p. 207)

The rapid development of information technology over the last two decades along with the liberalisation of international trade have led to flare up the global competition and diverse customer needs (Ivanko, 2013). Seminal researchers, such as Porter (1985), Hammer and Champy (1993), Mc Cormack (2007), and Trkman *et al.* (2015) contend that organisations can survive, succeed and ultimately enhance their performance and competitive advantage if they are willing to focus on improving their BPs. Focusing on the BP means viewing and managing an organisation as a combination of highly integrated processes not as a collective of functional areas (Hammer and Stanton, 1999) and being oriented towards processes, customers and outcomes as opposed to hierarchies (McCormack, 2007). This way of thinking of an organisation has been described by McCormack and Johnson (2001) as Business Process Orientation or BPO.

2.2 Business Process Orientation (BPO)

McCormack and Johnson (2001) define BPO as “*the level at which an organisation pays attention to its relevant (core) processes*” (*end-to-end view across the borders of departments, organisations, countries, etc.*)”. As such BPO explores how an organisation activities, jobs, structure, measures, rewards and resources augment around the horizontal sequence of processes that sit at the organisations core in a way that enhances overall performance whilst also ensuring value is provided to their customers. Baloh *et al.* (2008) and Skrinjar *et al.* (2008) consider focusing on BP as a best practice management paradigm correlated to organisational performance results. Bronzo *et al.* (2013) also concur suggesting the implementation of BPO can have a significant role in value creation and in improving companies’ performance. However, Kohlbacher (2009) advocates a wider range of potential benefits can be associated with the implementation of BPO including: enhancements to customer satisfaction, product quality, delivery and time-to-market speed. Reviewing the literature reveals a consensus amongst researchers regarding the main dimensions of a business process oriented organisation, as identified by McCormack (2007) and reinforced in the later work of Skrinjar *et al.* (2010), these principle features include:

- 1) A process view of the business thorough documentation and understanding from top to bottom and beginning to end of a process exists in the organisation;
- 2) Process jobs which pertain to define the tasks and roles required to operate and perform processes;
- 3) Structures that match these processes;
- 4) Management and measurement systems that direct and assess these processes;
- 5) Customer focused, empowerment and continuous improvement oriented values and beliefs (culture) that are embodied in all components.

2.3 Business Process in Construction

Despite the construction industry recognising the value of improving and optimising its processes as early as the 1970s, yet the real awareness of the importance of applying the process concepts in the industry has significantly increased after the mid of the 1990s (Alshawi, 2007). Accordingly a number of models and plans have been launched to improve the process of construction. The RIBA plan of work (RIBA, 1973), FIDIC tender procedure (FIDIC, 1994), Generic Design and Construction Process Protocol (GDCPP) (Kagioglou *et al.*, 1998), Framework for construction procurement (OGC, 2003), and Integrated Project

Delivery (AIA, 2007) are amongst the initiatives that have advocated in a way or another the process view with the aim of adding value to the customer, improving productivity, reducing defects and increasing profitability in construction. Therefore, most of these models have been developed mainly to improve the construction project processes through providing systematic ways and guidelines that enable the various parties involved in the projects to work in a more collaborated and integrated environment. Moreover, they have generally been designed from the client or architect perspective. While little attention has been paid to study or indeed improve the structure of BPs adopted by construction companies related to the delivery of their projects (Serpell and Diaz, 2016). Moreover, although this global orientation attempts to adopt the BP principles in the construction industry, the Iraqi context has yet to be appraised in this body of international literature. An exploratory study conducted by the researcher, however, revealed that IQGCCs have continued to adopt traditional operating systems with a hierarchical structure and very centralised control. A system that, Graetz and Smith, (2009) profess, has become out-dated and is now unable to cope with the challenges of the new business environment created as a result of neo-liberal, capitalist business structures adopted by IQGCCs international competitors. Accordingly, in order to survive and succeed, IQGCCs must now move away from the traditional functional model towards business process orientation, which can be seen as the most appropriate way to improve their performance and competitive advantage in the new post-conflict Iraqi as the economy is diversified and re-focused towards neo-liberalist ideals of competition and less government control (Steger and Roy, 2010). Yet, the lack of a framework or a systematic way for managing and continuously improving the BP in full, at the core of these companies means such change is hard to achieve in practice. Finnemore *et al.* (2000) assert that without a standard process model, companies would not be able to repeat or coordinate benefits and measure their performance over time. In the same vein, the senior manager of an Iraqi QGCCs interviewed by the researcher argued that the absence of a clear systematic strategy or roadmap driven by senior management can subsequently lead to a situation whereby each individual project is managed solely on the experience and skill of the project manager.

Accordingly, there seems to be an urgent necessity to develop a transformational organisational framework, employing BP principles, that will both address the challenges inherent within current practices of IQGCCs and whilst also ensuring they make a step change improvement in their performance. Moreover, the developed framework would provide the IQGCCs managements a roadmap to streamline and continuous improve their companies core business processes through suggesting tools to enhance their cross functional integration, decision-making, the quality of processes leading to improve outputs, and instilling knowledge based practices that capture and share lessons learnt across the organisation.

3. RESEARCH METHODOLOGY

To handle the challenges besetting the IQGCCs business processes, the researcher first needed to appraise the current processes operating at the core of IQGCCs to identify the main challenges faced by the government when seeking to transform practice. Accordingly, a comprehensive literature review was conducted through employing SOLAR Library Search, a facility offered by the University of Salford to search and access the resources available in both print and electronic form, to determine the most effective solutions. Other database search engines, namely Scopus and Google Scholar were also used. Keywords such as “business process elements”, “business process orientation”, “best practice in construction”,

“business process in construction”, etc. were used in searching required resources. Academic papers (journal and conference), books, official reports, and doctoral theses with these specific keywords in their title and abstract were briefly reviewed to identify the most related ones to be studied in depth. As a result, a number of solutions to address the challenges in the IQGCCs’ core business process were identified and synthesised together to form the proposed theoretical framework presented in this paper.

4. SOLUTIONS PROPOSED TO ADDRESS THE CHALLENGES OF IQGCCS' CURRENT PRACTICE

Four interrelated factors have been identified as the main causes for the most problems in the IQGCCs’ current practice. This section discusses how applying the business process orientation elements would help in overcoming most of these challenges by remedying their key causes.

4.1 Government Regulations

Since the government regulations in Iraq are generally formulated and adjusted at a very high ministerial echelon and national level, namely the Council of Ministers and Parliament. Accordingly, this factor can only be solved through recommendations and orders from the government itself. However, for the purpose of this research, it has been assumed that IQGCCs are profit-seeking entities, managed independently and not subject to the current governmental regulations and/or political interfere in their commercial operations or strategic planning.

4.2 Management

Multidisciplinary team versus functional departmentalization

A BP prospective is a managerial approach that views an organisation as a combination of integrated processes rather than a collection of functional areas. It concentrates on integrating and streamlining different functional expertise in the process with the aim of creating and delivering a product or service that has the best value to customers (Tang *et al.*, 2013). Thus, one of the essential anticipated results of adopting the BP view is the reinforcement of cross-functional integration. Cross-functional integration, as described by Troy *et al.* (2008), is the degree of interaction, communication, information sharing, and coordination across departmental boundaries. Turkulainen and Ketokivi (2012) profess that cross functional integration fosters employees to obtain a comprehensive overview of BPs and promotes organisations on reducing the functional sub-optimisation that is inherited in the traditional system. In organisations with a high level of cross-functional integration, the employees' activities are generally driven by the customers' needs and the organisation-wide values, rather than being directed by narrow departmental objectives or cost minimization (Johnson and McCormack, 2011; Tang *et al.*, 2013).

However, Willaert *et al.* (2007) argue that cross-functional integration endeavours are essential to be constituted in official functional areas. Similarly Johnson and McCormack (2011) argue levels of success are dependent on the extent to which the organisation is horizontal and vertical integrated. In fact, companies may need to replace their traditional structures with a process-based and value aligned structure that focuses on the delivery of

business efficiency and lean production if they are to continue to be successful in their target market. In other words, they should find a way to combine the specialisation and expertise of a functional structure with the adaptability and responsiveness of a process-based structure (Neubauer, 2009; Skrinjar and Trkman, 2013). Whilst such an endeavour can usually be achieved through multidisciplinary or task-focused teams, these teams need to work on asynchrony of processes crossing the functional silo boundaries and ending with the customer (Willaert *et al.*, 2007; Skrinjar and Trkman, 2013). This is in line with arguments expressed Johnson and McCormack (2011) and Tang *et al.* (2013) who both empirically evidenced that assigning stakeholders from different departments to a single team with a common goal and a series of supporting objectives will lead to increased cross-functional integration and thus eliminate the sequence of tasks with hand-overs between the various functions. Thereby reducing conflict between internal stakeholders while also enhancing organizational performance.

Documenting and redesign the organisation's business processes

Developing a good level of cross-functional integration requires every individual in the company has a clear view of the firm's common processes and a precise understanding of their own role in the processes and how that integrates into the bigger organisational picture (Skrinjar *et al.*, 2010). This, unfortunately, does not seem the case in IQGCCs. Solving such issues could be achieved by increasing the process view in organisations. Yet, this necessitates them producing a good and thorough organisational process map that clearly documents the organisation's BPs. Thus enabling all employees to understand the reality of their company's business whilst also encouraging every employee to identify potential problem points that need to be remedied (McCormack, 2007). Such a management approach allows and even encourages employees to look beyond their own tasks and the boundaries of their departments to consider any deficiencies and bottlenecks in the whole business process. Willaert *et al.* (2007) further stress that good process documentation becomes the basis for process performance measurement, analysis and improvement. Moreover, Tang *et al.* (2013) argue that the process view offers internal stakeholders with different expertise, a common language and a solid platform to cooperate and interact with each other under the same goal and objectives. It visually shows them the role of each stakeholder in the BP and how they work together to produce a final product or service (Bernstein and Singh, 2006).

Process owner

The most important advantage, which IQGCCs can gain from adopting the process focus as an alternative to the hierarchy, is the emphasis placed on assigning responsibility in a non-hierarchical manner (Campos and de Almeida, 2015). Under the process structure every BP has to have a process owner who takes overall responsibility for the horizontal overview of the assigned process from end to end (Kohlbacher and Reijers, 2013). In other words, the process owner is primarily accountable for the results of the process, which can have a direct effect on the customer. Their main role is to thereby ensure that all activities and tasks within the process are performed as planned. Furthermore, the process owner has additional responsibility for designing and continuously improving the assigned processes, measuring their performance and ensuring that all processes are running smoothly and effectively (Campos and de Almeida, 2015). Willaert *et al.* (2007) further suggest that the role of the process owner can be assigned to anyone within the organisational hierarchy, thus it does not

necessarily lead to the emergence of new managerial functions. Willaert *et al.* (2007) espouse that in some organisations it is common practice for certain employees to occupy multiple managerial roles. In this context, a senior manager, for example, could be both the manager of a certain functional area and the manager of an end-to-end process.

Stage gate and phase review

In order to improve the decision-making process and the overall organisational performance, it is proposed that the stage-gate processes proposed by Cooper (1994) be adopted for the final proposed transformational organisational framework. Cooper in his third generation process, noted that there is a necessity for “conditional-go” decisions at phase gates to provide and create aspects of concurrency among the various people involved in the process. Thus, such gates can be seen as decision points involving a collection of predefined standards or deliverables that must be or should be met by the process at certain points in time in order to proceed to the next stage of development. In other words, the gates represent quality control checkpoints and are typically controlled by senior managers and members of the task-focused team, who collectively have responsibility for allocating the resources needed to complete the processes identified (Cooper *et al.*, 2005). Moreover, the stage gates, or as often called phase review process provide the management with an effective means to record and update the organisations experiences throughout the core BP, and thus using such information later as lessons learnt to improve both the subsequent phases and the future projects (Kagioglou *et al.*, 1999; Wu *et al.*, 2001).

4.3 Authority

An important aim of process thinking is to streamline the business process and accelerate decision-making process through eliminating non-value added activities and unnecessary bureaucratic procedures. Yet, this requires the organisation breaks down the hierarchical and central control system and to redesign employees’ job roles around the organisation’s core BPs. Therefore, process jobs, which refers to the extent to which personnel's work is structured around the BPs that produce the final products or services, are deemed to be an essential element in conceptualising the BPO (Tang *et al.*, 2013). Johnson and McCormack (2011) argue that with process jobs, horizontal or process oriented authority is also enabled. According to them such level of authority is extremely important when looking to improve organisational performance, since this approach would extend across existing functional boundaries to guide and encourage personnel to work together towards common goals and objectives. McCormack (2007) also explains that in high-level business process maturity organisations, personnel usually work as process owners or in process teams. They have full responsibility and accountability for performing and improving the BPs related to creating products or delivering services adding value for the customer (Tang *et al.*, 2013). This concept, as Holt *et al.* (2000) express, leads to the autonomous mechanism of empowerment that gives employees greater freedom to manage their business processes in a way that creates self-responsibility and promotes self-efficacy. Researchers from different sectors including the construction industry emphasise the importance of the empowerment in providing a sustainable competitive advantage and improving the overall organisational performance (Meyerson, 2012, Kariuki and Murimi, 2015), reducing conflict and ambiguity in employees’ role and improving their performance and job satisfaction (Yang and Choi, 2009; Rajalingam and Jauhar, 2015).

4.4 Communication

Analysis of IQGCCs current practices revealed that one of the key contributors to both delay and increasing costs are failings in the communication systems adopted. The exploratory work revealed these processes are manually driven and paper based. Nevertheless, resolving the problems associated with the communication system through the introduction of an information communication technology driven system (ICT) is likely to significantly enhance efficiency across the organisation. Establishing, for instance, a central database, that links the company's headquarters, regional offices and projects together and is accessible by key internal stakeholders can substantially accelerate communications, improve their quality and importantly reduce the organisations' costs by providing a quick, reliable and robust communication process (Alshawi, 2007). Additionally, Information Technology (IT) also offers effective tools for storing and maintaining data in an organised and efficient way. Reports and other relevant documents developed throughout the execution of the BPs can be stored in an electronic database to be examined and presented in different views.

5. THE PROPOSED THEORETICAL FRAMEWORK

Cooper (1994:3) considers having a “*formal blueprint, roadmap, template or thought process for driving a new product from the idea stage to market launch and beyond*” as a fundamental element to succeed every company. Without developing a formal structure and systematic way for delivering new projects, companies can easily slip from their desirable result, by forgetting or neglecting stages in the process. Similarly, Lee (1998) advocates the most successful organisations are those that have adopted a generic process and developed and adapted it to fit their needs and continue to amend it to meet the needs of each individual project. Consequently, there is an utmost necessity to synthesise a framework that brings together all the proposed solutions and presents them in a visualised manner.

As a result the proposed theoretical framework has been synthesised through a comprehensive review of literature related to both business processes, best practice guidance for the management of large construction companies and the body of literature related to project delivery processes for both traditionally procured civil engineering and construction projects. Moreover, the Generic Design and Construction Process Protocol (GDCPP) launched by the University of Salford, has been employed as the key initial notion for development this framework. Whereby the Y-axis is used to represent the main drivers and controllers of the core business process, whilst the X-axis represents the time scales or stages that the core business process goes through:

5.1 Assumptions underpinning the theoretical framework

The framework has been developed for large contracting, construction companies that have repetitive construction works under the traditional procurement form, namely the “design-bid-build contract” and “unit price” agreement. Under such contracted form, the winner contractor is responsible for executing the project within its agreed costs, timeframe, and quality. Since this contracting form is the dominant form of procurement in Iraq.

5.2 Elements of the proposed theoretical framework

The proposed theoretical transformational framework is comprised of the following key elements as depicted in Figure 2.

1) Project phases and stages

The framework has been divided horizontally into four main phases, namely: bidding; pre-construction planning; construction; and closeout and termination. These phases have been defined to represent the different time segments of a construction company's core business process. However, in order to provide a better management of the business processes, each phase has further been split into a number of stages as shown in figure 2.

2) Process

Processes depicted in the framework represent the high-level or generic processes. Each process comprises a set of activities executed co-ordinately by a multidisciplinary team with the aim of generating information and/or producing deliverables for other processes.

3) Internal stakeholders

The framework has been designed to comprise the key stakeholders that they are directly involved in undertaking the core business process. Stakeholders would be grouped under various functional areas according to their specialties. The functional areas are proposed to be mainly allocated at the regional level to conduct specific activities and to be source of specialists and centres for training. Yet, every project based on its size, type, and complexity may have one or more stakeholders from each of these functional areas, which together perform the project management team that is directly linked to the project manager. The framework has also been designed to show who should be engaged in executing the processes and when. This would ensure achieving the concept of the right people having the right information at the right time. Moreover, it would also facilitate identifying the roles, responsibilities, accountabilities, experiences and efforts required of the various employees involved in conducting the different processes and what kinds of training they need in order to ensure undertaking the processes in an effective and efficient way. It is important to mention here, that these functional areas are not necessarily to be departments per se, but rather every individual department can be formed of one or more of these functional areas.

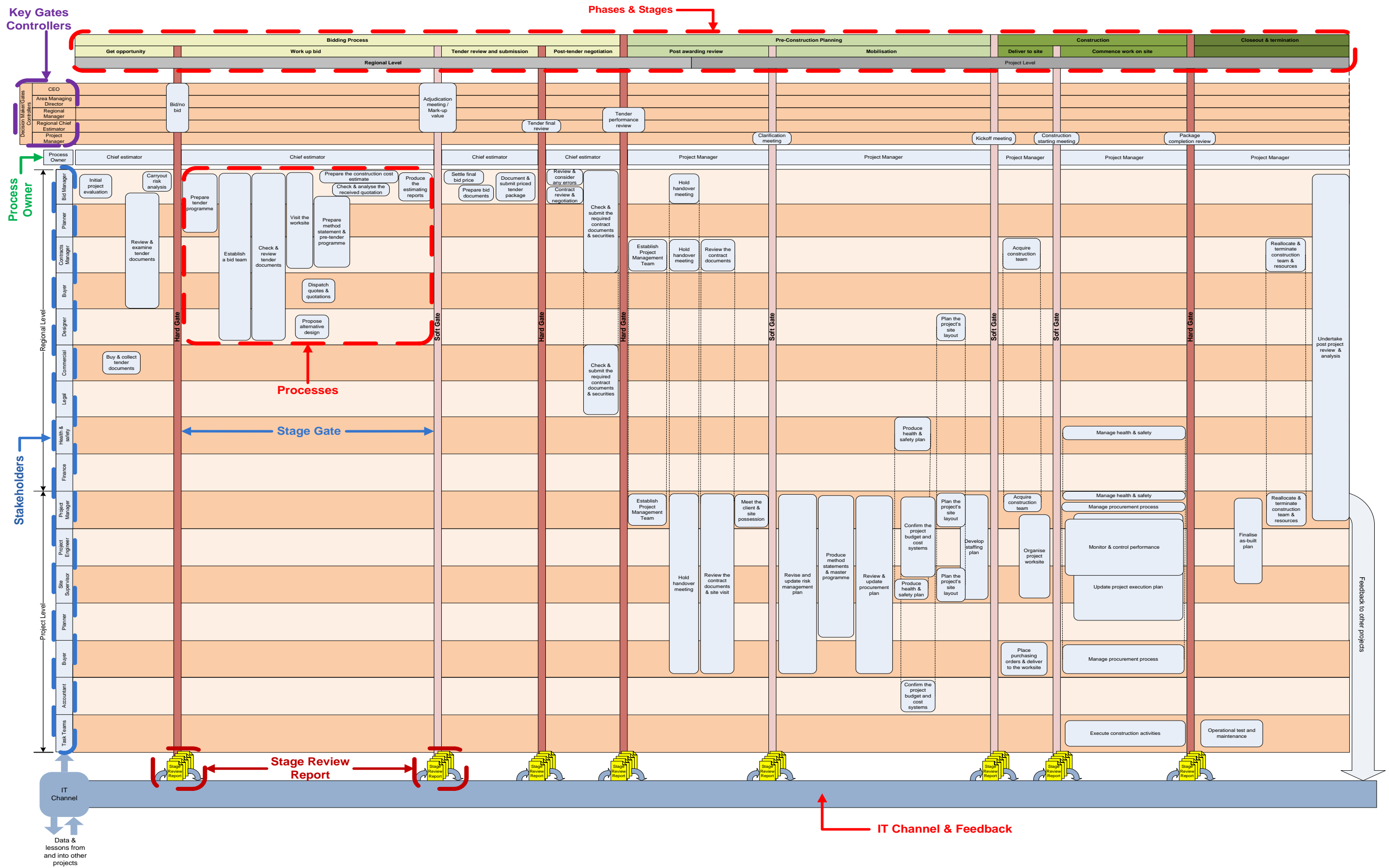


Figure 2: The proposed transformational organisational framework

4) Process owner

Two process owners have been identified and proposed to take the overall responsibility for managing and improving the core business processes, namely the regional chief estimator and project manager. The regional chief estimator is responsible and accountable for the whole bidding process. Whereas the project manager would take responsibility for managing the remaining phases within the core business process.

5) Stage gate and phase review

Each stage of the theoretical framework combines a number of the processes that should or must be performed. A stage gate acts as a quality control checkpoint at the end of each stage where preceding activities and expected deliverables are reviewed before a decision is made to proceed with the subsequent stage. The framework has two patterns of gates, specifically, “soft” gates and “hard” gates. A soft gate authorises conditioning proceeding to the next stage without having to complete all the activities of the prior stage. Thereby, it reduces the waiting time by giving the flexibility to the process to flow into next stage, while at the same time providing an efficient tool to identify and note the activities that are not completed in time. Whereas, with the hard gate proceeding to the following stage cannot be authorised unless all of the prior stage’s activities have been completed.

6) Gate controllers

In order to enhance the reliability and quality assurance of the decisions made at each stage gate, it has been proposed that the reviewing of the processes’ outputs at the end of each stage should be conducted through formal meetings. Such meetings can involve senior managers and employees from various functional areas.

7) Stage review report

Following to the phase review meeting, a stage report should be produced. This report generally comprises the main deliverables of work assessed, any decisions have been made, and the compilation of all related information and documents generated by the stakeholders throughout that stage.

8) IT channel and feedback

Stage review reports produced throughout the process have been offered to be stored and maintained in an electronic database. This would facilitate recording, updating, accessing and using information and data generated during execution the business process later as lessons learnt to improve both the existing processes in any stage of the project and future projects. In other words, the feedback allows the continued improving process through reapplying the successful experiences in the future practices and avoid unsuccessful ones, so the continued improvement of the process can be ensured.

6. CONCLUSION

In today’s turbulent business environment organisations worldwide have reached a conclusion that adopting business process view is the most appropriate way to survive and succeed. Yet, despite the radical changes occurred in the Iraqi construction business environment, an exploratory study has revealed that IQGCCs have continued to adopt traditional, hierarchical management processes that are unable to cope with the new business environment’s requirements. Accordingly, in order to survive and improve their performance, IQGCCs need to move away from traditional management systems towards a business process view designed to enhance value generated activities using multi-disciplinary teams

that cut across the organisation. However, the literature review revealed that most of the business process initiatives in the construction industry have focused on improving the construction project processes, often from the perspective of the client and their team of professional consultants. With little attention paid to the business or indeed project processes adopted by construction companies contracted to construct these projects. Through employing the business process principles and identified best practice revealed through an exhaustive literature review, this paper has identified a number of effective solutions to address the challenges identified in the current practices of IQGCCs. Moreover, the research presented in this paper proposes a theoretical transformational organisational framework that brings together all the proposed solutions to form a roadmap for making a step change improvement in IQGCCs performance. However, since the proposed framework is mainly based on the international literature and experiences of companies worldwide, applying the theoretical framework in its current form to IQGCCs is unlikely to be successfully. As a result the researchers have proposed a further phase of primary data collection to culturally embed the best practice framework into the Iraqi construction process using a series of expert interviews and focus groups with professionals working in the country for both IQGCCs and other private construction companies.

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THE USE OF OFFSITE CONSTRUCTION METHOD TO RECONSTRUCT IRAQ

N. Seffar and C. Abbott

School of the Built Environment, University of Salford, Salford M5 4WT, UK

Email: nehaladel81@yahoo.co.uk

Abstract: As a sustainable construction method, offsite construction is increasingly being adopted worldwide to improve productivity and to lessen the adverse environmental and social effects that result from traditional construction activities. OSC is no longer a new method and is adopted worldwide. Nevertheless, in some countries, such as Iraq, the adoption remains slow. While, there is a lack of knowledge and slow adoption of OSC in Iraq, simultaneously there is a vital need to rehabilitate the country after the many disasters it has faced. To identify the factors affecting the uptake of OSC, this paper reviews the advantages and disadvantages of using the OSC, such as economic, environmental and social. The advantages of using OSC such as reduced construction time and increased products' quality have the potential to be valuable to the Iraqi construction industry in addressing the housing shortage and the infrastructure deficiency problems. Furthermore, the construction industry in Iraq faces a problem of increasing waste materials. When using OSC this problem can be minimized as the products of OSC are prefabricated in the factory. Therefore, this paper firstly considers the benefits and drawbacks of OSC in general to assess how these characteristics align with the context of Iraq.

Keywords: Offsite Construction, Sustainable, Traditional Construction.

1. INTRODUCTION

The rapid growth of technologies affects different sectors of life. One sector is the construction industry, in which modern technology is expected to have an influence on its performance in the future. In addition, the global need for accelerating construction projects while maintaining reasonable cost and good quality has led to the emergence of new methods of construction. OSC is considered one of the new technologies emerging in the construction field. OSC is defined as “the manufacture and pre-assembly of building components, elements or modules before installation into their final locations” (Goodier & Gibb, 2007).

Much has been written about the advantages of off-site construction in terms of quality, time and lower cost, which in turns can be a fundamental solution for the growing demand for buildings. However, its adoption still differs from country to country. Goulding and Arif (2013) stated that the uptake and implementation of off-site manufacturing varies from country to country. They stated that some markets of developed countries such as the UK, Japan and Australia continued to demonstrate a steady growth in the use of off-site construction. However, in some developed countries the use of such method of construction can be low.

The challenges of increasing the uptake off-site construction in different countries are somewhat similar although it subject to context specific priorities (Goulding & Arif, 2013). For example, in some developed countries, the two main factors affecting off-site manufacturing are the cost of a skilled workforce and environmental issues; while in some

developing countries like Iraq, safety issues and cultural resistance can be the main reasons for slow of adoption of this type of construction. Iraq is in a post war situation and has a significant need for reconstruction. In particular, housing rehabilitant is required. Therefore, the off-site construction method can be a tangible solution for meeting the need for new buildings and housing in Iraq.

2. THE NEED FOR THIS RESEARCH

Iraq faced a serious of disasters from the period 1980-2016. Each disaster had a severe impact on this country and led to a later disaster. The nature of the current situation shows challenges, because the responses are weak and begin to diminish quickly or crash because of renewed, fork and breeding resulting there from past disasters. The period (2014-2016) showed the entry of ISIS to Iraq and the financial problems as a result of corruption, bribery, theft and deterioration of oil prices (the Iraqi economy is highly depending on oil revenues). These problems led to a halt of most construction projects in the country (AL-Azawi, 2015; Al-Kafaji & Salman, 2015; Al-Shaekli, 2016; Mahdi, 2015)

Residential needs are increasing and the gap between housing supply and demand is widening. Despite attempts to reduce the crisis, there are no signs of solving it. Instead its complexity is increasing (Al-Zubaedi, Al-Marsomi, & Katham, 2015). The problem has been further complicated due to overcrowding and the inability to supply the required housing from the government and the private sector. An additional problem is the high housing cost in comparison with lower income (Al-Zubaedi et al., 2015).

Therefore, the need to conduct this research is essential and fundamental in order to assist the government in its attempt to reconstruction of the country following the many disasters that have occurred by using new methods of construction. Moreover, the research will possibly support the efforts and plans being established by the Ministry of Housing & Reconstruction and may meet their objectives and principles in solving the housing shortage. Furthermore, the researcher believes that there is an importance need to highlight the use of off-site construction in Iraq, as this can open new perspectives towards this type of construction as there is knowledge gap about this type of construction. It can also achieve fruitful objectives in reducing some construction problems in Iraq like waste materials and delay of projects problem by using this type of construction as this type of construction has the advantages of saving time of overall project and reducing waste materials as its prefabricated. This is can be a great support to the Iraqi government in facing the challenges of construction industry in this country.

3. OVERVIEW OF OFFSITE CONSTRUCTION IN IRAQ

During the mid-seventies to mid-eighties of the last century, Iraq's government made great strides in the direction of introducing and adopting structural techniques and different methods of construction that helped to speed up the construction process in and minimize the housing shortage problems. However, the experience of such adoption of new construction methods in Iraq showed fluctuation in production and so there was a gap between what was required and what was produced (Abod, Hussain, & khafaji, 2011)

Abod et al. (2011) ascertained that there is a need to rehabilitate the prefabrication industry and the use of modern techniques of this type of construction to keep up with technological developments in the construction field. This is particularly necessary in order to develop residential buildings to limit the crises of supply as traditional construction is unable to implement the necessary construction in such a short time. There are few research studies that have highlighted the current status of pre-fabricated construction in Iraq. For example, Mohee (2011) affirmed the presence of a knowledge gap towards off-site construction in Iraq.

Moreover, Afif (2013) believed that pre-fabrication companies are rare in Iraq despite the fact that in 2013 the Iraqi Ministry of Housing and Construction declared that the pre-fabricated system would be the main construction system in Iraq. Furthermore, a recent study by Abbood, Al-Obaidi, Awang, and Rahman (2015) stated that off-site construction in Iraq is rare. He also cited that there is a lack of knowledge in many aspects of prefabricated construction, especially in its application. This thinking agrees with Mohee and Affef researchers' declaration.

In general, there is poor management of construction projects with regard to following, monitoring and adjusting the quality of the products. This leads to problems and deficiencies, which accrue on the products after implementation (Al-Ajeeli & Mehdi, 2015). The problem of inadequate management of construction projects had an impact on the fluctuation of the production of prefabricated buildings in Iraq. Abod et al. (2011) stated that the lack of quality of building products was the main reason for the rejection of a large number of them, thus increasing the cost of production and reducing the production performance economically. This gives a clear overview of available literature on the slow uptake of prefabricated construction in Iraq.

4. LITERATURE REVIEW

4.1 Off-site construction (OSC) and related terms

Off-site construction is the manufacture and pre-assembly of building components, elements or modules before installation into their final locations (Goodier & Gibb, 2007). For consultants, the definition of off-site construction is that products, either from a catalogue or bespoke, are manufactured in a controlled factory environment and assembled on site. From a contractor's point of view, this type of construction is a construction process, where the products are fabricated in a factory or somewhere near to the site and then installed there after being transported.

There are different terms for off-site construction in the literature. Off-site construction, off-site manufacturing, manufactured construction and modern methods of construction are some common terms that have been used interchangeably in the literature to describe pre-fabricated construction; the commitment is to move some of the construction effort into the controlled environment of a manufacturing facility (Goulding, Rahimian, Arif, & Sharp, 2012). It is important to know the differences between modern methods of construction and OSC. The OSC is a sub-set of modern methods of construction. Therefore, most off-site construction can fall under MMC but not all MMC can be considered off-site.

4.2 Types of off-site construction

The classification of the construction industry for OSC technologies is based on the degree of innovation in the process, products, construction materials and system (E. Elnaas, 2014). Two production sites are involved when using off-site construction technologies. There are off-site factory and on-site (Mostafa, Chileshe, & Zuo, 2014). Factory assembly offers advantages for manufacturing of complex components or highly repetitive building elements, which means that off-site is not restricted to the prefabrication of volumetric or big building elements. (Hall, 2010)

Various authors (Alistair Gibb & Pendlebury, 2006; Goodier & Gibb, 2007; Jonsson & Rudberg, 2014; Mostafa et al., 2014) classified OSC into the following types: -

Non-OSM construction methods

These methods are known as innovative construction methods. They use conventional components in an innovative way along with on-site techniques (Ross, Cartwright, & Novakovic, 2006). This type of off-site is intended to encompass schemes utilising innovative building techniques and structural systems that cannot be placed in the category of off-site manufacture. Some examples of this type are Thin Joint Masonry and Blocks Tunnel Form (Alistair Gibb & Pendlebury, 2006). The main characteristic of this type is innovation through the use of a construction method that is familiar in other sectors but new to house building, or through combining the traditional components in innovative ways (Alistair Gibb & Pendlebury, 2006; Rohani, Fan, & Yu, 2013).

Component manufacture and sub-assembly

This falls short of being categorised as systemic OSC but utilises factory manufactured innovative sub-assemblies or components. This category refers to relatively small items such as light fittings, windows, door furniture and trusses (Alistair Gibb & Pendlebury, 2006). The sub-assemblies and components are always produced off-site (Mostafa et al., 2014).

Non-volumetric buildings

No usable space is enclosed by these pre-assembly units (Alistair Gibb, 1999). Some examples for this type of OSC are pre-cast concrete bridge sections, structural steel work, timber trusses, pipework ...etc (Alistair Gibb & Isack, 2003).

Volumetric buildings

Volumetric buildings Alistair Gibb (1999) are produced by a type of off-site construction that includes units providing usable space. These units' form parts of a building but do not form a whole building. Very little work is needed to complete these units on-site because they are almost completed in the factory and ready for transportation and installation on site. Volumetric buildings involve 3D modules and commonly refer to pods that are pre-

assembled (Ross et al., 2006). Volumetric buildings design to be easily dis-assembled, moved and repositioned (Hall, 2010)
Some examples of volumetric building are toilets, rooms, bathrooms, and plant rooms (Alistair Gibb & Isack, 2003).

Modular buildings

This type of construction produces pre-assembled volumetric units, which form a whole or part of a building, including the envelope and structure (Alistair Gibb, 1999; Mostafa et al., 2014). Most work on the units is done off-site. However, some work may be completed on site, such as finishing the operation and assembly of the modules. There is also a possibility of assembling fully fitted out modules before transportation to the site (E. Elnaas, 2014). Examples include prison cell units, hotel/motel rooms and restaurant facilities.

4.3 Advantages and disadvantages of off-site construction

Many research studies, several seminars and conferences have highlighted the theme of sustainable construction to increase the developers' awareness of the importance of sustainability (Abidin, 2010). According to Chen, Okudan, and Riley (2010), there is a growing concern about sustainable development and sustainable construction. Therefore, the researcher categorises the advantages and disadvantages of using OSC according to sustainability aspects, which are economic, social and environmental. It is worth mentioning that (E. Elnaas, 2014), (Jaillon & Poon, 2008) and (Wasket, 2001) also categorise the benefits and drawbacks of OSC using sustainability considerations.

Advantages of OSC

The advantages of OSC will be categorised according to sustainability aspects, which as follows: -

Economic benefits

Alistair Gibb and Isack (2003) found that the main benefits of off-site construction are improvements in quality and reductions in time and cost. Moreover, Venables, Barlow, and Gann (2004) concluded that a reduction in on-site assembly time is one of the main benefits that make off-site construction superior to traditional methods. They also found that quality of production and finish is the single most significant benefit of off-site construction over on-site construction methods. The uptake of OSC has the potential to reduce on-site overall life-cycle costs, improve quality, decrease construction defects, and minimise construction time (Goodier & Gibb, 2007). According to (Jaillon & Poon, 2008), in the traditional method of construction, the output quality is highly dependent on the workmanship of construction labourers and the supervision team. In contrast, the use of off-site technologies in construction develops quality and offers more rigorous quality control, thus minimising defects and increasing the durability of components. Other OSC benefits include reduced and more predictable production time, as well as lower and more predictable cost and improved quality of the end product or facility (Larsson, Eriksson, Olofsson, & Simonsson, 2014).

Social benefits

Compared to traditional construction methods, off-site construction can offer several social benefits by providing better working conditions which lead to improved health and safety of workers. In addition, OSC offers better staff training. Since many workers involved in the factory live locally, this gives them a better chance to sustain their jobs. (Ross, 2002)

These arguments are also supported by Jaillon and Poon (2008) who state that improved safety control at the factory, in which working from height is avoided, leads to better working conditions. Therefore, worker's safety, as well as reduced ill health and accidents are social benefits of using OSC instead of on-site construction.

Environmental benefits

The use of off-site construction methods can contribute to materials conservation and waste reduction, since the waste generated from off-site construction is easier to re-use and to recycle (Jaillon & Poon, 2008). Moreover, Mtech Consult and Yorkon (2008) have stated that improved design of OSC can decrease waste of materials by nearly 50% and reduce on-site waste by up to 90%, particularly with the use of volumetric construction. The research also indicated that OSC can limit waste to less than 1.8% of the materials' total weight, with less than 0.6% of waste materials sent to landfill.

Regarding air pollution, Jaillon and Poon (2008), indicated that pollution that occurs during the manufacturing process is easier to control in a factory environment than pollution that is caused on-site. Moreover, OSC reduces the time spent in working on-site; this means that the impact of construction sites on the local environment is reduced and fewer hours are spent under extreme weather (Wasket, 2001)

A recent study by Gunawardena, Ngo, Mendis, Aye, and Crawford (2014) has found that OSC construction has proven to be more environmentally friendly than traditional construction because it requires minimum access roads. Prefabricated units can be shipped or transported on trucks and placed on-site using mobile cranes and less work will be required for installation on-site. Therefore, less pollution is generated by off-site construction.

Aye, Ngo, Crawford, Gammampila, and Mendis (2012) found that there is a significant potential for the re-use of materials in a pre-fabricated steel building and this lead to about 81% of the embodied energy in an original steel pre-fabricated building being saved.

Disadvantages of using OSC

The disadvantages of using OSC can be summarised according to the three parameters of economic, social and environmental impacts as follows:

Economic issues

1) Cost

- Realised as an expensive construction method when compared with conventional methods of construction, due to vertical transportation on site, setting up fabrication yards and transportation, labour training and jointing joints problems.

- long-distance transport for large and heavy loads can be considered costly and difficult when the site is narrow or when there is traffic congestion.
- Limited or expensive available skilled on-site labour.
- Higher initial cost and capital cost.
- High cost of carriage.

(N. Blismas & Wakefield, 2007; Chiang, Chan, & Lok, 2006; H. Elnaas, Gidado, & Philip, 2014; Pan, Gibb, & Dainty, 2007).

2) Time

Longer “lead-in time” is specifically needed in pre-planning and design (N. Blismas & Wakefield, 2007). According to Goodier and Gibb (2007); Vernikos, Goodier, Broyd, Robery, and Gibb (2014) all contractors claimed that long ‘lead-in time’ is the greatest disadvantage and barrier for off-site construction and if not managed well, the choice of OSC could add costs to the project and delay its beginning. It was commented that in order to reduce the lead in time, cost integration is needed from the start of the design (Goodier & Gibb, 2007; Vernikos et al., 2014). Vernikos et al. (2014) stated that building information modelling enables lead-in times to be managed more efficiently. The other disadvantage of using the OSC is inability to freeze design earlier. (N. G. Blismas, Pendlebury, Gibb, & Pasquire, 2005; Pan et al., 2007)

- 1) Limited capacity of suppliers and OSM’ plants to enhance OSM efficiency.
 - 2) Lack of off-site inspection expertise
 - 3) The expertise of designers and constructors in the marketplace of OSM and its processes are limited.
 - 4) Interface problems on site between manufactures and builders can lead to problems if they are not well managed.
 - 5) A problem can occur when future maintenance is needed for manufactured housing.
- (N. Blismas & Wakefield, 2007; N. G. Blismas et al., 2005; E. Elnaas, 2014; Venables et al., 2004)

Environmental issues

- Increasing pollution, especially CO₂ emissions, if the manufacturing factory is located a long distance from the site. There are some difficulties in transporting large, heavy components, especially for long distance transport. The environmental impact of the transport phase depends on the distance from the point of manufacture to the point of assembly, as pre-fabrication factories located at longer distances from the site have a higher environmental impact in the transport phase than non-prefabrication methods.
 - Increasing energy consumption and surrounding impact when using heavy machinery on-site for installation of units.
 - Hard to control the manoeuvre of large components and products with strict site location.
- (N. Blismas & Wakefield, 2007; N. G. Blismas et al., 2005; E. Elnaas, 2014; Jaillon & Poon, 2008; Pacheco-Torgal, Cabeza, Labrincha, & de Magalhaes, 2014).

Social issues

- Lack of understanding of OSM in local authorities and lack of support from the government.
- Possible increase of accidents. Despite the potential benefits of modular/prefabricated building construction in terms of safety, this construction strategy can be challenging and risky in some cases, for example, during moving and installation of massive components, especially in high-rise buildings. Hoisting, moving, and installation of heavy and large components in this sector are complicated and dangerous.
- Lack of codes and standards to cover lender's requirements & warranties.
- It appears non-cost effective when compared with traditional methods. (Unaffordable)
- Lack of skills among labour for installation and maintenance issues.
- There is an absence of media incentives to improve perception.
- OSC is still not well accepted among most of society, largely due to the legacy of its misuse and poor clients' perceptions due to past product deficiencies.

(N. Blismas & Wakefield, 2007; N. G. Blismas et al., 2005; E. Elnaas, 2014; Khalfan & Maqsood, 2014; Mirhadi Fard, Terouhid, Kibert, & Hakim, 2015; Zhai, Reed, & Mills, 2014; Zhang & Skitmore, 2012)

5. CONCLUSION

Iraq faced many disasters which led to many problems including the destroying of infrastructure and a sever housing shortage. Therefore, this paper introduced the offsite construction as a solution to help reconstruct the country. However, there is a knowledge gap and slow adoption of offsite construction in context of Iraq. Hence, there is a need to understand the drivers and challenges of using this type of construction in order to enhance the use of it.

Firstly, the paper clarified the definition for OSM, types and methods in relation to its use in construction. These are some terms that used in the literature review in worldwide like OSM, OSC, MMC and prefabricated construction. This paper indicated the advantages and disadvantages of using OSM regarding sustainability issues which are economic, social and environmental.

The main economic benefits of using OSC is increased quality of products and reduction in time of construction. Also, the main advantage is better working condition. In addition, the environment benefits are materials conservation and waste reduction, since the waste generated from off-site construction is easier to re-use and to recycle. Moreover, reduce pollution is generated by using OSC. However, the economic disadvantages of using offsite construction are mainly higher capital cost, longer lead in time and fewer offsite factories and few designers and constructors' experts of OSC. The environment drawbacks can be increased pollution if a long distance involves in transporting the products.

Furthermore, regarding social disadvantages of OSC there is absence of codes and slandered regarding this type of construction; workers' shortage skills. The general attitudes of people towards offsite construction is poor quality due to past deficiencies.

Secondly, the paper provided an overview of offsite construction in Iraq which showed a slow growth on it is adoption.

The next step will be assessing the barriers and drivers in worldwide through the literature review and depending on literature review a questionnaire will be built to examine the barriers and drivers in Iraq. Then, factors affecting the use of offsite construction in Iraq will be identified. Finally, a roadmap will be developed in order to encourage the use of offsite construction in Iraq to support the government efforts in reconstructing the country.

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EVALUATING DISASTER RESPONSE MANAGEMENT STEMMING FROM WAR OPERATIONS AND TERRORISM IN IRAQ: A METHODOLOGICAL APPROACH

H. Al-Dahash and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: H.F.Al-Dahash@edu.salford.ac.uk

Abstract: Iraq is exposed to numerous types of natural and man-made disasters. Because of economic sanctions, conflict, and war over the last few decades, the people of Iraq have suffered the consequences of economic stagnation and reduced access to essential services. One of the essential services that is crippled by war and post-war conflicts is disaster response management. As the institutional capacities to respond in an efficient manner were affected by the post war transitions, this paper is based on an ongoing PhD research, which aims to evaluate disaster response management stemming from war operations and terrorism in Iraq, as a method of enhancing disaster response management in Iraq. This paper will focus, particularly, on the methodological design of the above study and it will also elaborate on the philosophical stance taken and methodologies assumed to achieve the above aim.

Keywords: Disaster Response Management, Research Methodology, Terrorism, War Operations.

1. INTRODUCTION

Recent decades have seen significant increases in the number, complexity and scope of disasters and incidents (Alexander, 2005). A key feature of contemporary understandings of disaster management is that they aim to assure prompt and appropriate assistance to victims of disaster, avoid the potential losses from hazards, reduce vulnerability, and achieve rapid and effective recovery (Bang, 2012). Therefore, disaster management is considered one of the modern humanities and its importance has increased significantly in the present climate of increased terrorist incidents. Furthermore, it is considered a vital field that needs to be prioritized in order to reduce the impact on human lives, property damage and national economies (Al-Dahash, Kulatunga, & Amaratunga, 2014). Interestingly, Baharin, Shibghatullah, and Othman (2009) saw the response phase not as one of the *main* phases of the Disaster Management life cycle but as one of the *critical* phases in the Disaster Management life cycle. This might be due to the deviant and chaotic behaviour during the immediate response in a disaster (Fischer III, 1998a, 1998b), or due to the very altruistic nature of the behavioural response (Fischer, 2005). Madry (2015) noted that response is influenced by different factors, including the level of development, local culture, historical context, and the national readiness to respond. An efficient response to a disaster plays an important role in reducing its impact on affected victims (Muaafa, Concho, & Ramirez-Marquez, 2014).

According to Al-Dahash, Kulatunga, and Al-Dehesh (2015), Iraq has experienced various disasters, both natural and manmade. Within the context of manmade disaster, war and post-war conflicts have crippled many essential services needed to manage hazards, reduce risks, and respond to disasters. This has impacted on the response phase. Goodyear (2009) shows

that comprehensive and coordinated disaster management is lacking in Iraq, which includes a risk analysis based on an examination of hazards, vulnerabilities, capacities of populations' local community, and the first responders charged to assist at the time of the emergency. Further, with an extensive list of human-made hazards to address, Iraq is ill equipped at this time to encounter all these challenges without external support. As a result, the need for stronger infrastructural and technical capabilities within the Government of Iraq and other disaster risk reduction stakeholders is imperative to plan for effective response to potential disasters in the future. Based on international best practice, an efficient and effective response to disasters needs a national perspective. Yet a coordinating body to ensure an integrated response is lacking among the multiple agencies working on Disaster Risk Reduction (DRR) in Iraq. This could contribute to a fragmented response capacity (Humayun & Al-Abyadh, 2014).

This paper highlights the methodological design and discusses the rationale and justifications for the design of the study. The structure of the paper is as follows: Firstly, it describes the research methodology strategy, secondly, the research methodology choices are discussed, and thirdly, the research methodology techniques are explained. Finally, the data analysis process is discussed and conclusions drawn.

2. RESEARCH METHODOLOGICAL DESIGN

It is widely agreed that a research methodology should be prepared prior to conducting any research. According to Blessing and Chakrabarti (2009, p. vii) a design research methodology “*should help identify research areas and projects, and in selecting suitable research methods to address the issues*”. Blessing and Chakrabarti (2009, p. 9) also defined design research methodology as “*an approach and a set of supporting methods and guidelines to be used as a framework for doing design research*”. Despite the risk and uncertainty in the research process, the possibilities of any failure could be minimised through using appropriate research design and by forecasting and identifying pitfalls and problems that the researcher might come across. Further, the overall research strategy will be identified through examining the philosophical aspects of the research by using research design. Accordingly, many frameworks can be identified within the literature on methodological aspects of conducting research. Among those is the ‘nested’ model which gained popularity among researchers, introduced by Kagioglou et al. (1998) and the ‘research onion’ model by Saunders, Lewis, and Thornhill (2016). While the nested model includes three elements to establish the research methodology, including research philosophy, research approach and research techniques, the onion model involves six steps: research philosophy, research approach, research strategies, research choices, data collection methods and timescale. It is recognised that one of the important features of the nested model is that it is a simple way to understand the research methodology components, whereas, the research onion consists of more layers and provides the researcher with clear guidelines of how to design the research appropriately through a series of logical reasoning and decision-making steps. Both the nested model and the onion model are connected in three major areas, namely, research philosophy, research approach and research technique. The onion model was used in this paper to ensure academic rigor in the process of the research design.

2.1 Research Philosophy

Saunders et al. (2016) expressed the philosophy of research as an overarching term that relates to the development of knowledge and the nature of that knowledge. Easterby-Smith, Thorpe, and Jackson (2008) noted that having an understanding of philosophical issues is very important for at least three reasons:

- ✚ To clarify research design
- ✚ To recognise which design is most appropriate
- ✚ To identify, and even create, a design that may be outside the researcher's past experience.

Most literature classified research philosophy into three main perspectives, namely, ontology "*the assumption that the researcher makes about the nature of reality*", epistemology "*a general set of assumptions about the best ways of inquiring into the nature of the world or in other words, an assumption about how researchers acquire and accept knowledge about the world*" and axiology "*assumptions about the nature of values the researcher places on the study*" (Creswell, 2009; Saunders et al., 2016).

Within the context of an **ontological** position, there are two aspects; objectivism and subjectivism. This research seeks to evaluate and explore the current disaster response management system in Iraq. Furthermore, due to the involvement of different experts in this process and the fact that their "subjective" perceptions and decisions collectively "socially construct" what is seen as the response to disaster "phenomena", the research falls mainly within the ontological stance on the subjectivism continuum.

Epistemological stance, on the other hand is divided, by Saunders et al. (2016), into positivism and interpretivism. The authors in this paper, adopted an interpretivistic epistemological position in order to gain an in-depth understanding of social reality through studying peoples' attitudes and behaviours when responding to disaster events.

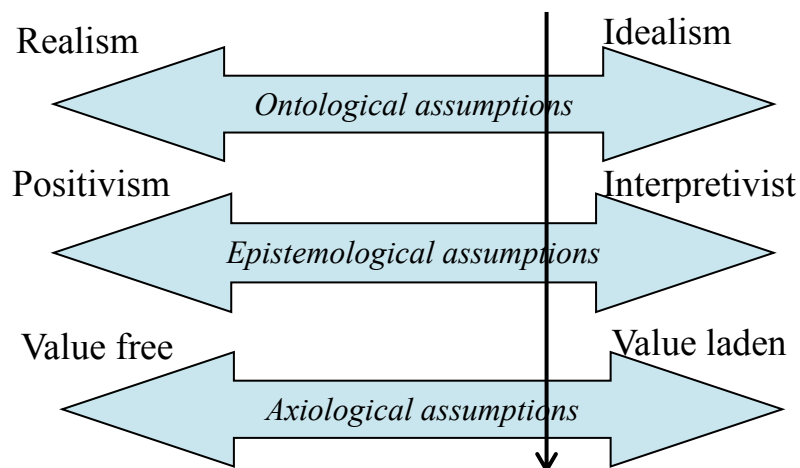


Figure 1 Philosophical Stance Pertaining to the Study

With regard to **axiology**, the main emphasis in this philosophical branch is whether research assumptions are made in a value-laden or value-free environment (Collins & Hussey, 2009). As this research is of an exploratory nature and the interpretation of interviewees (experts) forms a major component of understanding the reality, combined with the expertise of the

researcher in this particular field, it is value-laden, since value is added from both parties. Hence, a social constructionist approach is adopted. The philosophical stance pertaining to this paper is illustrated in Figure 1.

2.2 Research Approach

As reported by Saunders et al. (2016), whilst the research approach relates to theory development, the selected approach will enable the researcher to answer the research questions and meet the objectives of the study. A research approach consists of three types; deductive, inductive, and abductive. The researcher, in the deductive approach, develops a hypothesis or several hypotheses. Hypotheses are normally expressed in operational terms to explain the relationship between variables. The hypotheses are tested prior to examining the specific outcomes and, if necessary, the theory will be modified according to the findings. Conversely, in the inductive approach, there is no development of the theory prior to data collection. Researchers, in following an interpretive approach, start with the evidence and then build up a theory based upon it. Within the inductive approach, according to Pathirage, Amaratunga, and Haigh (2008), the theory would follow the data rather than vice versa as with deduction. The third approach is the combination of deduction and induction which is called an abductive approach (Saunders et al. (2016).

In this research, the authors used secondary data to review the significance of disaster management and deduce principles in building appropriate data collection tools. As such, the data collected are partly theory loaded. In addition, this research attempted to build a theory on improving disaster response management in Iraq. Therefore, this research used a combination of deductive and inductive approaches.

2.3 Research Strategy

Many strategies used in business and management to collect real data can be adopted by the researcher. For any study, an appropriate research strategy choice is based on the research questions, objectives, the amount of time, the extent of existing knowledge and other resources available, as well as the philosophical underpinnings (Saunders et al., 2016). Accordingly, research strategies commonly employed by researchers are an experiment, survey, case study, action research and ethnography (Easterby-Smith et al., 2008; Remenyi, 1998; Saunders et al., 2016). Yin (2014), on the other hand, included five major ways of undertaking social science research, namely, experiment, survey, archival analysis, history and case study, of which, the selection is based on the type of research question posed, the extent of control an investigator has over actual behavioural events and the degree of focus on contemporary (as opposed to historical) events. Yin (2014) did not include action research and ethnography in his division of research strategies. In fact, each strategy can be used for all three research purposes; exploratory, descriptive and explanatory. However, the most important issue is whether the selected strategy will enable the researcher to answer the research questions and meet the objectives of the study (Saunders et al., 2016).

Because the philosophical stance of this research leans towards an interpretivistic and subjective approach, the use of experiments and surveys are inappropriate. Experiments are mostly conducted in a laboratory setting under controlled environments where the context and the phenomena are separated (Yin, 2014). Experiments allow identification of casual

relationships through observing the effect of the dependent variable by controlling the independent variable. Likewise, with experiments, surveys are also related to the deductive approach (Saunders et al., 2016). A collection of large amounts of data is facilitated by surveys in an economical way.

As this research falls within the interpretivism and subjectivism stance, and to answer the research questions and meet the objectives of the study, the authors examined three different strategies: action research, ethnography, and the case study approach.

Firstly, an **action research** strategy is an iterative process involving researchers and practitioners acting together on a particular cycle of activities. Such a strategy is unique in the way it associates to research and practice (Avison, Lau, Myers, & Nielsen, 1999). This process forms a continuing action of planning, diagnosing, taking action and evaluating. Involving employees (as research objects) throughout the research process is very important to implement changes they have helped to create (Saunders et al., 2016). Despite providing an in-depth understanding of a specific phenomenon, this strategy is inappropriate to achieve research objectives due to the lack of the required access to perform the intervention in the Iraqi disaster response management system.

Saunders et al. (2016), stated that an **ethnography** strategy is one which *“is very time consuming and takes place over an extended time period as the researcher needs to immerse herself or himself in the social world being researched as completely as possible”*. Therefore, the second point is that because of the aforementioned factors, it was not practically possible for the authors to immerse themselves deeply into the actual environment. The ethnography strategy was, therefore, not suitable for this study.

Since the other possibilities were not appropriate for this paper, a **case study** strategy was adopted. Because of the open-ended inquiry used in case studies, it is suitable for building theory and generating hypotheses (Amaratunga, Baldry, Sarshar, & Newton, 2002). Further, due to the exploratory nature of the research, this paper collected data as part of a case study, as this was the most appropriate strategy for answering the research questions and verifying the research findings. A case study has been defined by Yin (2014, p. 18) as an *“empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident”*. Both ‘what’ type of exploratory questions and ‘why’ type explanatory research is covered by this approach. He added, that in the natural setting, such an approach can assist researchers to investigate the phenomenon. Denscombe (2010) declared that by using a case study, researchers can examine the studied phenomena or the real-life situation. Moreover, it allows them to gain an in-depth picture of the relationships and processes within the phenomenon. The case study approach, as a result, is more common in qualitative studies when compared with quantitative studies. Miles and Huberman (1994), in contrast, noted that the combinations of both quantitative (questionnaires) and qualitative (interviews and documents) data can be conducted in case studies to accomplish different aims and to serve different purposes. Yin (2014, p. 11) also supports this argument, he contends that *“the case study’s unique strength is its ability to deal with a full variety of evidence: documents, artefacts, interviews, questionnaires and observations”*. Therefore, the case study research strategy is capable of adopting different data collection methods and is usually used when it is required to obtain in-depth knowledge about a particular phenomenon.

To sum up, the research under consideration does not intend to change or influence the attitudes or procedures of the environment or the participants, as it does in action research.

Nor does it intend to study physiology or behavioural patterns of the participants as in the case of ethnographical approaches. So the case study approach was suitable for this research to explore the current practices related to disaster response management in Iraq.

2.4 Case Study Design

An exploration of the current practices related to disaster response management was required. Different views of individuals will be identified regarding the criteria of best practice disaster response management, challenges, strengths, and weaknesses facing disaster response process managers in different administrative functions. Therefore, this research requires a strategy which gathers experts' opinions and in-depth analysis. An in-depth analysis of the phenomenon under consideration is possible by case study (Gerring, 2007). Moreover, the views of the "actors" of the case under consideration could be incorporated by carrying out case study research (Zonabend, 1992). Further, according to the definition of a case study, stated by Collis and Hussey (2013), it is "*a methodology that is used to explore a single phenomenon in a natural setting using a variety of methods to obtain in-depth knowledge*". It is therefore normally used when obtaining in-depth knowledge on a particular phenomenon and is useful to accommodate different research techniques. Both qualitative and quantitative data also can be accommodated in case study research (Gerring, 2007; Yin, 2014). Although case study research presents many advantages to a research study as mentioned above, it is often criticised for bias, lack of rigour, use of incomplete evidence, and for being expensive and time-consuming (Remenyi, 1998; Yin, 2014). So far, it can be argued that, despite the fact that a case study can take time and can be expensive, the time and budget could be minimised by using careful design. Likewise, many drawbacks can be compensated by having a number of advantages. A variety of evidence is embraced by case study research, such as that obtained from interviews, observation, and document reviews (Saunders et al., 2016; Yin, 2014). The richness of the collected data will be increased while creating the prospects for data triangulation.

Accordingly, the case study approach appears to be the most suitable method for this study, which cater for 'What' and 'How' type research questions about a contemporary set of events, without differentiating between phenomena and context, where the researcher tends not to interfere with what is being studied.

Yin (2014) suggested four choices to design a case study, namely, a single case study (holistic), a single case study (embedded), a multiple case (holistic), and multiple case (embedded). Such choices depend on the number of cases; single (one case) or multiple (more than one case) and the number of units of analysis, holistic (one unit of analysis) or embedded (more than one unit of analysis). According to Yin (2014), "*a single case study approach is suitable when investigating critical, unusual, common, revelatory or longitudinal case*". A critical case is used when it challenges, confirms or extends a theory while the unusual case represents a rare situation. Conversely, a common case captures a typical or a representative project or case. Therefore, studying one case is adequate to get an understanding about the other cases. A revelatory case can be applied to study a phenomenon which was inaccessible previously. The phenomenon, as a longitudinal case, will be studied over a long period of time.

The research under consideration fell under the critical case because the General Directorate of Civil Defence is the main administrative body when responding to disaster (Humayun &

Al-Abyadh, 2014), especially when the situation was triggered by war operations and terrorism in Iraq. There are a number of stakeholders involved during the disaster response stage, namely, the General Directorate of Civil Defence, the Health Department, NGOs, and the Iraqi Red Crescent Society. The General Directorate of Civil Defence (working under the Federal Ministry of Interior) can rightly be termed as the focal response agency (Humayun & Al-Abyadh, 2014) and it is the main administrative directorate during the disaster response stage. Consequently, based on the critical view of experts involved in the disaster response activity, the extracted concepts were assessed. As a result, a valid theory which contributes to knowledge was developed after revising the extracted concepts. Hence, in accordance with Yin's rationale for doing a single case study design and the nature of the research objects, the opportunity to get better research outcomes was acquired in this paper because a single case study approach was adopted.

Regarding the unit of analysis, Miles and Huberman (1994, p. 25) stated that the unit of analysis of a study is a "*phenomenon of some sort occurring in a bounded context*". Based on Collis and Hussey (2013) it is the focal point where the research problem, phenomena and the variables refer to and about which the data is collected and analysed. Due to its importance, Miles and Huberman (1994) considered the unit of analysis as the "heart" of the research. According to Yin (2014), there is a relation between the chosen unit of analysis and the research objectives. The unit of analysis might help in shaping the scope of data collection in the later phase. In this paper, the unit of analysis was disaster response management.

Based on Yin (2014) opinion, a single case study has two variants, a holistic design and embedded design. Because the General Directorate of Civil Defence has the same administrative system in all its branches or subunits distributed in all Iraqi provinces, the research boundary takes the General Directorate of Civil Defence as a case study boundary, and this paper therefore focuses on the single (holistic) unit of analysis, being "disaster response management".

2.5 Research Choices

There are two main categories for research choices according to Saunders et al., (2016), the mono method and the multiple method. The mono method points to using a single data collection technique and its corresponding data analysis procedures, whereas multiple methods are where more than one data collection technique and analysis procedure is used to answer the research questions of a study. In addition, multiple methods have been divided into mixed-method and multi-method studies. Mixed-methods is defined as using both qualitative and quantitative data collection techniques and analysing procedures in one research design. Meanwhile, multi-methods is defined as using more than one method, either qualitative or quantitative, in a single study and analysing them in accordance with their relevant procedures (Saunders et al., 2016). Figure shows the two main categories for research choices.

In social science, Bryman (2012) and Creswell (2009) argued that a researcher can adopt either objectivist or constructionist ontological positions or either interpretivist or positivist epistemological positions. In other words, qualitative or quantitative data or both have been involved in research choices. Saunders et al. (2016) indicate that individual quantitative and qualitative techniques and procedures do not exist in isolation. According to Creswell (2009) and Onwuegbuzie and Teddlie (2003), there are critical issues for both quantitative and

qualitative research that might cause biases, if used in isolation. Therefore, in order to reduce the current gaps in each approach, the combination of both approaches in one main mixed approach was considered as beneficial. As a result, the validity of the findings was enhanced. Bryman (2012) noted that in the mixed research approach positive benefits can be brought by using different methods to collect data since the weaknesses of any one method can be ‘offset’ by the strengths of another method.

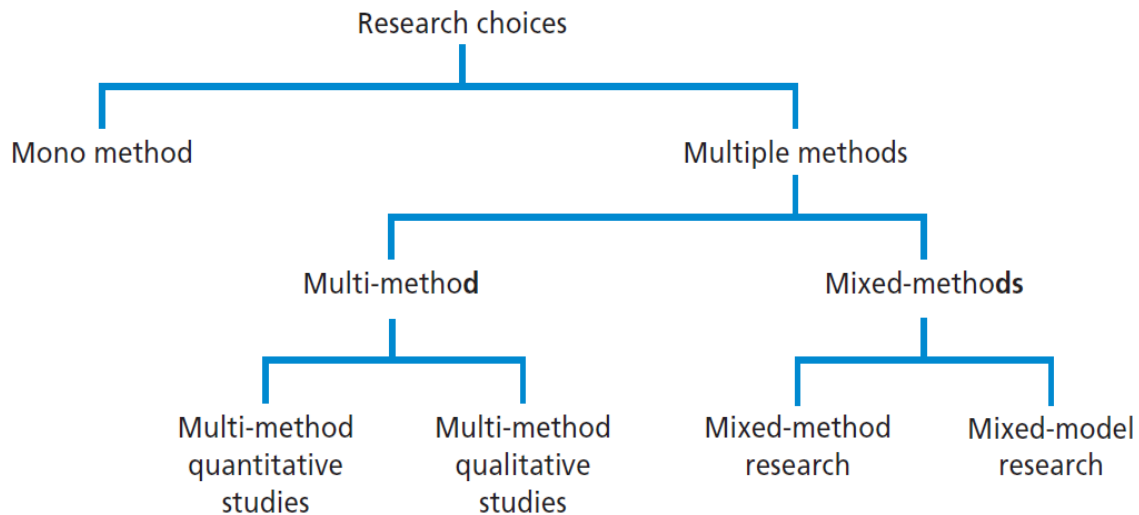


Figure 2: Research Choices (Saunders et al., 2016, p. 152)

Accordingly, more than one data collection technique and analysis procedure was used in this paper. The mixed-methods research choice was most suitable for this paper in order to address the research question. As a result of the complexity of disaster response processes and to understand the real situation of the phenomenon, one single technique would not have been adequate. A better understanding of the phenomenon was therefore obtained from mixed-methods and thus both qualitative and quantitative approaches were applied. The findings of one method were used to clarify the results created by the other.

2.6 Research Techniques

Data collection and their analysis procedures are related to research techniques. Walliman (2006, p. 50) defines data as “the essential raw materials of any kind of research. They are the means by which we can understand events and conditions in the world around us”. The type of data collected can fall into two categories: primary data and secondary data (Saunders et al., 2016; Walliman, 2006). When the data is collected from a researcher’s own study, it is called primary data, while secondary data is the data obtained from existing sources in the pertinent literature. Walliman (2006) argues that although data can be collected from virtually everywhere, it requires a plan of action that uses and identifies the most appropriate and effective methods of data collection. Accordingly, the next section will elaborate on data collection techniques adopted in this paper.

Data Collection Techniques

Various data collection techniques can be employed during a case study research strategy and that is considered one of the main advantages of it. Six sources of evidence can be obtained by a case study strategy, namely, documents, archival records, interviews, direct observation, participant observation and physical artefacts (Dooley, 2002; Yin, 2014), by using multiple sources of evidence, it makes the study more robust. Thus, an investigator can address a broader range of behavioural, historical and attitudinal issues, which lead to the development of a converging line of inquiry and a more accurate and convincing conclusion (Yin, 2014). Using multiple sources of evidence also encourages creating a case study database as well as maintaining a chain of evidence.

In agreement with the aforementioned argument, making records of all relevant evidence and creating a database may help the researcher to meet the study purposes. Such purposes can be obtained further by using a combination of both qualitative and quantitative research i.e. mixed methods research. Moreover, by triangulating the methods as such, a personal understanding of the phenomenon will be enhanced. In this paper, a general picture of the current situation regarding Iraqi disaster response management was gained by using a quantitative method. This provided the answer to the research question “What is the status of disaster response management in Iraq?” In addition, in order to get a fuller picture, an in-depth understanding of the quantitative results was obtained by exploring experts’ perspectives using the qualitative method of interviews. In order to triangulate, some significant and related documents were analysed to help build a more in-depth understanding, and further support the findings that were derived from questionnaires and interviews.

A wealth of information was therefore obtained from both primary and secondary data. In this paper, the resources of secondary data were articles, books, past theses, archival records, legislations, and relevant websites, while primary data were collected through questionnaires, interviews, and documents.

Apropos the questionnaire, an intensive investigation of the literature has been conducted to find the criteria of best practice disaster response management in order to formulate the design of the questionnaire. The questionnaire was therefore designed in accordance with the management stages of disaster management (planning, organising, directing, and controlling) and these were translated into the Arabic language. By conducting the questionnaire survey within the case study, the difference between the levels of importance and implementation of various factors related to the different stages of disaster response management was investigated. By using Likert scale questions, the opinion and behavioural variables can be captured. Five scales of “importance” (unimportant, of little importance, moderately important, important, and very important) were represented by the scale to capture the level of importance. Further, a different five scales of “frequency” (never, rarely, sometimes, very often, and always) were used to capture the level of implementation. In addition, a column for “no opinion N/O” was added for both the scales. This addition is important as it minimises the tendency for giving an inaccurate answer when the respondents lack knowledge or opinion for a specific question (Kulatunga, 2008). In order to deal with the missing data, the “no opinion N/O” option, as Saunders et al. (2016) argue, a special code can be assigned and acknowledged by statistical analysis software. For example, 999 cannot be assigned, it would automatically be removed (Wilson, 2013). Therefore, subsequent analyses can exclude such missing data when necessary (Kulatunga, 2008; Saunders et al., 2016;

Wilson, 2013). **Error! Reference source not found.** represents the values designated for the Likert scale.

The questionnaires were distributed to the staff who were executives responsible for disaster response in the Iraqi General Directorate of Civil Defence. The respondents to the questionnaire were of Captain military rank and above. 53 questionnaire surveys were conducted. All the respondents, for both the questionnaire and the interview, were selected based on the experts' rank, knowledge, experience, and involvement with disaster response teams. The questionnaire was designed to identify the best practice and any gaps in every stage of disaster response management in Iraq. The extent of such gaps acts as a good indicator of the weaknesses and the best practice highlights the strengths of current disaster response management.

Table 1 Values Designated for the Likert Scale

| Scale for importance | Unimportant | Of little importance | Moderately important | Important | Very important | No opinion N/O |
|---------------------------------|--------------------|-----------------------------|-----------------------------|-------------------|-----------------------|---------------------------|
| Scale for implementation | Never | Rarely | Sometimes | Very often | Always | No opinion N/O |
| Value | 1 | 2 | 3 | 4 | 5 | 999 |

Regarding the interviews, Amaratunga et al. (2002) stated that this tool is deemed to be favourable in different research areas when in-depth data is required. It is widely considered as one of the common sources of evidence for case studies, as it generates data which is meaningful, through the possibility of probing questions. The authors were able to clarify any unclear answers (Kumar, 2011) and access sensitive information which might not have been achievable through other means. Further, because this research contains an in-depth study on the current practices related to disaster response management, a semi-structured interview gave flexibility in responses from various viewpoints with the consistency coming from similar themes. The interview was designed and translated to elicit the weaknesses and the strengths of the disaster response management and the recommendations to enhance the current disaster response practices. 28 intensive semi-structured interviews were conducted with Lieutenant Colonel military rank and above. The following are examples of the types of questions that the semi-structured interviews included:

Planning stage

- What are the weaknesses of disaster response at planning stage?
- Why do you think proper planning is needed for disaster response?
- Who are the stakeholders involved?
- What are the strengths of disaster response at planning stage?
- How can we further improve the disaster response at planning stage?

With respect to archival records and documents, this type of data were collected to enhance the reliability and triangulate the research questionnaire and interview data. According to Saunders et al. (2016) and Yin (2014), a collection of archival and current documents as empirical research field data is acknowledged as being important.

In this paper, the archival records and documents that were analysed were identified and provided by the interviewees. Documents such as studies, reports, statistics, follow-up, and legislation were gathered from the IGDCD and other organisations related to disaster response, such as the Iraqi Ministry of Health.

To sum up, by triangulating such techniques, rich and meaningful sets of data have been obtained for analysis, contributing to a more robust study.

3. CONCLUSION

This paper adopted a single holistic case study approach, maintained with the triangulated methods of data collection (questionnaires, semi-structured interviews and document analyses) to explore the current practices related to disaster response management in Iraq. By using a combination of both qualitative and quantitative research i.e. mixed methods research, sets of rich and robust data, including weaknesses, strengths, and recommendations to enhance the current disaster response practices were obtained. Such sets of data were useful to fulfil the authors' information needs towards meeting the aim and the objectives, and answering the research questions in an on-going PhD study. It can be concluded that the use of case study research, combined with triangulated data collection tools and content analysis, facilitated a meaningful in-depth study, which had high reliability and validity, to explore the current response practices within disaster management in Iraq.

4. ACKNOWLEDGMENTS

The authors would like to acknowledge the Iraqi Ministry of Higher Education, who supported this work. In addition, the financial support received from the Centre for Disaster Resilience, University of Salford, enabled the publication of this paper. Special thanks to Maggie Hardman, of the University of Salford, who supported the English language development.

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THE NEED FOR THE RECONSTRUCTION OF AFFORDABLE HOUSING FOR THE INTERNALLY DISPLACED PEOPLE DUE TO CONFLICT IN NIGERIA: A LITERATURE REVIEW

Y.A. Abdu and C.P.Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: y.a.abdu@edu.salford.ac.uk

Abstract: Over the years, Nigeria has witnessed its share of conflicts as a result of tribal, political and religious differences. All these conflicts become pale in comparison to the destruction caused by Boko Haram Islamic extremist group. As a result of several attacks carried out by the group, more than five million people have been displaced. Internally displaced people are group of people who lost their shelter and livelihood due to conflict. The internally displaced people in Nigeria are faced with different problems ranging from lack of clean water, food, medicine, clothes among others, but the biggest challenge these people are facing presently is lack of housing. The aim of this paper is to examine the need for the provision of affordable housing to the internally displaced people in Maiduguri, Nigeria. The critical literature review on the need for the provision of affordable housing to the internally displaced people shows that one million houses belonging to the IDPs have been destroyed by the Boko Haram terrorist in Borno State, Nigeria. The vast majority of IDPs are presently domiciled in makeshift camps spread across the country. Most of these camps are breeding grounds for inhumane and undignified conditions which in turn give rise to a multitude of appalling factors ranging from lack of the bare social amenities needed to survive to rape and death from exposure and malnutrition. Lack of adequate housing has exposed the IDPs especially women and children to all sorts of environmental and manmade dangers. Provision of housing to this group of people will play a significant role in their rehabilitation by improving their living condition.

Keywords: Affordable Housing, Boko Haram, Conflict, Internally displaced people, Post-conflict reconstruction.

1. INTRODUCTION

The danger attach to violent conflict, terrorism and war at different levels ranging from intra-individual violent conflict self-harming to general inter-group violent conflict in the process of capturing political, economic or social power is consider by World Health Organisation as the greatest challenge ever the entire world will face in this era (Senevirantne et al, 2014). Post-conflict reconstruction is like any other concept, there is no single acceptable definition regarding post-conflict reconstruction. Post-conflict reconstruction is an activity carried out by the government in collaboration with non-governmental organisations, stakeholders, civil societies after a natural or manmade disaster to rebuild the damage areas for achieving sustainable peace and development (Hongguang and Zhengai, 2015). Post-conflict reconstruction also includes some aspects such as social and economic development, security, political leadership, gender, and justice. The intensity of the consequences of violent conflict can be noticed based on some statistical analysis.

According to Secretariat (2015) 191 million people have died as a result of political conflict and war in the 20th century, and at the end of the century additional 4 million people lost their lives due to armed conflict. However, after the Second World War, over 189 violent conflicts

took place and presently every part of the world has experienced or is witnessing violent conflicts or armed conflicts. In 2008, 28 conflicts took place in 24 different countries around the world, and it is estimated that more than 1000 people will be dying each year because of conflict. This analysis did not include Africa and Asia being considered as the most violent affected regions with almost 80% out of the world armed conflicts.

In addition, the violent conflicts such as political conflict, terrorism, a war that took place across the world have left many governments with the task of rebuilding the post-conflict communities like Afghanistan, Iraq, Ivory Coast, and Nigeria. Recently post-conflict reconstruction has developed and become an important approach with a special history (Amaratunga et al, 2010). The objective of post-conflict reconstruction go beyond providing humanitarian aid and include achieving international stability, regional agenda, security and building a sustainable democracy. The aim of this paper is to examine the need for the reconstruction of affordable housing for the internally displaced people due to conflict in Nigeria. A critical literature review was conducted to explain the need for the reconstruction of affordable houses for the internally displaced people due to conflict in Nigeria. The paper is set out as follows. The paper discusses the concept of post-conflict reconstruction, disaster and its management, affordable housing in general, nature of the Boko Haram conflict, impact of the conflict on housing demand in Nigeria and the need for the reconstruction of affordable housing for the internally displaced people due to conflict in Nigeria.

2. DISASTERS AND ITS MANAGEMENT

The natural and manmade disaster has caused a lot of damage to the entire world. The significant impact of the disaster on the built environment and societies have been noticed by the entire world in the past decade, due to the increase in the destruction of human, built and natural environment. According to Forcael et al. (2014) there are about 373 natural disasters that took place which caused the death of 296,000 people and directly or indirectly affected 208 million others and believe to have cost 110 million dollars. The concept of disaster has been defined in different ways by different authors and disaster management practitioners. Smith et al. (2014) defined disaster as a social phenomenon that occurs unexpected and societies suffer a lot due to the level of destruction of lives and properties. In a situation where hazard turns to active reality and cause damage to the human and natural environment, that automatically becomes a disaster. Amaratunga et al. (2011) argued that, though the origin and the causes of disasters vary, the impacts of disasters on communities remain the same which include loss of life, destruction of the economy, social institutions and livelihood among others. There are two types of disasters namely natural and manmade disasters and these disasters have caused a lot of damage to every part of the world.

Natural Disaster; this is a major disaster that occurs naturally which cause human and environmental destruction. A natural disaster can take different forms such as earthquake, flood, storms, volcanic eruption, tsunami and other geological disasters (Kruger et al, 2015). The nature of the consequences of the above-mentioned disasters depends on the resilience of the communities or their ability to recover from the damage caused by these disasters. The impact of different disasters on societies and the built environment is one of the major challenges global communities are facing presently.

Manmade Disaster; when talking about disaster it is necessary to also talk about human suffering; manmade disasters are quite different from natural disasters and these disasters can

come in different forms such as conflict, war, terrorism, diseases, geological disasters, financial crisis, unfavorable economic and social policies can also form an important part of the disaster. These disasters are responsible for causing a lot of suffering specifically among the vulnerable groups most especially women and children, poor and older people. The definition of disaster has continued to expand and presently it has included manmade disasters. The level of destruction caused by natural disaster across the world is so broad, but the impact of manmade disasters on societies and built environment is much broader. According to Secretariat (2015) millions of people were displaced recently from different locations out of 59 conflicts and it was estimated that over 1.4 million children were killed during the conflict.

Conflict can occur when there is a clash of political, social, economic interest between individuals, group or communities or because of religious differences. Crossman (2014) sees conflict as an irreconcilable discussion that takes place between individual, group or community in the process of pursuing some certain goals by preventing other community, groups or individuals from pursuing the same goals and achieving them. Bhavnani (2006) further explain that conflict is part of society and has significant influence over the evolution of society. However, Billon and Waizenegger (2007) adds that conflict is part of society and it causes societal disorder and integration. Alexander (2013) argued that researches conducted within disaster management have concentrated more on areas such as disaster impact, disaster risk reduction, post-disaster recovery, and reconstruction instead of focusing on the consequences emanating from manmade disaster.

There are different phases through which disaster can be managed or control. Disaster management cycle is an important instrument mainly use for controlling disaster and its consequences. Caymaz et al. (2013) divide disaster management cycle into four different phases, which include preparedness, emergency response, relief, mitigation, recovery, and reconstruction. However, Smith et al. (2014) further divides disaster management into two different parts. Preparedness, Mitigation and risk assessment as pre-disaster protection and relief, rehabilitation and reconstruction as post-disaster recoveries. Therefore, in order to minimize the impact of the disaster and to be disaster resilient, there is a need to concentrate on all the disaster management activities. Pre-disaster protection encompasses different activities such as risk assessment, for example, identifying and understanding the degree at which the society are vulnerable to disaster. The preparedness stage reflects on how ready the society is to respond to disaster when it occurs in terms of short term and long term.

Post-disaster recovery involves different activities that are carried out in stages immediately after a disaster. The rescue operation will be the first activity; follow by the provision of relief materials to the victims such as food, medicine, water and other means of livelihood to avoid further threat to the life of the victims. The next activity is the rehabilitation which commences normally in a few days after the rescue operation to bring normalcy within the community affected (Smith, 2013), and the extent of the rehabilitation will depends on the impact of the disaster. The final activity will be the reconstruction project; this is a long-term activity which is carried out by the government in collaboration with donor agencies to rebuild the structures affected by the disaster. Reconstruction is a process of rebuilding the area damaged by the natural or manmade disaster to achieve sustainable peace and development. Figure 1 shows disaster management cycle by Kawata (2001).

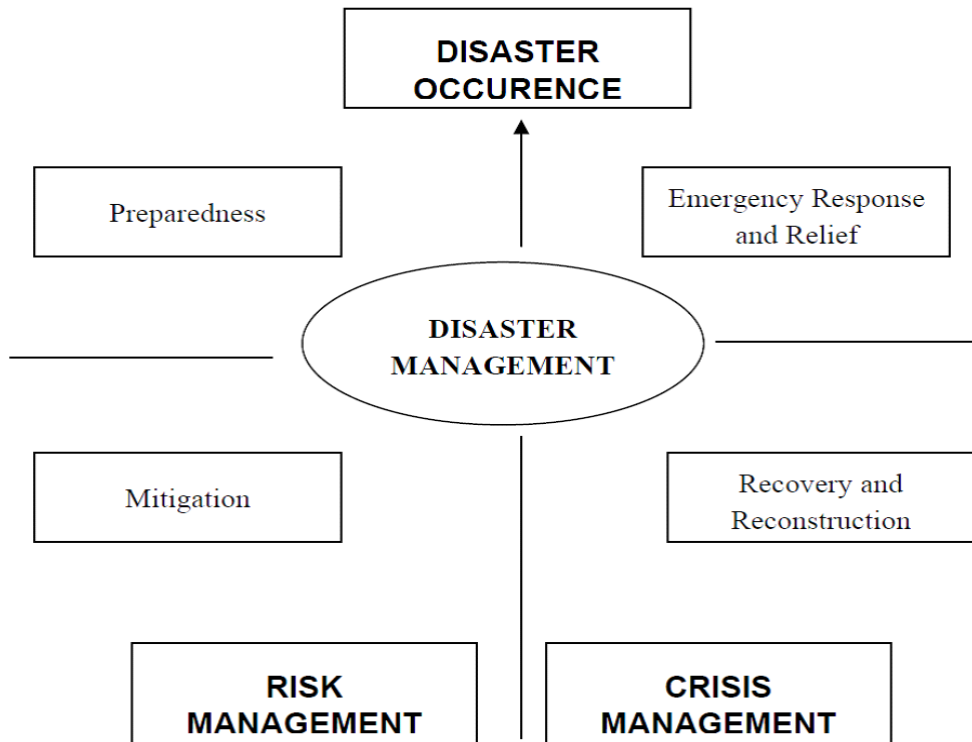


Figure 1: Disaster management cycle (Source: Kawata, 2001)

According to Lin et al. (2007) providing humanitarian assistance or intervention during or after a disaster and providing means of livelihood is part of the relief activities. The most significant aspect of relief activities is the provision of temporary camps until when affordable housing is provided for the displaced people (Lloyd-Jones and Kalra, 2010). Reconstruction of housing for the victims of natural or manmade disaster is one of the most important aspects of post-disaster reconstruction (Pheng and Chuan, 2006). This paper focused on the need for the reconstruction of affordable housing for the internally displaced people due to conflict in Nigeria.

2.1 Post-Conflict Reconstruction

Post-conflict reconstruction play significant role towards moving away from a conflict situation to a peace situation within the affected community through rebuilding the socioeconomic activities of the affected community. Considering the nature of the violent conflict, the end of hostilities does not in any way indicate the actual transition is achieved, but it does signify a significant point in this regard. Post-conflict reconstruction does not only mean reconstruction of the affected physical infrastructure or rebuilding the stable socioeconomic activities that exist before the conflict (Hongguang and Zhengai, 2015). Conflict if last for so long has the potential of transforming society and for the society affected to return to its normal state may take time. What is important is the reconstruction of enabling an environment for a healthy, functioning peaceful society. The role played by non-governmental organisations including World Bank is to support the process, but not to implement it. After the Second World War, an international organisation such as United Nations, World Bank, International Monetary Fund and Non-governmental organisations have played a significant role by providing a lot of resources for post-conflict reconstruction (Yilmaz, 2009). The post-war reconstruction of Germany and Japan set an example of the

importance of post-conflict reconstruction and nation-building in some countries like El-salvador (1991), Cambodia (1993) and Gaza in (2009). Recently post-conflict reconstruction has developed and become an outstanding approach with a special history. The objectives of post-conflict reconstruction have gone beyond providing humanitarian aid and comprise the introduction of regional agenda, international stability, security and democracy building.

The literature reviewed in the past on post-conflict reconstruction and nation building has resulted to some conclusions. The first conclusion is that there is a lack of enough theory on post-conflict reconstruction. Certainly, the post-conflict reconstruction carried out in Iraq in the last few years, and the assessment conducted by the Inspector General of the Reconstruction (SIGIR) which was titled the Hard Lessons concludes that post-conflict reconstruction is a difficult project. In the past United States was found in post-conflict reconstruction efforts which the country did not expect (Kamps et al, 2009). The assessment also traced the existence of post-conflict reconstruction gap or gaps between the number of post-conflict reconstruction projects to be carried out and the number of projects that were successfully completed.

3. AFFORDABLE HOUSING

The concept of affordable housing is multi-dimensional and complex but can be generally defined in economic terms. Asfour (2017) sees housing as one of the basic needs of every human being and having access to quality and affordable housing play a crucial role in individual lives. Housing has a great impact on the socio-economic advancement of a country as well as contributes to the growth, stability and health conditions of a society, which can lead to the development of a society. However, (Woo and Mangin, 2009) defined affordable housing as a house that a certain family can acquire within a long period without pressure, which sometimes can take up to 25 to 30 years. (Gopalan and Venkataraman, 2015) further explained that the period can be determined by the family purchasing power and the financial assistance or support the family might receive in the process as loans, subsidies or credits.

The issue of affordable housing is a global phenomenon as many governments around the world have made efforts and still making effort to tackle the challenges of providing adequate, affordable and quality housing to their citizens in the last few decades. Housing is among the major components for sustainable growth and development of a society (Nubi and Oyalowo, 2010). However, (Keiner, 2005) further explain sustainable development from a general perspective and classified it into three interactive concepts which include social, economic and the environment.

4. METHODOLOGY

Research methodology is an organised way or framework through which a research is carried out (Remenyi and Williams, 1998). It also explained the best approach to a problem that can be put into practice during the process of conducting a research. The aim of this paper is to examine the need for the reconstruction of affordable housing for the internally displaced people in Maiduguri due to Boko Haram conflict in Nigeria. This paper is purely based on literature review, which includes journals, previous research, articles and other theories related to the area of the study. The literature will be the only source of data gathering in this research and discuss what the researcher gathered from the literature. However, different

studies were reviewed and critically analysed. The aim is to examine the effect of the Boko Haram conflict on the housing demand in Nigeria to identify and understand the need for the reconstruction of affordable housing for the internally displaced people in Maiduguri due to Boko Haram conflict in Nigeria. Therefore, the researcher reviewed the nature of the conflict, the effect of the conflict on housing demand in Nigeria and the need for the reconstruction of affordable housing for the internally displaced people in Maiduguri due to Boko Haram conflict in Nigeria.

5. NATURE OF THE BOKO HARAM CONFLICT IN NIGERIA

Nigeria is divided into three regions the Northern region which is predominantly Hausas practicing Islam, the western region which is predominantly Yoruba's with majority practicing Christianity (Bliesemann, 2014) and few practicing Islam while the Southern region is predominantly Igbos and other tribes practicing Christianity. Northern Nigeria is made up of 19 states out of 36 states in Nigeria. Northern Nigeria is the original home of the Boko Haram terrorist and home to over 120 million northerners with 95% all Muslims. (Adesoji, 2010) believe the issue of radical Islamism is not a new phenomenon in the northern Nigeria considering the violent crisis that took place between Islamic group called Maitatsine and Nigerian police force in Kano in 1980 and Maiduguri in 1982. In 2002 an Islamic group called Boko Haram emerged in the North-Eastern part of Nigeria.

The word Boko Haram is a combination of words derived from Hausa Word Book, which means (Book), and Haram is an Arabic word, which means impermissible (Forbidden). Combined Boko Haram means Western education is forbidden. Mohammed Yusuf formed Boko Haram in 2002 with aim of practicing Islamic teachings and later the group try to influence Borno state government to introduce Islamic legal system (sharia) in Borno State (El-Bushra et al, 2014). Yusuf builds a big Islamic center in Maiduguri that comprises Mosque and Quranic School where a lot of the poor Muslim families across the North and neighboring countries of Chad and Cameroon enrolled their children to learn Arabic.

The group succeeded in recruiting more than 270,000 members across Nigeria, Chad, and Cameroon. The members of the group are retired Bankers, University lecturers, Politicians, Unemployed graduates, Migrants and Drug addicts. In 2009, the mosque where the group observes their prayers was searched by the combined team of military and police, guns, ammunitions and other materials the group used in making explosives were recovered and seized by the security officers (Agbiboa, 2013). However, as a result of the operation, the group mobilised their members and stage a violent attack against security agencies, which caused the deaths of many security officers and civilians. However, during the operation, the leader of the group Yusuf together with over 800 members was captured and killed by the police.

5.1 Impact of the Boko Haram Conflict on Housing in Nigeria

The nature of the consequences caused by conflict is so enormous, but it all depends on how the communities affected react to the damage caused by the disaster. Lipsky (2007) believe people leave in conflict, which is not by mistake, but because of human nature, as people try to control one another. However, man overview could not end the search on why violent conflict occurs in the society. Therefore, the need to understand the causes of a conflict

became the basis for developing effective conflict management mechanism. In the past, Nigeria has experienced different violent conflicts caused by different religious groups, but the violent caused by the Boko Haram group is quite different (Ahokegh, 2012). For example, the violent conflict that erupted in Jos that caused the death of many people took place only in Plateau State and the Niger Delta conflict was within the creeks of Rivers State.

The group carried out several bombs and snip attacks that caused the death of thousands of people from all parts of Nigeria. The number of people dying increased every day which shows how strong and sophisticated the group is in terms arms (Agbiboa, 2013). The human right organisation stated that more than 3500 people were killed from 2009 to 2012 because of Boko Haram violent attacks (Onuoha, 2012). In April 2013, more than 186 people were killed after a crossfire confrontation between the group and joint task force, which thus Baga town in Maiduguri was burnt completely. During the attack 2,128 houses, 40 cars and other structures were destroyed. The post-conflict assessment carried out in accordance with standard practice which is verified through satellite images (Shettima, 2016), and physical analysis by the Borno State government recently shows that one million houses were destroyed by the Boko Haram terrorist across the 27 local government areas in Borno State, since emergence of the group in 2009. This has drastically increased the demand for housing in Nigeria particularly in Borno State considering the number of houses destroyed by the terrorist group from 2009 to date.

6. THE NEED FOR THE RECONSTRUCTION OF AFFORDABLE HOUSING FOR THE INTERNALLY DISPLACED PEOPLE DUE TO CONFLICT IN NIGERIA

The concept of internal displacement due to natural or manmade disasters and violation of human rights is an old phenomenon. In 1990 United Nation started giving serious attention to internally displaced people and in 1998 the United Nation Commission on Human rights came up with a guiding policy with regards to internal displacement (Adewale, 2016). Though, the commission grants non-governmental organisations (NGOs), stakeholders and other corporate bodies the permission to assist internally displaced people. However, the commission places the responsibility of internally displaced people (IDPs) rehabilitation, reconstruction, and settlement on government. Internally displaced people are victims of natural disasters or due to a humanitarian crisis. Kalin (2008) sees internally displaced people (IDPs) as individuals, group of people who are forced to leave their original homes as a result of natural or manmade disasters.

Nigeria has experience different crisis since independence and this is due to ethnic and religious differences which make it very difficult for the people to live in peace and harmony (Basse and Dokubo, 2011). These crises were caused by different militia groups since when the country returned to democracy in the third republic. The names of these groups are as scary as their set objectives. For example, the Maitatsine, the Odudua People`s Congress (OPC), the Egbesu Boys of Africa Congress (EBAC), the Movement for the Actualisation of the Sovereign State of Biafra (MASSOB). The conflict caused by these groups pale in comparison to the violent conflict caused by Boko Haram in terms of destruction of human, built and natural environment. The terrorist group have carried out different attacks from 2009 to 2016 which caused the deaths of thousands of people and caused internal displacement of millions of people across Nigeria. On 27 of July 2009 the group carried out an attack on the police headquarters and police mobile college and other structures in Maiduguri. The group manage to get access into police mobile college and destroyed over 9

houses and killed many police officers. During the attack, which lasted for five days several churches, mosques and other police stations in Lamisula and Gambori Gala in Maiduguri were also attack (Onuoha, 2012). After the attack, over 3500 people were confirmed displaced, 1264 children became orphans and over 392 women also became widows. However, 28 police officers, five prisoners and many soldiers were killed. Among the properties destroyed includes 48 buildings, three schools several churches, mosques and court buildings among others (please refer to Table 1).

Table 1: Damages in Maiduguri (source: Onuoha, 2012)

| | |
|--------------------|-------------------------|
| displaced people | 3500 people |
| Orphans | 1264 children |
| Widows | 392 Women widows |
| police officers | 28 police officers died |
| prisoners | 5 prisoners died |
| soldiers | Many soldiers killed |
| buildings affected | 48 buildings destroyed |
| schools affected | 3 schools destroyed |

In Nigeria, presently there are more than five million people that are displaced as a result of several attacks carried out by Boko Haram terrorist across the country. The internally displaced people in Nigeria are faced with different kinds of challenges that include lack of clean water, medicine, food, clothes, security among others, but the biggest challenge these people are facing is a lack of reasonable housing. The way in which these people are living in various camps within Nigeria are raising a serious concern about the level of attention these people are receiving from the government agencies responsible for their rehabilitation (Shettima, 2016). The Majority of the camps are breeding places for inhumane and undignified conditions which in return provide a platform where some appalling factors such as lack of bare social amenities to survive rape and death from exposure and malnutrition. Lack of adequate housing has exposed these people most especially the women and children to all sort of environmental and manmade dangers. Therefore, provision of housing to this group of people will improve their living condition and play a significant role towards their rehabilitation back to the society.

7. CONCLUSIONS

This study has examined the need for the reconstruction of affordable housing for the internally displaced people in Maiduguri due to Boko Haram conflict in Nigeria. The researcher finds out that, post-conflict reconstruction is an important aspect towards achieving sustainable peace and development. The objectives of post-conflict reconstruction presently are beyond providing humanitarian aid, but also include achieving international stability, security, and democracy building. Therefore, the internally displaced people in Nigeria will continue to be exposed to all sort of environmental and manmade disasters until the government provides affordable housing to this group of people. However, it is expected the findings from this research will provide insight to the Nigerian government on the need for the provision of affordable housing to the internally displaced people in Maiduguri due to Boko Haram conflict in Nigeria.

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KEYS ELEMENTS OF EFFICIENCY OF LAND TENURE SECURITY AND PROPERTY' RIGHTS

L. Al-Ossmi¹, M. Hammad², D. Baldry¹, H. Al-Mimar³ and A. Al-Janabi³

¹ *School of the Built Environment, University of Salford, Salford, M5 4WT, UK*

² *College of Engineering, School of the Architecture, Libya University, Libya*

³ *Al-Israa University College, Baghdad, Iraq*

Email: Laithhady@ymail.com

Abstract: This paper explored in detail the administrative performance of the Land Tenure Administration (LTA) and the Land Tenure Security (LTS) regarding to the Iraqi land users' views. The aim of this paper is to explore the obtained results from the quantitative data that were considered in a case study, by analysing the quantitative data collected from the questionnaire survey applied in the Al-Nassiriya city in Iraq. To achieve this, a survey was undertaken targeted at land users in the case study sample within 3 settlements in Al-Nassiriya city. The data comes from 293 participants. The paper' findings help to highlight the critical factors that contribute to the LTA implementation and to assess their current level of success in Iraqi case. The gathered data also helped identify the current barriers preventing end-users to successfully implement the development of LTA in their current experience in term of tenure rights. Evidences showed that the Iraqi LTA system carries out further steps to enhance and respond to the emergency needs during this period, but problems are directly linked to the authority' weakness, the current sphere of interim conflicts, and a wide set of complex emergencies after the collapse of regime in 2003. The outcomes of this study indicated that the Iraqi LTA is qualified and stemmed from the Iraqi rooted legislations within long periods to develop their strategies in ILAs, which helped its resistance against the critical situation, and it has a further authenticated mechanism to provide solutions against the insecurity of tenures.

Keywords: Land Tenure, Land Administration, Tenure Security, Property Rights, Iraq.

1. INTRODUCTION

It has suggested that 'Tenure' is a matter of possession awareness; it can be held by individuals or groups and under various forms in order to secure the users' rights (Payne, 2012; USAID, 2005). Also, a useful summary of the land tenure is provided by UN-Habitat (2005) that observed that it as an issue of varying elements created to manage land right within the registry titles within the institutional authorities. In practical terms, land tenure is the relationship, whether legally or customarily defined, among people as individuals or groups, with respect to land (UN-Habitat, 2012). In general, the Land Tenure Administration (LTA) is not a new discipline (see UN-Habitat, 2003; FAO, 2012). Noticeably, reviewing the literature shows that the governance of tenure is a crucial element in determining tenure policies and how peoples use and benefit from tenure rights officially, thus LTA is an effective way of enhancing the people rights in lands. In general the empirical studies stressed that policies of LTA need to be related to the legislative capability, community relationships and the stakeholder's satisfaction regarded the land tenure administration (Davis, 2004; Sinha, 2002; UN-Habitat, 2006; Hamid, 2007; FAO, 2012). According to USAID (2010) land tenure policy is the tool employed by governments to outline a set of goals, and measures aimed at meeting objectives related to land administration structures. In addition, tenure security is linked with the users' right which is closely relevant to a state's ability to manage a protection to the rights through legal declarations and plans of action

(UN-Habitat, 2012; Sietchiping, 2012). Thus, the instable tenure' governance is the essential way in which tenure problems are raised, as it may lead to bureaucratic inactivity and corruption situation in LAS procedures since tenure policies can be affected directly by the quality and governance efficiency.

In relation to Iraqi judicial regulations, the Iraqi Land Authorities (ILAs) have showed many inadequate administrative problems (USAID, 2005; Shaikley, 2013). A significant number of which are a result of social and political conflicts and complex legal institutional policies (Al-Rashid, 2005; UN-Habitat, 2012; Shaikley, 2013). In general, the post-war environment, inter-communal violence and continue instable periods have a significant role in the Iraqi land administration and therefore it needs to be well-documented. With this in mind, the paper has focused on the sustainable institutional aspects of the tenure administration as the principal mechanism through which tenure security can be sought. As result of this, the absence of an ability to address the more fundamental supply rights of land and property, inappropriate regulatory frameworks, conflicting policies (weak governance), disagreeing ideologies, and weakness of local administrative mechanisms; all will lead to a lack of tenure security.

The study urges that the effective management and monitoring of LTA can help the national development and build of a strong plan within the ILA in order to improve its efficiency. This motivation can be used as a powerful tool to help ILA to reach reasonable LTA solutions in relation to land tenure security. To achieve this, a survey was undertaken targeted at land users in the case study samples in Al-Nassiriya city. The data came from 293 questionnaires samples which were returned after distribution of 384 questionnaires was made. This research has been motivated by the continued impact of instable and insecurity situation in Iraq. Also, the paper aimed to identify the impact level of the current insecurity situation and the weakness of the government's role on the tenure security, and this can be done through interviewing samples of people as an end-users of LTA and the current policies associated with the ILAs, at the local level (in the case study of Al-Nassiriya city). The case study's experience in the LTA will provide the opportunity to identify current levels of satisfaction and as well as the administrative problems which can be directly linked to the future development in the Iraqi urban areas.

1.2 The study design

This study is driven by the need to bridge the gap in the current literature in terms of identifying the sustainable institutional aspects of the land administration system under the current situation in Iraq as the principal mechanism through which LTA can be sought. It has been motivated by the continued impact of instable and insecurity situation in Iraq. As the critical situations of post-war, economic crisis and terrorism waves in Iraq are now heading towards leading the country to a develop an urgent national policy, there is also a need to put forward a strategic approach that helps the ILA policy to build an efficiency implementation of LTA and ensuring the users' satisfaction in Iraq to achieve better practices. While post-war environments and inter-communal violence impacts continue to occur in the country, the research provided the opportunity to identify current problems of LTA, which can be directly linked to these factors of the current insecurity situation in the Iraqi urban areas. The paper aimed to identify the impact level of the current insecurity situation and the weakness of the government's role on the tenure security and end-users' rights, and this can be done through interviewing samples of people as an end-users as beneficiaries of LTA and the current

policies of tenures associated with the role of the Iraqi Land Authorities (ILAs) at the Iraqi local level (in the case study of Al-Nassiriya city). The case study's experience in this paper used to provide the opportunity to identify current levels of the end-users satisfaction and as well as the administrative problems, which can be directly linked to the future development in the Iraqi urban areas. In this connection, this paper built on the obtained key themes of the research, which are shown as follow: 1) *the role of ILAs strategies for meeting the LTA and the end-users' rights*. 2) *The factors affecting the Success/failure of LTA, and for obtaining LTS*. 3) *The perception of future success*. In general, these themes were constructed in order to answer the survey questions, which are listed as follow: 1) *What are the main factors affecting the efficiency of LTA, and how do these factors affect the current LTA in ILAs strategy?* 2) *How effective is the implementation of LTA in ILAs strategy, and does it meet the end-users' rights?*.

The selected samples

The selected sample of the questionnaire and a key issue in choosing were identified. The sample comprised 384 people (end-users) of 3 different Neighbourhoods in Al-Nassiriya city in Iraq. It was targeted to secure responses from a wide variety of land user's respondents with real experience of land tenure and security of tenure rights. The sample was constructed by asking individuals who experienced LTA and have current level of security of land tenures rights in these 3 different Neighbourhoods. The nominated neighbourhoods are these were established during the Baath's period such as Al-Seef neighbourhood (the oldest neighbourhood in the Al-Nassiriya city), and Al-Salihiya neighbourhood, also one neighbourhood (AL-Eskan neighbourhood) was selected as a presentative simple of current situation after the collapse of the Iraqi regime in 2003. The survey was distributed to 384 land users of different age, gender and qualifications in nominated neighbourhoods inside the Al-Nassiriya city.

Of these copies despatched to the selected sample, only 293 were returned, thereby giving a response rate of 86 %. As such, a very good response rate was achieved under the unstable and insecurity situations. Table 1 gives detailed of the sample. It is noted from table 1 that the sample included 293 people (86%) in 3 neighbourhoods. Table 1 gives detailed of the sample.

Table 1: Samples of the questionnaire respondents

| Neighbourhood names | ^(a) Municipal No. | ^(b) Units No. | ^(c) Population | Sample size | Obtained response | ^(d) Percentage |
|----------------------------|-------------------------------------|---------------------------------|----------------------------------|--------------------|--------------------------|----------------------------------|
| • <i>Al-Seef</i> | 106 | 87 | 21392 | 100 | 98 | 33.43 |
| • <i>Al-Salihiya</i> | 138 | 448 | 26035 | 100 | 100 | 34.13 |
| • <i>Al-Eskan</i> | 406 | 1264 | 12048 | 184 | 95 | 32.44 |
| Total | - | 1799 | 59475 | 384 | 293 | 100.00 |

*a. Gatherings squatter camp in the residential neighbourhood (Municipality of Al-Nassiriya city, 2015).
b. Number of squatters units in the neighbourhood (The Iraqi Central Bureau of Statistics, 2015:p.70).
c. Estimation of population of neighbourhoods (Municipality of Al-Nassiriya city, 2015).
d. The percentage of the returned samples from these distributed in each neighbourhood.*

The total response from these nominated neighbourhoods was higher in these couple neighbourhoods that were established and inhabited before the collapse of Iraqi regime in 2003 (AlSeef and Al-Salihiya) than that one which was established and inhabited after, because this neighbourhood (Al-Eskan) was influenced with illegal occupancies and most of its land users had lived in semi-slums settlements and the researcher had to rely upon the directors and policemen to visit and contact them to request their participations. In general, the samples used in the survey were drawn from shelters unit's users, only families were selected and the head of the family was surveyed. Before carrying out questionnaires in these 3 neighbourhoods, letters were despatched to these selected samples in which the research was introduced, its goal explained and permission for its execution asked. In this research, the Cronbach's alpha was used to measure the internal consistency of the questionnaire. In this context, the Cronbach's alpha for this questionnaire was found (0.771443) which is in the acceptable range, thus implying that the results obtained from the questionnaire are repeatable, trustable and reliable to an acceptable level. All the participants are doing so completely voluntarily and may choose to withdraw at any time. Also, potential participants were asked whether they were willing to participate in this survey. In addition to a participant invitation letter to invite participants to contribute in this survey which confirm that his/her response to this survey, or any individual question on the survey, is completely voluntary and that his/her identities or personal details will not be disclosed to others, except for research purposes, and any data used in the report will not be linked to any respondents. For safety reasons no surveys in semi-slum zones were performed under the police supervision. Also, Data were collected in Jan. 2016 for Al-Seef neighbourhood, and Al-Salihiya neighbourhood, and later for AL-Eskan neighbourhood. Figure 1 graphically illustrates the study areas, in which the data was distributed and collection in Al-Nassiriya city, Iraq.

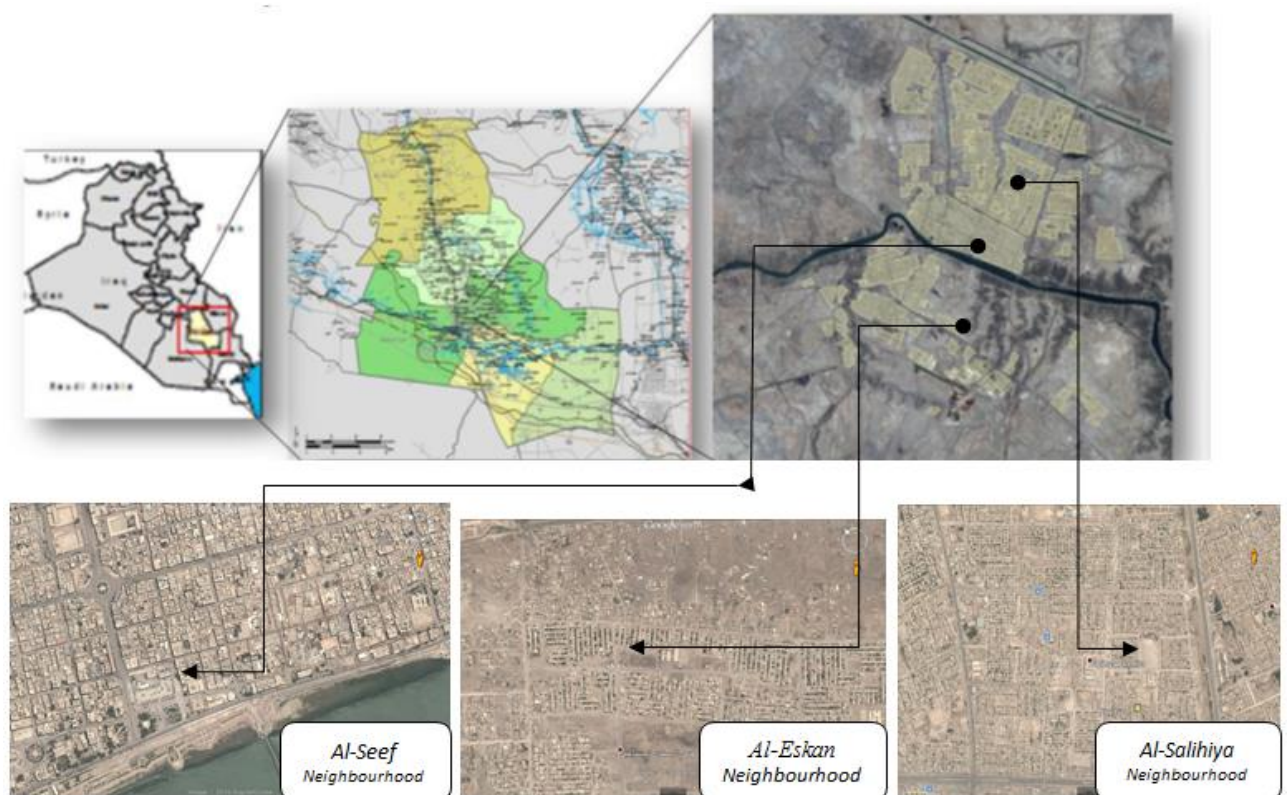


Figure 1: The study nominated areas and data collection sites in Al-Nassiriya city in Iraq.
(Collected from Google maps)

2. PROFILE OF THE NEIGHBOURHOODS

Questionnaires were either taken face to face in the participant's shelter or by sending the copies and waiting to receiving them after two days according to the favourite of the participant; many copies were unanswered and needed to be resent to the participants particularly in AL-Eskan neighbourhood. The first neighbourhood is Al-Seef which is located in the older portion of the city was built mainly from sun-dried brick and I-shape steel ceiling frame for traditional Courtyard Housings (UN-Habitat, 2010a), new portions of the city are comprised mostly of concrete block or brick buildings. Recently, the city is consisting of 26 neighbourhoods with the University site. Al-Seef neighbourhood is the oldest neighbourhood in the Al-Nassiriya city. This neighbourhood is also located in the southern central portion of Nassiriya; it is a part of the largely residential Al-Jazeera section of the city north of the Euphrates River, and lies on the north bank of the river itself (Figure 2). Al-Salihiya is the second sample which is located in the northeast of Al-Nassiriya city, adjacent to part of Al-Seef's northern border. This neighbourhood is a part of the largely residential Al-Jazeera section of the city, and north of the Euphrates river. According to the Al-Nassiriya city municipality, Al-Salihiya was established in the 1960s, when the government distributed plots to people primarily for residential use, and in the 1980s, homes were also distributed to families of war casualties, military members, and teachers under the Baath's regime (Figure 3). Al-Eskan is located towards the south eastern edge of Al-Nassiriya; it is part of the largely industrial Al-Shamiya section of the city south of the Euphrates River, and lies close to the south bank of the river. In other parts of this area, empty government land has given way to squatters and informally constructed dwellings, within informal housing zones, where vacant plots have been occupied illegally. Many parts of this area are in severe need of improved basic infrastructure (Figure 3).



Figure 2: The Al-Seef Neighbourhood in Al-Nassiriya City (Google earth map, 2016).



Figure 3: The Al-Salihya Neighbourhood in Al-Nassiriya City (Google earth map, 2016).

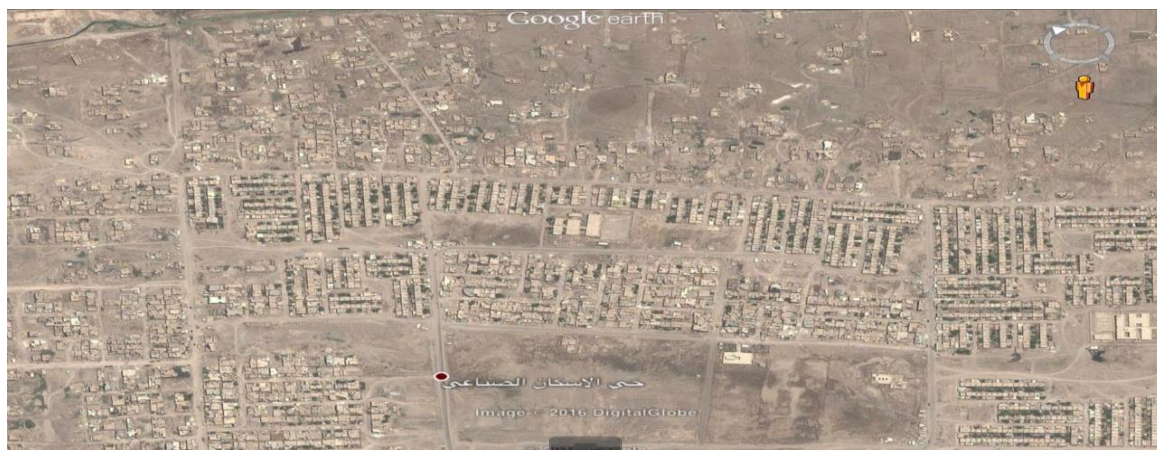


Figure 4: The Al-Askan Neighbourhood in Al-Nassiriya City (Google earth map, 2016).

As mentioned in table1, the paper objectives are achieved by presenting the data collected through the questionnaire process. To achieve this aim, the questionnaire consisted of the following sections:

Section I :The Role of ILAs Strategies in Meeting the LTA

This section asked for responses of participants regarding the role of ILAs programmes in meeting the LTA and securing the end-users rights and then opinions regarding suitability of current aspect of LTA and Conventional procedures in the current mechanism allow land users to obtain these rights, and then the end-user’s satisfaction level regarding the applying of LTA implementation from ILAs policies.

Section II: The Factors Affecting the Success/Failure of LTA

Participants were asked to identify the main factors influencing the success/failure, and how do they influence the LTA regarding the security of the end-users rights. Therefore, Participants were asked to evaluate the existing impact of the Iraqi social and political

conflicts period after the events in 2003, and how the existing administration of LTA is influenced (success/failure) as a result of the Iraqi situation.

Section III :Indicators for Success/ Failure

This section explored the opinions of end-users regarding the land authorities' awareness of these factors that enable /hinder the applying of LTA implementations, and what was the current level of its success in ground. This section investigated participants' responses concerning their legal awareness about their permissible rights and responsibilities under the current situation influence or in the ILAs performance.

2.1 The data analysis

The following statistical tests were used conducted where appropriate:

- a. Analyses of attributes:** in this paper, Participants' backgrounds were grouped into two categories which were analysed in percentages and summary of frequency. This helped to explore the response sample in relation to their gender, age, current position and level of education.
- b. Analysis of responses:** some of data collected from participants' responses was ranked within 1 to 3 categories, and the percentages of frequency in each of these neighbourhoods were calculated and tabulated. Also, other data was collected from multiple-choice questions.
- c. Mean Scores:** This technique was used to investigate the factors influencing the development of LTA and the level of satisfaction.
- d. Cross Tabulation:** This technique was used to determine relationships between one variable or more and other. For example the cross tabulation between the type of documents and type of tenures and the cross tabulation between neighbourhood and respondents' satisfaction.
- e. Chi-Square Test:** In this research, it was need to determine the significant difference in views between the three groups of participants (in each of these neighbourhoods) for all values of $P \leq 0.05$ in most of the satisfaction level. This indicates that the average scores are a fair representation of the population's opinions irrespective of the type of participants.

The rest of this section provides summary of the results generated from these investigations:

A. Role of ILAs strategies in meeting the LTA in line with the end-user's views:

This section includes questions which are associated to the main factors influencing the success/failure, and how do they influence the LTA regarding the security of the end-users rights. Participants were asked to identify their views about these factors and how they found them in ground. Also, Participants were asked to evaluate the existing impact of the Iraqi social and political conflicts period after the events in 2003, and how the existing administration of LTA is influenced (Success/Failure) as a result of the Iraqi situation. It aims to explore and provide an insight of end-users in regards to the current factors influencing the

development of LTA in term of LTS in Iraq. Table 2 reveals that the responses of participants which were expressed as percentages and mean scores of the main factors/ barriers connected with the development of LTA in term of LAS aspects. These indicate agreement among the respondents on the presence of all the listed factors. The majority of the responses of participants showed the highest agreement with all listed factors, who completely agreed that political and government situation's factor was the main barrier effect on having an effective LTA and giving average score of 3.22 ,and Social and cultural factors were the second main factor in average score of 2.71. Results also revealed a similar of agreement for other factors facing the end-users of land in Iraq, which indicated Religious rules factors (Islamic sharia) and Economic and financial related factors, giving average scores of 2.66 and 2.25 respectively.

a) The political and security issues factor

These key or core Constraints results in table 2 could be associated to the administrative deficiencies. The reasons for these deficiencies might be because of the critical unstable and insecurity situations in Iraq and then the current leak of presence of land authorities in taking its role in LTA and the securing the end-users' tenure rights. It is interesting to note that the results reveal that most participants gave a high score to Deficiency of laws management and monitoring setting, Misdirected policy and poor executions and Lost indigenous /minority rights, giving average scores of 3.41. Besides this, from the perspectives of respondents, between (69%) and (68%) gave equal scores of (3.4) to four of this factor' barriers, these being: Deficiency of laws management and monitoring setting, Misdirected policy and poor executions, Informal or illegal occupation situations and Lost indigenous /minority rights. On the other hand, a minority of the respondents gave a low score to Significant misunderstanding about how to reform local regulations with modern categories and Data on land ownership usually is incomplete, and out of date, giving an average score of 1.93 and 2.90.

b) Social and cultural factors

Participants' responses were expressed as percentage and mean scores of their views of which barriers influence regarding the factor of Social and cultural issues, the obtained results were presented in Table 2. From table 3, it is seen that 82 % and 76% of respondents strongly agreed that there are Difficulties of Women' rights with Social and traditional conceptions and Islamic sharia' rules clashes with modern categories were the main barriers regarding the factor of the Social and cultural issues. Both these barriers achieved average score of 4.11 and 3.80. Furthermore, more than half of the total responses (69% and 64%) agreed that Tribal, ethnic regulations clashes with modern categories and Difficulties of indigenous /minority rights. Both these barriers achieved average scores of 3.46 and 3.21. Findings in table 19 also show a similar trend of agreement for the other challenges which the respondents that they face, the minority of the respondents (43%) gave a low score to the barriers of Livelihoods deprivation between rural and urban areas, Difficulties of dealing with the complexity of land modern regulations and Economic and financial problems, giving average scores of 1.71 and 2.97. In general, the results show that the participants agreed on the presence of all the listed challenges. The majority give the highest agreement in relation to women's rights and these difficulties with the social traditional/ Islamic religious conceptions.

c) The Economic and financial related factor.

This section explores the respondents view related to challenges in terms of the economic and financial factor. Table 2 reveals the responses expresses as percentages and mean scores of the main challenges/barriers in this respect. In general, the results indicate that the participants agreed on the presence of all the listed challenges. It is seen that the majority of respondents (between 87% and 72%) strongly agreed that Weakness of the families' incomes and Housing deprivation, Deteriorated housing conditions, the capital stock of housing is continuing to decline as a result, giving the highest scores of 4.35 and 4.33. Findings also show a similar trend of agreement for the other two barriers including Absence of formal housing finance and Deficiency of land availability. Both these barriers achieved average score of 3.68 and 3.60. Likewise, between the range of 68% and 61% of participants shows either strong agreement or agreement with the barriers that they face related to obtaining their rights, such as Deficiency of co-operations in land authorities' policies, the refugee's dispute and relocation problems and Livelihoods deprivation. These challenges generated average scores of 3.41 and 3.04. On the other hand, it can be seen that the good rate of the respondents (57%) gave a low score to the challenge of Informal or illegal occupation situations and Declining infrastructure service levels and inadequate maintenance, giving an average score of 2.87 and 2.56.

Table 2: Percentage Frequency of Mean scores of participants about their view of which barriers regarding the LTA issues factor

| Factor | Barriers | *Response | | | | | Average scores out of 5 |
|---|---|------------|-------|------------|----------|-------------------|-------------------------|
| | | Completely | Agree | Moderately | Disagree | Strongly disagree | |
| 1- Authority' gaps and Security issues. | • Weakness of the governance. | 283 | 10 | 0 | 0 | 0 | 3.82 |
| | | 98% | 2% | | | | |
| | • Deficiency of laws management and monitoring setting. | 200 | 89 | 4 | 0 | 0 | 3.41 |
| | | 68% | 30% | 2% | | | |
| | • The refugee's dispute and relocation problems. | 211 | 82 | 0 | 0 | 0 | 3.60 |
| | | 72% | 28% | | | | |
| | • Misdirected policy and poor executions. | 78 | 200 | 15 | 0 | 0 | 3.41 |
| | | 26% | 68% | 4% | | | |
| | • Transparency level; Bureaucratic corruption. | 273 | 20 | 0 | 0 | 0 | 3.65 |
| | | 93% | 7% | | | | |
| | • Informal or illegal occupation situations. | 90 | 203 | 0 | 0 | 0 | 3.46 |
| | | 31% | 69% | | | | |

| | | | | | | | |
|--|---|------------|------------|-----------|---|---|-------------|
| | • Significant misunderstanding about how to reform local regulations with modern categories. | 88 | 113 | 92 | 0 | 0 | 1.93 |
| | | 30% | 39% | 31% | | | |
| | • Data on land ownership usually is incomplete, and out of date. | 123 | 170 | 0 | 0 | 0 | 2.90 |
| | | 42% | 58% | | | | |
| | • Lost indigenous /minority rights. | 88 | 200 | 5 | 0 | 0 | 3.41 |
| | | 30% | 68% | 2% | | | |
| *From the total of participants (293) in each factor, responses were listed in according to the total number and the total percentage. | | | | | | | |

Table 2: (Continued)

| Factor | Barriers | *Responses | | | | | Average scores out of 5 |
|---|---|------------|------------|------------|----------|-------------------|-------------------------|
| | | Completely | Agree | Moderately | Disagree | Strongly disagree | |
| 2- The Social and cultural issues: a) <i>Social and traditional conceptions;</i> b) <i>Wars/ post war sphere, Civil violent, conflict/Post-conflict instability;</i> c) <i>Tribal/ethnic clashes/conflict rights;</i> d) <i>Religious rules factors (Islamic sharia);</i> e) <i>Economic and financial related factors.</i> | • Tribal, ethnic regulations clashes with modern categories of laws. | 203 | 90 | 0 | 0 | 0 | 3.46 |
| | | 69% | 31% | | | | |
| | • Islamic Sharia' rules clashes with modern categories. | 67 | 223 | 3 | 0 | 0 | 3.80 |
| | | 23% | 76% | 1% | | | |
| | • Difficulties of Women' rights with Social and traditional conceptions. | 241 | 52 | 0 | 0 | 0 | 4.11 |
| | | 82% | 18% | | | | |
| | • Difficulties of Women' rights with Islamic sharia' rules. | 81 | 188 | 24 | 0 | 0 | 3.21 |
| | | 27% | 64% | 9% | | | |
| • Difficulties of indigenous /minority rights. | 88 | 200 | 5 | 0 | 0 | 3.41 | |
| | 30% | 68% | 2% | | | | |
| • Difficulties of dealing with the complexity of land | 67 | 99 | 127 | 0 | 0 | 2.17 | |

| | | | | | | | |
|--|---|------------|------------|------------|---|---|-------------|
| | modern regulations. | 23% | 34% | 43% | | | |
| | • Livelihoods deprivation between rural and urban areas. | 74 | 119 | 100 | 0 | 0 | 1.71 |
| | | 25% | 40% | 35% | | | |
| | • Economic and financial problems. | 174 | 119 | 0 | 0 | 0 | 2.97 |
| | | 59% | 41% | | | | |
| *From the total of participants (293) in each factor, responses were listed in according to the total number and total percentage. | | | | | | | |

Table 2: (Continued)

| Factors | Barriers | *Responses | | | | | Average scores out of 5 |
|--|---|------------|------------|------------|----------|-------------------|-------------------------|
| | | Completely | Agree | Moderately | Disagree | Strongly disagree | |
| 3- The Economic and financial related factor. | • Weakness of the individual/ families' incomes. | 254 | 20 | 19 | 0 | 0 | 4.33 |
| | | 87% | 7% | 6% | | | |
| | • Absence/ lack of recognised housing finance. | 211 | 78 | 4 | 0 | 0 | 3.60 |
| | | 72% | 27% | 1% | | | |
| | • Deficiency of land availability. | 216 | 75 | 2 | 0 | 0 | 3.68 |
| | | 74% | 25.6% | 0.4% | | | |
| | • Declining infrastructure service levels and inadequate maintenance. | 168 | 110 | 15 | 0 | 0 | 2.87 |
| | | 57% | 37% | 6% | | | |
| | • Housing deprivation, Deteriorated housing conditions, the capital stock of housing is continuing to decline as a result. | 255 | 38 | 0 | 0 | 0 | 4.35 |
| | | 87% | 13% | | | | |
| • Deficiency of co-operations in land authorities' policies. | 94 | 199 | 0 | 0 | 0 | 3.39 | |
| | 32% | 68% | | | | | |
| • The refugee's dispute and relocation problems. | 178 | 113 | 2 | 0 | 0 | 3.04 | |
| | 61% | 38.6% | 0.4% | | | | |
| • Informal or illegal occupation situations. | 134 | 150 | 9 | 0 | 0 | 2.56 | |
| | 46% | 51% | 3% | | | | |
| • Livelihoods deprivation. | 88 | 200 | 5 | 0 | 0 | 3.41 | |
| | 30% | 68% | 2% | | | | |
| *From the total of participants (293) in each factor, responses were listed in according to the total number and total percentage. | | | | | | | |

Likewise, between the range of 68% and 61% of participants shows either strong agreement or agreement with the barriers that they face related to obtaining their rights, such as *Deficiency of co-operations in land authorities' policies, the refugee's dispute and relocation problems and Livelihoods deprivation*. These challenges generated average scores of (3.41 and 3.04). On the other hand, it can be seen that the good rate of the respondents (57%) gave a low score to the challenge of *Informal or illegal occupation situations and Declining infrastructure service levels and inadequate maintenance*, giving an average score of (2.87 and 2.56). The *Chi Square Test* in Table 3 shows the significance of the distribution of rating scale responses by main factors and these related barriers, revealing no significant difference in opinion between the participants' responses for all values of $P \leq .05$ in all factors and most of these barriers. These results indicate that all respondents encounter all the factors and their listed barriers relating to LTA and then end-users' rights.

Table 3: *Chi Square Test (χ^2 test): Level of significance between end-users' responses by main factors and these related barriers influencing LTA in term of LTS (using GPower 3.1.9.2 statistical programme).*

| <i>Factors</i> | <i>Barriers</i> | <i>Value of χ^2 test</i> | <i>Significance (p value)</i> |
|--|--|--|-------------------------------|
| 1- Authority gaps and Security issues. | • Weakness of the governance. | 9.717 | 0.044 |
| | • Deficiency of laws management and monitoring setting. | 9.517 | 0.045 |
| | • The refugee's dispute and relocation problems. | 9.610 | 0.043 |
| | • Misdirected policy and poor executions. | 9.517 | 0.045 |
| | • Transparency level; Bureaucratic corruption. | 9.634 | 0.044 |
| | • Informal or illegal occupation situations. | 9.542 | 0.044 |
| | • Significant misunderstanding about how to reform local regulations with modern categories. | 8.784 | 0.046 |
| | • Data on land ownership usually is incomplete, and out of date. | 9.269 | 0.045 |
| | • Lost indigenous /minority rights. | 9.896 | 0.032 |
| 2- Social and cultural issues | • Tribal, ethnic regulations clashes with modern categories. | 9.542 | 0.044 |
| | • Islamic sharia' rules clashes with modern categories. | 9.708 | 0.044 |
| | Difficulties of Women' rights with Social and traditional conceptions. | 9.859 | 0.043 |
| | • Difficulties of Women' rights with Islamic sharia' rules. | 9.420 | 0.044 |
| | • Difficulties of indigenous /minority rights. | 9.517 | 0.044 |
| | • Difficulties of dealing with the complexity of land modern regulations. | 8.915 | 0.045 |
| | • Livelihoods deprivation between rural and urban areas. | 8.692 | 0.046 |
| | • Economic and financial problems. | 9.303 | 0.045 |
| 3- Economic and financial | • Weakness of the families' incomes. | 9.966 | 0.043 |
| | • Absence of formal housing finance. | 9.610 | 0.044 |

| | | | |
|-----------------|---|--------------|--------------|
| related factor. | • Deficiency of land availability. | <i>9.649</i> | <i>0.044</i> |
| | • Declining infrastructure service levels and inadequate maintenance. | <i>9.254</i> | <i>0.045</i> |
| | • Housing deprivation, Deteriorated housing conditions, the capital stock of housing is continuing to decline as a result. | <i>9.976</i> | <i>0.043</i> |
| | • Deficiency of co-operations in land authority's policies. | <i>9.508</i> | <i>0.044</i> |
| | • The refugee's dispute and relocation problems. | <i>9.337</i> | <i>0.044</i> |
| | • Informal or illegal occupation situations. | <i>9.104</i> | <i>0.045</i> |
| | • Livelihoods deprivation. | <i>9.517</i> | <i>0.044</i> |

Summing up the results of this section, it is clear that the gathered data helped identify the barriers preventing end-users to successfully implement the development of LTA in their tenure rights. All respondents agreed that they are influenced by the full range of factors affecting to security of their tenure rights in LTA, and these challenges/barriers pertaining to these factors, and there is no significance difference in the level of agreement evident between them ($P \leq .05$), and these results indicate that the average scores are a fair representation of the population opinion regardless of the location of participant.

3. SUMMARY AND MAIN FINDINGS

The data analysed in this paper was gathered from participants in 3 nominated neighbourhoods inside the Al-Nassiriya city. The samples used in the survey were drawn from shelters unit's users, only families were selected and the head of the family was surveyed. The paper explores the role of ILAs policies in meeting the end-user's requirements within the Iraqi context, identifying the main factors affecting the efficiency of LTA. Building on the 3 themes of the conceptual framework, Participants were asked to evaluate the ILAs strategy and identify their satisfaction levels regarding the main factors influencing its success/failure, and how do these factors influence the LTA regarding the security of the end-users rights, and how do they affect the end-user's rights in Iraq. The following main findings were reached as a result of a number of observations:

- There is no doubt that the deterioration in the Iraqi economy has been dramatically associated with a paralysis in the construction of buildings as well as in the real estate markets in Iraq. The Iraqi housing crisis could be added to continuous negative impacts of three wars and these related insecurity situations, which were continued starting from 1980s in Iraq.
- The population sample enjoyed and appreciated the role of ILAs and always demanded on its policies regarding the tenure rights, although the higher responses were given to the role of land agencies by managing and monitoring in meeting the people rights, however, this was credited to their shelters type and documented units.
- Private houses/rented units is the most commonly shelter used type, where the majority of users have a written agreement as official types of documents that protect their rights in shelter.

- Samples' responses to the administrative deficiencies such as the lands availability and complexity and the routine of procedures were generally higher. However, these results are contracted with the opinions expressed in the interviews with TSMs in ILAs which showed that the majority of them believed that their agencies policies were met the Iraqi end-user's ambitions.
- Findings also show a similar trend of agreement for the other challenges which the respondents that they face, the minority of the respondents gave a low score to the barriers of *Livelihoods deprivation between rural and urban areas, Difficulties of dealing with the complexity of land modern regulations and Economic and financial problems*. In general, the results show that the participants agreed on the presence of all the listed challenges. Majority give the highest agreement in relation to *women's rights and these difficulties with the social traditional/Islamic religious conceptions*.
- The majority of respondents strongly agreed that *Weakness of the families' incomes and Housing deprivation, Deteriorated housing conditions, the capital stock of housing is continuing to decline as a result*, giving the highest scores.
- Findings also show a similar trend of agreement for the other two barriers including *Absence of formal housing finance and Deficiency of land availability*.
- The gathered data helped identify the barriers preventing end-users to successfully implement the development of LTA in their tenure rights. All respondents agreed that *they are influenced by the full range of factors affecting to security of their tenure rights in LTA, and these challenges/barriers pertaining to these factors*.
- To determine which of the reasons they thought was being used in previous period. These given responses show that is most commonly the main reasons was linked to *the efficiency of administrative role such as Efficiency of employees and Financial supports*. These obtained results can be explained by the administrative agencies associated with LTA and then reflect the satisfaction level. The results also show that the role of ILAs in 'planning' and 'monitoring' is dependent on *the participants' rate with regards to dissatisfaction reasons*.
- For a closer examination of the step (s) required to advance the adopted System in current authorities, the frequency distribution of scores given by participants are summarised to determine which of the administrative steps is being required in end-user's views to advance the adopted System. These given responses show that *Modifying and development the administrative issues are most commonly required to advance the adopted system which can be explained by the cost associated with administrative efficiency*.
- These key or core Constraints results could be associated to the administrative deficiencies. The reasons for these deficiencies might be because of *the critical unstable and insecurity situations in Iraq and then the current leak of presence of land authorities in taking its role in LTA and the securing the end-users' tenure rights*.
- It is interesting to note that the results reveal that most participants gave a high score to *Deficiency of laws management and monitoring setting, Misdirected policy and poor executions and Lost indigenous /minority rights to four of this factor' barriers*,

these being: *Deficiency of laws management and monitoring setting, Misdirected policy and poor executions, Informal or illegal occupation situations and Lost indigenous /minority rights*. On the other hand, a minority of the respondents gave a low score to *Significant misunderstanding about how to reform local regulations with modern categories and Data on land ownership usually is incomplete, and out of date*.

- Similar responses strongly agreed that *there are Difficulties of Women' rights with Social and traditional conceptions and Islamic sharia' rules clashes with modern categories were the main barriers regarding the factor of the Social and cultural issues*. Furthermore, more than half of the total responses agreed that *Tribal, ethnic regulations clashes with modern categories and Difficulties of indigenous /minority rights*. Both these barriers were generally higher.

4. CONCLUSIONS

This study is driven by the need to bridge the gap in the current literature in terms of identifying the sustainable institutional aspects of the land administration system under the current situation in Iraq as the principal mechanism through which LTA aspects can be sought. It is clear that the gathered data helped identify the barriers preventing end-users to successfully implement the development of LTA in their tenure rights. In fact, the current influence of informal occupancy and illegal activities still need more innovation from ILAs strategy to ensure more effective security of tenures.

The main point is that ILAs were attempting to develop their current strategy with the private sector as an essential outcome of LTA in ILAs programmes, which agreed with the literature evidences, it must be taken into account that the current impact of the instability of system in Iraq has influenced gradually the ILAs performance and then its efficiency in implementation of LAS and LTA aspects regarding the end-users' rights. From the quantitative data, there is a positive view from the decision-makers (TSMs) apposite to negative views from the majority of end-users. The important point is that the current system is built on a rock-hard legislative base from the social/ cultural and religious forms that helped it to resist the current impacts.

However, outcomes of this study indicated that the LTA applying aspects are influenced by a set of critical factors which have impacted on both the productivity of the institutional aspects of LAS and on stakeholder's satisfaction with the existing system performance in Iraq. Nevertheless, there is a highest level of agreement with all investigated factors, that the Iraqi existing system is still offering significant levels of the management and monitoring support. Concerns were; however, shed a light on the vast influence of the current unstable situation and its negative interventions, confirming that the quality situation affects the quality of LTA directly or indirectly in response to the end-users' needs.

5. ACKNOWLEDGMENT

Grateful acknowledgment is made to the following sources for helping to produce material in this paper: Professor David Baldry for his supportive time and academic help. Also, thanks

go to Iraqi urban executive councils, and the Al-Nassiriya city's district councils for giving their support time and precious data. I am thankful to all those who have contributed in one way or the other to this research study in Iraq and the UK.

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STAKEHOLDERS RESPONSIBILITIES' FOR TIME OVERRUN RISKS OF HIGHWAY PROJECTS IN TERRORISM AFFECTED AREAS

I. Zafar¹, G. Shen¹, S. Ahmed² and T. Yousaf²

¹ Department of Building and Real Estate, The Hong Kong Polytechnic University, Hong Kong

² Department of Construction Engineering & Management (Risalpur Campus), National University of Science & Technology, Pakistan

Email: irfan.zafar@connect.polyu.hk

Abstract: Around 124 countries worldwide are facing the menace of terrorism, and underdeveloped regions are believed to be the nourishing grounds for it. However, execution of development works in these regions are found as the key to controlling and eliminating this hazard. Highways are the symbol of prosperity and progression, and they supplement further development hence their timely completion is essential. Besides the severity of the risks associated with the region affected by terrorism, it has also been found that the responsibilities of these risks are not clear among the stakeholders, creating confusion for their mitigation, causing extra delay. Hence, there is a requirement to establish the responsibilities among stakeholders for the risks associated with such regions in the execution of the road projects, which is the focus of this research study. Pakistan has been taken as a case study for this research, being one of the most terrorism affected countries worldwide. The study is conducted through questionnaire survey based on 19 time overrun risk factors obtained through literature review and expert interviews. The responsibilities were delineated in four groups which include client, consultant, shared and those which can not be identified. The results revealed that 96% of the responsibilities of risks causing delay could be established among the stakeholders. Whereas, contractors have to shoulder maximum projects' risks. The results of this study can be used as a guideline for other such terrorism affected areas around the world.

Keywords: Highways, Risk, Stakeholder's Responsibilities, Time Overrun, Terrorism.

1. INTRODUCTION

Since 9/11, the world has experienced the menace of terrorism more closely and even after the lapse of several years this problem is still incorrigible. The population deprived of basic human facilities living in these regions are found to be an easy target for the terrorists to use them as their agents and facilitators in trade of trivial benefits. However, it has been realized that development work in these areas can bring dividends in term of controlling and eliminating this plague (Zafar et al., 2016). The road network is believed to bring prosperity in the region and opens the prospects for further progression. Its construction in the terrorism-affected area is a challenging task as it faces a delay in its scheduled completion time due to various risks associated with the dynamics of the area. These delays result into cost overburden on clients and contractors leading to various conflicts complementing further delay. Besides the severity of the risks associated with the region causing schedule overrun, it has also been found that the responsibilities of these risks are not clear among the stakeholders which at time create confusion for its mitigation thus adding further delay to the project. Any previous research study on the subject lacks in delineating these responsibilities among the stakeholders. Hence, to bridge this gap, a need arises to ascertain risks responsibilities associated with the terrorism affected regions among various stakeholders. Therefore, the main objectives of this research study are: -

- a. To establish risk responsibilities among the stakeholders involved in the construction of the highway projects.
- b. To suggest suitable measures to meet these responsibilities.

As per the statistics from Global Terrorism Index (GTI-2016), almost 124 countries are facing the menace of terrorism worldwide, and Pakistan ranked fourth among these affected countries. Furthermore, PIPS (2014) establishes Federally Administered Tribal Area (FATA) as the top terrorist affected area within Pakistan. Hence, Pakistan (FATA) has been taken as a case study for this research work.

2. LITERATURE REVIEW

Ahmed et al. (2003) described schedule overrun as a universal phenomenon complemented by the cost overrun in the construction projects. Delay beside affecting negatively to the project progress also put stakeholders into conflicts resulting into litigation (Mahamid et al.,2012). The importance and necessity of completing projects within time have been understood and acknowledged by all stakeholders. However, these projects are seldom completed as per schedule. The percentage projects delay ranges in various countries viz-a-viz these ranking as per Global Terrorism Index (GTI - 2016) is shown in Table -1 and trends are presented in figure -1 for comparison.

| Countries | Time Overrun above schedule planned time (%age) | Global Terrorism Index (GTI) 2016 | Authors / Publication Year |
|-------------|---|-----------------------------------|--|
| Nigeria | 188% | 3 | <i>Omoregie & Radford (2006)</i> |
| India | 55% | 8 | <i>Doloi et al. (2012)</i> |
| Philippines | 50% | 12 | <i>Matthews (2016), CoST (2011)</i> |
| Tanzania | 110% | 49 | <i>Matthews (2016), CoST (2011)</i> |
| Ethiopia | 130 % | 54 | <i>Matthews (2016), CoST (2011)</i> |
| Jordan | 82% | 58 | <i>Al-Momani (2000), Battaineh (1999)</i> |
| Malaysia | 49% | 61 | <i>Ibrahim et al. (2010)</i> |
| Bosnia | 51% | 62 | <i>Žujo, Car-Pušić et al. (2010)</i> |
| Ghana | 70% | 106 | <i>Frimpong, Oluwoye & Crawford (2003)</i> |

Table 1: Time overrun (%age) in various countries in highway projects

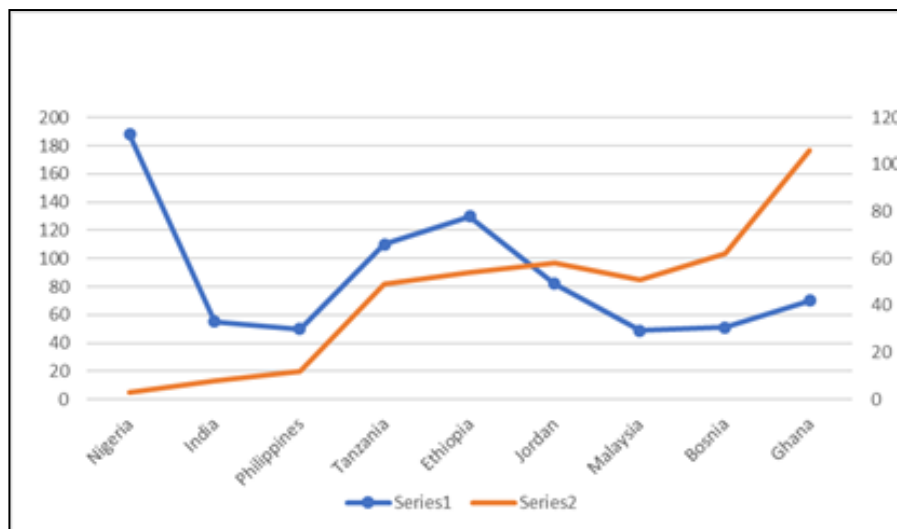


Figure 1: Time overrun Vs GTI ranking

The comparison of the trend line in figure 1 revealed that the country high (ascending order) in GTI index (2016) are experiencing more time overrun or schedule delays in completion of the construction projects. Whereas, with the increase in GTI Index (descending order) the time overrun effect is reduced. Furthermore, the rise in time overrun trendline at the mid of graph demonstrated that the developing countries although experiencing lower influence of terrorism but have poor economic and political conditions still confront delay completion of the projects. Hence a country with poor economic and political condition augmented by the menace of terrorism may experience the worst effect of delays in construction projects.

An exhaustive study on the topic revealed that till date no explicit research attempted in identifying the time overrun risk factors for highway construction projects of terrorism affected regions. Hence, the literature was further explored while focussing on developing countries with similar social, political and construction environment, as of understudy area i.e. FATA. The intention was to obtain critical time overrun risks of highway projects in particular and other construction projects in general, and then sieve them through expert opinions for further research.

Sujka and Jacob (2013) in their study to identify the causes of the project delays in the Niger Delta Region found thirty-eight (38) factors including improper planning, inappropriate design, delay or non-payment of the completed work, inappropriate construction methods used by contractor resulting in rework, unskilled manpower resulting in low productivity, non-availability/inadequate equipment, lack of reward and punishment in contract as a result of poor contract management, extreme weather conditions, interference by the political leader for their vested interest and lack of local community support. The study conducted by Kaliba et al. (2009) on highway projects of Zambia for identification of cost and time overrun factors were design changes, delay in progress payments by owner, delay in material procurement, non-availability of skilled staff, non-availability of the equipment, construction errors, poor coordination and weak management on site as the main reasons for road projects delay. The responsibility of each factor was also stated in terms of major stakeholders i.e. client, consultant, and the contractor.

The prime factors influencing time overruns as concluded by Sambasivan (2007) in a study conducted in Malaysia was improper planning, poor contractor experience and financial health, and delayed payment of completed works. Sweis et al., (2007) explained major reasons for scheduled delays in Jordan as poor planning and scheduling, the presence of unskilled labors and a shortage of technical specialists with the contractor. In Saudi Arabia, delay in payments for completed work, poor planning, lack of skilled labor and poor workmanship resulting in frequent re-work and low productivity were prime reasons for project delays (Assaf et al., 1995 and Assaf, 2006).

Choudary et al., (2012) conducted a comprehensive research to establish the major factor causing time and cost escalation of highway projects in Pakistan. He found a strong linkage between delay and budget overrun by identifying the factors like delay in progress payment to the contractor, conditions under force majeure including extreme weather conditions and law & order situation, Contractor's incompetence and incapacity to complete the project, difficulty in land acquisition and resettlement and ineffective planning and scheduling.

Apolot et al., (2011) identified 22 factors responsible for cost and time overrun in his study in Uganda. These were rework due to poor workmanship and wrong use of construction methods, inappropriate and unskilled workforce, delayed payment to the contractor and

subcontractors, severe weather, inadequate and inefficient equipment, tools and plant, discrepancy/deficiency in contract documents, contractor's workload capacity and political insecurity and instability in the area of work. Afshari et al., (2010) ranked inability to select a suitable contractor as the prime reason for time overrun in the construction projects. Olajide Timothy Ibronke et al., (2013) highlighted the prominent factors causing non-excusable delays in Nigeria construction projects as shortage of construction material and skilled labor resulting in reduced labor productivity, lack of desired plant & equipment and their frequent breakdown, delay in payment to contractor, improper planning and scheduling, inaccurate site investigation and survey, poor design, weather conditions and conflict, war and public enemies in the area demanding additional security requirements.

Ameh and Osegbo (2011) found inadequate planning of project, temporary stoppages or suspension due to adverse weather condition and local community issues, political instability and change in government policies as time overrun factors along with contributing factors of low productivity further enhancing the gravity of the issue i.e. use of wrong construction method, lack of skills from the labor, unfriendly working atmosphere, extreme weather conditions and political insecurity. Non-availability of the desired plant and equipment, its frequent breakdown, and maintenance problem due to non-availability of mechanics was ranked among five top most factors causing a delay in the projects (Aibinu and Odeyinka, 2006). Assaf & Al-Hejji (2006) in their research for identifying major reasons for delays in construction project of Saudi Arabia concluded that delay in payment of completed work by the owner, lack of incentives to contractor for early finishing the project, rework due to error in construction, ineffective planning and scheduling, improper construction method used by contractor, inadequate contractor's work, shortage of construction materials, shortage of machinery and its frequent breakdown, shortage of labor and non-availability of qualified workforce, low productivity level of labors, absence of utilities on site and effect of social and cultural influences were among the leading factors for causing time delay.

3. RESEARCH METHODOLOGY

The risk factors affecting time overrun in terrorism affected area were furnished through exhaustive literature review complimented by expert's interviews. Due to lack of explicit literature on highways construction in terrorism affected areas, expert interviews were found significantly important. Eleven experts (clients-2, consultants-3 and contractors-6) from industry were selected based on their minimum working experience of seven years in highway projects in FATA. Inferred from the literature review and structured interviews a questionnaire was developed with 19 risk factors specific to FATA only and validated through a pilot study. Moreover, to mark the responsibility of schedule delay risks in highway projects, the respondents were required to choose between various stakeholders groups in the questionnaire. The groups included; Group -1; client & consultants (joint), Group-2; contractors, Group 3; Shared (i.e. group 1 and 2) and Group 4; un-determined responsibilities. Consultants mostly work for clients only, hence they were grouped together with client in group-1 for this study. Total 103 questionnaires were distributed among respondents which include contractors (sub-contractors, suppliers, project managers, site engineers and site supervisors), consultants (design engineer/architects), and clients (federal/provincial government, FATA Secretariat), 72 received back, and after scrutiny only 63 were found valid for the research. In the survey, the respondents were required to choose between four groups for each identified risk. The percentage responsibility for each of the

risk was calculated using the formula given below (Shahid, 2012), whereas social network analysis was done using UCINET software:

$$\text{Percentage Responsibility}(\%) = \frac{R}{N} \times 100$$

Where:-

R : Total number of the respondents selecting the responsibility among four groups

N : Total number of respondents

The factor scoring more than 50% in any category assumed to be the ultimate responsibility of that specific category.

4. RESULTS AND DISCUSSIONS

4.1 Overall responsibility of time overrun risks

The overall results of time overrun responsibility in percentage are summarized in Table 2.

Table 2: Summary – Responsibility of time overrun risks

| Risk Code | Risk | Risk Responsibility (%) | | | | Result |
|-----------|---|-------------------------|------------|-----------|-----------------------|--------|
| | | Client / Consultant | Contractor | Shared | Cannot be Established | |
| | | (Group-1) | (Group-2) | (Group-3) | (Group-4) | |
| T1 | Unrealistic planning & scheduling due to hostile environment | 5% | 67% | 28% | 0% | G-2 |
| T2 | Poor designing due to insufficient data collection & survey | 100% | 0% | 0% | 0% | *G-1 |
| T3 | Difficulty in land acquisition | 83% | 0% | 17% | 0% | G-1 |
| T4 | Forced selection of contractor due to tribal compulsions | 25% | 0% | 0% | 75% | G-4 |
| T5 | Contractor's capacity to undertake work | 8% | 78% | 14% | 0% | G-2 |
| T6 | Delay due to incompetent contractors using inadequate construction methods | 4% | 90% | 6% | 0% | G-2 |
| T7 | Delay due to non-availability/shortage of construction material | 11% | 60% | 29% | 0% | G-2 |
| T8 | Non-availability of desired plant & equipment | 3% | 67% | 30% | 0% | G-2 |
| T9 | Non-availability of local mechanics for repair/maintenance of plant & equipment | 0% | 71% | 29% | 0% | G-2 |
| T10 | Low productivity due to unskilled workforce | 5% | 62% | 33% | 0% | G-2 |
| T11 | Absence of utilities on site | 7% | 10% | 83% | 0% | G-3 |
| T12 | Suspension of work due to insecurity/terrorist threat | 25% | 5% | 70% | 0% | G-3 |
| T13 | Rework due to poor construction | 3% | 89% | 8% | 0% | G-2 |
| T14 | Rework due to terrorism acts | 13% | 17% | 70% | 0% | G-3 |
| T15 | Delayed payments for completed work | 81% | 3% | 16% | 0% | G-1 |
| T16 | Lack of local community support | 11% | 6% | 78% | 5% | G-3 |
| T17 | Interference by political leaders due to vested interests | 65% | 16% | 19% | 0% | G-1 |
| T18 | Force Majeure (i.e. Extreme weather conditions, Flashfloods, earthquake etc.) | 59% | 8% | 33% | 0% | G-1 |
| T19 | Lack of reward & punishment in contract | 76% | 3% | 21% | 0% | G-1 |

| | | | | | |
|---------------------------|------------|------------|------------|-----------|--|
| terms & Conditions | | | | | |
| Summary | 31% | 34% | 31% | 4% | |
| * G-1 referred as Group-1 | | | | | |

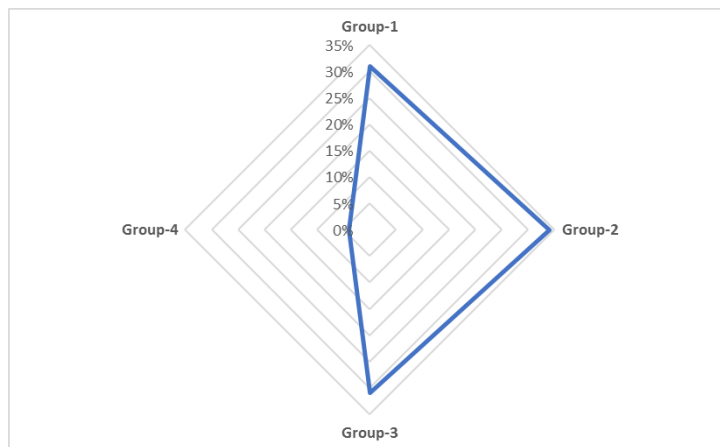


Figure 2: Responsibility distribution trend

The results (Table 2) reveals that 96% of the time overrun risk responsibilities could be delineated among first three groups. The inclination of the trend line (figure -2) towards first three groups explains that the responsibility of the time overrun risks has to be shouldered by these stakeholders, either independently or jointly. Moreover, the results further reveal that the contractors (group-2) bear the maximum risks as they are executing the project on ground. Only the responsibility of one risk out of 19 could not be established among any of the major stakeholders.

To further clarify the situation, social network analysis software named UCINET version 6.628 was used. The social network analysis explains dyadic attributes (Borgatti & Everett, 1997), hence make it easier to understand the complex relationships. The results obtained through netdraw (UCINET) is shown in figure 3: -

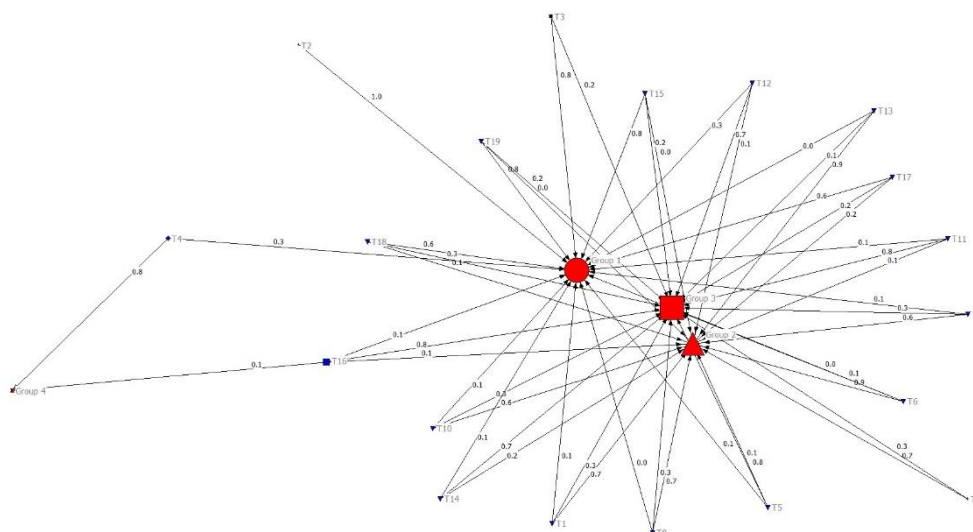


Figure 3: Social network analysis for risk responsibilities

In figure -3, all groups and risk factors have been differentiated by various shapes called nodes. The risks are woven together to each group through arrow lines emanating from each

risk node showing the weight or strength towards the group nodes. The strength has been defined between 0 to 1. The concentration of group 1 to 3 on the right side of the figure further augment the results explained in figure-2. It describes that the responsibilities of identified risks in the study are exceedingly pronounced among clients and contractors. Furthermore, the closeness of group 2 and 3 shows that besides contractors well-defined risk responsibilities (group-2) the weight of shared responsibility has more inclination towards contractors. This situation further augments the fact that contractors is more vulnerable to risks and has to shoulder a major portion of the responsibilities, this warrant proactive mitigation plan and if necessary adding financial effect to the project cost. Figure 3 also highlights some risks giving 100% weight to one group e.g.T-2 (poor designing due to insufficient data collection and survey). Moreover, the presence of group 4 on the extreme left and connected through few risk lines clarifies that ambiguity in terms of risks responsibility does not exist and major stakeholders cannot use it as an excuse. Zou et al. (2006) and Saaidin et al. (2017) in their study in Australia and Malaysia respectively obtained similar results. They ascribed construction risks among stakeholders in order of priority as contractors, clients and designers. Moreover, While comparing their result with the finding of the current study, it can be opined that regardless of any working environment and conditions; contractors remains the most vulnerable stakeholder in any construction project. Hence, they need to follow pro-active approach to mitigate these risk right at the beginning of the project.

The top construction risks identified in various studies conducted worldwide in regions with low or no threat of terrorism are improper planning of the projects (Sambasival 2007, Ameh and Osegbo 2011, Sujka and Jacob 2013), design changes (Kaliba et al, 2009), delay in progress payment (Assaf & Al-Hejj 2006, Chouadary et al 2012), rework due to poor workmanship (Apolot et al, 2011) and shortage of construction material (Ameh & Osegbo 2011). Although, the current study also ascertained these risks for schedule delays but their significance and severity are found to be distinctive for terrorism affected areas. Hence, their mitigation approach needs to be variant then the normal. Therefore, it is envisaged that seemingly same risks for peaceful and terrorism affected regions cannot be mitigated with the same technique.

4.2 Group -1: Client/Consultant's responsibility for time overrun risks

Figure 4 elaborates the delay risk responsibilities of the client and consultant together. The depth of the arrow line from each risk node provides significance of that risk towards the group. The figure also illustrates the distribution of the same risk among other groups, which indicate that group 3 and group 2 have a certain link in order of priority. To further explain the results, it has been found that respondents have given 100 % responsibility for the delay due to inaccurate design to the consultants (see figure 4). The major reason for the inaccurate design is weak field survey due to security threats which can be overcome by the use of modern survey technologies. Furthermore, 83% respondents feel that owner is responsible for schedule overrun due to non-availability of land in time. The client fully cognizant of this risk has to negotiate proactively with the regional leaders for ensuring timely availability of the land. It's a fact that the contractors loses their interest in the project if the payments for completed work are not given in time. Hence 81% feels that owner and consultant are responsible for the delay caused due to this factor. Similarly, 76% agree on the fact that the client and consultant are responsible for the delay in work due to the absence of any reward for early completion of work and penalty for delaying the work in the contract agreement. The incentive in terms of the further award of work can be useful to motivate contractors for

timely completion of work. 59% respondents believed that high influence of the political leader in the area forces the client to bear the loss of time due to their interference in the project progress for their personal/political gains.

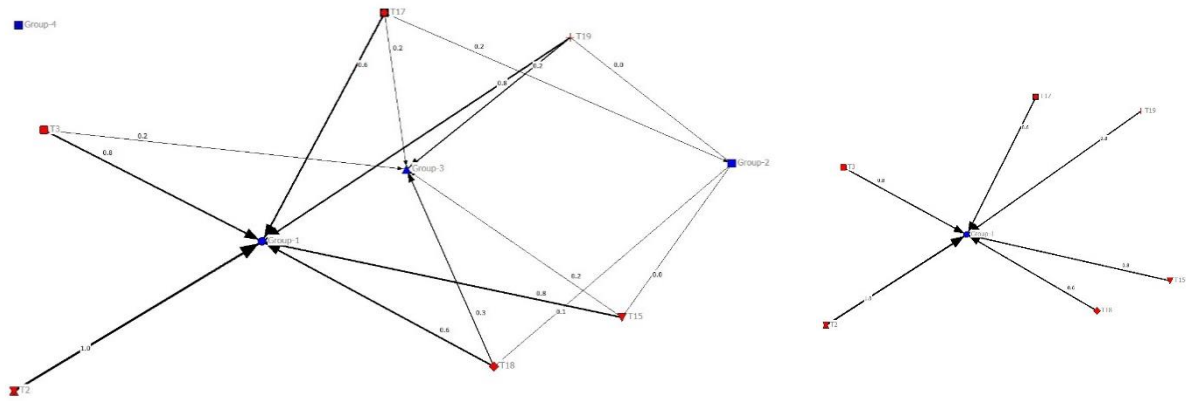


Figure 4: Client/Consultant's responsibility of time overrun risks

4.3 Group -2: Contractor's responsibility for time overrun risks

As contractors execute work on the ground and are closely netted with various other sub-stakeholders like sub-contractors, suppliers, fabricators, labors and public, etc. hence the probability of risk associated with them is also large. The results of this study indicate that responsibility for most of the risks is associated with contractors. Hence they need to understand and respond appropriately to mitigate them. Figure 5 shows the relationship of the associated delay risks to contractors along with the strength and their weights. It further elaborates comparative association of the risks with other groups besides group-2. In the survey, 90% respondents believed that contractors are mainly responsible for delay due to their incapacity to undertake the large-scale construction work, rework due to poor workmanship and use of poor construction methods. However, it is believed that this shortcoming can be improved by hiring skilled manpower while offering extra financial incentives. In addition, delays due to the suspension of work mainly due to non-availability of construction material, plant & equipment, and their repair & maintenance facilities can be effectively controlled by detailed initial planning and preparation of risk mitigation plan. Respondents also highlighted low productivity due to unskilled workmanship need to be controlled and improved by the contractor. These can be amicably improved by grouping unskilled with skilled manpower and motivating them to learn through on job training practice. 67% respondents think that lack of detailed survey due to hostile security situation leads to the unrealistic planning of the project by the contractors which usually surfeit the completion time of the project. It is believed that the risks identification and their mitigation plan can improve the situation.

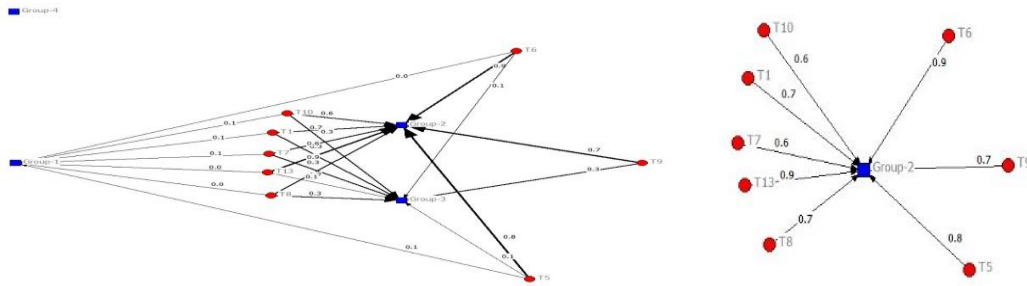


Figure 5: Contractor's responsibility for time overrun risks

4.4 Group -3: Shared responsibility for time overrun risks

Risks which cannot be completely assigned to either client or contractor are placed in group-3 i.e. shared responsibility. In this group, client and contractor together bear the risk consequences, hence must plan its mitigation in consultation with each other. The network in figure 6 reveals closeness between group 2 and 3. Hence this inclination towards contractors (group-2) necessitates them to shoulder their responsibility actively. This analysis can also help the contractors to accept the risks and include additional financial effect (if any) in project cost for its mitigation. The results further highlight that most respondents believed that delay caused due to unavailability of the necessary services at the site, rework and suspension of work due to terrorist attack/threat and absence of the support from the local community are to be shared by owner and contractor equally. As neither client nor contractor has control of such risks, hence they must share the burden of additional cost due to this delay. Moreover, proactive negotiations with local leaders and execution of quick impact projects for the locals can bring dividends in mitigating these risks.

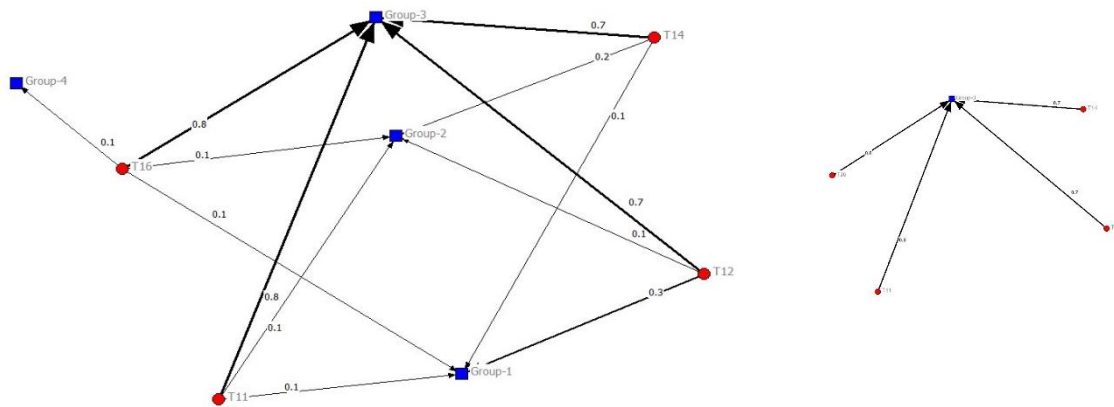


Figure 6: Shared – responsibility for time overrun risks

4.5 Group -4: Undetermined responsibility for time overrun risks

As per the local tribe traditions, customs and rules; only local contractors be employed on the project to be executed in their area. No foreign contractor (national or international) is permitted to enter and execute work in their area. Hence, a large group of respondents (75%) believed that responsibility for the delay caused due to the employment of incompetent and

inexperienced contractor on the project could not be given to client or contractor. However, the network analysis (figure 7) shows a little inclination of responsibility towards the client. It is important to note that this risk is more pronounced in FATA (Pakistan) and Afghanistan, (as both enjoys common culture). However, the client needs to take an extra leap and hold an exhaustive meeting with the regional leaders to convince them on employing experienced contractors for producing high-quality work, ultimately benefiting them.

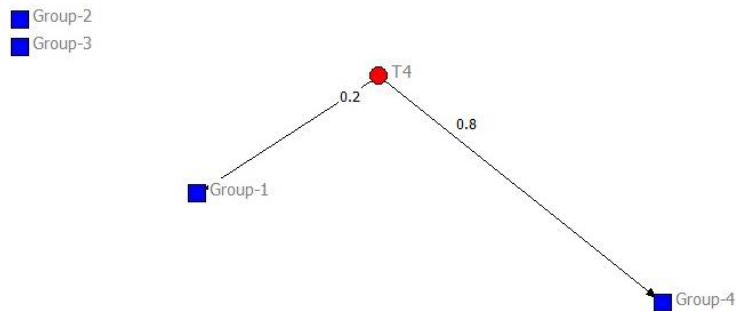


Figure-7: Undetermined responsibility of time overrun risks

5. CONCLUSIONS

This study was conducted to establish the responsibility of time overrun risks among various stakeholders working on highway construction in terrorism affected areas worldwide. As per global terrorism index (GTI, 2016), Pakistan (FATA) rank fourth among terrorism affected countries in the world, hence was selected as a research area. Most construction projects (particularly highways) have experienced schedule delays resulting in additional financial burden and loss of expected social benefits of these projects. Likewise, besides several reasons for the delay, it has been found that these projects experience further lag due to unclear risks responsibility among stakeholders. This ambiguity in responsibilities create conflicts among stakeholders requiring extra time in their resolution. Hence, this study attempted to educe the risk responsibilities among major stakeholders i.e. clients, consultants, and contractors. Four groups were made, which included clients and consultants (Group-1), contractors (Group-2), shared responsibility between Group 1&2 (Group-3) and risks whose responsibility could not be specified to above three groups (Group-4). This study found that 96% of the responsibilities could be established among first three groups whereas only 4 % cannot be assigned to anyone being beyond anyone's control. It is further added that contractors are found more exposed to risks as they are working in the field and dealing with several sub-stakeholders like sub-contractors, labors, suppliers, local population, etc. Moreover, the risks which cannot be designated to any stakeholder either alone or jointly may be taken over by the clients. The clarity in the risk responsibilities will allow all the stakeholders to effectively control and mitigate the project risk through risk mitigation plan. Thus, reducing the chances of conflicts among stakeholders ensuring improved efficiency and schedule completion of the project. This study has established risk responsibilities among stakeholders for time overrun in terrorism affected area in FATA, Pakistan; the same results can be used for other regions/countries with slight modifications specific to that region.

6. ACKNOWLEDGMENT

The work described in this paper was supported by a grant from the Research Grants Council of the Hong Kong Special Administrative Region, China (PF14-16079).

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PERFORMANCE MEASUREMENT AND MANAGEMENT IN CONSTRUCTION: A CONCEPTUAL FRAMEWORK

S. Sonson, U. Kulatunga and C. Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: sjsonson@hotmail.com

Abstract: The dynamic and competitive business environment has motivated and compelled construction firms to implement contemporary performance measurement and management (PMM) systems and frameworks to generate more comprehensive information on their performance. The aim of this research is to develop a conceptual framework to better measure and evaluate the performance of construction firms. The methodology of this research is based on a comprehensive literature review of PMM in general, and in construction. This research discusses performance measurement concepts, key PMM frameworks in general use and in construction, and also presents the salient components of the proposed conceptual framework. The research findings reveal the relevance of PMM to the construction industry and show seven generic perspectives that can cover all facets of construction firms' performance. The critical success factors and related key performance measures that reflect the circumstances of construction firms and the industry were also identified for the framework. This research contributes to the body of knowledge in the area of PMM by proposing a conceptual framework, and developing an understanding of the need for PMM in construction. This research is part of ongoing research study being undertaken in Saint Lucia on PMM in construction.

Key words: critical success factors, construction firm, conceptual framework, performance measurement and management, performance measures.

1. INTRODUCTION/BACKGROUND

Business organisations in both developed and developing countries are operating in a rapidly changing and highly competitive business environment which impacts on their strategies and performance measurement and management (PMM) systems/frameworks. Changing customer demands and advances in technologies are some of the most important environmental factors in recent years that have impacted on effectiveness of the PMM within business organisations (Yadav-Sushil and Sagar, 2015). These environmental factors have caused business organisations to constantly modify or revise their strategies and PMM systems/frameworks in order to reflect the changing circumstances (Munir and Baird, 2016; Pekkola et al., 2016). Over the past three decades, the evolution of the business environment has triggered a PM revolution (Neely, 1999), which has led to a change in three foci as follows: (1) a shift in focus from traditional PM systems/frameworks relying solely on financial measures to contemporary performance measurement and management (CPMM) systems/frameworks using both financial and non-financial measures to assessing business performance (Behery et al., 2014); (2) a shift in focus from merely measurement and control towards performance measurement and management for measuring and managing business performance (Yadav-Sushil and Sagar, 2013); and (3) a move from merely concentrating on the interest of shareholders to focusing on the interest all stakeholders (Yadav, Sushil and Sagar, 2013). Consequently, numerous CPMM systems/frameworks such as the Balanced

Scorecard (BSC) were developed and diffused over the years to evaluate organisations' performance (Baird, 2017; Micheli and Mura, 2017).

The PM revolution has moved to the construction industry but at an incremental pace (Deng and Smyth, 2014). In light of this, CPMM frameworks have been adapted and implemented by a number of construction organisations to drive performance improvement (Horta et al., 2012). Over the past few decades, there are many studies on PMM in construction (Yang et al., 2010) and most of these studies have focused on the evaluation of project-level performance (Ali et al., 2013; Jin et al., 2013). In recent years, however, studies on PMM in construction at organisational level has increased (Yu et al, 2007; Jin et al., 2013). A few previous studies have attempted to develop conceptual frameworks for the performance evaluation of construction organisations, and there have been few follow-up studies (Yu et al., 2007). Furthermore, there is a paucity of papers that attempt to critically review the extant literature on PMM in construction (Yang et al., 2010). In response to the above gaps in the literature, this research aims to provide a critical review of PMM literature to develop a conceptual framework that will better measure and evaluate the performance of construction firms with a view of improving their success.

2 LITERATURE REVIEW

2.1 Performance measurement and management in General

In the context of organisations, performance measurement refers to as “a systematic process for obtaining valid information about the performance of an organisation and the factors that affect performance” (Yaghoobi and Haddadi, 2016, p.960), whereas performance management involves the use of the information generated through performance measurement (PM) to manage performance (Saunila, 2016). Organisational PM can be classified as traditional PM and contemporary performance measurement and management (CPMM). The traditional PM focuses solely on financial performance measures (Yaghoobi and Haddadi, 2016) such as profit, cash flow and return on investment. Many researchers and practitioners have criticised the exclusive use of financial performance measures because of their shortcomings. Financial performance measures are no longer adequate to evaluate organisations' performance in today's rapid changing business environment (Munir and Baird, 2016). They are lagging indicators, in that they provide information on the results of management actions already taken (Ali et al., 2013). To overcome these criticisms, a proliferation of CPMM systems/frameworks were subsequently developed that comprise both non-financial and financial performance measures, representing different perspectives to evaluate organisations' performance (Silvi et al., 2015; Baird, 2017). Some other salient attributes of a CPMM systems/frameworks include inter alia: they contain both internal and external performance perspectives, measure short-term and long-term performance, comprise forward and backward- looking measures, are characterized by causal relationships among the different measures and perspectives (Silvi et al., 2015); and link performance measures with strategy and/or value drivers (Baird, 2017).

CPMM systems have been adopted as a practice in many different organisations of all sizes (Akhtar and Mittal, 2015), and have also been practiced in mostly all sectors and industries around the world (Bititci et al., 2012; Deng and Smyth, 2014). They can balance organisational strategic, tactical and operational perspectives; improve organisational performance and competitiveness (Parida et al., 2015); support decision making (Taticchi et al., 2012; Silvi et al., 2015) and ultimately lead to organisational effectiveness (Upadhaya et

al., 2014). CPMM systems play an integral part in all the fundamental components of management practice including strategic management (Jin et al., 2013), for example by facilitating the execution of strategy (Niven, 2014; Micheli and Mura, 2017); performance management (Bititci et al., 2012), for instance by influencing people's behaviour (Yuliansyah et al., 2017); and risk management for example by identifying and managing key risk factors in an organisation (Moullin, 2017).

2.2 CPMM frameworks

The literature identifies various key CPMM frameworks that can be adopted by business organisations (Baird, 2017). The life cycle stages of a new PMM system/framework entails design, implementation, and use and review (Gutierrez et al., 2015). Some well-known CPMM frameworks include but are not limited to the Balanced scorecard (Kaplan and Norton, 1992), Results and Determinants Framework (Fitzgerald et al 1991), Performance Pyramid (Lynch and Cross, 1991), Performance Prism (Neely et al., 2001); EFQM business excellence model (EFQM, 2017). Folan and Browne (2005) differentiate between structural and procedural frameworks. The BSC, which is a structural framework, is now discussed below.

The BSC has evolved over time (Sigalas 2015), and is the most widely used, universally accepted PMM framework (Lueg, 2015). Typically, it contains performance measures from four distinct perspectives, namely, financial, customer, internal business process, and learning and growth to evaluate an entity's performance (Sigalas, 2015; Baird, 2017). The BSC can help organisations to link and align financial and non-financial performance measures with their strategy (Behery et al., 2014), and thereby monitor their performance in line with their strategy and vision (Mehralian et al., 2017). Business organisations can use the BSC to translate their strategic objectives into a coherent set of performance measures and targets (Moullin, 2017). It enables organisations to link together their performance measures across the different perspectives through strategy maps, which reflect the cause-and-effect relationships with the view of meeting their strategic goals (Francioli and Cinquini, 2014; Perkins et al., 2014). It can also be deployed for organisational decision making (Hoque, 2014), and for management and organisational change (Pimentel and Major, 2014). Lueg (2015, p.35) suggests that the BSC provides organisations a comprehensive view of their business model, and helps managers focus on what really matters to the organisations' business model by using a set of suitable measures.

Despite its popularity and usefulness, the BSC, however, has some limitations that should be noted if it is to be effectively implemented within organisations. The BSC is claimed to be mainly a top-down performance management approach (Nørreklit et al., 2012), which limits the contribution and involvement of employee in strategy. Some authors (Nørreklit et al., 2012; Francioli and Cinquini, 2014) argue that the cause-effect relationship between and within BSC perspectives is overly simplistic, ambiguous, dangerous and are not well understood, and consequently will mislead management. Also, the four perspectives of the BSC could ignore some critical stakeholders and aspects of the organisation and its value chain (Barnabè, 2011), and are based on impressions rather than reasoning (Nørreklit et al., 2012).

2.3 Performance measurement and management (PMM) in construction

Overview of PMM in construction

PMM in the context of construction is typically centred at three different levels, namely: project, organisation and industry levels (Elyamany et al., 2007; Chan, 2009; Deng et al., 2012). Previous studies on PMM in construction have focused on evaluating project performance (Lin and Shen, 2007; Ali et al., 2012). In the last few decades, however, PMM in construction at the organisation level has received growing attention in the literature (Ali et al., 2012; Jin et al., 2013). More specifically, there has been a plethora of studies conducted in construction (e.g. El-Mashaleh et al., 2007; Yu et al., 2007; Bassioni et al., 2008; Luu et al., 2008; Jin et al., 2013; and among others) that examine the importance of PMM, and the application of CPMM frameworks to construction organisations in order to measure, evaluate and manage their performance.

The need for PMM in construction

There is growing recognition of the need for CPMM systems/frameworks within construction organisations to provide information to meet their strategies and objectives. They can deploy CPMM frameworks to achieve continuous improvement (Meng and Minogue, 2011; Halman and Voordijk, 2012), including project management improvement (Haponava and Al-Jibouri, 2012) and improvement in their competitiveness (Oyewobi et al., 2015). According to Yu et al. (2007), construction organisations can adopt CPMM systems for evaluating management performance, managing human resources, and formulating corporate strategy (p.131). Effective CPMM frameworks enable construction firms develop strategies to improve their competitiveness, support their decision making process, to perform benchmarking (Ali et al., 2013; Ercan and Koksall, 2016); to achieve profitability and sustainable growth (Horta et al., 2013); and to capture the interests of all their key stakeholders (Cheng et al., 2014). Furthermore, CPMM frameworks can improve the budgeting process for construction projects and organisations (de Azevedo et al., 2013), and can support and improve collaborative design in construction (Ren et al., 2013).

PMM frameworks in construction

The three main CPMM frameworks that have been proposed, adapted and applied in construction to measure project, organisational and industrial performance are the balanced scorecard (BSC) model, key performance indicators (KPIs) model, and European Foundation for Quality Management (EFQM) excellence model (Yang et al., 2010; Meng and Minogue, 2011; Oyewobi et al., 2015). In addition to EFQM model, the Malcolm Baldrige National Quality Award (MBNQA) is another business excellence model, which is based on the seven criteria (i.e. leadership, strategy, customers, measurement, analysis, and knowledge management; workforce; operations; and results), that has been widely applied in construction in the USA and many other countries to evaluate performance (Oyewobi et al., 2015; NIST, 2017).

Yu et al. (2007) propose the adoption of the original BSC to evaluate the performance of construction companies and Chan (2009) considers and applies the original BSC to evaluate the performance of the construction industry. Jin et al. (2013) and Halman and Voordijk (2012) propose the use of a modified BSC for performance evaluation of organisations.

Following the Egan's (1998) Rethinking Construction Report, Constructing Excellence plays a central role in the UK construction industry PMM by continually developing and annually publishing the main sets of industry Key Performance Indicators (KPIs) covering the three aspects of sustainability – economic, social and environment performance of firms and projects (Constructing Excellence, 2016). Examples of economic KPIs include client satisfaction, contractor satisfaction, and productivity; social (people) KPIs include staff turnover rate, sickness absence, and training; and environment KPIs include energy use, mains water use, and waste (Constructing Excellence, 2016). The KPIs allow firms to measure and benchmark their performance as well as their project performance (Constructing Excellence, 2009; Haponava and Al-Jibouri, 2012).

Meanwhile, the EFQM Excellence Model can be used for “enabling an organisation to gain a holistic overview of their current level of excellence and prioritise their improvement efforts to maximise their impact” (EFQM, 2017, p.7). This Model uses nine criteria of performance. Five of these criteria are ‘*enablers*’ which measure what an organisation does and how it does it, and four criteria are ‘*results*’ measuring what an organisation achieves (EFQM, 2017). Leadership, people, strategy, partnerships and resources, and processes, products and services are the five ‘*enablers*’ criteria; while people results, customers results, society results and business results are four ‘*results*’ criteria of the Model (EFQM, 2017). An EFQM based model was proposed by Mohamed and Chinda (2011), and Shanmugapriya and Subramanian (2016) to evaluate the safety practices and safety performance improvement in construction organisations.

3 RESEARCH METHODOLOGY

The aim of this research, which is part of a larger research, is to develop a conceptual framework for evaluating the performance of construction firms. A comprehensive literature review was conducted to investigate PMM in general and in construction to inform the development of the conceptual framework. This research articulates and discusses the key components of the framework including the perspectives, critical success factors and performance measures that are applicable to construction organisations. Construction firms were selection in this research because they play a pivotal role in the national and global economy. Bassioni et al. (2004) refer to construction firms as “firms that undertake construction of civil or building facilities and can include a design function” (p.42). In this research, construction firms are entities that undertake the construction of civil and/or building works, and construction related services. The literature review provides information on well-established CPMM frameworks such as the BSC that are used to measure and evaluate the performance of organisations, in particular construction organisations. The proposed conceptual framework is based on BSC because it is found to improve organisational performance and climate (Molina et al., 2016) and it is the most widely used and diffused PMM framework (Lueg, 2015), which is now discussed below.

4 DEVELOPMENT A CONCEPTUAL FRAMEWORK

The proposed conceptual framework in this research is shown in figure 1. CPMM frameworks such as the BSC should help organisations capture the interests of their key stakeholders. Accordingly, the proposed conceptual framework considers the needs of shareholders as well as other relevant stakeholders in the construction industry such as

customers, suppliers, and the environment/community which were often ignored in most previous PMM frameworks (Chan, 2009). Its development involves providing a definition of conceptual framework, formulation of strategy and description of its components, which are now discussed below.

4.1 Definition of conceptual framework

Shanmugapriya and Subramanian (2016) define a conceptual framework “a process comprising of concepts and causal relationship between these concepts”. A conceptual framework intends to achieve desired goals for an organisation. In this study, the proposed PMM conceptual framework encapsulates the key components of PMM, and attempts to demonstrate the interaction between them to produce the desired results or outcomes for a business entity.

4.2 Strategy-driven

Construction organisations should ensure that every key component of their PMM framework should be derived or translated from their strategy (Niven, 2014). This view is supported by many authors (e.g. Soderberg et al., 2011). They need first to formulate their strategy and then establish the linkage between strategy formulation processes and PMM framework as articulated by some authors (Gimbert et al., 2010; Micheli and Mura, 2017). Gimbert et al. (2010, p.479) define strategy formulation as “the process through which a firm defines its overall long-term direction and scope” to create value. In a study on PM of construction firms, Lu et al. (2008) found that performance measures were derived directly from corporate strategy formulation using a strategic map.

4.3 Identification of the key components of the conceptual framework

The proposed conceptual framework comprises the following potential key components: BSC perspectives, critical success factors (performance criteria), and corresponding performance measures that are relevant the construction industry, which is exhibited in Table 1 below.

Table 1: The potential key components of the proposed conceptual framework

| # | Perspective | Critical success factors | Performance measures |
|---|-----------------------------|---|--|
| 1 | Financial | Profitability, growth and stability (Yu et al., 2007). | Return on investment, profit margin (Liu et al., 2015); revenue growth rate (Yu et al., 2007; Ali et al., 2013). |
| 2 | Customer | Client or customer satisfaction (Jin et al., 2013; Cheng et al., 2014); market share (Yu et al., 2007). | Customer satisfaction ratings, percentage of Repeat Customers, relative market share (Ali et al., 2013). |
| 3 | Internal business processes | Research and development, technological capability, business efficiency (Yu et al., 2007); risk management (Bassioni et al., 2008). | Defeat rate, successful tenders’ rate, accident rate, percentage of expenses to sales (Ali et al., 2013). |

| | | | |
|---|-------------------------|--|---|
| 4 | Learning and growth | Organisational competency (Yu et al., 2007); employee development, and technology competency (Luu et al., 2008). | Employee productivity (Yu et al., 2007); Employee satisfaction survey (Jin et al., 2013); investment in IT for construction (Luu et al., 2008). |
| 5 | Supplier | Supplier management (Bassioni et al., 2008). | Materials return rate, supplier on-time delivery, quality of purchased goods (Halman and Voordijk, 2012). |
| 6 | Project | Project management (Cserháti and Szabó, 2014). | Safety, cost, time, quality, client's satisfaction (Yeung et al., 2013). |
| 7 | Environment & community | Sustainability (Jin et al., 2013). | Energy and water consumption; waste and scrap level, contribution to the community (Parmenter, 2015). |

The following sub-sections describe the key components of the proposed conceptual framework.

Step 1: identification of perspectives

It is imperative for construction organisations to identify their performance perspectives that represent a comprehensive coverage of all pertinent aspects of their business model. Some authors have proposed the use of the original perspectives of BSC to evaluate the performance of construction organisations (Yu et al., 2007). However, Lueg (2015) suggests that the original BSC ignores developments in the industry-specific, social and natural environments (p.37). Accordingly, some other authors have added relevant perspectives to the original perspectives of the BSC to evaluate the performance of construction organisations (Jin et al., 2013; Ali et al., 2013) or have replace existing perspectives of original BSC with new ones (Ozorhon et al., 2011). The conceptual framework proposed in this research includes three additional performance perspectives to the four original perspectives of the BSC namely project perspective (Kagioglou et al. 2001); supplier perspective (Kagioglou et al. 2001); and environment & community perspective (Parmenter, 2015; Björklund and Forslund, 2013) to reflect the distinct characteristics of the construction industry. The proposed conceptual framework therefore attempts to include the triple bottom line aspects of sustainability, namely economic, social and environmental performance (Yadav-Sushil and Sagar, 2013). The seven potential interrelated performance perspectives are now briefly discussed.

(1) Financial perspective: The financial perspective focuses on providing more value to the shareholders of construction organisations in terms of improvements in the bottom line results (Chan, 2009). Construction organisations can use this perspective to demonstrate their financial accountability and stewardship through the production and validation of financial statements.

(2) Customer perspective: PMM in construction is usually client-driven. Therefore the customer perspective is critical for construction organisations to assess their customers' requirements (Oyewobi et al., 2015) and hence increase customer value, which can lead to close customer relationships and high-quality in their operations (Jin et al., 2013).

(3) Internal business processes: This perspective requires construction organisations to place emphasis on integrating and improving the internal efficiency of their business processes to achieve excellence (Ali et al., 2013; Jin et al., 2013).

(4) Learning and Growth: This perspective requires construction organisations to invest in their human resources development, their competency, and informatization (Yu et al., 2007), in order to manage their business and improve their performance and ability to adapt to change (Perkins et al., 2014).

(5) Project perspective: The construction industry is mainly project based (Ozorhon et al., 2011; Keung and Shen, 2013). Therefore, this perspective requires construction organisations to drive focus on evaluating the successfully achievement of project performance. Project performance is the realization of predefined project objectives (Ozorhon et al., 2011) and hence project success.

(6) Supplier perspective: The supplier perspective requires construction organisations to evaluate and monitor suppliers' performance in term of service quality and speed of service delivery, flexibility, and the relationships and partnerships with them.

(7) Environment & Community perspective: The importance of environmental and community perspective and its corresponding measures within CPMM frameworks is growing (Björklund and Forslund, 2013) in order to manage the environmental impact on organisational activities. These authors further suggest that an improvement in community/environmental performance will increase the focus on customers and suppliers, and it is an important source of competitive advantage for organisations.

Step 2: identification of CSFs and performance measures

Some construction researchers (Kulatunga et al., 2011; Cheng et al., 2014) have underscored the importance of identifying organisational critical success factors (CSFs) that are aligned with each perspective within the CPMM framework. CSFs are a number of important factors on which organisations should direct and concentrate their limited resources in order to achieve success (Yong and Mustafa, 2013). Construction organisations also need to identify an appropriate set of performance measures and associated targets for each of the identified CSFs (Toor and Ogunlana, 2010; Parmenter, 2015) to monitor the achievement of their mission, strategy, goals and objectives. The proposed conceptual framework uses both financial and non-financial measures of performance to reflect the holistic coverage of an organisation's business model.

Step 3: definition of a framework review procedure

A PMM framework should also include a procedure for review or assessment (Taticchi et al., 2012). The review process should be conducted to ensure that its relevance to organisational strategy and the business environment, for continuous improvement and for questioning strategic assumptions and actions, and hence could improve its effectiveness (Gutierrez et al., 2015). Moreover, the results of the review process can be used to refine the key components of, or the entire PMM framework (Gutierrez et al., 2015) to meet key stakeholders' expectations.

Step 4: diagrammatical representation of the conceptual framework

Figure 1 exhibits the initial conceptual PMM framework for evaluating the performance of construction firms. This initial proposed conceptual framework, called the Holistic Business Scorecard (HBS), focuses on specifying the key components required for evaluating the performance of construction organisations, which are also link to strategy formulation. It includes a component to perform review procedures that will ensure its relevance to strategy and the changing business environment as suggested by Gutierrez et al. (2015). It is important to note that the presented conceptual BSC framework is developed only from the literature. Primary data are currently being collected from a questionnaire survey amongst industry practitioners, and detailed case studies including semi-structured interviews with practitioners within case study firms in Saint Lucia to empirically test and further develop the conceptual framework. Furthermore, the proposed BSC conceptual framework will be validated with some semi-structured interviews with practitioners in the construction industry. Consequently, the conceptual framework will undergo revisions or refinements after gathering and analysing the data from the empirical investigation stage of the research. The conceptual BSC framework will provide a structured way for construction firms to better measure and evaluate their performance, and assess the contribution of key stakeholders. Consistent with prior studies (Ali et al., 2013; Ercan and Koksall, 2016), the conceptual framework can facilitate benchmarking of performance within each construction organisation, and among the organisations in the construction industry. Furthermore, it has the potential to be tailored to different organisational needs and contexts.

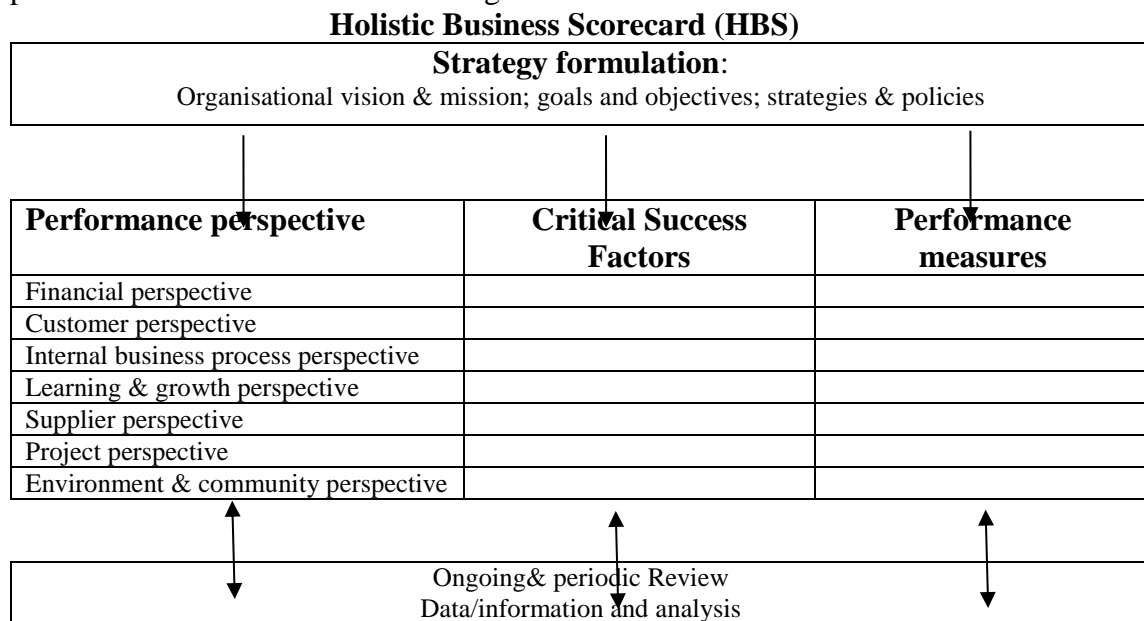


Figure 1: Proposed conception framework

5. CONCLUSION

This research comprehensively reviews the current literature on performance measurement and management (PMM) in general and in construction. In particular, this research presents an understanding of the need for PMM in construction, and concludes that the major PMM frameworks adopted in construction for evaluating performance include BSC, KPI, EFQM excellence model, and MBNQA. By using the BSC, in particular, construction firms can achieve performance improvement, determine and successfully execute their strategies, and

compare their performance to others in the industry by using benchmarking. In this research, a PMM framework based on the theoretical underpinnings of the BSC has been conceptualized for construction firms to better measure and evaluate their performance. Using the literature review, seven perspectives with associated critical success factors and performance measures that are applicable to the construction industry are identified for the proposed conceptual framework. In particular, the identified core components of the proposed BSC framework are capable of capturing the performance of the key business areas of construction firms. Ongoing research is currently being undertaken in the construction industry in Saint Lucia to empirically test the proposed BSC conceptual framework using questionnaire surveys and case studies, and then validate it with some semi-structured interviews. Finally, the findings from this research provide preliminary insight on the development and synthesis process of the conceptual BSC framework for the performance evaluation of construction firms.

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ASSESSING THE SAFETY CLIMATE IN GHANA'S UPSTREAM OIL AND GAS SECTOR

F. Horbah, C. Pathirage and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: f.horbah@edu.salford.ac.uk

Abstract: Oil and Gas industry reported that the industry has highly hazardous environments, with multiple technological, human and environmental challenges which have potentially severe consequences to workers' lives, asserts loss, environmental pollutions and disruption of security of energy supply. The use of safety climate measures to assess safety performance in an organisation is considered as a proactive or predictive approach to safety management. There are insufficient empirical studies on the establishment of current safety performance in Ghana's upstream oil and gas operations. This paper seeks to assess the current safety climate predictive influences on major accident risks in Ghana's upstream oil and gas sector. Safety climate survey questionnaires made up of 60 items in 14 constructs were used to assess the current employees' safety perceptions. 212 responses from upstream oil and gas workers were received and analyzed. The results show that safety priority and supportive environment were found to have high predictive influence on major accident risks. In addition, safety supervision, management of change, equipment maintenance and management commitment indicate predictive influence on major accident risks. The findings of this study provide valuable guidance for researchers and industrial practitioners to identify mechanisms by which they can improve existing safety at the work environment.

Keywords: safety climate, safety indicator, safety management, safety performance, upstream oil and gas operations.

1. INTRODUCTION

There have been many researches indicating an increasing trend of industrial work-related injuries, fatalities and asserts losses at the various workplaces in Ghana (e.g. Ayarkwa et al., 2010; Norman et al., 2015; Bayire, 2016). The economic cost of industrial accidents in the country is estimated to be \$16 million annually (Norman et al. 2015). Ghana's oil and gas industry is one of these industries recently experiencing work-related fatalities, injuries and asserts loss (Ocloo, 2017; Tetteh, 2017). Studies (e.g. Amorin 2013; Hystad et al. 2014) have found that workers in this safety critical industry operate in highly hazardous environments, with multiple technological, human and environmental challenges which have potential severe consequences to workers' lives, asserts loss and environmental pollutions.

Safety climate is the shared perceptions of the employees on safety policies, procedures and practices at the work environment (Zohar, 2003; Brondino et al., 2012). Safety climate has been found as a robust predictor of organisational safety performance (Cooper & Phillips, 2004; Andreas et al., 2016; Griffin & Curcuruto, 2016; Huang et al. 2017). However, there are limited studies that have investigated the relationship between safety climate and major accident in the oil and gas industry. Existing studies are characterised with poor investigation of such relationship. There is confusion between the terms 'conditions' and 'causes' of accident in the literature. It can be argued that safety climate best measures conditions (indirect indicators) contributing to accidents and not causes (direct indicators) of accident.

Safety climate serves as a leading indicator for major accident risk. There are limited empirical studies on prevailing conditions that could contribute to major accident risks in Ghana's upstream oil and gas sector.

The purpose of this paper is to assess the current safety climate constructs that could predict major accidents risks in Ghana's upstream oil and gas sector. Ghana's upstream oil and gas sector (exploration and production sector) strategically contributes to the country's energy needs and assert of high value to its local economy. There is the need to know and understand the prevailing human and organisational conditions that could provide 'early warning' of potential safety system failures in the industry. Exposing these conditions would help managers to put corrective measures in place to avoid possible future major incidents in the Ghana oil and gas industry. Overall, this study contributes to the development of safety climate as a leading major accident risk indicator.

The paper is organised as follows: the next section reviews safety climate as a leading major safety indicator; the third section presents the methodology of the study, the fourth section presents the results and analysis of the study, and finally concludes in the fifth section.

2. SAFETY CLIMATE AND MAJOR ACCIDENTS IN THE OIL AND GAS INDUSTRY

Most major accident investigative reports in the oil and gas industry (e.g. Cullen, 1990; Baker, 2007; CSB, 2014) and scientific studies on analysis of hydrocarbon leaks (e.g. Sklet, 2006; 2010; Vinnem et al, 2007a; Okstad et al. 2009; Haugen et al, 2010) have indicated that human and organisational factors are the main important causal factors. Various studies have established that culture is the main driver and predictor of shaping organisational safety performance (Flin et al., 2000). However, given the conceptual challenges of measuring safety culture (Guldenmund, 2000; 2007; Glenton & Stantan, 2000), most studies have used the term safety climate to describe the tangible outputs or indicators of an organization's safety culture. Safety climate' has been established in the literature as an indicator that predicts organisational safety performance. However, many of the existing safety climate assessment relating to the high-risk industries focus on personal safety indicators which have limited scope to capture proactive indicators of major accident risk factors.

2.1 Organizational Climate

Organisational climate is defined as the workers' perception of work environment events and the expectations that the organisation has of workplace behaviour, attitudes, and norms (Ostroff et al., 2003). According to Schneider (1990), organisation climate is made up of shared perceptions among employees regarding the procedures, practices and the kind of behaviour that is rewarded and supported relating to the specific environment in question. From these definitions, the key attribute of organisational climate is the *shared* employees' perceptions regarding the work environment. Zohar (2000) argues that this attribute emerges as a group-level property which actually develops from individual members' experiences and perceptions of the work environment and progressively become *socially shared*. According to Schneider (1975), organisational climate arises through individual perceptions of order in the workplace and also through the creation of new order by inferring from what is perceived. It is a multidimensional construct that is made up of individual evaluation of the work

environment. Organisational climate provides the context in which specific individual evaluation of the value of safety are made (Neal et al., 2000). This implies that organisational climate can predict specific safety climate.

2.2 Safety Climate

The original paper defines safety climate as “shared employee perceptions about the relative importance of safe conduct in their occupational behavior” (Zohar, 1980: p.96). Other researchers view it as a specific facet of social climate in organizations regarding perceptions of the priority of policies, procedures and practices relating to safety (Flin et al., 2000; Zohar, 2000; Zohar and Luria, 2005). Payne et al. (2010) defines *policies* as “the organizational goals and means for goal attainment, while *procedures* provide tactical guidelines for actions relating to these goals”. And *practices* refer to the “implementation of policies and procedures by managers within each workgroup” (p.806). From these definitions of safety climate, the term safety climate is identified as mainly social consensual or shared social cognition.

The number of scientific studies on safety climate has been progressing over the last 30 years. In recent times, safety climate is found as a robust indicator of both subjective and objective organisational safety performance (Bosak et al. 2013; Andreas et al., 2016; Huang et al., 2017). There have been much focus on methodological issues rather than its theoretical or conceptual issues (see e.g. Høivik et al. 2009; Bosak et al., 2013; Mihajlovic, 2013; Dahl & Olsen, 2013; Hystad et al., 2014; Rémi et al., 2015; Kvalheim & Dahl, 2016; Bayire, 2016). However, there are conceptual ambiguities in the safety climate literature which need to be clarified. As evident in several previous studies (see e.g. Cox & Cheyne, 2000; Flin et al., 2000; Glendon & Stanton, 2000; Glendon, 2008), many variables are commonly found in both organisational safety climate and culture measurements. From the literature, there is no real consensus on how to describe the climate or culture of an organisation.

In the literature, few attempts have been made to differentiate between culture and climate. Culture reflects belief or value, while climate relates to perception or attitude (Guldenmund, 2000, 2007). safety climate is described as a “snapshots” of safety culture at a specific time (Flin et al., 2000). According to Andreas et al. (2016), climate emanates from psychometric tradition, while culture originates from sociological and anthropological tradition. These differences as found in the literature only point to the methodological relationship between the two concepts rather than the theoretical aspects. However, given the limited theoretical underpinnings on the discrimination of safety climate and safety culture, scientific efforts are required to conceptually establish the clarities of the two concepts.

Zohar (2010) identified relative priorities as one of the key attributes of safety climate that emerging studies on methodological issues should take into consideration. Zohar argues that operationalisation of safety climate should focus on the nature of relationship between policies, procedures and practices in relation to safety which must take into consideration rules and procedures associated with safety competing with other operational demands. It is found in extant safety climate literature focusing on the oil and gas industry (see e.g. Mearns et al., 1997; Fleming, 2001; Mearns et al., 2001; Mearns et al., 2003; Bayire, 2016) that climate perception variables hardly relate to the nature of relationship between the relative priorities among the dimensions rather than considering the individual variables in isolation. Retrospectively, reports on causes of major disasters in the oil and gas industry indicate that

pressure for increasing production competes with ensuring safe operations (e.g. BP Texas Explosion in 2005 (Baker, 2007); Deepwater horizon disaster in 2011 (DHSG, 2011). One must compare an immediate profit gain to an accident resulting to concurrently loss in production, lives, environmental pollution and the potential impact on the organisation's reputation. It makes economic sense to sacrifice the immediate economic gain for safety. Emerging studies need to consider construction of safety climate variables from the perspective of how management choose between production/cost demands and that of the organisational safety policies, procedures and practices requirements. This is because in a practical sense, a high safety climate perception score favouring management's relative choice for production/cost as against compliance of safety rules and procedures could suggest a weak indicator for safety performance. The main challenges in safety research is to find the factors and process that influences safety climate. There have not been much studies on safety climate as a leading indicator for major accident risks.

2.4 Safety Climate as a Leading Major Accident Risk Indicator

To avoid accidents from occurring, one important strategy is to be incessantly vigilant through the use of indicators (Øien et al., 2011). Safety indicators are developed to mainly monitor the level of safety in a system, to motivate action, and to provide the necessary information for decision-makers about where and how to act (Skogdalen et al., 2011). In the oil and gas industry, the common safety indicators traditionally used may include: *Fatal accident rate*, *Lost time injury frequency*, and *Total recordable injury rate* and supplemented by hydrocarbon release statistical information (IOGP, 2015; Tamim et al., 2017). Occupational accidents descriptively are summarized as trips, slips and falls (Skogdalen et al., 2011), whilst major accidents are "adverse events such as major leaks/releases, fires, explosions or loss of structural integrity, leading to multiple deaths and/or major damage to the environment or property" (Amyotte et al., 2016, p.1). There are common characteristics associated with major accident cases: they have relatively low frequencies but extremely severe consequences (Amyotte et al., 2016); their occurrences were not due to unknown physical or chemical process hazards but in all cases the hazards were known for long time; why they continue to occur are mainly characterised by management quality, organizational and human factors (Knegtering & Pasman, 2009); they are caused by multiplicity of flaws, lacks and deficiencies (Reason, 1990). The controversial issues characterizing safety indicators measurement involve whether managing indicators for preventing occupational accidents the same way as managing indicators for major accidents, and should safety indicators be measured retrospectively or predictively?

At least experience of past major accidents in the oil and gas industry (e.g. *Shell's chemical Company Plant Explosion in Texas in 1997*, *BP Texas City refinery disaster in 2005* and *Deepwater Horizon accident in 2010*) have indubitably shown that the long assumption of occupational accidents indicators as relevant indicators for major hazard risk is misleading (Baker, 2007; Skogdalen et al., 2011). Lagging safety indicators are reactive indicators for measuring potential contributing factors of accidents which uses retrospective analysis. Leading safety indicators are predictive indicators measuring potential contributing factors which involve active monitoring to achieve organisational safety outcomes. Many studies measure safety climate as a lagging indicator to assess workers' perception of the history of safety within the organisation. The reason is that retrospective designs are easier to conduct simply because of availability of previous event data (Payne et al., 2010). However, there is the need to proactively monitor potential factors that contribute to the emergence of major

accident than to wait for accident to occur and before beginning to investigate its causal factors (direct indicators). Given the apparent significance of leading indicators, there has been very little development of academic research focusing on leading indicators. Some studies (see e.g. Antonsen, 2009; Kvalheim et al., 2016) have criticized the inability of safety climate scores to predict major accidents. However, the link between safety climate indicators and major accidents have been poorly investigated in the literature.

Antonsen (2009) investigated the relationship between safety climate and major accident by comparing safety climate results and findings from an accident inquiry in a specific installation. The results of the safety climate scores (the pre-incident survey) indicate that “the culture of the company in question was “a culture of compliance and learning, sensitive of the risks involved and highly oriented towards safety” (p.247). The results obtained from the inquiry after the accident show an inverse association with the safety climate scores. In a similar study, Kvalheim et al. (2016) investigated the ability of safety climate measurements to assess the risk of major accident in the Norwegian offshore oil and gas operations. The study was conducted in three installations and the results were inclusive. In installation A and C, positive safety climate scores were interpreted as acceptable and which did not attract further attention from the management for corrective measures. In installation B, the results show a negative development which could suggest that the safety conditions were deteriorating. The results of these studies were methodologically challenged. The studies only focused on few cases under one construct of safety climate. However, if more cases were investigated with more constructs the results could have been significantly different.

Contrarily, in the work of Payne et al. (2010), which investigated the lagging and leading effects of safety climate assessment on the major accident risk resultantly gave a different perspective. The results indicated that safety climate perceptions (good routine housekeeping, the prevention of backlogs, and prompt correction of health and safety issues) were important predictors of major accident in a chemical process industry. Moreover, in the works of Vinnem et al. (2010) and Kongsvik et al. (2011) on hydrocarbon leaks analysis, safety climate results were found to be a leading indicator for major accident risks. One could draw support from the ‘Swiss cheese model’ of accident causation (Reason, 1990), ‘failed defences’ is the most promising for effective prevention of organisational accident. The gaps in the defences emerge from *active failures* (ie. those unsafe acts such as error and /or procedural violations) and *latent conditions* (e.g. high workload, time pressure, inadequate skills, experience and poor equipment etc.). These latent conditions mostly exist within the defences for a long period and may be exposed by systems auditing or occurrence of incidents (Reason, 1990; 2016). Some studies have developed safety climate variables by capturing those elements of active failures and latent conditions to measure organisational safety performance (see e.g. Mearns et al., 1997; Fleming, 2001; Mearns et al., 2001; Mearns et al., 2003; Bayire, 2016). Safety climate perception reflects a distal antecedent of safety behaviour which is mediated by the more proximal drivers of safety performance (Zohar, 2010). By implication, safety climate can be used as a proactive measure to identify the organisational latent conditions of major accidents and also prevent organisational shortcomings from becoming the root cause of future accidents. Having established the measures about the failed defences, one could provide possible predictive indicators of the likelihood of accidents. Again, what is more important is to develop safety climate scales that are valid and reliable to measure predictive conditions of major accident risks.

2.5 Dimensionality of Safety Climate

As a result of the multi-dimensional nature of safety climate, there is no universal accepted dimensions to measure it. In many review studies (see e.g. Guldenmund, 2000, 2007; Gao et al., 2016), the emphasis is placed on the validity of the constructs and its robust prediction of an organisational safety climate. On the development of safety climate constructs, the relationship between occupational accidents and major accidents variables have not received much attention in the literature. The conditions that predict occupational accidents and major accidents are not the same because there are different nature of hazards emergence.

Table 1 presents constructs found in the literature which are relevant in influencing major accident risks in the upstream oil and gas industry. In most major accident cases, most studies have found these constructs as important indicators contributing to major accidents in high-risk industries: However, ‘causes’ and ‘conditions’ of major accidents have not been clarified in the literature. Safety climate is considered as a distal antecedent of organisational safety outcome. This paper holds the view that safety climate dimensions are more skewed to reflect conditions that potentially contribute to predicting major accidents at the work environment.

Table 1: Safety Climate Dimensions for Major Accidents Risks

| Constructs | Literature Source |
|---------------------------|---|
| Safety policies | Payne et al., 2010; Baker, 2007 |
| Safety priority | Zohar, 1980; Kvalheim et al., 2016; Høivik et al. 2013 |
| Safety training | Hopkins, 2000; Baker, 2007; CSB, 2014; Høivik et al. 2013; Kvalheim et al., 2016; Yuang, et al., 2017 |
| Management commitment | Zohar, 1980; Vinodkumar & Bhasi, 2010; Kines, et al., 2011 |
| Safety rules & procedures | Vinodkumar & Bhasi, 2010; Hopkins, 2011; Neal et al., 2000 |
| Management of change | Baker, 2007; Sklet et al., 2010 |
| Safety communication | Sklet et al., 2010; Kines, et al., 2011; Skogdalen & Vinnem, 2012 |
| Equipment maintenance | Payne et al., 2010; Baker, 2007 |
| Safety involvement | Høivik et al. 2013; Kvalheim et al., 2016 |
| Safety supervision | Baker, 2007; Bhasi, 2010; Kvalheim et al., 2016 |
| Supportive environment | Baker, 2007; Payne et al., 2010 |
| Safety empowerment | Shannon et al., 1997; Baker, 2007; Kines et al., 2011; Wurzelbacher & Jin, 2011 |
| Safety motivation | Vinodkumar & Bhasi, 2010; Kvalheim et al., 2016; Høivik et al. 2013 |
| Safety behaviour | Bayire, 2016; Huang et al., 2017 |

3. METHODOLOGY

3.1 Sample and Procedures

The sample was drawn from a full time workforce in the Ghanaian upstream oil and gas sector from five companies. The survey questionnaires were distributed to 250 employees which eventually had a response rate of 84.8% ($N = 212$). Table 2 summarises the demographic details of the participants used for the study. 72.1% of the participants were male, while 27.8% were female. The mean age range of the sample was 3.0 (30-39 years). The job functioning category of the workers include: engineering professionals maintenance/craft technicians, operators, full time HSE employees, operation management, contractors and maintenance management. More than half (50.5%) of the participants had Bachelor degree qualification. In terms of area of operation, 65.6% of the participants work in offshore, while 30.7% work in onshore. 57.1% of the participants were reported to have

experienced occupational accidents/injuries at their respective work environment, while 36% had no accident/injuries experience.

Table 2: Demographic Information of the Participants

| Variable | Frequency (N=212) | Percentage (100%) |
|--|--------------------------|--------------------------|
| Gender | | |
| <i>Male</i> | 153 | 72.1 |
| <i>Female</i> | 59 | 27.8 |
| Age | | |
| <i>Under 25</i> | 5 | 2.4 |
| <i>25 - 29</i> | 53 | 25 |
| <i>30 – 39</i> | 94 | 44.3 |
| <i>40 – 49</i> | 56 | 26.4 |
| <i>50 or above</i> | 4 | 1.9 |
| Job functioning Category | | |
| <i>Engineering professionals</i> | 90 | 42.5 |
| <i>Maintenance/craft technicians</i> | 41 | 19.3 |
| <i>Operators</i> | 10 | 4.7 |
| <i>Full time HSE employees</i> | 16 | 7.6 |
| <i>Operation management</i> | 26 | 12.3 |
| <i>Contractors</i> | 7 | 3.3 |
| <i>Maintenance Management</i> | 22 | 10.4 |
| Education qualification | | |
| <i>SSCE</i> | 5 | 2.5 |
| <i>Diploma</i> | 24 | 11.3 |
| <i>Bachelor Degree</i> | 107 | 50.5 |
| <i>Master Degree</i> | 70 | 33 |
| <i>Doctoral Degree</i> | 6 | 2.8 |
| Area of operation | | |
| <i>Offshore</i> | 139 | 65.6 |
| <i>Onshore</i> | 65 | 30.7 |
| Experience of occupational accidents/injuries | | |
| <i>Yes</i> | 121 | 57.1 |
| <i>No</i> | 78 | 36.8 |

The selected organisations were contacted through a letter seeking approval for this study to be undertaken. The survey questionnaires including the participant information sheet and informed consent forms all in envelopes were presented to the companies’ reception desks after approval had been granted for this study. Participation in the study was made voluntary and respondents could discontinue his participation without giving reasons. The returned questionnaires were sealed. It takes 20-30 minutes to complete the questions. Safety climate was measured at two hierarchical levels of the organizations: work group level and top management level. In the oil and gas industry, operations are assigned to work groups that is led by supervisors. Scientific research indicates that a comprehensive safety climate investigation should capture both employees’ perceptions of his/her immediate supervisor (group level) and their perception of top management (organizational level) relating to safety (Brondino et al. 2012; Haung et al., 2017). This would help to identify the issues that affect safety management in the upstream sector from the employees’ perspective.

3.2 Survey Instrument

The research was designed to assess the workers’ safety climate in Ghana’s upstream oil and gas sector and this was initially measured by using a 82-item safety climate scale. The instrument was made up of 4 sections: ‘demographic information’, ‘occupational accidents

and near-misses”, “workers’ perception about safety”, and “workers’ experiences of major hazards”. The instrument contains 14 constructs developed from the literature (e.g. Zohar, 1980; Baker, 2007; Vinodkumar & Bhasi, 2010; Kines et al., 2011). The prepared survey questionnaires were piloted with 50 sample size. 11 items were deleted mainly because they were repeated and some items were positively reworded.

The final questionnaires comprised 60 items in 14 constructs: safety policies (2-items), safety priority (2-items), safety training (4-items), safety rules and procedures (2-items), management commitment (3-items), equipment maintenance (3-items), safety communication (2-items), supportive environment (3-items), safety involvement (4-items), safety empowerment (6-items), management of change (3-items), safety supervision (4-items) safety motivation (3-items), and safety behaviour (2-items). It scores a 5-point likert type scale from *strongly disagree* to *strongly agree* on “workers’ perception about safety”; and from *very unsafe* to *very safe* on “workers’ experiences of major hazards”. The scale had a high level of internal consistency, as determined by a Cronbach’s alpha of .834.

3.3 Data Analysis

The IBM SPSS v23 software was used to perform the statistical analysis required for the study. Descriptive statistics and pearson correlation were conducted for the studied constructs to establish some pattern of associations among them. Given the large number of variables under studied, factor analysis was computed to identify the latent coconstructs. The data were subjected to principal component factoring and orthogonal Varimax rotation. The analysis indicates that Kaiser-Meyer-Olkin (KMO) Measure of Adequacy was .709 suggesting that the data were appropriate for this analysis (Kaiser, 1974). Bartlett’s Test of Sphericity was significant at [$\chi^2=1005.969$, $p<.000$] indicating that there exist correlation among the safety climate scales. Multiple regression analysis was computed to determine stronger causal inferences from the observed relationships among the constructs. The five factors (F₁, F₂, F₃, F₄, F₅) were constituted as the independable variables and the dependable variable is the major accident risks.

4. RESULTS

The results of the statistical analysis and pearson correlation among the constructs have been presented in table 3. The high mean scores were found in the following constructs: supportive environment (M =4.32; S.D. =.432), safety priority (M=4.19; S.D. = .44), safety policies (M= 4.09; S.D. = .37), equipment maintenance (M = 4.09; S.D. = .34), and safety behaviour (M = 4.04; S.D. = 1.21). It was found that there were negative correlations among most of the safety climate constructs. Workers’ perceptions of feeling “unsafe” for major accidents risks were found negatively correlated with these safety climate constructs: safety policies (r = -.18, $p<0.5$), safety training (r = -.04, $p<0.5$), management commitment (r = -.09, $p<.05$), equipment maintenance (r = -.15, $p<.05$), safety communication (r = -.07, $p<0.5$), safety motivation (r = -.01, $p<.01$), and safety behaviour (r = -.03, $p<0.1$).

Table 3: Descriptive Statistics and Correlations

| | M | S.D. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---------|------|------|--------|--------|------|--------|--------|-------|-------|--------|--------|--------|--------|--------|------|------|----|
| 1. SP | 4.09 | .37 | | | | | | | | | | | | | | | |
| 2. PR | 4.19 | .44 | -.19** | | | | | | | | | | | | | | |
| 3. TR | 1.95 | .60 | -.17* | .15* | | | | | | | | | | | | | |
| 4. RP | 1.88 | .32 | -.59** | -.04 | -.04 | | | | | | | | | | | | |
| 5. MC | 2.64 | 1.00 | -.27** | .04 | .10 | -.25** | | | | | | | | | | | |
| 6. EM | 4.06 | .34 | .07 | -.18** | .12 | -.14* | .28** | | | | | | | | | | |
| 7. CM | 3.16 | 1.29 | .04 | -.05 | -.01 | -.16* | .19** | .20 | | | | | | | | | |
| 8. SE | 4.32 | .42 | -.34** | .18** | -.11 | .06 | -.20 | -.13 | -.07 | | | | | | | | |
| 9. IN | 2.47 | .96 | .11 | .01 | -.03 | -.11 | .31** | .22** | .16* | -.09 | | | | | | | |
| 10. EP | 2.64 | 1.00 | .30** | .27** | .00 | -.28** | .54** | .10 | .21** | -.15* | .45** | | | | | | |
| 11. MG | 2.75 | 1.15 | .23** | -.02 | .06 | -.24** | .51** | .08 | .21** | -.20** | .42** | .78** | | | | | |
| 12. SV | 2.87 | 1.10 | .24** | -.03 | -.00 | -.25** | .39** | .09 | .24** | -.13 | .41** | .72** | .82** | | | | |
| 13. MO | 3.62 | 1.06 | .26** | -.01 | -.08 | -.20** | .22** | .04 | .10 | .01 | .25** | .32** | .31** | .53** | | | |
| 14. BE | 4.04 | 1.21 | .04 | .04 | -.06 | -.22** | -.31** | .01 | .05 | .10 | -.20** | -.31** | -.31** | -.28** | -.10 | | |
| 15. HAZ | 1.7 | .60 | -.18* | .07 | -.04 | .17* | -.09 | -.15* | -.07 | .14* | .12 | .13 | .17* | .10 | -.01 | -.03 | |

N = 212, **, p < 0.01. *, P < 0.05.

Abbreviation of safety climate constructs: **SP**=Safety Policies; **PR**=Safety Priority; **TR**=Safety Training; **RP**=Safety Rules & Procedures; **MC**=Management Commitment; **EM**=Equipment Maintenance; **CM**=Safety Communication; **SE**=Supportive Environment; **IN**=Safety Involvement; **EP**=Safety Empowerment; **MG**=Management of Change; **SV**=Safety Supervision; **MO**=Safety Motivation; **BE**=Safety Behaviour. **HAZ** = Major accident risks.

The results for the factor analysis were presented in table 4 which show the factor score coefficients, the rotated factor loading and the communality coefficients. The analysis shows that 5 factors have Eigen values greater than 1 (Kaiser, 1974) with communality coefficient (h²) score above 50%. Factor 1 (F₁) has the following constructs: *Safety supervision, Management of change, Safety empowerment, and Management commitment.* Factor 2 (F₂) has *Safety policies, Safety rules and procedures, and Safety behaviour.* Factor 3 (F₃) comprises *Safety priority and Supportive Environment.* Factor 4 (F₄) comprises *Equipment maintenance and Safety communication.* Factor 5 (F₅) has *Safety training and Safety priority.* These five factors (F₁, F₂, F₃, F₄, & F₅) as independent variables were selected for the multiple regression analysis to determine which factor has more predictive influence on major accident risks.

Table 4: Results of Factor Analysis

| | Factor Score Coefficients | | | | | Rotated Factor Loading (f) | | | | | Communalities (h ² =100%) |
|----|---------------------------|----------------|----------------|----------------|----------------|----------------------------|----------------|----------------|----------------|----------------|--------------------------------------|
| | F ₁ | F ₂ | F ₃ | F ₄ | F ₅ | F ₁ | F ₂ | F ₃ | F ₄ | F ₅ | Communality |
| SP | -.014 | .408 | -.282 | -.165 | -.118 | | .730 | | | | .829 |
| PR | .068 | .128 | .375 | -.196 | .475 | | | .531 | | .584 | .706 |
| TR | -.037 | .009 | -.094 | .061 | .653 | | | | | .812 | .687 |
| RP | .025 | -.513 | -.029 | -.009 | -.150 | | -.849 | | | | .788 |
| MC | .133 | .009 | -.138 | .074 | .215 | .601 | | | | | .561 |
| EM | -.078 | -.040 | -.112 | .599 | .068 | | | | .780 | | .679 |
| CM | .011 | .002 | .185 | .525 | -.057 | | | | .667 | | .520 |
| SE | .043 | -.035 | .564 | .069 | -.095 | | .773 | | | | .633 |
| IN | .162 | -.112 | .086 | .204 | -.074 | | | | | | .441 |
| EP | .246 | -.008 | .007 | -.049 | .021 | .862 | | | | | .767 |
| MG | .254 | -.033 | -.010 | -.064 | .038 | .876 | | | | | .790 |
| SV | .261 | -.002 | .098 | -.036 | -.082 | .876 | | | | | .793 |
| MO | .157 | .150 | .236 | -.030 | -.206 | | | | | | .488 |
| BE | -.185 | .373 | .247 | .198 | -.029 | | .536 | | | | .572 |

Multiple regression analysis was used to test which factors have more predictive influence on major accident risks. As the results are presented in table 5, it is found that the model was

significant, $F(5, 206) = 4.61, p < .001$, which accounted for 31.7% of the variance. Factor 3 (F₃) indicated a more predictive influence on major accident risks ($Beta = .180, p < .001$). In addition, Factor 1 (F₁) shows a predictive influence on major accident risks ($Beta = .143, p < .001$).

Table 5: Results of Multiple Regression

| Predictor | Unstandardized Coefficients | Standardized Coefficients | t | P |
|-----------|-----------------------------|---------------------------|--------|------|
| | B | Beta | | |
| F1 | .085 | .143 | 2.165 | .032 |
| F2 | -.107 | -.180 | -2.723 | .007 |
| F3 | .107 | .180 | 2.718 | .007 |
| F4 | -.070 | -.118 | -1.785 | .076 |
| F5 | -.024 | -.040 | -.607 | .545 |

Note: $F(5, 220) = 4.61, p < .001, R^2 = .101$

Factor 3 comprises these constructs: *safety priority* and *supportive environment*. Factor 1 is made up of: *safety supervision*, *management of change*, *equipment maintenance* and *management commitment*. As established in the literature (see e.g. Zohar, 1980; Baker, 2007; Høivik et al. 2013; Kvalheim et al., 2016), the prioritisation of safety and supportive environment have become important factors that contribute to major accidents in the oil and gas industry. When management sees safety as a value of the organisation, other equally important operational demands could be sacrificed. Safety supervision is found to have a predictive influence on major accident risks. It appears that in the various work groups in the industry, supervision practices were weak. Weak supervision practices may reflect the low attention allocated to work procedures and practices relating to ensure that maintenance is safe before such activities are initiated. For example, this became one of the key contributory factors in the BP Texas City gas explosion in 2005 (Baker, 2007). Supervisors need to take actions when a worker engages in poor safety practices and also take appropriate action in response to suggestions for process safety improvements. Given that the upstream oil and gas operations are technical and organizational complex, and dynamic, most times changes in working procedures and practices are initiated by management. Weak predictive indicators may imply that workers are not always updated fully regarding the changes in working procedures at the work environment. This factor was also found contributing to the Deepwater Horizon disaster in 2010 (Sklet et al., 2010; CSB, 2014). Management always needs to implement changes efficiently. Management commitment was found to have a predictive influence on major accident risks. This confirms the literature position that management commitment to safety drives existing safety performance in the organisation (Zohar, 1980; Vinodkumar & Bhasi, 2010; Kines, et al., 2011). Managers do not have to compromise safety by short-term financial goals. When near-miss or accidents are reported, management must act quickly to solve the problems.

As discussed in the ‘Swiss cheese model’ of accident causation (Reason, 1990), these constructs found in Factor 1 (F₁) and Factor 3 (F₃) constitute the latent conditions which mostly exist within the defences for a long period and may be exposed by systems auditing or occurrence of incidents. Exposing these latent conditions (safety priority, supportive environment, safety supervision, management of change, equipment maintenance and management commitment) would help managers to put corrective measures in place to avoid contributing to the occurrence of major accidents in the oil and gas industry.

5. CONCLUSION

The study was designed to assess the current safety climate predictive influences on major accidents risks in Ghana's upstream oil and gas sector. Many workers have experienced occupational accidents or injuries at the work environment. Safety climate is found to be a leading indicator to major accident risks. The relationship between safety climate measurement and major accident risks have not received adequate research attention to clarify the discrimination between what constitutes 'condition' or 'cause' of accident causation. The results of the study indicate that safety climate measures were predictive indicators for major accident risks in the oil and gas industry. Safety priority and supportive environment was found to have high predictive influence on major accident risks. In addition, safety supervision, management of change, equipment maintenance and management commitment indicate predictive influence on major accident risks.

It suggests that managers need to allocate more attention on the realignment of the organisational safety priority and improve on the existing culture of supportive environment. There is also the need to improve on supervision practices, effective implementation of working procedures and facilities changes especially on the perspective of workers' updates, improvement on equipment maintenance and management commitment to safety in the work environment. The findings of this study provides valuable guidance for researchers and industrial practitioners to identify mechanisms by which they can improve existing safety performance at the work environment.

This study was only limited to identifying those latent conditions that have predictive influences on major accidents risks in Ghana's upstream oil and gas industry. The antecedents of these factors were not explored. Further research needs to focus on investigating the antecedents of those established predictive constructs by using qualitative approaches. This would form part of the researcher's current research project.

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DEVELOPMENT OF A FRAMEWORK TO IMPROVE MATERIALS MANAGEMENT ON LIBYAN CONSTRUCTION PROJECTS

N. Maauf and R. Gameson

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: n.a.a.maauf@edu.salford.ac.uk

Abstract: Poor materials management on construction sites is one of the key factors of delay in construction projects in Libya, involving poor handling of materials and Waste Materials (WM). Further challenges to managing materials on construction sites include materials, labour, machinery and the project's environment. The aim of this research is therefore to develop a framework for materials management on Libyan construction sites. The objective of this paper is to investigate and analyse problems pertaining to inappropriate application of materials management. This paper reports on the early stages of the research, and presents a critical review of the literature on materials management in order to identify the key factors in construction projects and thereby develop a theoretical framework. The study also explores the potential role of supply chain management and lean construction methodologies in relation to materials management in recovering from delay and reducing WM. The research to date concludes that human error and unskilled labourers have an impact on the use and application of materials in construction activities and management. It also highlights the need to further investigate the most advanced solutions to the management of materials in order to solve the delay problem. The theoretical framework presented will be tested empirically, and then validated at a subsequent stage of the research.

Keywords: Construction Projects, Lean Construction, Libya, Materials Management, Supply Chain Management.

1. INTRODUCTION

Construction projects play a significant role in the Libyan economy, retaining and creating jobs and wealth for the country. They represent an important business that contributes 5.2% of the national Gross Domestic Product (GDP) (Fathi et al. 2016; Omran, 2015). However, construction projects in Libya face several problems that prevent achievement of their goals, including materials, labour, machinery and the market. Although over the last two decades Libyan researchers have focused on the causes of delay in construction projects, they have ignored the role of materials management to overcome these problems, through coordination, planning and monitoring to control quality and optimise the use of materials. The three determinants are time, cost and quality. To ensure that materials management results in improvement of the construction project and control of the site, it should be linked to specific roles in order to provide materials at the right time and reduce the waste of materials, for example, by the use of supply chain management and lean construction. Koskela (2000) identified that supply chain management (SCM) has four roles in construction sites in Finland: 1. feasible action to improve construction supply chains; 2. improve supply chains; 3. transfer activities from the site to the supply chain; and 4. integrate the site and the supply chain. On the other hand, James et al. (1990) identified that lean construction is a useful technology to manage and improve the construction process, and therefore deliver the needs of the customer. This study critically reviews the role of materials management on site to reduce the delay in building projects in the Libyan construction sector.

2. BACKGROUND

According to the Libya General Council for Planning (GCP) (2002), construction projects began under trying circumstances and then entered into a process of evolution after oil was discovered in 1951. Construction projects were dependent on oil income. Over the last four decades, the public construction sector in Libya has improved, becoming an important business that contributes 5.2% of national GDP. (Omran and Abdulrahim, 2015; Fathi et al. 2016) agreed and pointed out that, given the availability of raw materials, Libya has the largest cement factories in North Africa, located in Derna in the east of the country, as well as factories in Tripoli, Benghazi and Sabha, and an iron and steel factory in Misrata. Handfield et al. (2005) stated that the primary objective of materials management in construction projects is to reduce time. Murali and Yau (2007) agreed and added that any delay will increase cost, reducing the feasibility of the project and failing to contribute to the development of society. However, Libyan researchers have conducted several studies during the last a few years, although most discussed delays in construction without recommending the need for materials management (Shebob et al., 2012; Abdullah et al., 2002; Abdelnaser et al., 2005). The exception is Mustafa (2009), who identified that most of the delay factors are related to materials management because it has an important role in saving time and reducing costs, while retaining quality. One of the difficulties faced by construction projects in Libya is that they largely depend on foreign experts. Currently, the projects need improvement and development in order to meet the national housing supply and infrastructure needs: new homes, airports, ports, railways and roads. Hotels, office buildings and resorts are also required to meet the needs of potential tourism (Mostafa, 2009; Shebob et al. 2012).

3. MATERIALS MANAGEMENT: AN OVERVIEW

Materials management is the process which links supplies and organisations to obtain a standard of service ensuring that the right materials are available on the construction site at the right time and at the lowest cost (Safa, 2014). Madhavi et al. (2008) identified materials management as a process of planning, implementing and controlling the right source of equipment with specific quality at the right place and time for an optimised cost-construction process. Agapiou et al. (1998) added that successful materials management and reduction of the project cost involves three critical phases: purchasing, storing and using. Ayegba (2013) examined materials management as applied to building construction sites in Niger state, focusing on the methods of procurement and the factors affecting management of the construction site and suggesting measures for effective materials management. This researcher also highlighted delays in the supply of materials, unskilled supervision, poor site security, weather and other natural occurrences, alterations of designs, theft, over-ordering of materials and vandalism, leading to the wastage of materials on building construction sites in Malaysia. However, Abdul-Rahman et al. (2006) identified shortage of materials as an important factor in Libyan construction projects.

Hannure and Kulkarni (2014) observed that materials management is a scientific technique concerned with preparing, organising and control of the flow of materials from their initial purchase to the end. They recommend carrying out materials management to minimise wastage and damage of the material, and to overcome shortages, the lack of storage space, and delays in supply. In Libya, Amar et al. (2015) observed that building materials in construction projects have to be managed; be suitable for the project, the cheapest for a given quality, and delivered on time.

In Afghanistan, Ghulam and Kassim (2012) identified the high price of materials, fluctuation in availability and estimation of quantity as major problems in construction projects, leading to cost overrun. In Libya, Shebob et al. (2011) identified the most critical delay factors in construction projects as delays in materials delivery and increased cost of materials. Furthermore, materials management in Libya is required to control the waste of material on site Bennett et al. (2011).

Abdelnaser (2012) concluded that in Libya a good material management could safely impact on labour productivity. For instance, work time can become no productivity or idle time due to lack or shortage of equipment and tools on the right place at the right time. Also, double handling due to the distance of storage can affect the availability of materials. Materials quality and availability, therefore, can impact critically on the project success. As for labour- and productivity-related factors, a United Nations report (1995) stated that two broad sets of factors affect the site worker productivity requirement: organisational continuity and execution continuity. Abdulbagei et al. (2012) and Kumar (2000) agreed that materials management is essential to manage productivity and cost efficiency because it contributes the major portion of expenses in construction projects. Moreover, can reduce total project cost and complete the project on time by controlling procurement, carrying value.

3.1. Materials Handling

Inappropriate handling of materials on site is a significant issue that badly affects the performance of construction projects (Kasim et al., 2008) and can hamper project achievement (Ogun, 1996). Shebob et al. (2012) identified significant issues which affect the management of materials activities, such as restricted storage areas, site logistics in relation to materials handling and delivery, and also arranging and posting of materials on the building site.

Previous studies have discussed further issues of materials management, such as unsuitable storage (Canter, 1993; Agapiou et al., 1998); difficulties of transportation, and untimely delivery of materials (Zakeri et al., 1996); non-compliance with specifications (Dey, 2001); late delivery (Aibinu and Odeyinka, 2006); and lack of materials (Abdul-Rahman et al., 2006). However, Akbar et al. (2013) stated that there are many types of approach to addressing materials management problems, including proper planning of materials, and the concept of Just-In-Time (JIT).

3.2. Waste of Materials

Waste materials is one of the serious problems in construction projects; it leads to difference between the estimated and actual consumption of individual items (Kambiz et al., 2016; Gulghane and Khandve, 2015). Kulatunga et al. (2006) identified that by implementing waste materials practices, construction projects improve and achieve economic, quality and sustainability goals. Vivan et al., 2007) and Lingard et al. (1997) have argued that by implementing waste materials practices, contractors can reduce the cost of construction projects. Construction waste materials planning also helps to achieve benefits such as cost reduction in purchasing materials (Nilupa et al., 2015; Guthrie, 1998; Jaillon et al., 2009). However, Formoso et al. (1999) and Mohammed and Anumba (2006) explained that waste of materials is a loss that creates various costs but does not add any worth to production. On the

other hand, Abuzaid and Balmoor (2013) conducted study in Libya and focused on materials for construction. They identified that sources, transport and storage of materials are the key issues impact and lead to waste.

4. SUPPLY CHAIN MANAGEMENT (SCM)

Supply chain management is a tool used to describe the relationship between companies which convert a series of required materials or services into the final product for the customer (Koskela, 2000). Christopher (1992, p.26) identified the supply chain as a “network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer”. In construction projects, Subramani and Tamizhanban (2016) suggest that the main contractor, designer, surveyor and subcontractor are all part of a supply chain (see Figure 1).

The Five Parts of Supply Chain Management in Construction

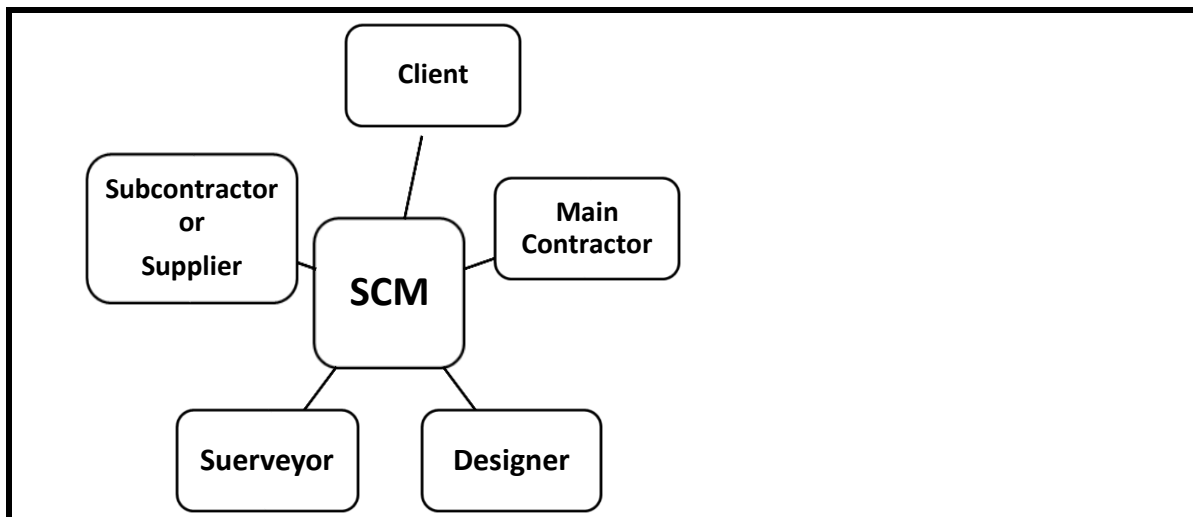


Figure.1 Five Parts of Supply Chain Management in Construction (Subramani and Tamizhanban, 2016)

Within the chain, each company has a client to provide services; however, incorporated supply chain management aims to work wholly in the interests of the project client (Construction Excellence, 2004). There is a relationship between the main contractor’s position, and the activities and errands leading to the preparation of the SCM in construction on site, including clients and the design team. Activities and errands in the delivery of construction suppliers, sub-contractors, and professional contractors in relation to the main contractor also need consideration (Saad et al., 1999; Akintoye et al., 2000; Kaschola, 2000). This means that there is a relationship between the delay of construction projects and the supply chain. Moreover, the process of reducing the real cost and removing waste from projects is one of the benefits of the supply chain in construction. Vrijhoef and Koskela (2000) have identified four roles of the supply chain management (SCM) in construction (see figure 2).

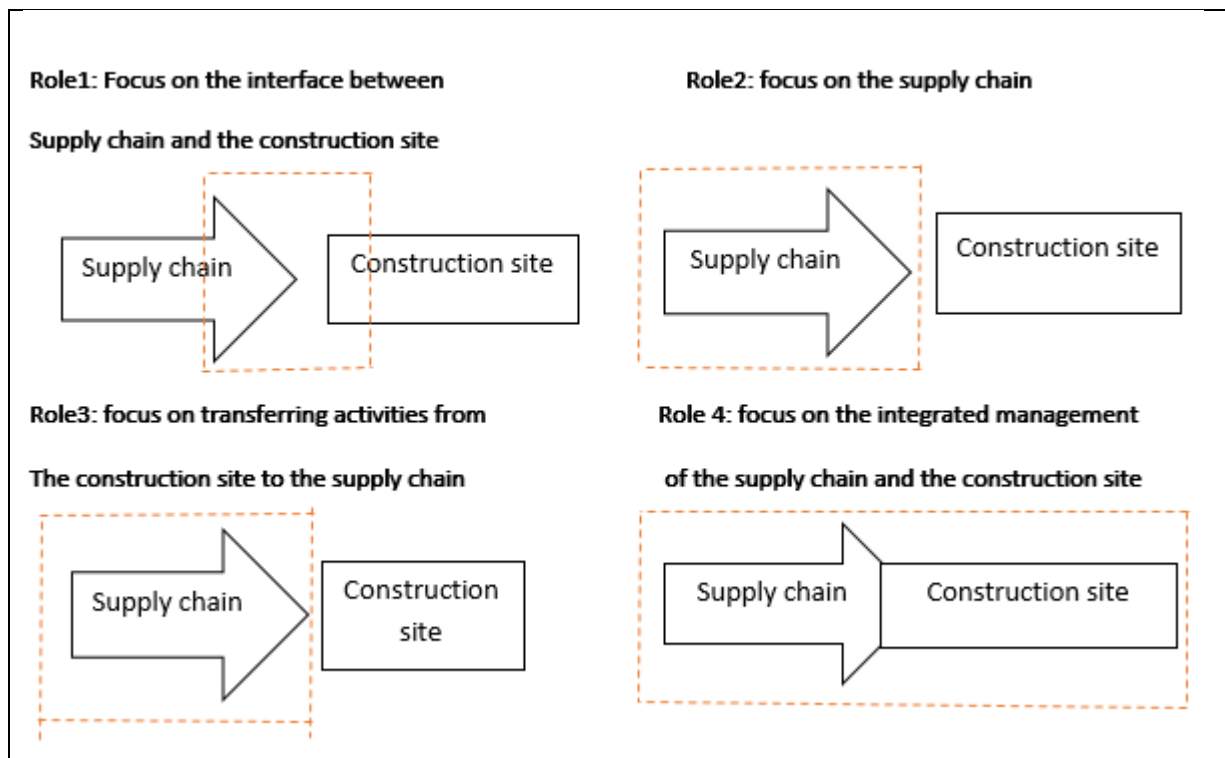


Figure 2. Four Roles of Supply Chain Management (SCM) in Construction.

Source: Vrijhoef and Koskela (2000: 7)

Role 1: Improving the interface between site activities and the supply chain.

In the field of construction logistics, the supply chain management (SCM) has the clearest roles related to co-operation between suppliers and contractors in order to improve materials. (Asplundh and Danielson, 1991; Wegelius - Lehtonen and Pahkala, 1998, cited in Koskela 2000). However, traditional treatment of construction and handling of materials has concentrated on site activities. On the other hand, (Salah, 2014) highlighted that the weak connection between suppliers and contractors is a key problem in Libya and leads to non-delivery of materials at the specified time.

Role 2: Improving the supply chain.

This is the main aim for the development of particular supply chains, such as prefabricated concrete elements or elevators (Koskela, 2000; Laitinen, 1993). It necessitates analysis of cost and time to identify specific improvement for the development of a supply chain, and when the supply chain is developed, a comparison should be made between transportation and production costs in order to achieve global improvement because productivity and supply chain performance may decrease when changing site ability conditions (Al-hajj. 2011).

Role 3: Transferring activities from the site to the supply chain.

(Oyedele et al. 2013) conducted a study in the UK and pointed out in order to provide JIT production in the construction there is the need for supply chain management. Therefore, the focus should be on redesigning the supply chain by transferring onsite activities to off site.

Industrialisation materials, especially prefabrication, can be observed as a structural means for eliminating on-site activities from the total production chain (Warszaswki, 1990). Thus, the earlier, and still actual initiatives towards industrialisation of construction must also be seen as a form of SCM concentrating on the design of the supply chain (Sarja, 1998).

Role 4: Integration of site and supply chain.

(Van Randen, 1990) presented a number of suggestions for management of a supply chain such as open building to enable users to defer decisions regarding the interior of the building. The idea is to structure the site work as successive realisations of autonomous sequences (this resembles group technology as developed in manufacturing). On the other hand, (Koskela, 2000) explaining the relationship between supply chain and lean construction and stated that lean construction improves the downstream of supply chain onsite projects; moreover, open building aims to optimise the quality of the built environment, by improving the relationship between the customer and the building industry. Meanwhile, the aim of Lean Construction is to optimise building and construction. Both of them have the benefit of improving supply chain onsite projects.

On the other hand, Saad and Jones (1999) recommended the need to improve SCM downstream because it is the weaker link in construction. Erik et al. (2010) conducted a study to improve the supply chain in construction and concluded that in order to improve downstream, there is a need to apply lean thinking to construction. This means improving activity on the construction site by defining units of production, and using tools such as visual control of processes. Design teams work exclusively on one design from beginning to end, supporting sub-contractors in developing tools for improving processes (Kaschola, 2000; Lean Construction – Construction Excellence, 2004).

5. LEAN CONSTRUCTION (LC)

Hoop and Spearman (1996) identified that lean construction aims to achieve the objective of the project and meet customer requirements using fewer resources. Koskela et al. (2002) identified it is a system to minimise waste of materials, time and effort to generate the maximum possible amount of value. Womack and Jones (2003) defined lean construction as a philosophy that depends on the notion of lean manufacturing, concerning control and improving the construction process to meet the customer's needs on time.

Howell (2001) stated that the construction sector is often described as one with many problems including lack of efficiency. and recommended using the lean construction concept as a solution. Murman et al. (2002) added that the principles of lean construction include waste minimisation. Lean construction concepts have recently received attention as a modern way to improve performance and labour productivity (Abdel-Razek et al., 2007; Koskela, 1992; Lean Construction - Construction Excellence 2004). Abdelhamid and Salem (2005) presented five principles of lean production in the construction sector: "1. reduce variability; 2. reduce cycle times; 3. minimise the number of steps, parts and linkages; 4. focus control on the complete process; and 5- balance flow improvement with conversion improvement, benchmarking, increased output flexibility and improved process transparency".

6. THEORETICAL FRAMEWORK

The literature review shows that many studies have been conducted in different countries. The researches studies focus on factors related to materials management that lead to the delay of construction projects (see table1).

Table 1: Factors Affecting Construction Projects

| Factors | Countries | | | | | | | |
|---------------------------------------|-----------------------------|---------------------|--------------------------|-------------------|-----------------------------|------------------------|--------------------|--------------------------|
| | Sullivan and Harris UK 1986 | Odeh 2002 In Jordan | Malaysia Sambasivan 2007 | Ayegba Niger 2013 | Owolabi et al, Nigeria 2014 | Phu and Cho Burma 2014 | Hannure India 2014 | Ngwu et al, Nigeria 2015 |
| Contractor experience | | ✓ | ✓ | | | | | |
| Labour productivity | | ✓ | | | | | | ✓ |
| Improper planning | | ✓ | | | | | | |
| Unqualified subcontractor | | ✓ | | | | | | |
| Control cost | | | | | | | | ✓ |
| Labour cost | | | | | | | | ✓ |
| Plan management | | | | | | | | ✓ |
| Poor site management | | | ✓ | | ✓ | | | |
| Poor control of materials wastage | | | | | | ✓ | ✓ | |
| Problems with the subcontractor | | | ✓ | | | | | |
| Labour supply | ✓ | | ✓ | | | | | |
| Material shortage | | | | | | | ✓ | |
| The lack of storage space | | | | | | | ✓ | |
| Delay in material supply | | | | ✓ | | | ✓ | |
| Inadequate supervision | | | | | | ✓ | | |
| Poor site security | | | | | | | | |
| Weather and other natural occurrences | | | | | | ✓ | | |
| Alterations of designs | | | | ✓ | | | | |
| Over ordering of materials | | | | ✓ | | | | |

The above table indicates delaying factors in different countries around the world. In the UK, Sullivan and Harris, (1986) highlighted failure to choose the best supplier in the large construction projects was the key issue, and an alternative was not found. Clearly, materials management was not considered. In Niger Ayegba (2013) confirmed that delays in materials supply, weak supervision skills, poor security on site and the weather were the biggest problems in the construction projects, which shows a lack of materials management. In Malaysia there were different problems; the supply of labour, subcontractor issues and improper contractor planning were the major causes of delay, which also means that materials management was not applied. On the other hand, in Jordan, contractors experience, labour productivity, improper planning and unqualified subcontractors were the most serious issues. Another study conducted in Nigeria (2014) highlighted poor site management as a key issue. However, in Nigeria (Ngwu et al., 2015) added that poor control of waste materials, materials shortages, the lake of storage space and delays in material supply were also problematic. In Burma (2014) there was poor control of materials wastages. In considering the state of construction projects in Libya the literature review showed that Libyan researchers had explained the reasons for delay; however, construction projects in Libya still suffer from the risk of delay. For example, Shebob (2012) listed several reasons for delay in construction projects in Libya including contractor experience, labour productivity, improper planning, unqualified subcontractors and poor site management. Also, Abuzaid and Balmoor (2014) listed several problems related to construction and building materials in Libya and indicated that problems with sources, transport and storage had an impact on the Libyan

national economy and environment. The present research will develop a framework for improving materials management and discuss the factors causing delay that related to materials management. Thus, poor materials management appears to be the main problem affecting construction projects in terms of poor planning, uneducated subcontractor, labour costs, incentive schemes and productivity, plant management and control cost and time and cost overruns. Handling and waste of materials also key factors. To control the wastage of materials, this study reveals the need to apply chain management (SCM) to reducing waste by improving the links between the main contractor, subcontractors/suppliers, designer and surveyor. It also shows that applying LP to improve SCM downstream in construction sites will support the designer and subcontractor and improve the processes which lead to the reduction or removal of waste (see table 2).

Table 2 MM, LP and SCM Processes on the Construction Site

| Input | Process | Output |
|--|---------------------------|--------------|
| <ul style="list-style-type: none"> • Contractors unskilled • Subcontractors/supplier • Designer • Surveyor • Activities • Unskilled supervision • Poor materials handling • Lack of storage • Waste of materials • shortage of materials • improper planning • Poor site security • Labour productivity | Supply Chain Management | Zero Waste |
| | (SCM) | Reduced Cost |
| | Lean Construction (LC) | Time Saved |
| | Materials Management (MM) | |

Table 2 illustrates the role of Materials Management (MM), Supply Chain Management (SCM) and Lean Construction (LC) in the on-site operation of the construction project. The table consists of three columns: input, process and output. SCM has an important role in construction, linking the designer, surveyor, main contractor, client and subcontractor/supplier. LC thinking ensures that the SCM downstream has improves. The role of MM is to improve labour productivity, avoid shortage of materials and storage space, prevent damage to materials and implement appropriate planning. The result of the process is zero waste, reduced cost and time saved.

7. CONCLUSION

This paper presents a critical literature review of materials management in construction projects. Moreover, it identified factors affecting in construction projects and causing delay. for instance, subcontractor/suppler, labour, shortage of materials, lack of store, materials handling and waste of materials (WM). It shows the need to apply lean construction (LP) and supply chain (SCM) to improve activities in construction projects and support subcontractors/suppliers, the designer and the main contractor: the five parts of SCM. LP improves downstream SCM. The study focuses on handling materials and waste materials as key factors affecting construction projects and causing delay; it develops a framework to

explain the roles of LC, SCM and MM processes on construction sites. Also this paper highlighted the relation between LP, SCM and material management on site.

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THE POTENTIAL OF BIM FOR STAKEHOLDER MANAGEMENT IN INFRASTRUCTURE PROJECTS

S. Singh, E. Chinyio and S. Suresh

Faculty of Science and Engineering, University of Wolverhampton, Wulfruna Street, WV1 1LY, UK

Email: s.singh13@wlv.ac.uk

Abstract: This article which is based on a systematic and critical review of literature is part of an on-going PhD study in which the capability of Building Information Modelling (BIM) to manage stakeholders effectively is being explored. Numerous infrastructures have either failed or ran out of budget and time due partly to ineffective stakeholder management. Indeed stakeholder management is critically essential especially when the project is large and complex. Meanwhile BIM is changing the traditional modus operandi of delivering construction projects and is suitable for addressing the issues of sustainability, waste management, 3d, clash detection and stakeholder management. The critical success factors (CSFs) of using BIM to manage stakeholders have been established as: it facilitates and expedites communication, collaboration and more reliable decision making. The key features of stakeholder management were also analysed and mapped against these CSFs to identify how they are interrelated. This mapping led to the development of a conceptual framework which is presented. The findings show that BIM has got huge potential to assist in the effective management of external and especially internal stakeholders. The findings can greatly help project managers to manage stakeholders more effectively as part of their many core responsibilities.

Keywords: BIM, collaboration, communication, project managers, stakeholder management.

1. INTRODUCTION

Infrastructure projects differ from other projects because they have high uncertainty, high capital investment, high risks, high complexity, political sensitivity, complex procurement arrangements, long durations, significant socio-economic impact and are linked to diverse stakeholders directly or indirectly from planning till completion stage. As the size and/or complexity of a construction project increases, the number of stakeholders' increases and as stakeholders are in vast numbers, so they have varying needs, demands, interests, rights, backgrounds, power, among others (Baharuddin *et al.*, 2016; Aapaoja *et al.*, 2013; Giezen, 2012). Therefore, they have a very strong social attribute (Jia *et al.*, 2011). Due to this they usually face opposition from NGO's, interested groups, community, among others, which can lead to cost overruns, significant delays or sometimes even project fails to deliver the expected value. There are numerous studies by various authors showing the essence of stakeholder management such as by: Aaltonen *et al.*, (2008), Schepper *et al.*, (2014), El-Gohary *et al.*, (2006).

Missonier and Loufrani-Fedida (2014) postulated that projects fail due to ineffective social interactions between the project stakeholders rather than due to lacking or ineffective project management practises. Projects that actively engage with stakeholders are highly likely to succeed. The main purpose to engage with stakeholders is to make them believe that their needs and preferences would be incorporated in the project (Baharuddin *et al.*, 2016). BIM advocates stakeholder engagement and has the potential to increase social interactions by

facilitating and expediting communication, collaboration and decision making among project stakeholders.

The next section will discuss BIM and stakeholder management. The sections after that will consecutively cover methodology, framework, results and discussion, and conclusion.

2. CRITICAL LITERATURE REVIEW

2.1 Building Information Modelling (BIM)

The concept of BIM was developed in mid-1970s by Eastman and was called Building Description Systems (Cao *et al.*, 2015) and was originated at Georgia Institute of Technology (Rokooei, 2015). The National Building Information Model Standard (NBIMS) defines BIM as “Building Information Modelling (BIM) is a digital representation of physical and functional characteristics of a facility creating a shared knowledge resource for information about it forming a reliable basis for decisions during its life cycle, from earliest conception to demolition”. This definition does not present an explicit relationship between BIM and project stakeholder management because in the first instance it gives reflection of technical aspect mainly. However, Succar (2009, p.357) defined BIM as “a set of interacting policies, processes and technologies that generating a methodology to manage the essential building design and project data in digital format throughout the building’s life-cycle”. This definition promotes the holistic nature of BIM that also incorporates project management related tools and processes in addition to the software’s that enables 3D modelling and input of information. Therefore, from this perspective BIM is viewed as a tool for project management (Bryde *et al.*, 2013). Therefore, Succar’s (2009) definition is adopted as a basis for this research.

BIM data incorporates geometry, spatial relationships, geographic information, quantities and properties of building components, and can be used to elucidate the whole lifecycle of a facility (Smith, 2013) whereas traditional CAD objects do not hold any metadata or very less metadata (Succar, 2009). Throughout the project lifecycle BIM acts as an information repository for all project stakeholder, hence it keeps on developing as the project progresses (Sebastian, 2011).

2.1.1 Strengths of BIM

The various aspects in which BIM can be helpful in managing stakeholders are:

(1) Communication – the characteristic of a federated model to input, modify and analyse data will enhance communication between different project participants and make them to coordinate as well thus reducing the disputes between different project participants. BIM acts as a repository of information and thus enables all stakeholders to assess the same version of data which consequently reduces the risk of poor communication (Rokooei, 2015). It facilitates communication among project participants relative to spatial, logistical, material, performance specifications and requirements (Love *et al.*, 2011). Moreover, as all the data is in 3D, it facilitates the use of real-time visualisations as a tool to share information and communicate ideas among different stakeholders (Johansson *et al.*, 2015; Wong and Zhou, 2015) because 3D models are relatively easy to understand than 2D models where a person has to analyse the drawing first and then to visualise what a structure would look like in 3D.

Communication is a key factor to develop mutual understanding about objectives of the project among stakeholders (Fazli *et al.*, 2014). To keep key stakeholders satisfied, it is must to provide them with constant information about the project and decisions taken especially the construction projects which have considerable impact on the public. Open and trustworthy communication plays a key role in keeping media and affected stakeholders satisfied (Manowong and Ogunlana, 2010). By good communication, different requirements of stakeholders can be addressed. To satisfy stakeholders requirements communication is not the only solution but it plays a key role in satisfying stakeholders (Khafaji *et al.*, 2010).

(2) Collaboration and team building – BIM provides project managers opportunities to improve and promote collaboration among stakeholders (Bryde *et al.*, 2013) because different models prepared by different parties are federated into one model, so all parties have to work on one model simultaneously as a team (Rokooei, 2015). Moreover, it provides opportunities to project participants to collaborate as well during the various stages of a facility's lifecycle by enabling them to create, amend, update, extract and reuse information throughout the project lifecycle (Alreshidi *et al.*, 2017; Getuli, 2016; Sebastian, 2011) which will reflect their roles and support other's roles. It provides time and place restriction-free collaborative working platform (Sebastian, 2011). It promotes integrated project delivery (IPD) approach which in itself promotes collaboration among project stakeholders (Eastman, 2011). According to Liu *et al.*, (2017) when designers and contractors collaborate intensely in the environment of BIM, they openly share information which enables other project participants to understand their expectations in a better way, helps to anticipate their actions and offers a willingness to help them. Different project teams show a commitment to each other. This eventually generates an atmosphere of trust and hence the trust between teams is enhanced. Liu *et al.*, (2017) investigated in their research that BIM made project stakeholders to meet frequently which resulted in generating higher trustworthy environment and strengthening their relationships. For instance, Azhar (2011) investigated in his research that in Savannah State University (Georgia), stakeholders organised several collaborative sessions to discuss three virtual models (made by using BIM tool) with client. This enhanced communication and trust between them and facilitated quick decision making which eventually helped to save \$1,995,000 at the pre-design stage by helping to select most economical design.

(3) Facilitates decision making – BIM models are usually composed of objects rather than geometries (such as line, surface etc.). Thus, whole model can be broken down into small and distinct objects which facilitates to have a clear and defined scope of a project. This enables to take better estimation and management decisions (Rokooei, 2015). Zhang and Hu (2011) has discussed 4 levels of 4D in BIM which can help project managers in different aspects such as: to find integrated solutions that includes process simulation, conflict analysis, dynamic management, safety analysis. All this data can be linked to 5d to get cost estimation (Smith, 2014). This will help project managers to analyse their decisions (Rokooei, 2015).

BIM holds a vast amount of electronic information related to a project as compared to 2D drawings and specifications. As this is electronic information, it can be easily extracted (partially or as a whole) and can be exchanged quickly, efficiently and can be reused as well. This accumulated information can be helpful in making decisions (Porwal and Hewage, 2013). Moreover, BIM tools makes it easy to see the consequences of decisions taken which eventually enables project managers to perform effectively (Fazli *et al.*, 2014).

2.2 Stakeholder management

The term “stakeholder” varies in definitions (Jergeas *et al.*, 2000). Mitchell *et al.*, (1997) has mentioned various definitions postulated by different authors among which the most famous is by Freeman in 1984 which states stakeholder as any group or individual who can affect or is affected by the achievement of the organisation’s objectives.

In this study Freeman 1984 definition is adopted because mega projects has vast number of stakeholders with very dynamic nature because of the dynamic attributes attached to them. According to Yang *et al.*, 2011, pp.903, PMI (2004) defined project stakeholder management as “the systematic identification, analysis and planning of actions to communicate with and influence stakeholders”. Due to uncertainty and complexity of construction projects, construction industry has a very weak record of stakeholder management during the last decades (Yang *et al.* 2009). Many researchers have proved that project stakeholder management is one of the most critical factors to make a project successful (Offenbeek and Vos, 2016; Travaglini *et al.*, 2014) because the project’s success or failure significantly depends on the perceptions of every individual stakeholder backed by their ability and willingness to act either in favour or against the project. The failure can be due to the perceptions which supporters built that their expectations were not met, or the promises were not fulfilled, or their thinking that the available resources could be used at some other place. The perceptions need not to be based on logic but are usually based on the quality of the relationship between the project and its stakeholders (Bourne, 2005).

Stakeholder management also incorporates to balance competing claims on resources between various parts of the project, between project and other projects, and between a firm and a project but an element of complexity and uncertainty makes it more difficult to achieve this balance (Bourne, 2005).

Critical Success Factors (CSFs) for stakeholder management

Yang *et al.*, (2011, pp.902) has described CSFs as “those activities and practices that should be addressed in order to balance stakeholders’ interests and further ensure that projects are moved forward”. Critical Success Factors (CSFs) helps project team to know whether it is successfully managing stakeholders or not? Table 1 below depicts CSFs for stakeholder management.

Table 1: Critical success factors and the authors mentioned them

| CSF’s | References* |
|---|--------------------------------------|
| Managing stakeholders with social responsibilities | 1 (1) |
| Exploring stakeholder needs and constraints to project | 1, 3, 5 (3) |
| Communicating with and engaging stakeholders properly and frequently | 1, 2, 3, 6, 7, 8, 9, 10, 12, 13 (10) |
| Understanding of stakeholder interest area | 1, 7 (2) |
| Properly identifying stakeholders | 1(1) |
| Keeping and promoting a good relationship | 1, 2, 3, 7, 8, 11, 12 (7) |
| Analysing conflicts and coalitions among stakeholders | 1 (1) |
| Accurately predicting the influence of stakeholders | 1, 3 (2) |
| Formulating appropriate strategies for the management of stakeholders | 1 (1) |

| | |
|---|-----------------------|
| Assessing attributes of stakeholders | 1 (1) |
| Effectively resolving conflicts among stakeholders | 1, 7 (2) |
| Formulating a clear statement of project missions (common goals, objectives and project priorities) | 1, 2, 3, 4 (4) |
| Predicting stakeholder reactions to implementation of the strategies | 1 (1) |
| Analysing the changes in stakeholder influences and relationships | 1 (1) |
| Assessing stakeholder behaviour | 1 (1) |
| Decisions taken without analysing consequences on stakeholders | 3 (1) |
| Build and maintain a base of trust | 3, 7, 10, 14 (4) |
| Early involvement of key project participants | 4, 12, 15, 16, 17 (5) |
| Proactive interaction with affected stakeholders to mitigate potentially arising conflicts | 3 (1) |

*1 = Yang *et al.*, (2009) 2 = Jergeas *et al.*, (2000) 3 = Olander and Landin (2008) 4 = Smith (2013) 5 = Bourne (2005) 6 = Bakens *et al.*, (2005) 7 = Aaltonen *et al.*, (2008) 8 = Rowlinson and Cheung (2008) 9 = Bourne and Walker (2005) 10 = Hartman (2000) 11 = Olander (2006) 12 = Yong and Mustaffa (2013) 13 = Khafaji *et al.*, (2010) 14 = Schepper *et al.*, (2014) 15 = Erkul *et al.*, (2016) 16 = El-Gohary, *et al.*, (2006) 17 = Missonier and Loufrani-Fedida (2014)

Table 1 shows that communication is the most important CSF for stakeholder management (mentioned by 10 authors). This is followed by relationship management (7 authors) which is further followed by early involvement of project stakeholders (5 authors) and by trust building (4 authors) and setting common goals (4 authors).

This can be enhanced with the use of BIM. Prior to discussing about the conceptual framework, the methodology is discussed.

3. METHODOLOGY

Literature was reviewed. Content analysis was adopted as a basis for the methodology because it enables researchers to analyse vast amount of data in an organised manner. It is a technique to compress many words into fewer content categories (Mok *et al.*, 2015). NVivo software was used to analyse the content and to code themes. The search engines used were EBSCO host, Web of Science and Science Direct. Second approach to search articles was also adopted to search as many articles as possible. In that approach, journals were searched by their names in university's e-journals database. Then for a particular journal it's each volume, and each issue of each volume was explored dating back to 2000. The journals searched in this way were International Journal of Project management, Construction Management and Economics, Journal of Civil Engineering and Management, Automation in Construction. For example, in "Automation in Construction" there are 62 articles published related to BIM from 2015-2017, 47 from 2013-2014, 8 in 2012, 10 in 2011, 11 in 2010, 4 in 2009 and almost negligible number from 2000 till 2008. This shows that research related to BIM increased pace from 2013. One hundred eighty-six articles were read and summarized. In this paper the articles which are cited are referenced only. The analysis of 186 articles provided a comprehensive view about the research area and helped to set a base to identify the relationship between the two main topics. The searching of articles and refining of

literature review will continue into the data collection and analysis stage. Table 2 shows the frequency of articles cited from various journals. The contents teased out related to both stakeholders and BIM are mentioned in Figure 1. The strengths of BIM were analysed from and applied to effective stakeholder management.

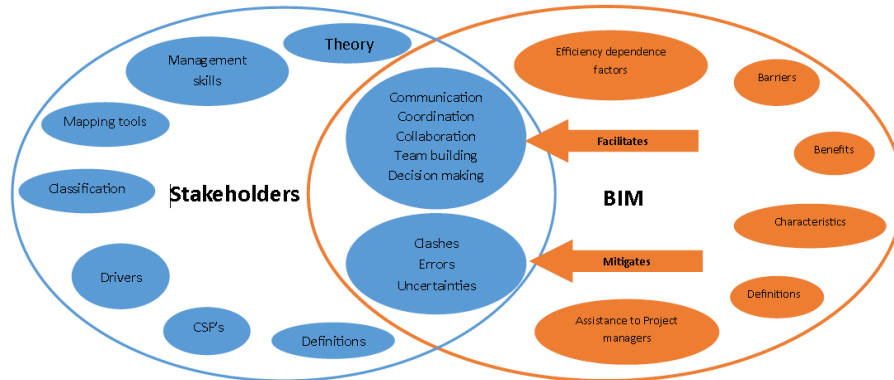


Figure 1: The topics researched on stakeholder management and BIM and the relation they have

Table 2: Number of articles cited in this paper

| Publication source: Journals or conference paper | Number of articles cited |
|---|--------------------------|
| AACE International Transactions | 1 |
| Academy of Management Review | 1 |
| Automation in Construction | 6 |
| Building Research and Information | 1 |
| Construction Information Services | 1 |
| Construction Management and Economics | 4 |
| Engineering, Construction and Architectural Management | 1 |
| International Journal of Performance Management | 1 |
| International Journal of Project Management | 12 |
| Journal of Building Engineering | 1 |
| Journal of Civil Engineering and Management | 1 |
| Leadership & Management in Engineering | 1 |
| Management Decisions | 1 |
| Organisation, Technology and Management in Construction | 1 |
| PMI Research Conference (2000) | 1 |
| Procedia Engineering | 2 |
| Procedia Social and Behavioural Sciences | 2 |
| Procedia Technology | 1 |
| Proceedings of the CIB World Building Congress (2016) | 1 |
| Research in Engineering Design | 1 |

4. CONCEPTUAL FRAMEWORK

The conceptual framework in Figure 2 illustrates how the strengths of BIM can assist in effective stakeholder management whereas Figure 3 shows in detail the interrelationships between various elements required for effective stakeholder management.

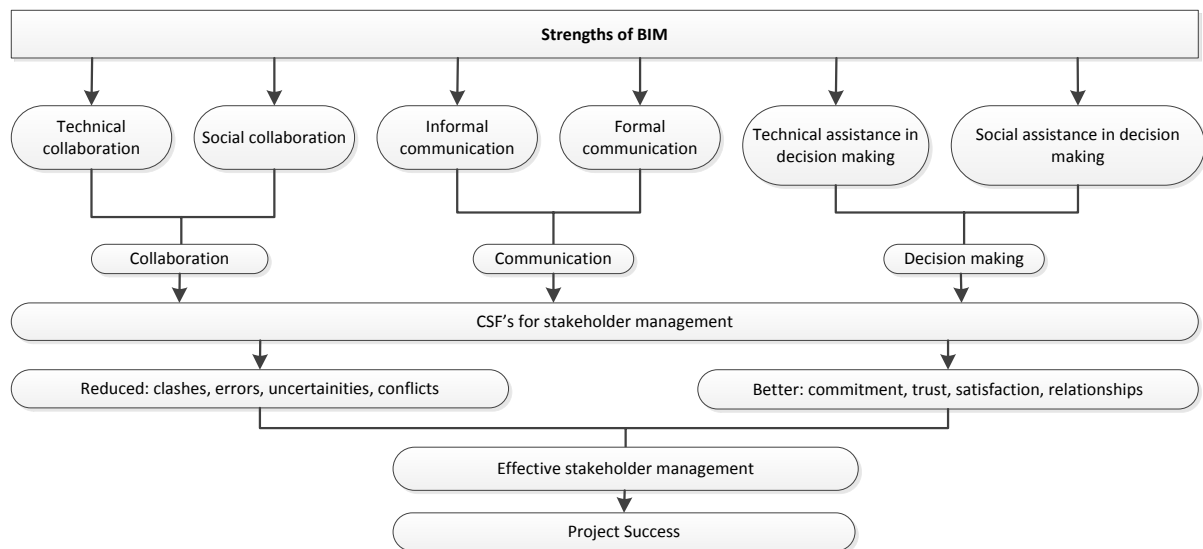


Figure 2: Conceptual framework showing the relationship between BIM and stakeholder management

BIM promotes formal communication and technical collaboration through various documents published in the UK such as Employer’s Information Requirements (EIR) (discussed in section 5). It promotes informal information exchange and social collaboration by promoting collaboration based design processes such as IPD, and by providing an environment to both design team and contractor team to come together to work on a federated model. Technical decisions regarding various aspects such as: various design analysis, sustainability, waste management, quality and points mentioned in section 2.1.1 (3) can be taken to a high level of accuracy through various BIM tools. This will help to manage internal stakeholders especially. By providing a platform for collaboration and by providing realistic data rich visualisations about various design options, it encourages various stakeholders especially non-BIM users (for example, client and public) to participate in decision making processes as well. Hence it promotes social aspect of decision making process which will help in managing external stakeholders. For example, in a case study by Olander and Landin (2008) about an expansion of a railway line, public was not involved in finalising the railway route. Public protested against the proposed route and demanded more design alternatives. Public proposed route which was more social friendly but economically and technically was the worse solution. This led the project to be delayed by eight years. Olander and Landin (2005) postulated that the location, size, design of a project could become the topics of conflict or controversy among stakeholders if potential impact of a proposed project is not properly communicated. BIM can assist in cases like these by facilitating more design alternatives to be developed and analysed in less time by costing less money, and by facilitating to discuss their potential effects with external stakeholders. Therefore, it can assist in setting common goals with external stakeholders which will eventually lead to manage them efficiently.

Figure 3 shows how communication, collaboration and decision making are related to other elements required for effective stakeholder management. It also shows how all the elements are interrelated to each other in a holistic view. The both side arrows in Figure 3 shows the mutual dependency of elements. It means if one flourishes, other will flourish as well due to that. Communication is at the core of all these. It is related to most of the elements directly. According to Yong and Mustaffa (2013) communication should not be focused only on tasks or words, it should rather be focused on to foster relationships among stakeholders. Stakeholders should meet to spend time together both at project level and at personal level.

Effective communication is a critical tool to maintain existing relationships (Chinyio and Akintoye, 2008; Khafaji *et al.*, 2010).

Stakeholder engagement at an early stage can assist in tackling various CSF's. For example, it can help in exploring stakeholders' needs and constraints to projects, can help in understanding stakeholders' interest area, can help in properly identifying them, can help in analysing conflicts and coalitions among stakeholders, can help in assessing their attributes, can help in effectively resolving their conflicts, can helps in setting common goals. As BIM promotes collaboration and early stakeholder involvement, so these CSF's can be indirectly implemented with the help of BIM.

Explicitly, properly and mutually set common goals enhances commitment among stakeholders because common goals ensure that stakeholders' requirements are well understood and satisfactorily fulfilled. Stakeholders who have good understanding of the project objectives engage with project more closely (Manowong and Ogunlana, 2010).

Strong relationships with stakeholders are directly linked to the project success as these make stakeholders to engage more closely and with more commitment (Khafaji *et al.*, 2010; Manowong and Ogunlana, 2010). Stakeholders' relationships can contribute insight, knowledge and support in refining project vision and objectives (Bourne, 2005).

Trust is a key element in any organisation dealing with communication (whether formal or informal or regular project reports) in maintaining the relationships (Bourne, 2005). Hartman (2000) postulated that trust increases effective communication, reinforces relationships, improves team work. The project managers who are trusted by their teams, clients and suppliers are more successful.

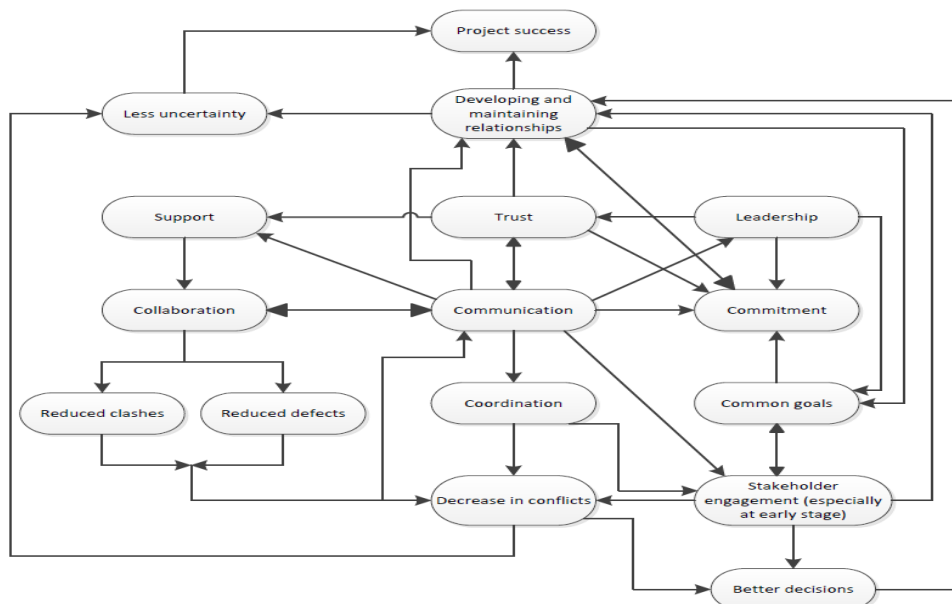


Figure 3: Interrelationship of various elements required for effective stakeholder management

5. RESULTS AND DISCUSSION

As the purpose of BIM is the management of information, hence it places BIM strongly in a category of project management (Travaglini *et al.*, 2014). Succar (2009) has mentioned various guides, reports and visions developed by different countries to facilitate the adoption of BIM but he has not specified any documents and guides published in the UK. The reason can be that these documents are published few years after his article was published. The documents and guides published in the UK are PAS 1192-2:2013, PAS 1192-3:2014, PAS 1192-5:2015, CIC BIM Protocol, BIM Execution Plan (BEP), Employers Information Requirements (EIR), among others. All these documents are interrelated and are required to be followed on a BIM implemented project. Hence it can be inferred from this that BIM is more of a process than just 3d cad modelling for visualisation and clash detections otherwise there was no need of these documents to be produced. Now processes are the core responsibility of project managers to manage. So, it means project managers has to increase their scope of knowledge to actually understand BIM processes by understanding all the above-mentioned documents so that they can unleash the full potential of BIM to all fields related to project management (including stakeholder management).

Employer's Information Requirements (EIR) is a document which is designed to be included in the tender documents for the procurement process of both design and constructor team. It a key document with regards to communication information requirements and information management requirements. It clearly divides its content into three parts: technical, management and commercial. The "management" aspect demands the explicit description of coordination and clash detection process, and collaboration process as well from the bidders. Moreover, it demands the explicit explanation about standards to be used and roles and responsibilities of each party (EIR Version 7 2013). This will make project stakeholders to overcome the boundaries of procurement approaches (for example, traditional procurement approach) and contractual barriers and make them to collaborate and coordinate with each other. This is because Liu *et al.*, (2017) investigated that legal and contractual issues often become barriers for project stakeholders to work collaboratively. Furthermore, CIC BIM Protocol (2013) sets the responsibility for employer to appoint an Information Manager who will not have any duty related to the design of a project. Out of the four key responsibilities stated in BIM Protocol (2013) for Information Manager, two are: managing the processes and procedures for information exchange on projects, and implementation of the BIM Protocol. This will help in taking better decisions by preventing information loss which usually occurs while exchanging information between various stakeholders and misinterpretation of information which often leads to communication problems. Moreover, traditional ways to exchange information in isolated files were also responsible to miss many opportunities for coordination. PAS 1192-2:2013 requires to answer the "Plain Language Questions" at each stage with appropriate level of detail. Stage 0 and stage 1 have questions related to stakeholder's needs as well (PAS 1192:2-2013).

Several companies have developed different software and mobile applications to promote collaboration between project participants. For example, BIM+ (Allplan A Nemetschek Company, 2017), Sablono (Sablono, 2017), Clever (Clever, 2017), among others. Sablono is specifically designed for project managers or project controllers to manage projects from anywhere. This will help in tracking and analysing decisions taken. Clever facilitates communication with non-BIM users or project stakeholders. No special hardware or software is required by non-BIM users to access Clever.

Most of the literature has focused only on exploring the benefits of BIM related to: 3d, 4d, 5d, waste management (which is called lean construction), sustainability (which is called Green BIM). There is paucity of research exploring the benefits of BIM related to stakeholder management. The few researchers, namely, Bryde *et al.*, (2013); Smith (2013); Rookie (2015); Travaglini *et al.*, (2014) and Fazli *et al.*, (2014) have explored and specified the benefits of BIM related to project management but they have not specified any tangible benefits related to stakeholder management (as stakeholder management is also a part of the role of project managers). However, it is acknowledged that those benefits will help project managers to take better decisions so eventually they will help project managers to manage internal stakeholders effectively but external stakeholders are still ignored and they can be the most problematic on large infrastructure projects. This study has provided a view of an unexplored aspect of BIM and has set a foundation to develop this view further.

6. CONCLUSION

This paper has focused on identifying critical success factors for stakeholder management. Thereafter by correlating them with the essence of BIM to prepare a conceptual framework. Findings show that communication, collaboration, trust, relationship management, stakeholder engagement are all directly interrelated concepts. Developing and maintaining trusty relationships is the key for managing stakeholders effectively. But communication and collaboration are the basis of all aspects. So by increasing communication and collaboration among project stakeholders, they can be managed effectively. Stakeholder engagement at the early stage of a project is required to get information about their concerns, needs, expectations, and to set common goals and increase satisfaction. Again to make stakeholder engagement effective, it needs effective communication (which is planned, tailored, focused, targeted and timely). The findings show that BIM promotes technical collaboration and formal communication between stakeholders and project manager, and among stakeholders themselves. It promotes social collaboration by promoting the use of the IPD approach which in turn promotes informal communication. It further assists project managers in taking more reliable decisions in real-time concerning various aspects which eventually assist them in managing stakeholders as well among other aspects like time, cost and quality. BIM has a huge potential to manage internal stakeholder effectively on large infrastructure projects by mitigating clashes, errors and uncertainties. It provides a platform to manage external stakeholders by promoting the IPD approach and by facilitating stakeholder engagement at the early stage of a project. For future research data will be collected from industry (on BIM implemented projects) to investigate how BIM had assisted in stakeholder management and also to investigate the knowledge of project managers about the BIM implementing processes.

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THE EVOLUTION OF ETHICS IN THE IRISH REAL ESTATE PROFESSION

L. Colley and L. Scott

School of Surveying & Construction Management, Dublin Institute of Technology, Ireland

Email: lorna.colley@dit.ie

Abstract: Since the Economic Collapse of 2008 much discussion and analysis of the role of ethics in the financial sector in Ireland has occurred. However little if any of this focus has been on the real estate profession. The purpose of this paper is to examine how the Irish Real Estate Profession deals with the issue of ethics. How has this relationship evolved over time? Has the Irish political context influenced the approach to ethics on a societal level and has this fed into the profession's approach? The role of ethics education is also examined in current Irish real estate qualifications, Property Services Regulatory Authority license requirements and the various professional body membership requirements.

The first phase of this research project has addressed the underpinning and background research literature on this topic. The evidence indicates that the Irish Real Estate Profession relies on a self-regulation approach to ethics in line with global RICS Standards. The literature review indicates that very little data exists on complaints and reprimands. Ethics forms a tokenistic element of education for the profession and in continued professional development. The issue of "whistle-blowers" is also a complex one in an Irish context and is currently being debated at a national level.

Keywords: Education, Ethics, Ireland, Real Estate, Self-Regulation.

1. INTRODUCTION

This paper addresses the ethical evolution of the Irish real estate profession from 1900 to 2017 which forms part of the literature review phase of a funded Independent News & Media PhD project on "Property Valuation Best Practice for Conflict of Interest Management: The Irish Experience.

The discussion about the Irish economy and in particular the property market is often referred to as a 'National Obsession' or a 'National Past-time'. Following the global financial collapse in 2008 and the resultant recession in Ireland, culminating in a bank bailout estimated to have cost the State 60 billion euros, much public anger and recrimination was evident. The establishment of the National Asset Management Agency (NAMA) to manage the now state owned property packed loan books of financial institutions, the lack of public sought accountability for the failings in regulation of the markets particularly financial and property and the lack of the 'Sacrificial lamb' or 'Scalp' of individuals who had appeared to contribute to the bubble, were particular bones of contention. (Hearne, 2015). Many of the individuals now under scrutiny were professionals in trusted positions with long, well regarded careers and questions were beginning to surface around accountability and ethical behaviour. (Cahill, 2014). However these were not new issues either nationally or internationally where a series of global financial scandals had cast aspersions over the integrity of many professions "*There is certainly unease about professional ethics, not only by the professionals themselves, but by*

the general public, who are the clients or consumers of professional services” (McDonnell, 2000, p.1).

A full scale investigation was ordered in February 2010 by the then Minister for Finance Brian Lenihan TD into the performance of the Central Bank and Financial Regulator which resulted in the establishment of the “Banking Inquiry” culminating in a report produced in May of that year. One of the key findings was that *“A rather defensive approach was adopted to external critics or contrarians. For years many observers had raised some concerns publicly or privately, albeit sometimes in coded form, about the sustainability of the property boom, which was indeed dramatic by international standards.”* (Governor of the Central Bank, 2012, p.10). Focus continued around this time on the role of the perceived lack of ethical behaviour by the financial institutions, politicians and key wealthy individuals. The property industry itself, the role of property professionals during this time period, regulation of the property industry and the quality and reliability of the services provided, largely avoided scrutiny on a meaningful level.

A report published by The Central Bank of Ireland in December 2012 titled “Valuation Processes in the Banking Crisis – Lessons Learned - Guiding the Future” did identify potential issues within the property profession and recommend best practice for the credit institutions going forward. Most notable was the issue of conflict of interest and it is stated that *“During the volume led transaction phase of the property development boom, certain valuation practises were accepted by credit institutions that involved significant conflict of interest.”* (Central Bank of Ireland, 2012, p.11). This finding, however, did not lead to any calls for a formal review of the role of the property profession in the collapse or indeed the potential for need of reform going forward.

2. ETHICS & PROFESSIONAL STANDARDS

Very little research exists in regard to the real estate profession and ethics specifically and this research explores the unknown territory to try to make sense of what has shaped the profession today. It aims to chronologically explore and decipher the evolution of the profession in the context of the country’s development.

Much research has been undertaken around the area of ethics, ethics in business, professional standards and codes of ethics. (Hurley, 1996), (Kaler, 1999), (Wofford, 1999), (Wolverton, 1999) and (Plimmer & Sayce, 2003). There are many ethical theories or schools of thought but at its most basic the word Ethics comes from the Greek word ethos, meaning ‘Character or custom’. An individual’s ethical position on an issue will usually inform their view on the rights and wrongs and dictate their response or behaviour i.e. ethical relativism. Most individual’s assessment of the ethical issues are derived from their concept of ‘Norms’ i.e. what is the usual acceptable response relative to their family, religion, political views etc. i.e. their culture. ‘Culture’ is defined by Hofstede (1991) as the *“collective programming of the mind which distinguishes the members of one group or category of people from another”*.

2.1 Professions

Professions comprise of many individuals and their individual “norms” and “customs”, therefore, it is necessary to agree on a set of “norms” or standards for an array of issues

including ethics i.e. “ethical relativism”. *“Professional ethics are important for establishing the standard of behaviour expected of individual professionals.”*(Dabson, Plimmer et al, 2007, p.9). Depending on the locality the professional body may be relied upon by Government to control and monitor the profession or there may be additional laws which supersede any professional dictate. Often it is noted that that where a legal framework exists that the professional body’s standards *“Are normally expected to be in excess of any legally required standard and may be regarded as reflecting the culture of the group of individuals to whom they are applied.”* (Dabson, Plimmer et al, 2007, p.9). The importance of these standards and their value to all stakeholders cannot be underestimated *“It cannot be disputed that principles and codes of practice are important, both for professionals, for their clients and for the general public at large”* (Plimmer & Sayce, 2003, p.3). Some are critical of the role of ethical codes and the influence they have on the overall standard of professional services. Deinhardt (1995) argues that ethical codes cannot and do not alter the ultimate behaviour of a professional and that ultimately codes *“promote unethical behaviour, because the true aim of such codes is to serve the interests of those who write them”*.

2.2. Codes of Ethics: Issues

An issue with standards or codes of ethics that are applied across a profession e.g. surveying, accounting etc. is that the ‘Customs’ or ‘Norms’ may lead to some degree of variety in interpretation and practical application. One way to deal with this issue is through active governance where the aim of this governance is to ensure compliance by all members to the codes of ethical conduct.

Another way to ensure appropriate application of ethical codes is through education. There is debate over whether ethics can be taught with the resulting outcome being a more ethical individual and the defence for a lack of focus on ethics education is the idea that an individual’s behaviour is ingrained from their cultural experiences as discussed above. There is research to confirm that ethics education is worthwhile in that *“Students are receptive to education programmes designed to develop moral judgement”* (Harris, 1998) and that *“It is important to have a language of ethics that we can all understand and that is clinical and non-evaluative”* (McCoy, 2009).

2.3 Methodology

This work forms part of the literature review of an Independent News and Media PhD project on “Property Valuation Best Practice for Conflict of Interest Management: The Irish Experience. This paper was compiled by means of a literature review of all available literature relevant to the aim of tracking the ethical evolution of the real estate profession in Ireland.

3. ETHICAL EVOLUTION: THE IRISH REAL ESTATE PROFESSION

In considering the ethical evolution of the Irish real estate profession, it is necessary to consider this in the context of political and economic developments across the same time periods.

3.1 1900 to 1929

At the turn of the twentieth century, the Irish political landscape was a complex one. The roots of which spread as far back as 1155 when John of Salisbury visited Pope Adrian IV at Rome and got permission for Henry II to invade Ireland. At the turn of the twentieth century the Irish desire for independence was reaching a crescendo with successive Home Rule Bills being defeated in the House of Lords and recent establishment of the Gaelic League, the Irish Socialist Republican Party and Cumann na nGaedheal (Ferriter, 2005). The unfulfilled desire for independence had a profound effect on the Irish psyche not least in the attitude towards those in positions of power resulting in an almost two-tier society, a ‘Them and us’ outlook. (Inglis, 2014). Also, the perception that the continuation of English Rule was achieved through corrupt means by patronage and bribery influenced the early decisions made by those seeking independence, *“Memories of the long-term implications of a disreputable political system were the underlying motivation of the governments and civil servants of the early 1920s to prevent the perception of history repeating itself.”* (Byrne, 2012, p.19).

Due to the influence of English Rule in Ireland, those who wished to conduct a property related service had to obtain a “Licence” which was *“Governed by a variety of Victorian statutes dating from 1845, while the law relating to appraisers’ licences dates back to King George III in 1806.”* (Power, 1997, p.25). A licence was obtained by application to the Courts and the payment of a monetary sum. There was no requirement to be educated or experienced in the property industry or indeed to maintain any level of professional standards. The situation was somewhat different within the United Kingdom where the Institution of Surveyors was founded in 1868, incorporated by Royal Charter in 1881 and renamed the Royal Institution of Chartered Surveyors at this time.

In 1922 the Irish State was founded. However, the terms upon which this was achieved was the basis for a fundamental split within the Irish political system that led to a Civil War. Despite this fact *“The Governments of the early 1920s established, legitimised and consolidated many of the institutions of government, which remain with us today.”* (Byrne, 2012, p.25). From its very first days of business, corruption and ethical behaviour was a significant issue debated in the newly formed Dáil Éireann. When calls arose for legislation on the matter the Irish Taoiseach, Eamonn DeValera, stated *“Ultimately of course, the conduct of members will be determined by their own sense of what is fit and right and proper.”* (deValera, 1947).

1922 was also a significant year for the Irish Property Profession *“As it was in 1922 that the Irish Auctioneers’ and Estate Agents’ Association (IAA), subsequently to be renamed Irish Auctioneers and Valuers Institute (IAVI), came into formal existence.”* (Power, 1997, p.15). The core aim of the IAVI was to obtain protection for the property industry through the cessation of unqualified persons obtaining a licence. Eleven objectives were established for the Association, none of which referred either expressly or by implication to ethical behaviour of members. *“By the end of 1929, it was considered that about three-quarters of the practising auctioneers, valuers, house and estate agents in the Saorstát were now members of the IAA.”* (Power, 1997, p.22).

3.2 1930 to 1949

The 1930s saw many changes across both the political and economic landscape with the rise of Fianna Fáil and their protectionist economic policies which were a significant change from Cumann na nGaedheal's liberalist ideals. Across this decade there were many political scandals which at their core were based on the ethical stance of power holders and their allocation of resources in line with the new protectionist outlook. *"The establishment of the Control of Manufacturing Acts 1932-34, initiated under Patrick McGilligan and enacted under Seán Lemass, provided the Minister for Industry and Commerce with varying degrees of latitude in the issuing of licences, shares, leases and export quota."* (Byrne, 2012, p.36).

Much was changing in Ireland in connection with the right to own and lease property under various Land Acts. *"Socially, the Land Acts had brought about dramatic social changes throughout the country in previous decades, shifting economic power from the elite landlord class to a wider and more prosperous property-owning democracy."* (Power, 1997, p.37) The Landlord and Tenant Act 1931 while heavily criticised by some quarters for interpretive issues is widely seen as *"One of the most important legal reforms made by the legislature since the setting up of the Irish Free State."* (Power, 1997, p.43). The main changes brought about under the Act were rights to rights of renewal, rights to compensation for improvements and the ability to create new building leases.

Within this climate of legislative control, the property industry was still seeking regulation led by the IAVI. They were successful in getting their demands to Bill stage twice in the early 1930s: Auctioneers, Valuers and Estate Agents Bill 1931 and 1933. Both Bills failed to pass with the second attempt ending when *"Minister for Finance Mr McEntee said that, while the Government was not prepared to accept the provisions of the measure, it recognised that certain steps should be taken against dishonest practitioners and accordingly, a bill was in preparation which he believed would afford the public the necessary protection."* (Power, 2012, p.47).

Politically there were four tribunals over a twelve year period: The Wicklow Gold Inquiry 1935, The Great Southern Railways Tribunal 1943, The Ward Tribunal 1946 and The Locke Tribunal 1947. The nuances of each obviously varies although at the heart of each was corruption, relationships indicating conflict of interest and the new Irish State trying to figure its ethical positioning on matters of professional conduct. While often the allegations initially were politically timed and motivated against competitors, at the root was a Government trying to confirm the boundaries within which acceptable behaviour occurred. *"Debates on conflicts of interest were not new, but the attention they received was. Questions on whether the private life of a politician influenced their actions as a public representative were raised in a sustained way."* (Byrne, 2012, p.62). Interestingly no legislative reform or guidelines were produced as a result of these tribunals and these ethical debates would continue to be a feature of Irish politics.

The Irish property industry was still seeking legislative control after their two failed attempts early in the 1930s. They were finally successful to some degree with the Auctioneers & House Agents Act 1947. However, the desire for control over those whom could obtain a licence was not linked to educational and/or professional experience as desired. The Act's definition of a "Certificate of Qualification" does not refer to any form of academic qualification or indeed previous professional experience, it refers to a process of notifying both the public and the Gardaí of your intention to obtain a licence. The Act contained no

mention of required professional standards, monitoring of conduct or indeed penalties if found to be failing in professional duties.

The IAA itself had introduced a new “Code of Conduct” just prior to the Act that included *“No member shall conduct himself either in his personal or professional capacity, in such a manner as would be likely to prejudicially affect his own professional status, or injure the reputation of the Association.”* (Power, 1997, p.60). By the end of 1949 there were 580 members of the IAA who were bound to adhere to this rule, however, there was no legislative control so self-regulation remained the only regulation of the Irish real estate profession.

3.3 1950-1979

“By the middle of the 1950s a serious crisis of confidence developed, caused by widespread anxiety that the performance of the economy was so poor the country was falling behind Western European Standards, not only in productivity, but in the social benefits that productivity might confer.” (Lyons, 1973). During this period there was a marked change in Ireland’s demography with more people living in urban areas than in rural ones for the first time since the formation of the State.

The 1950s marks a period of professional jostling as the industry tried to establish its “ownership” of other functions such as rights to sell and value. The main adversary was the Irish legal profession who had been providing these services to clients unofficially for some time. *“The matter of professional boundaries had, however, been causing friction for some time.”* (Power, 1997, p.90). The 1951 annual general meeting was asked by a member *“if it was professional and recognised by the Incorporated Law Society for Solicitors to act as valuers”*. (Power, 1997, p.90). The legal profession was not the only industry to receive criticism for some practices.

The 1960s represented a period of awakening within the Irish economy and the property industry was suitably influenced. *“The blinds were let up, the windows were thrown open, the doors were unlocked; and good, bad or indifferent, the modern world came in among us at last”*. (Tobin, 1984). The IAA joined the International Real Estate Federation (FIABCI) and provided the National Chapter’s executive and coordinating functions. The modern commercial property market effectively began with the introduction of the 1963 Planning and Development Act where power to rezone agricultural land was ultimately left with public officials. In short, the capacity to zone agricultural land incentivised property speculation. *“The potential for enormous financial profits created an added inducement for corrupt transactions between developers and local officials and representatives.”* (Byrne, 2012, p.70).

Despite the growth and changes over this period the property profession was still regulated by the Auctioneers, Valuers and Estate Agents Act 1947 which was now significantly insufficient when considered in line with the expansion of more sophisticated services being provided by the industry. *“It was no mere coincidence that 1964 marked a high point of the IAA’s educational efforts with the establishment of a high-level structured course.”* (Power, 1997, p.111). Membership of the IAA was now conditional on completion of this course or a similarly recognised programme. The industry itself, through self-regulation, was trying to increase the standards of services being provided to the public. Professional conduct did

form part of this educational programme but most certainly the focus was on valuations and law.

The Government did produce a new Act in 1967, The Auctioneer and House Act. However, there was no place for professional standards or penalties for poor behaviour instead it increased the bond required to obtain a licence, the introduction of a client account, and an additional requirement on the “Certificate of Qualification” to include certification of compliance by an accountant. These additions were certainly aimed at narrowing those eligible for a licence to provide property related services.

“From January 1, 1971, the IAA was renamed The Irish Auctioneers and Valuers Institute (IAVI)” (Power, 1997, p.123). The Institute of Professional Auctioneers, Valuers and Livestock Salesmen (IPAV) was also founded this year adding another dimension of self-regulation to the profession.

In 1973 a review of the property industry was undertaken by the Revenue through the National Prices Commission (NPC). Their aim was to examine auctioneering fee structures and a consultant was duly appointed to carry out the review. *“The NPC report was the most comprehensive study of the profession yet completed, but was by its own admission flawed in certain key aspects.”* (Power, 1997, p.127). The main flaw related to the level of engagement on the professional groups and the number of replies received by those professionals surveyed weakened the value of the report findings. Again this review focused purely on fees and no review was sought or carried out on professional standards and level of services provided by the industry.

A new Act was enacted by the Government in 1973, The Auctioneers and House Agents Act of 1973, however, this was not well received by the professional bodies such as the IAVI. In their view the Act was *“Introduced without prior consultation with the Institute – which transferred the obligation to pay the auctioneer’s fees in the case of a sale of a property from the purchaser to the vendor of the property by making void any contract for the purchaser to pay such fees.”* (Power, 1997, p.126). In 1977, the IAVI continued to improve levels of professional regulation as they introduced a voluntary compensation fund for those who may have been penalised by poor performance or negligence of a member.

3.4 1980-1999

“It was the best of times, it was the worst of times – the 1980s, when the property market plumbed new lows before ultimately scaling fresh heights.” (Power, 1997, p.161).

There was no further State led regulation of the property industry but the IAVI continued to develop their standing with a focus on education and communication with the public. *“In 1985, the educational programme was transferred from the College of Commerce in Rathmines to the College of Technology, Bolton Street, Dublin on a three year, whole-time diploma basis. The opportunity was taken to suitably upgrade the programme at the time of transfer. Auctioneering, valuation and estate agency courses were also commenced at both Limerick and Galway Regional Technical Colleges and the University of Ulster at Jordanstown.”* (Power, 1997, p.168). The educational programmes focused on the technicalities of valuations, law, building construction etc. and a small tokenistic element on professional practice.

In 1983 the IAVI had a public case of misconduct relating to the avoidance of stamp duty being facilitated by a member. Their response was significantly important as it was an opportunity to reinforce their stance on misconduct to both the public and its members. Following notification of the claim, the council accepted the resignation of the member in question and placed a notice in the national daily newspapers to the effect on April 18th *“It is a matter of considerable regret that this default has arisen, particularly as there has been no claim against a member of the Institute on grounds of dishonesty since 1959.”* (Power, 1997, p.174). A strong response that highlighted the need for proper channels for the regulation and governance of the industry.

Politically this was a dark period for allegations of corruption that went right to the most senior offices of the State. *“This period was distinct from previous scandals because it marked the possibility of the gravest form of corruption, that of state capture within political decision making.”* (Byrne, 2012, p.103). *“The Beef Tribunal Inquiry (1991-1994) was perhaps the most extraordinary political episode in modern Irish history. For the first time since the 1940s, the reciprocal relationship between politics and vested interests was placed under intense political, public, judicial and media scrutiny. This was a period when questions about political corruption, golden circles and the integrity of public officials were raised in a meaningful way.”* (Byrne, 2012, 107). Transparency and professional reputations were the order of the day and the property industry was aware of these demands.

“In February 1996, the IAVI Practice Handbook was launched at the Merrion Square headquarters by Minister for the Environment, Brendan Howlin. The publication of the manual represents yet another significant landmark in the ongoing IAVI commitment to improving auctioneering standards.” (Power, 1997, p.216). The goal of the Handbook was to produce a transparent base for all aspects of services provided by its members. From an ethical stand point, section 1 laid out the “Code of Conduct” for members which was binding. Rule 4 stated *“Members shall at all times make it their first duty to protect and promote the legitimate and ethical interest of their clients to the utmost of their ability.”* Rule 14 stated *“No member shall act for two parties in the same transaction without the full knowledge and consent of both parties.”* Rule 22 states *“If, on a consideration of any matter referred to it, the Disciplinary Committee decides that a member of the Institute has been guilty of a breach of the rules of conduct the Committee may: Hold that a breach of the rules has been committed but decide to take no further action.”* Rule 27 states *“The Institute shall be entitled to publish in the “Property Valuer” journal of the Institute and in general the press or any publications selected, notice of the expulsion or suspension or resignation of any member.”* This was a strong position taken by the IAVI, however, no examples of what constituted acts that would place a member in breach were provided, no requirement to publish numbers of complaints, outcomes etc. was included and ultimately these rules were relevant to its members only.

A survey undertaken of Irish attitudes towards the real estate industry revealed a worrying trend that 25% of respondents would not avail of services provided. Writing in a subsequent issue of the IAVI journal, auctioneer John Harrington articulated the sentiments of many of his colleagues on the key issue of standards. He acknowledged that greater professionalism, coupled with high-end marketing and a good corporate image would go some way to restoring the public confidence. In a bid to further regulate and legitimise the industry the IAVI joined the European Property Agents Group, the European Secretariat for the Liberal Professions and TEGOVOFA.

Moving towards the Millennium the Irish State still grappled with corruption in the form of “*political favouritism, tolerated conflicts of interest, tax evasion, fraudulent practices*” (Byrne, 2012, p.131) and Irish society was in an apathetic state on the trustworthiness of “those in suits”.

3.5 1990-2010

The period of the late 1990s up to 2012 was again marked by three sizeable tribunals: The McCracken Tribunal 1997, The Moriarty Tribunal 1997-2011 and the Flood/Mahon Tribunal 1997 – 2012. Ethics, professional integrity and the boundaries of improper conduct were at the heart of all three with the slight difference from previous periods being “*For the first time that unaccountable political decisions were not isolated incidents, as previous episodes seemed to suggest. The various inquiries instead exposed how those at the highest positions of power periodically abused their political discretion to benefit private interests.*” (Byrne, 2012, p.134). Public apathy continued as did a rising tide of frustration over the benefit-cost outcome of these tribunals. However, as the economy had now entered the period referred to as “The Celtic Tiger” the politicians were somewhat shielded by the available Exchequer coffers for investment in services and infrastructure, that for the most part grumblings were muted.

The property industry was gaining rapid pace along with the economy, the residential markets in particular were experiencing high levels of activity with anecdotal evidence of gazumping and poor agent practices. In July 2005 the report by the Auctioneering/Estate Agency Group was published containing a list of recommendations to reform the Irish property industry. The brief given to the Group by the then Minister for Justice, Equality and Reform was “*To carry out a review of all aspects of the auctioneering profession in Ireland and equivalent services in appropriate comparable jurisdictions.*” It is important to note that this was produced by the Group focused on the residential market as they believed “*It is in this area that most problems are perceived to exist.*” (Auctioneering/Estate Agency Review Group, 2005, p.7) They noted the role of the professional bodies in providing governance and guidance to the profession but expressed concern “*That there is no appropriate system to control entry to, or to set or maintain practice standards in this market.*” (Auctioneering/Estate Agency Review Group, 2005, p.7). The most significant recommendation to come from the review was the establishment of an “*Auctioneers and Estate Agents Regulatory Authority in order to achieve uniformity and transparency in licensing, regulation and information provision.*” (Auctioneering/Estate Agency Review Group, 2005, p7).

As a result of the review and after much delay caused by economic and political developments, the Property Services (Regulation) Act was enacted in 2011. As a direct result the Property Services Regulation Authority was established by Minister Shatter on the 3rd April 2012. “*The main function of the Authority is to control and regulate Property Services Providers (i.e. Auctioneers/Estate Agents, Letting Agents and Management Agents) this includes the licensing of all such services providers, the establishment of a complaints investigation and redress system for consumers, the setting and enforcement of standards in the provision of property services, the administration of client accounts, the establishment and maintenance of a compensation fund and the creation of three Public Registers.*” (PSRA, 2016). The three registers in question are the Residential Property Price Register, Commercial Leases Register and the Register of Licensed Property Services Providers.

Criticism of the PSRA has been widespread largely focused on the lack of transparency and slow processing times *“The first thing to note about the PSRA is the lack of transparency on its record to date.”* (Leman, 2015). *“The authority has also been provided with significant powers to tackle improper conduct by estate agents. There have been unconfirmed reports of action against some estate agents.”* (Irish Times, 2014). Presently the PSRA has a section on their website briefly detailing six cases involving *“Convictions, Prosecutions, and Major Sanctions”* but no detail is included on the number of complaints received.

On 18th December 2012 the Central Bank of Ireland published *“Valuation Processes in the Banking Crisis-Lessons Learned – Guiding the Future”* which was the second document published after a commitment made by the Central Bank *“To provide credit institutions with details of lessons learned from the banking crisis, and to provide guidance on recommended practice.”* Of particular relevance to the property industry was the observation that *“Many best practice valuation standards have been overlooked, omitted and in some cases totally disregarded during the property market boom.”* This finding however did not lead to any calls for a formal review of the role of the property profession in the collapse or indeed the potential for need of reform going forward.

3.6 2010-2017

The Celtic Tiger continued and led Ireland into one of the biggest property bubbles in the developed world’s history. Much analysis and conjecture continues on the causes of its collapse, the choices made to avoid national bankruptcy and the austerity measures selected but the impact on an ethical level are less considered. Certainly the financial industry and its perceived lack of ethical practices: bonuses, selling products they knew to be high risk but not marketing as such etc. has come under the most scrutiny but the role of property professionals has not been analysed. Property was undoubtedly the key asset class involved in the Irish financial collapse yet the industry has managed to escape any meaningful analysis of ethical standards during the period.

Anecdotally due to the establishment of the PSRA, the role of the professional bodies was to some extent less prevalent within the Irish property market. In April 2011, after a long consultation and implementation process, the Society of Chartered Surveyors Ireland was formed by a merger between the IAVI and the SCS. The new body states that *“Working in partnership with RICS, the pre-eminent Chartered professional body for the construction, land and property sectors around the world, the Society and RICS act in the public interest: setting and maintaining the highest standards of competence and integrity among the profession; and providing impartial, authoritative advice on key issues for business, society and governments worldwide.”* (SCSI, 2017).

The SCSI Rules of Conduct include, in their Professional and Personal Standards section, requirements for members to *“at all times act with integrity and avoid conflicts of interest and avoid any actions or situations that are inconsistent with its or their professional obligations.”* Failure to do so it is noted *“May lead to action by the Director of Regulation and Professional Conduct Committee under these Rules.”* There is no readily available information at present on the number of complaints received about members, numbers of disciplinary proceedings and their outcomes.

The SCSI offer their own part time degree in partnership with Dublin Institute of Technology and there are approximately twenty-two educational programmes at either undergraduate or master's level across the Republic that are accredited by the SCSI. In examining the programme documents for each it is evident that little if any credits are linked directly to Professional and Personal Standards and ethical conduct.

In March 2017 the RICS published the first edition Professional Statement "Conflict of Interest" with rules coming into effect on 1st January 2018. Compliance with its contents is mandatory for all members and it defines a conflict of interest in three contexts: a party conflict, an own interest conflict and a confidential information conflict. Some activities are banned outright, however, a sizeable amount of situations where conflict would arise are permissible if "Informed Consent" is received prior to providing any services. There is no additional monitoring of compliance detailed so breaches will either have to be reported to the SCSI or may be captured through their risk assessment procedures.

Throughout the history of the State and right up to present day, the role of "whistle-blowers" is a controversial one. Some argue this is linked to before the formation of the State, where those in authority were seen as a "foreign entity" that were not to be trusted and Irish people deal with their own transgressions amongst themselves. *"Attitudes towards informers have traditionally been hostile and perceived as having traitorous qualities."* (Byrne, 2012, p.134). While undoubtedly there has been progress around this issue, the recent "whistle-blower" controversy in the Gardaí demonstrates that all may not be well. While an inquiry is to determine the facts of the matter it is worth noting that *"An investigation by Mr Justice Kevin O'Higgins in 2016 found there had been a corporate closing of ranks, alteration to the Pulse recording system and delays in producing documents concerning allegations made by Sgt McCabe. The latest exercise, conducted by Mr Justice Iarfhlaith O'Neill, arose from allegations by former head of the Garda Press Office Supt David Taylor that he had been formally instructed to discredit Sgt McCabe"* (Irish Times, 2017). While evidence of such alleged mistreatment of an individual reporting misconduct at the highest levels of a national institution like the Gardaí are in the public mind, is it reasonable to expect others to come forward to report misconduct in their spheres of practice.

4. CONCLUSIONS

This exploration of the evolution highlights the emergence of the context of ethics in the Irish property sector and points to many factors that have influenced and impacted it.

For much of the last nearly one hundred years the real estate profession in Ireland has been purely self-regulated from a professional standards and ethical view point. Any legislation referred to the procedure of obtaining a licence to practice and no monitoring of the industry was deemed necessary. The IAVI, SCS (both merged to form the SCSI) and IPAV to varying degrees provided the only monitoring of educational requirements of members, rules of conduct and disciplinary proceedings for failure to comply. The PSRA was formed in 2011 and after a slow start is providing some evidence of monitoring of professional standards and ethical behaviour of licence holders however for an industry of its size and relevance to national issues a much more active approach is required.

The PSRA does detail varying educational requirements to obtain licences, however, as highlighted above the accredited programmes do not offer significant education in the area of ethical issues.

In obtaining membership to the professional bodies all require evidence of knowledge of their standards ethical conduct which are tested through a mix of interview and diaries of professional practice. Once a member continued professional development is necessary however there is no particular onus that any element of this must relate to professional conduct.

As evidenced through the vast array of tribunals and political scandals over the history of the State, individuals do report inappropriate conduct. However, it cannot be denied that due perhaps to historical influences, those that do inform are not always received in a positive manner. Bearing this in mind it is logical to argue that a more aggressive system of auditing led by the PSRA is required as opposed to relying on a system of complaint and follow-up as has been the main feature of Irish real estate profession regulation up until the last number of years.

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A PHENOMENOLOGICAL STUDY ON DECISION MAKING UNDER UNCERTAINTY IN REAL ESTATE INVESTMENTS IN SUB-SAHARAN AFRICA - A CRITICAL REVIEW OF LITERATURE

C. Nsibande and M. An

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: c.nsibande@edu.salford.ac.uk

Abstract: Decision making under uncertainty can be traced back to the beginning of the 20th century as defined by Von Neumann and Morgenstein in what was termed expected utility theory. Kahneman and Tversky reinvented decision making theories and introduced prospect theory. They later introduced cumulative prospect theory which has been the central theory for studies and research in decision making under uncertainty. Kahneman and Tversky introduced psychological approaches to decision making and introduced the concept of value function and weighting function. Other important scholars include Cohen who focused on the psychological aspects of decision making. Several other authors have completed research in behavioral aspects of decision making including Slovic, Nocetti, Shefrin and Statman. The purpose of this paper is to present a critical review of the literature published on decision making under uncertainty, understand the gap and knowledge, and to develop new knowledge in decision making under uncertainty for real estate investment decisions in Sub-Saharan Africa. The relevance of the literature to the doctorate research was established through the extensive discussion section of the paper.

Keywords: Biases, Decision making, Heuristics, Literature, Real estate.

1. INTRODUCTION

The aim of this paper is to review literature that is relevant to the doctorate research topic, decision making under uncertainty in real estate investments in Sub-Saharan Africa. The paper establishes from the literature that there is a gap in knowledge from the identified practice problem, hence supporting the case that the research will lead to establishment of new knowledge on the subject under investigation. The paper has sections on how the current literature and current practice relate to the subject topic. The paper concludes with showing how the research questions on the topic of real estate decisions under uncertainty for the doctorate research were developed, linking the identified practice problem to the gap in current knowledge.

Recent literature, notably Kahneman's ground breaking research on decision making under uncertainty (1979, 1992) shed light onto the possibilities of exploring the real estate investment decision using psychological and behavioural science approaches. Further work has been undertaken by Kahneman and Tversky (1992) on prospect theories with regard to decision making process for management science. Cohen (1981) has also developed theory on psychological aspects of decision making under uncertainty.

It is acknowledged that the real estate investment decision process has both an analytical (technical rationality) stage as well as a behavioural (tactical) stage. The analytical stage involves analysis of financial and economic data and is quantitative in nature. The behavioural stage fills the gaps in the analytical phase and is subjective in nature, hence

qualitative. In every investment decision, both stages are undertaken and are an integral part of the investment decision process. In cases of uncertainty, where limited information or where data is unavailable, for concisely completing the quantitative analysis, the weight on the decision process shifts towards the subjective behavioural stage. As portrayed by Blas (2013) and Jerven (2013), economic data and market information is limited on the Sub-Saharan Africa investment markets hence the importance of understanding the effects of reliance on subjective qualitative processes for investment decision making.

2. AIM OF THE RESEARCH

The aim of doctorate research is to develop a method for practice on how rational real estate investment decisions under uncertainty can be made. For the purposes of this paper, rational refers to the process followed by investment decision makers that will maximise utility (return) for the investments. The method should maximise utility or returns through a structured, consistent and thorough process in decisions making.

The research problem came about in identifying a gap in methods, having to experience discomfort in seeing decisions made at a point in time that cannot be verified until a later date. Due to uncertainty, at the time of the decision process, investment decisions are not verifiable. It is not possible to confirm if the correct decisions were made until a much later time, during investment performance appraisal. Unfortunately, investment committees and decision makers, make investment decisions under uncertainty due to the limited available information, which in most cases is inadequate to make rational decisions. In addition, in the Sub-Saharan market, there is a greater level of complexity (risk) due to uncertainty in economic and political events. Under these uncertainties, the researcher has observed investment decision makers making investment decisions and has questioned why and if these decision makers were making rational investment decisions.

From the research title, the paper focuses on the literature around how real estate investors make decisions, decision making processes by different professional investors (behaviour, style and preference), heuristics and biases, decisions under uncertainty, studies on behavioural finance in real estate investments, and how intuition and experience of investment professionals influence the decision making process?

3. LITERATURE REVIEW

3.1. Current scholarship in decision making

Expected utility theory dominated the analysis of decision making under risk for most of the early part of the 20th century. According to Keeny and Raifa (1976), expected utility was the normative model of rational choice and was widely applied in decision making analysis. According to Friedman and Savage (1948), expected utility theory was widely used as a descriptive model for economic behaviour in decision making under risk. Further, Von Neumann and Morgenstein (1944) observed that most reasonable people would wish to obey the axioms of the theory.

Kahneman, Slovic and Tversky (1982) are perhaps the leading scholars on the subject of modern decision making under uncertainty. Their book, “judgement under uncertainty – heuristics and biases” gave a good background on the subject. The book outlined five

important biases and heuristics common in decision making, namely, representation, causality and attribution, availability, covariation and control and overconfidence. The representation heuristic refers to believing in the law of small numbers. Causality and attribution heuristic refers to the popular induction that information is not necessarily informative and people make judgements without taking into consideration all the information. Availability heuristic is failure to make the correct judgement on frequency and probability. Covariation and control heuristic refers to incorrect decisions when people are faced with making a choice between data based assessment versus theory based assessment. The illusion of control refers to the fact that people interpret results as they think they should be, not necessarily correctly. Overconfidence heuristic refers to people relying more on their own experience and rationality rather than on the information and facts.

In 1979, Kahneman and Tversky introduced a concept of prospect theory, which superseded the classical theory of expected utility theory (EUT) of the 19th and 20th Centuries. Prospect theory introduced the concept of the value function and the weighing function. The value function takes into consideration the wealth of the person making the decision and introduces the concept of relativity, that people's "perceptual apparatus is attuned to the evaluation of changes rather than to the evaluation of absolute magnitudes". The weighting function is the multiple of the decision weight which are "inferred from choices between prospects", subjective and not probabilities measures that the decision maker considers to be possible outcomes in his interpretation.

Another article by Kahneman and Tversky (1992) on prospect theory introduces a newer approach to decision making under uncertainty that employs cumulative rather than separable decision weights and extends the prospect theory in several ways.

Maital (2004) summarizes nicely the salient points in Kahneman and Tversky prospect theory and rationality. He states that there are two ways that people make judgements and decisions under uncertainty, namely; mathematical and behavioural. This is the essence of the doctorate research as the researcher seeks to capture the optimum process in making real estate investment decisions under uncertainty, with focus on the behavioural aspects.

The literature review would be incomplete without citing the work of Jonathan Cohen, another leading scholar in decision making under uncertainty. His work, from 1971 to 1981, covers many different angles on the subject of decision making under risk. His work is mostly on psychological aspects of the decision maker, including the "psychology of prediction" (Cohen, 1979), "what has induction to do with causality?" (Cohen, 1980), and "intuition, induction and the middle way" (Cohen, 1982). Cohen has also published reviews of the book by Kahneman, Slovic and Tversky (1982).

Cohen (1981) identified four categories of psychological research in human rationality, namely: conditions under which people suffer from genuine cognitive illusions; circumstances in which people exhibit mathematical or scientific ignorance (intelligence or education); a fallacy whereby people are applying the relevant normative criteria of human irrationality in an appropriate way or where the normative criteria being applied are not the appropriate ones.

3.2 Investment appraisal for capital projects and real estate investments

Investment appraisal that leads to investments in real estate follows capital projects appraisal methods as developed by Sharpe (1964) capital asset pricing model for cases of risk (known probability). The practice is based on the premise of discounting the projected cash flows by a risk premium factor that is determined by the level of risk (known probability). Earlier research on utility of choices involving risk was completed by Friedman and Savage (1948). For cases of utility choices under uncertainty, elementary work has been concluded by Merton (1969). The focus of the research is on the latter case, the case of uncertainty for which the gap in practice and knowledge has been identified. The research approach is a phenomenological study that focuses on the human experience, signifying the behavioural aspects of decision making under uncertainty.

3.3. Scholars in behavioural finance and decision making

Other scholars of note to consider in decision making under uncertainty include Stracca (2004) who identified anomalies in the behavioural finance literature with a focus on those that might impact on market prices. Stracca grouped the anomalies into five distinct groups, namely: decision heuristics; emotional and visceral factors; choice bracketing; unknown preferences; and reference dependence. Stracca concluded that the “fertilization” of finance and economics with psychological ideas had a huge potential and was gaining ground. Supporting Stracca’s conclusion was Thaler’s prediction of the “end of behavioural finance”. In his article, Thaler (1999) predicted that behavioural finance was becoming an integral part of main stream financial analysis as in future will not be treated as a separate subject.

More recent articles by Shefrin and Statman (1994) entitled “Behavioral Capital Asset Pricing Theory” and Shefrin and Statman (2000) entitled “Behavioral Portfolio Theory” also support the idea that behavioural science is relevant to financial analysis. It is a growing trend in financial analysis and several scholars are exploring the subject. The purpose of the doctoral research is to investigate this phenomenon in real estate investment decision making in Sub-Saharan Africa. The focus would be on the behavioural attributes of decision making under uncertainty, investigating the impact of heuristics and biases during the decision making process. The literature peaks on the article by Nocetti (2006) entitled “Markowitz meets Kahneman: Portfolio selection under divided attention” where Nocetti brings along the concept of scarcity of cognitive resources in play. The theory of cognitive resources focuses on the influence of the leader's intelligence and experience on his or her reaction to stress. The theory concluded that stress was the enemy of rationality. The leader's experience and intelligence can lessen the influence of stress on his (or her) actions, that is, intelligence is the main factor in low-stress situations, whilst experience counts for more during high-stress moments.

4. DISCUSSION

The scholarship discussed above is from the main researchers in behavioural finance but several other researchers have explored the field and then applied the concepts to particular aspects of decision making research. The purpose of the doctorate research is to test the theories developed by Kahneman, Tversky, Slovic, Nocetti, Shefrin and Statman, and then further apply it to the specific field of real estate investment decision making under

uncertainty. The purpose of the doctorate research is not to reinvest the wheel but to apply and advance the concepts already developed by these scholars. The aim is to investigate if there is evidence of behavioural analysis, that is, if the behavioural theory can be identified and verified in real estate investments from which a method can be developed for investors to follow in cases of uncertainty.

Several other scholars have followed similar research, notably, Gurevich, Kliger and Levy (2009) where they have investigated “decision making under uncertainty – a field study of cumulative prospect theory. On their research they tested the prospect theory developed by Kahneman and Tversky (1979 and 1992) in the financial market, using US stock option prices. They found that in the practical results in comparison to the laboratory results, the estimated functions (value and weighting) were closer to linearity and the loss aversion was less pronounced. Brendle (2006) looked at the power utility aspects of decision makers when they selected portfolios under incomplete information. Brendle used a stochastic approach to measure the impact of incomplete information and the power utility on the selection of the optimal portfolio. Bosch-Domenech and Silvestre (2010) investigated averting risk in the face of large losses in Bernoulli versus Tversky and Kahneman. In prospect theory, the thesis is that people display risk attraction in high probability losses but in their investigation and analysis Bosch-Domenech and Silvestre found that their subjects tended to avoid fair risks (\$30 to \$90), high-probability (80%) real loss, vindicating Bernoulli’s view that risk aversion is the dominant attitude.

Other scholars including Bailey, Kumar and Ng (2011) examined the effect of behavioural biases on the mutual fund choices of a large sample of US discount brokerage investors. They found that behaviourally biased investors typically make poor decisions about fund style and expenses resulting in poor performance. Kester, Hultink and Lauche (2009) identified three genres of portfolio management decision making, namely: formative-reactive, intuitive, and integrative. Each genre could be identified as a unique set of portfolio management practice. Kester, et al found that firms employing an integrative approach toward portfolio decision making were mostly likely to be successful in the long run compared with the others. Other scholars who applied modern statistical decision theory were Mao and Sarndal (1966) who reviewed Markowitz’ portfolio selection model in light of the newer theories in decision making. Mao and Sarndal explored the subjective nature of investor’s estimates regarding probability, which brings about the subject of heuristics and biases in decision making.

Another approach identified in the literature is the development of other models, building on the existing theory on prospect theory as described by Edwards (1996) in “Prospect theory: A literature review”. Edwards makes example of other scholars who have successfully developed other models from prospect theory like Loomes and Sugden (1982). Other researchers have developed variant models on prospect theory include Schmidt and Zank (2009) who presented a paper that combines the loss attitude and linear utility by providing an axiomatic analysis of cumulative prospect theory in the framework for decisions under uncertainty. Schmidt and Zank (2008) also investigated risk aversion in cumulative prospect theory. Their research found strong risk aversion implies a convex weighting function for gains and a concave one for losses, bringing more light into Kahneman and Tversky (1992) cumulative prospect theory.

Other researchers like Abdellaoui, Bleichrodt and Kammoun (2013) completed experimental studies to determine if financial professionals behave according to prospect theory.

Ultimately, the purpose of the identified literature was to find gaps in current knowledge (that supports the identified problem in practice) from which the doctorate research questions were developed. The literature detected the tone and direction of arguments upon which new knowledge will be developed. Without the relevant literature, the question of new knowledge would not be answered. New knowledge builds upon existing knowledge identified in current literature.

5. CONCLUSIONS

Decision making processes have been studied for generations beginning with expected utility theory as described by Von Neumann and Morgenstein in 1944. Modern decision theories have been developed in the 1960s and 1970s by Kahneman and Tversky (1979, 1992). The work of Kahneman and Tversky is the central theory for the proposed doctorate research. Further research completed by other scholars like Shefrin and Statman (1994, 2000), Stracca (2004) supports the work of Kahnemen and Tversky and will also form the basis of the theory for the proposed doctorate research. Thaler's (1999) proposition that behavioural finance was entering an era where it will be an integral part of main stream econometrics and financial analysis is the premise for the doctorate investigation.

The objective of the doctorate research is to investigate the psychological and behavioural aspects of decision making in real estate investments, taking into account that real estate investment decisions are usually made under uncertainty.

Further, from the literature, the methodology for the doctorate research will follow the work of Bailey, Kumar and Ng (2011), Bosch-Domenech. and Silvestre (2010), Brendle (2006), Friedman and Savage (1948), and Gurevich, Kliger and Levy (2009).

From the literature discussed on this paper, it was clear that behavioural finance is an area of research that is gaining momentum. The literature also showed that it has now become a popular subject for research as it has had numerous papers published in the last fifty years. There now seem to be consensus amongst several scholars in decision making, whether be in finance, management or medicine, psychological analysis, that behavioural aspects are critical.

More so, for professionals who rely to a great extent on experience and intuition for making professional decisions, it becomes even more critical that the human and psychological aspects of the processes are scrutinized. Even more so when you consider real estate investment decisions in developing countries, in Sub-Saharan Africa to be precise, where economic and markets' information is scarce and often unreliable.

Another benefit of the literature review was presentation of methodology examples for topics in decision making. Some of the papers reviewed provided practice based research and outlined in detail the methodology for collection of data and its analysis. Other papers presented techniques and approaches for the analysis of the data in decision making experience and field studies. The methodology described in these papers was helpful in developing the methodology for the doctorate research.

The identified literature provided a good platform for developing new ideas that could be further developed into research questions and hypotheses. The literature reviewed also

supported the importance of the human and psychological aspects in investment decision making.

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HOW PROJECT MANAGEMENT OFFICE (PMO) CAN BE USED TO IMPROVE BUSINESS PERFORMANCE AND CONSTRUCTION PROJECT SUCCESS

A. Alqahtani and A. Higham

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: A.Alqahtani1@edu.salford.ac.uk

Abstract: The evolution of the construction industry and the increase of its complexity on current projects, in accordance with the global economic crisis and concerns of repeating unsuccessful experiments, have resulted in significant pressures on construction organisations forcing them to establish new programmes and departments to identify their priorities and achieving effective results. With every project, there is a competition with many different factors and the importance of using project management (PM) practices is increasing dramatically. This is one of the factors that has increased the pressure on construction firms to engage in these practices properly. A large number of researchers and experts have found that investing in Project Management Offices (PMOs) can lead to higher levels of project success whilst also embedding strong and consistent project management practices, processes, and procedures into the organisation. This study is provided to develop the concept of PM and the application of best practice through the use of PMO. Approximately a number of 120 questionnaires have been distributed to the PM department of five large construction firms in the KSA. The findings shown that 69% of respondents agreed that the PMO should be responsible for implementing some important factors of projects. As a result, this paper is concluded by identifying a number of PMO's roles in the management of construction projects to improve business performance and to increase the project success rate.

Keywords: project management office; project management; project manager; construction.

1. INTRODUCTION AND RESEARCH BACKGROUND

Due to the changes and challenges occurring in the past few years in the world of construction, the use of different sources of technology in materials and devices, as well as the need of companies to meet these challenges through the development process to maintain the efficiency of the organisation. Researchers and organisations, such as Association of Project Management APM (2006), Project Management Institute PMI (2009), and Tylor (2011), have found that investing in Project Management Offices (PMOs) can lead organisations to higher project success rates and drive strong and consistent project management practices, processes, and procedures. The idea of PMO began to spread in the 1990s (Hurt and Thomas, 2009). The idea was developed in order to help organisations to create modern methods of monitoring and following up on projects to ensure that they are delivered on time either on or under budget. Construction firms are realising the increasing benefits of using PMO to centrally manage, facilitate, and control the diverse range of projects delivered by the organisation (Valle et al., 2008; Kerzener, 2009; Andrew, 2013). This entails the uniform application of policies, processes, and procedures adopted by PMO. It has a significant role for developing and establishing different PM practices (Sontosus, 2003; Almagrabi, 2012; Rouse, 2014). The involvement of PMOs in construction projects may provide consultation services to promote better knowledge to be shared across the whole organisation (Hobbs, 2007; Koskinen & Pihlanto, 2008).

1.1 The research problem:

The majority of government projects in the KSA are suffering from the problem of faltering and abandoned projects (Magdad, 2011; Diry, 2011). Several government agencies spotted a large number of faltering projects that have been diagnosed since the establishment of the National Anti-Corruption Commission in 2011. Approximately 1526 of large government projects were executed in different fields in the last five years and the number of projects that not completed and abandoned was (672) with a percentage of 44 (NACC, 2016). However, according to the statistics of the Ministry of Labour in Saudi Arabia (2011), approximately 75% of construction firms do not adhere to any specific programmes for implementation; this is left to personal interpretations only.

1.2 Research questions

What is the importance of implementing PMOs for achieving administrative organisation and increasing project success factors?

In order to fulfil the research questions, the objectives of the research are:

1. Developing the concept of PM and the application of best practice in construction projects through the use of PMO.
2. Clarifying what are the important roles and success factors that can be achieved by the PMO to improve business performance in the management of construction projects.

1.3 The Rationale for the research:

The construction sector in the KSA are suffering from some difficulties and problems that faced many organisations to not complete the execution of projects. This study is aiming to make a positive impact in the management of construction projects. This can be done by using the PMO to deal properly with these issues. However, regarding to Hobbs and Aubry (2007) have been conducting a study on around 500 different organisations from around the world about PMO's function and finding almost 75 unique roles of using PMOs that have been recognized. The result indicated that general PMO procedures and theories cannot be applied to different type and size of organisation. Therefore, to emerge from this dilemma. The discussion will be focused more on the important roles of PMO that can suites the execution of projects. This study seeks to advance current knowledge by identifying the effective roles of PMOs to increase the level of project success in the KSA construction sector.

2. PMO

2.1 Definition and Nature of the PMO

The PMO has been defined as *“a strategic, management orientated concept designed to manage business processes orientated towards construction as it is not designed to manage construction projects”* (Obrochta *et al.*, 2011:4). PMOs can also be define as a group of experts or department that includes a number of people from different areas within an organisation, tasked with applying best PM practice (PMI, 2012; Andrew, 2013; Rouse,

2014). Hobbs & Aubry (2007) develop this definition, noting the PMO often act a regional office, coordinating multiple projects. Alternatively, the PMO can also fulfil the role of acting as a centre of excellence supporting the implementation of best practice and encouraging the sharing of knowledge across the organisation in an attempt to improve performance (Hizamul, 2010; Alsadeq et al, 2011). However, the PMO can be a specialised set of people who work with a group of projects to run and fill a number of functions and roles to reflect on an organisation's performance. The construction sector's variety of process, policies, and procedures, which will convince the PMO to work as coordination centre to bridge the gap between projects that are currently being implemented with senior management (Taylor, 2011; Almagrabi, 2012; Andrew, 2013).

2.2 What Is a PMO?

PMO is contributed to maintain a list of PM best practices and provide effective guidance for instruments and expertise in PM. This can lead to the improvement of using a formalised PM process (Hobbs and Aubry, 2007; Kendrick, 2009). The involvement of PMOs in construction projects may provide consultation services to promote better knowledge to be shared across the whole organisation (Hobbs, 2007; Koskinen & Pihlanto, 2008). PMO is, to a large extent, about improving business performance. It should work as an agent for spreading PM standards, practices, and culture throughout the organisation (Obrochta & Finch, 2011; Dawson, 2012; Thiqah, 2013). PMO can increase the organisation's maturity level, project efficiency, and help in quantifying the impact on the project's success (Kendrick, 2009; ESI International, 2013). Generally, as discussed by Dawson et al., (2012) there are some main goals of having PMOs as:

- Standardization of project management methodology.
- Alignment of projects with organisational strategies.
- Provision for training, mentoring, and consultation.
- Compilation of project performance metrics.

2.3 Why Is PMO Used?

There is no single answer to this question, but in many cases, PMOs can be used for anything required by the organisation. Hobbs & Aubry (2007) defined some important tasks for PMOs, firstly to coordinate multiple projects under the same company. Secondly, it acts as a centre or mentors of a wide range of best PM practices. Lastly, aiming to improve business performance by encouraging sharing effective knowledge across various projects. Kendrick (2009) and Nehme (2014) summarised two significant factors as to why PMOs are required. The first is to provide project manager (PMs) with a good administrative assistant to allow them more time to focus on critical tasks by eliminating their minor responsibilities. The second is to control and support one or more projects from the inception date to completion. In particular, Tylore (2011) suggested that PMOs can be:

- The community of PM-wide practices and methodologies.
- Training, coaching, and certification.
- The process of decision-making and the project-selection process.
- The reporting system and management activities.
- Supporting, mentoring, and following up on financial aspects.

However, the main role of PMO by today's construction firms is to be the department that provides the quickest response to project-related issues. Dawson (2012) and Rouse (2014) discuss the primary functions of PMOs; metrics for improving PM practices, providing a source of guidance, and documentation for the process of implementing more projects within the same organisation.

2.4 How Is PMO Used?

The majority of researchers, including Al-Nahj (2012), Daptiv (2013), Andrew (2013), and Jordan (2015) assume the PMO's core function can be divided into three operational functions, including: supportive, controlling, and directive. Each function has its own strategy and role in the delivery of the organisation's output.

1. Supportive:

This level of PMO is mainly working to assist the PMs and various project teams by benefitting from having in place some type of support forms, such as guidelines, templates, knowledge, and PM best practices. This can be achieved by bridging the gap between different projects and bringing them together as one project community. This is an important model that should be used throughout the whole organisation to access these benefits:

- Increasing the project success levels by supporting widely the existing projects.
- Allowing the PMs and project teams to have in place some types of suitable PM information.
- Encouraging and empowering PMs and project teams to come up by ideas for solving various project problems.

2. Controlling:

This level of PMO is appropriate when the organisation needs to have discipline and standard formats across their existing project procedures, processes, activities, and methodologies. The utilisation of this model should be available to the organisation for ensuring all standards and methodologies are used across projects. This model should allow the organisation to achieve these underneath goals:

- Ensuring all standards and methodologies are used across projects.
- Ensuring the new types of projects are executed under its estimated budget.
- Spreading the regulatory compliance among different parties and projects.

3. Directive:

This level of PMO is empowering the office to have more directive roles. For instance, the PMs will be assigned by the PMO leader and their project progress will be reported to PMO in order to make some types of decisions. However, the majority of construction companies begin with the supportive model, then over time, they move to control and directive models regarding their levels of business needs. This should be used to gain the following factors:

- Ensuring PM practices are applied across projects.
- Reducing the overall costs and time by discussing the risks in early stages.

2.5 What Types of a PMO are Used in Construction Sector?

There are a wide range of types; each company needs to identify PMO types by evaluating the organisation's size and their number of projects. Almaghrabi (2011) and Godbole (2014) describe the types of PMO that can be used in construction sector, as follows:

1. PMO in a Single Project:
This is intended to be a limited version, which means that this type is only provided to manage one specific project and its job is almost done after the project is completed.
2. PMOs as a Portfolio Management Office:
Here, the responsibility is to support some PM practices and act as one small department, but its job does not involve in managing projects.
3. PMOs as a Centralised Office:

As the organisation executes a number of projects, PMO will be located centrally across all the organisational units and projects. This type has other sub-PMOs who report to the main PMO; this can be seen if the organisation is implementing more than one project in different regions.

3. THE APPLICATION OF PMO IN IMPROVING BUSINESS PERFORMANCE AND CONSTRUCTION PROJECT SUCCESS

Nowadays, organisations are trying to find some modern methods to use in managing business towards construction projects (Obrochta & Finch, 2011; Dawson, 2012;). As a result of applying those types of methodologies, companies are becoming more successful in achieving their desired goals. Similarly, PM intends to be more managerial; this has increased the number of practices but needs some suitable tools to increase its importance and adoption as a PMO. While this is the case, PMO can be defined as the real helm for various organisations that pursue different types of management across projects (Keyedin, 2012). PMOs can be an effective tool to deal with the major project factors such as; time, quality, cost, customer satisfaction, and staff satisfaction. Equally important, PMOs need to show their contributions to improving business performance. This paper discusses these ideas and goes into more in-depth detail, as follows:

1. The existence of PMOs should be used in the clarity of the decision-making process (Almaghrabi, 2011; ESI International, 2013; Godbole, 2014). This can benefit from the availability of such techniques as regular reports; it monitors various project statuses. In today's work environment, there is a huge need for transparency in order to make the right decision, PMOs increase the level of clarity needed to ensure the efficiency of project work. PMOs nowadays are supporting the PMs by integrating in most of the decisions. PMs must report to the PMO team; they cannot stand with more responsibility (Hobbs, 2007).
2. PMOs can offer the more effective management of human resources, technical and financial aspects, as well as the variety of resources that will be administrated and coordinated by the office (Kendrick, 2009; Dawson, 2012; Alsahli, 2013; Amanah, 2013). However, managing resources can be a big challenge currently faced by most organisations. The delivery of projects can be managed through the shortages or conflicts of resources. PMOs in this regard are working to balance demand by

understanding the organisation's resource capacity and applying each factor at the right time. Effective utilisation of resources will no longer be a big obstacle, as the PMO team should be ready to receive orders from different projects and then apply their roles to deal with these orders in regard to the entire organisation's needs.

3. PMOs can serve the organisation by spreading the PM culture and knowledge competencies, unifying, building, and confirming the quality of the implementation of PM practices (Obrochta & Finch, 2011; Majmah, 2013; Godbole, 2014). It needs to achieve a suitable balance in the process of choosing the right PM practices, delivering company needs, and ensuring its implementation. The office should find methods, standards, and procedures for improving the PM process. Nowadays, companies are struggling to develop the PM methodologies and applying best practices as there so many approaches that might work for them. Over time, PMOs will become the source of knowledge for assisting various projects.
4. The presence of PMOs will achieve the necessary levels of support and provide current project information available to senior management (NHS, 2008; Keyedin, 2012; Dawson, 2012; PMI, 2012). The process of providing accurate reports on a regular basis will support the achievement of this factor. Reporting should become one of the most crucial jobs that a PMO does in order to mentor and control their various projects. PMO teams need to understand to whom they should be reporting and prepare various types of reports such as using different forms and styles regarding the different tasks. The support of senior management with regular and accurate reports will increase the organisation's ability to be more successful.
5. PMOs should be in place to minimise expenses, costs, time, and give initial warnings in the event of risk issues or the rising levels of providing professional schedules (Hobbs, 2007; Kendrick, 2009; Almaghrabi, 2011; Alnahj, 2012; Alsahli, 2013). This will increase the accuracy of spending, return on investment, and save time overall. By considering that the establishment of PMOs will cost money, for instance in hiring staff, running the office, and maintaining its functions, one must also think about how it makes a great deal of sense to have common methodologies, templates, and processes as well as reducing the overall time and cost by monitoring all the projects in their early stages.
6. PMOs might be the right tool to increase the performance of individuals as PMs and levels of teamwork as well as increasing the ability of implementing future projects at high levels of efficiency (Alnahj, 2012; PM Solutions, 2013; Majmah, 2013; Halwah, 2013). Construction firms are advising to benefit from the previous lessons learned; a rehabilitation of competencies is required by the various departments by paying more attention to KM (Hill, 2008; Julian et al, 2008; Villa, 2010; Mysliviec, 2013; Muller et al, 2013; Shahram et al, 2014). The analysis of project indicators to measure the performance can be a good way to ensure continuous improvement.
7. The availability of PMOs should provide more transparency and clarity to various projects' policies, standards and procedures (Hobbs, 2007; Dawson et al., 2012; Keyedin, 2012). The process of creating an environment that is considered to be more efficient to manage different projects should adopt some regularity options. However, as there are so many various models of PMOs in place, there is a new trend of beginning to take accountability of simplifying the wide KM approaches. These

growths of PMOs are being tasked to share and gained effective knowledge abilities as a concept of increasing the importance of PMOs as a tool.

In brief, it can be claimed that PMO is the real thinker to bridge the gap between defining the PM practices and implementing them within the organisation. Alternatively, PMO is the reform of management issues and/or a real supporter of increased coordination and communication among all parties and/or projects. These are clear indications that the investment in this area will have a positive impact on the business' performance. Table 1 summarises the application of PMO in improving business performance based on, but not limited to, the previous literature:

Table 1: The application of PMOs in improving business performance (Alqahtani, 2016)

| References | Factors of PMOs in improving business performance |
|---|---|
| (Godbole, 2014; ESI International, 2013; Almaghrabi, 2011; Kendrick, 2009; NHS, 2008) | <i>The clarity of decision making process.</i> |
| Godbole, 2014; Majmah, 2013; Pwc, 2012; Kacst, 2012; Obrochta & Finch, 2011; Rouse, 2011) | <i>An effective tool to adopt PM practices.</i> |
| (Alsahli, 2013; Amanah, 2013; Dawson, 2012; Sheaff, 2011; Kendrick, 2009; PM Solution, 2009) | <i>Effective management of human resources, technical and financial aspects.</i> |
| (Shahram et al, 2014; Mysliviec, 2013; Muller et al, 2013; Villa, 2010; Hill, 2008; Julian et al, 2008; Desouza et al, 2006) | <i>The source of knowledge (center of excellence)</i> |
| (Scott, 2016; Keyedin, 2012; Dawson, 2012; PMI, 2012; Obrochta & Finch, 2011 Emcanat, 2011; NHS, 2008) | <i>Support and providing current project information (regular and accurate reports)</i> |
| (Alsahli, 2013; TenStep, 2013; Alnahj, 2012; PMI, 2012; Kacst, 2012; Sheaff, 2011; Almaghrabi, 2011; Kendrick, 2009; Hobbs, 2007) | <i>Minimizing the expenses, costs, time, and reducing risk factors.</i> |
| (PM Solutions, 2013; Majmah, 2013; Halwah, 2013; Alnahj, 2012; Obrochta, 2011; Visitacion, 2009) | <i>Increasing the performance of individuals, teamwork and the implementation of future projects.</i> |
| (Jordan, 2015; Dawson et al., 2012; Keyedin, 2012; Pwc, 2012; Emcanat, 2011; Hobbs, 2007) | <i>More transparency and clarity to various projects policies, standards and procedures.</i> |

4. RESEARCH METHOD

The data used for this study were collected by the questionnaire method as it gathers data, when other types of methods might cause some issues such as: the questions type seems to be

sensitive or confidential to the respondents or they might need more time to consider their answers (Muller et al, 2013; Shahram et al, 2014). The questionnaire method is usually cheap as it is easy to access a large amount of data from different people. The analysing process in using closed questions can be straightforward, which is considered in this study (Saunders et al., 2009).

The sample was selected according to the National Anti-Corruption Commission (NACC, 2014), considering that there are around 400 large contracting or construction firms in the KSA back to 2014. Since this is an official statistic from the KSA government, the population size was 400. Approximately a number of 120 questionnaires have been distributed. The response rate was 44%, which is equal to 53 that have been completed.

The sampling method used was random sample as it suits answering research question; What is the importance of implementing PMOs for achieving administrative organisation and increasing project success levels? The random sample was distributed equally to two groups (Head Office group and Project Site group) and every individual in the population might be selected. The electronic mail surveys were used as a method of collecting the survey data. Individual participants had the chance to read, answer, and replay or send the completed survey through the survey Monkey program. The analysis of the collected data has been analysed statistically and statistics programmes (PSS) was considered to facilitate the analysis method. However, statistical analysis was used in this research to illustrate the data in a numerical value, which is computed from the sample to describe the mean and makes interferences about the population.

The questionnaires were sent to a number of 120 people who work in the PM department of five large construction firms in the KSA named as Ministry of foreign affairs, Jeddah Municipality, Saudi Electricity Company, Saudi Telecom Company, and Alarrab contracting company. The Experience of the participant in this research was selected based on two criteria: First, People who work in the PMO or deal with the office as PMs for no less than five years and have relevant information to the research. Second, People who are able, accessible, and willing to give the level of information that is needed. However, their roles in the project team and organisation it had to be within four areas; PMO leader, PMO administration, PMs and head department, and operators whether engineers or staff.

The justification of using questionnaire method as it deals with questions such as; clarifying what are the important roles and success factors that can be achieved by the PMO to improve business performance in the management of construction projects. This method shall enable a greater number of people to give their different viewpoints on the PMOs and how participants in this survey understanding the role of the office.

5. RESULTS

Through asking respondents to evaluate the average performance of the project management practice of the current or last project. There is a significant trend by people to dissatisfaction with the performance of the PM practice that described in figure 1. For example; the risk management and resource management were carrying the highest negative ratios of about 53% and 43%, respectively, were selected poor. There are a number of weakness with these figures: Firstly, the loss of a lot of sources that are outside the project needs, or in many cases there are no better places to store them. Secondly, if there are no exceptions of the risk

factors, it might be occurred suddenly, which requires paying a lot of money and time in addressing them later on.

However, there is some sort of satisfaction with the performance of financial management with approximately 29% that described as good. This can present the demand of government to implement more projects and encouraging construction firms that there are no problems for receiving payments. Otherwise, the rest of communication, knowledge, and delivery management that ranges from poor to average. It is evident that there is a great need for the majority of construction firms in the KSA to improve these practices via PMO office which can help them to improve the overall business performance.

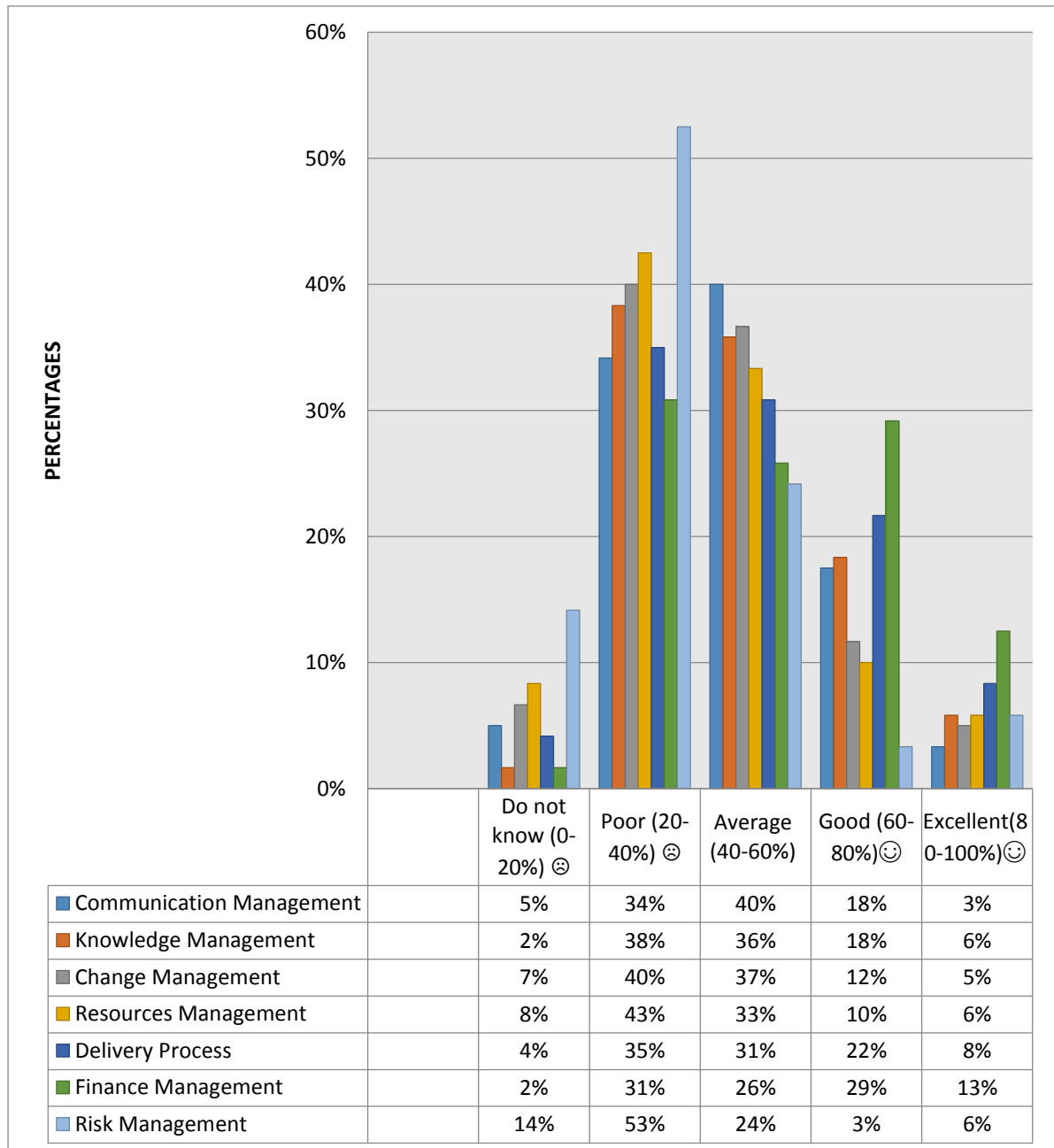


Figure 1: Evaluating the performance of the project management practices in the KSA (Alqahtani, 2015)

The respondents also have been asked about the impact of some important factors on the implementation of construction projects in the KSA? The implementation of construction projects always requires a lot of stages, procedures and regulations. However, the presence of an effective practice in the management of projects can help to achieve great success ratios. Therefore, there is a positive ratio illustrate the importance of those practices described in the figure 2, which ranges between good to Excellent.

There are approximately 69% who agreed that the PMO should be responsible for the implementation on the management of different projects. Although, the highest percentage can be provided by the impact of work reports on a permanent basis because it can affect the overall project and lacking the management department to get informed of the project work. In addition, 42% of respondents were selecting good for describing the impact of communications and coordination among parties.

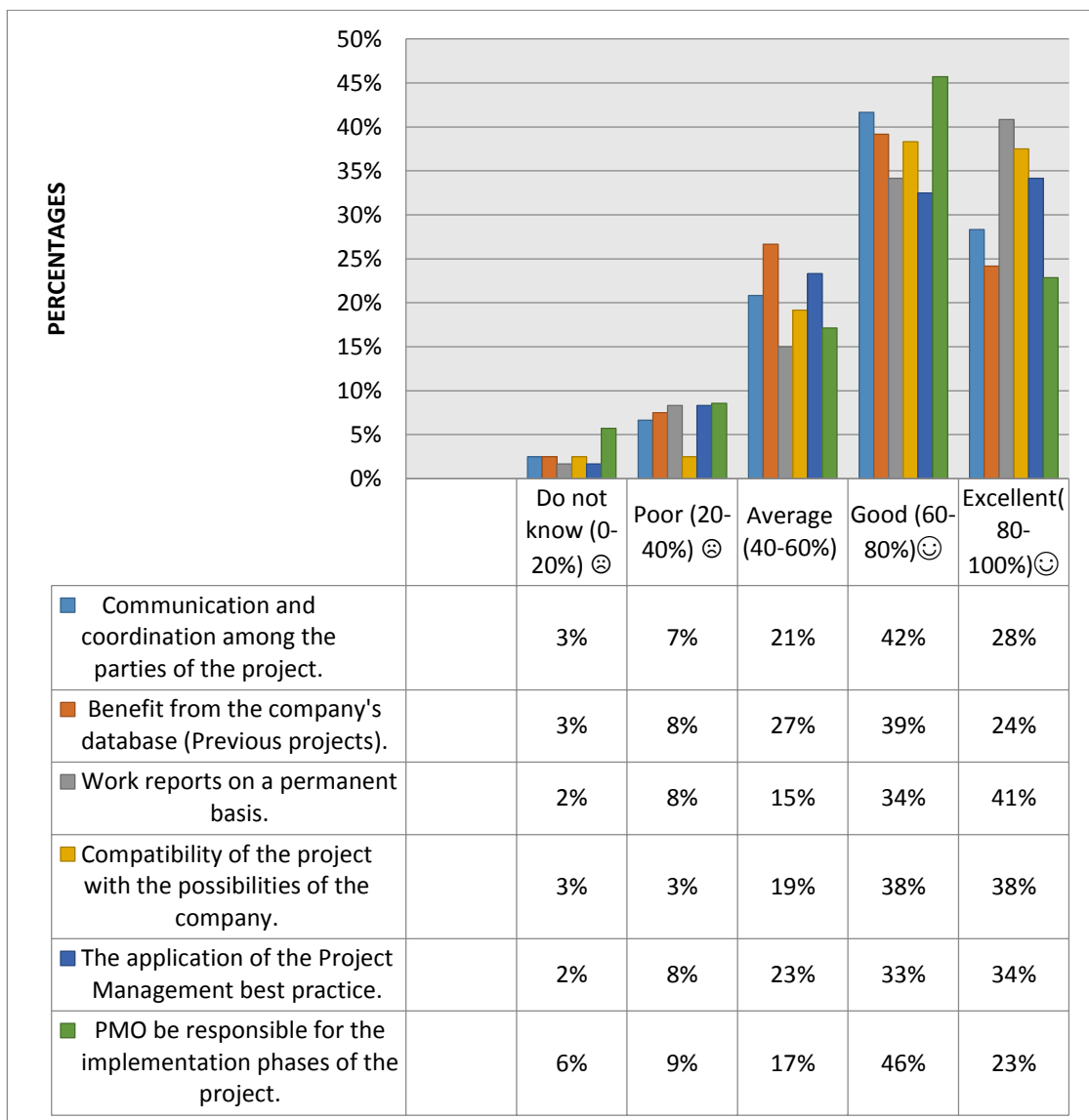


Figure 2: Evaluating the effectiveness of PMO roles and its importance (Alqahtani, 2015)

6. DISCUSSION

The findings of this study can be based on the outcome of various literatures that discussed the application of PMOs in improving business performance, which is summarised in table 1. Additionally, the confirmation of research methods in section 5 that used to evaluate the performance of PM practices in the KSA and the effectiveness of PMO roles and its importance. One explanation is the questionnaires illustrated that the average performance of dealing with PM practices are ranged between 20-40%, which is poor. However, this lack of applying best practice of PM in the KSA can be reduced by the existence of PMOs, as it can play many roles in the management of construction projects and maximising the availability of best PM practice. This challenged the research to conclude with 7 important roles that can be adopted by the PMO office and answering the research question. These factors shall contribute in the successes of construction project and the improvement of the overall business performance; as illustrated in figure 3:

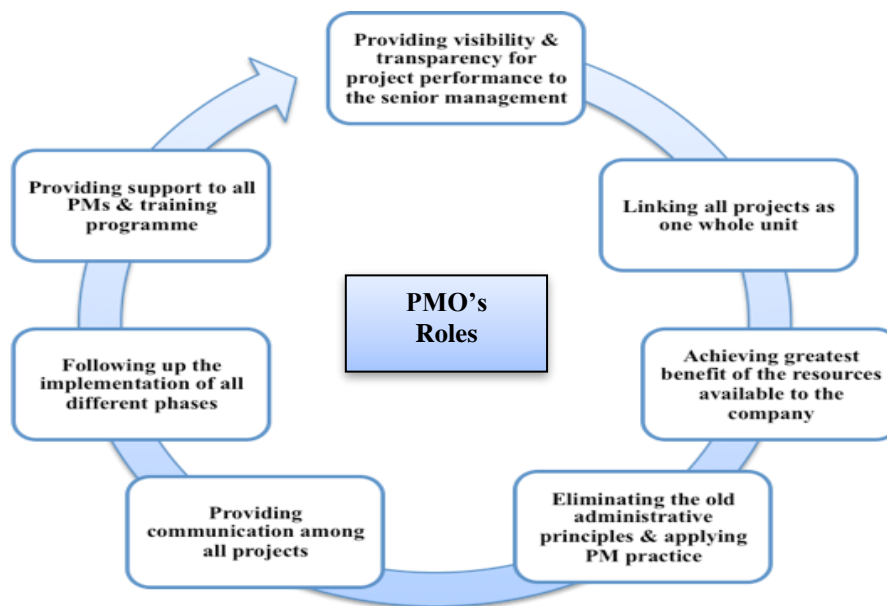


Figure 3: PMO's roles in the management of construction projects (Alqahtani, 2016)

7. CONCLUSIONS

Project Management Office (PMO) is one of the most important phenomena that has spread widely to provide basic organisational means to construction firms. However, the uncertainty of its importance is still under debate by some researchers in this field or organisations in the KSA construction market. Therefore, this paper is provided to develop the concept of PMOs in terms of increasing the success factors that mainly contribute to it. However, the research has focused widely on the importance of the office work to achieve best practice of PM and to be the main coordinator to monitor the various stages toward project implementation. Finally, this study has shown that the KSA construction firms, according to their current complexity of managing construction projects do not mind supporting new approaches such as PMO, but on the condition that these global practices should be more realistic to implement.

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HOW PROJECT MANAGEMENT OFFICE (PMO) CAN BE ESTABLISHED IN THE SAUDI ARABIAN CONSTRUCTION ORGANISATIONS

A. Alqahtani and A. Higham

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: A.Alqahtani1@edu.salford.ac.uk

Abstract: Current researchers into the project management offices (PMOs) has highlighted the PMO's functions as a knowledge brokers between project and top management and between different projects under the same organisation. Nonetheless, current literature of PMOs does not provide sufficient evidence to increase awareness of the Kingdom of Saudi Arabian (KSA) construction firms to establish this office. These issues are investigated in this paper through conducting a survey in five construction firms. The main contribution is insight into highlighting the challenges and difficulties in the KSA construction market and how PMOs can be proposed to overcome these factors. The methodology is used to evaluate people's knowledge of PMO and its importance to be established in the KSA as well as evaluating some important elements of managing projects in the KSA to clarify and confirms the needs behind establishing the office. Approximately a number of 120 questionnaires have been distributed to the PM department of five large construction firms in the KSA. The findings shown that 49% of PMs or who works in the management field consider their knowledge of PMOs as poor. While 69% of participants agreed on the need of establishing PMOs. As a result, this paper is concluded by proposing some steps and procedures to address the establishment of PMO and to increase the awareness among firms about its importance.

Keywords: project management office; project management; project manager; construction.

1. INTRODUCTION AND RESEARCH BACKGROUND

Construction firms are realising the increasing benefits of using PMO to centrally manage, facilitate, and control the diverse range of projects delivered by the organisation (Valle et al., 2008; Kerzener, 2009; Andrew, 2013). Due to the changes and challenges occurring in the past few years in the world of construction and the need of companies to meet these challenges through the development process to maintain the efficiency of the organisation. Researchers and organisations, such as Association of Project Management 'APM' (2006), Project Management Institute 'PMI' (2009), and Tylor (2011), have found that investing in Project Management Offices (PMOs) can lead organisations to higher project success rates and drive strong and consistent project management practices, processes, and procedures. The idea of PMO began to spread in the 1990s (Hurt and Thomas, 2009). The idea was developed in order to help organisations to create modern methods of monitoring and following up on projects to ensure that they are delivered on time either on or under budget.

However, before approaching PMO in KSA, organisations are advised to consider: First, what is a PMO? PMO is contributed to maintain a list of PM best practices and provide effective guidance for instruments and expertise in PM. This can lead to the improvement of using a formalised PM process (Hobbs and Aubry, 2007; Kendrick, 2009). PMO is, to a large extent, about improving business performance. It should work as an agent for spreading PM standards, practices, and culture throughout the organisation (Obrochta & Finch, 2011;

Dawson, 2012; Thiqah, 2013). By recognising the reasons behind projects to not completed and abandoned; PMO can increase the organisation's maturity level, project efficiency, and help in quantifying the impact on the project's success (Kendrick, 2009; ESI International, 2013). The second, what does the PMO do? The main role of PMO in today's construction firms is to be the department that provides the quickest response to project-related issues. Rouse (2014) assume the primary functions of PMOs: metrics for improving PM practices, source of guidance, and documentation for the process of implementing more projects within the same organisation.

1.1 The research problem:

The majority of government projects in the KSA are suffering from the problem of faltering and abandoned projects (Magdad, 2011; Diry, 2011). Several government agencies spotted a large number of faltering projects that have been diagnosed since the establishment of the National Anti-Corruption Commission in 2011. Approximately 1526 of construction projects were executed in different fields in the last five years back to 2016; and the number of projects that not completed and abandoned were (672) around 44% (NACC, 2016). However, according to the statistics of the Ministry of Labour in the KSA (2011), approximately 75% of construction firms do not adhere to any specific programmes for the implementation process; this is left to personal interpretations only.

1.2 Research questions

1. How can an organisation develop its own understanding of PMO's approaches, roles, functions, and retain them in the long-term?
2. What process do companies need to establish or evaluate unique PMOs?

In order to fulfil the research questions, the objectives of the research are:

3. Highlighting the reasons behind project to falter and abandoned and clarifying what are the important roles and success factors that can be achieved by the PMO to face these current challenges in the KSA's construction sector.
4. Finding the basic principles for establishing PMOs and how to evaluate its performance during the different phases of the project.

1.3 The Rationale for the research:

The construction sector in the KSA are suffering from some difficulties and problems that faced many organisations to not complete and abandoned the execution of projects. This study is proposed to make a huge difference in the management of construction projects. This can be done by using the PMO to deal properly with these factors. However, regarding to Hobbs and Aubry (2007) have been conducting a study on around 500 different organisations from around the world about PMO's function and finding almost 75 unique roles of using PMOs that have been recognized. The result indicated that general PMO procedures and theories cannot be applied to different type and size of organisation. Therefore, to emerge from this dilemma. The paper will be focused more on the important roles of PMO that can be linked directly with the factors that effect the execution of projects in KSA. This study

seeks to advance current knowledge by finding an effective and professional plan for the establishment of PMOs to increase the level of success in the KSA construction sector. The PMO can be used as one of the modern methods for creating new departments for PM or the development of these sections in a place, which can be centrally located across various projects to address and support their requirements and needs.

2. PMO AND ITS EXISTENCE IN THE KSA

Increasing the implementation of PMO has been highlighted in the KSA government's strategic plan 'vision 2030' which articulates a series of reforms for government. One of which is the introduction of a national PMO, formed by the ministry of Economy and planning in 2015 (Khatib, 2016; Bakkah, 2016; Fattah and Nereim, 2016). The national PMO will be used to review government projects to ensure their efficient implementation, consistent development by identifying needs and priorities as well as to apply the latest PM approaches to public sector projects. The application of PMO in government entities in KSA can already be seen in different sectors such as the Jeddah Municipality, Majamah University, the national information centre, Ministry of Interior, and Ministry of Health (Bakkah, 2016; Fattah and Nereim, 2016).

2.1 The KSA Construction Sector

There has been great attention paid by the KSA's government to executing a large number of projects in the coming years in order to deal with the large increase in population, with an estimated annual increase of 2.7 percent (Ccdos, 2013). The KSA construction market will therefore become one of the largest emerging markets in the Middle East, considering that the KSA government increased its spending to \$385 billion for the next ten years (Khatib, 2016; Bakkah, 2016).

In order to benefit from this, KSA construction firms are beginning to execute more than one project at the same time. As a result, companies are engaging in more types of projects that are not usual for their size, or they do not have enough professionals experienced in leading their specific types of projects. Organisations are finding that PMO should be applied to meet these challenges, in case its implementation was to be successfully defined (Alnahj, 2012; Halawah, 2013).

2.2 The Reasons Behind Project to falter and abandoned in the KSA

The reasons for faltering and stalled projects in the KSA can vary. NACC (2016) identified four major factors that causes delay and failure in many projects: lack of planning, lack of visibility during the studies and design stage, deficiencies in study of the project's nature, and the lack of the existence of a project management office (PMO) in large companies. Recently, it has been disclosed that the value of non-performing government projects is estimated to be 100 billion Riyals (Alsahli, 2013).

Table 1 underneath indicates that several researchers have stated there are a lot of factors that cause delays and increased project failure rate. Alnahj (2012) and Halawah (2013) largely share the same concepts and focus clearly on the lack of coordination and communication

between all parties as well as investigating how to take advantage of past experiences obtained by the company in the implementation of previous projects. In contrast, others focus on the weakness of support from the top management and training programmes that were supposedly established in many companies, according to their needs and requirements. Going into more in-depth critique on the table 1 below, many have asked about the key aspects of project failure. To access the appropriate answer, there are a number of strengths and weaknesses of this argument; as follows:

Firstly, there is a failure to fully acknowledge the importance of having a good communication system and knowledge sharing among projects (Emcanat, 2011; Halwah, 2013; Alsahli, 2013; Majmah, 2013). It would be effective for construction firms to connect all projects as one whole unit and uniform the procedures, policies, and standards.

Secondly, all define the most serious limitation, which can easily increase the percentages of project failures, as the lack of implementing PM practice (Thigah, 2012; Majmah, 2013). One question that might need to be asked is how companies are making decisions and implementing their projects.

Thirdly, evidence to support this can be found in the work of both Majmah (2013) and Amanah (2013) who explained that the majority of the KSA's organisations make decisions individually. This would not be appropriate in situations where there are no qualified PMs who can deal with all project aspects, as proved by Kacst (2012) and Alnahj (2012).

Fourthly, Thiqah (2012) and Halwah (2013) have challenged this on the ground that poor coordination among various departments results in not taking advantage from previous projects. Emcanat (2011) and Majmah (2013) have both criticized the lack of adequate reporting systems in the current management of KSA's projects. Espousing this presents difficulties in practice. For example, how the senior management or PMs can follow up on all project procedures?

As a result, this section was provided to make a comparison table between many practitioners, researchers, and organisations in the KSA in terms of the reasons of uncompleted and abandoned construction projects. This is can be shown in the following table 1:

Table 1: Reasons behind project to falter or abandoned (Alqahtani, 2015)

| | HALAWAH (2013) | EMCANAT (2011) | MAJMAH (2013) | KACST (2012) | THIQAH (2012) | AMANAH (2013) | ALNAHJ (2012) | ALSAHLI (2013) | Magdad (2011) |
|----------|---|---|--|--|---|--|--|---|---|
| 1 | <i>Poor coordination</i> | <i>Weakness of rehabilitation and training of various factors</i> | <i>Lack of project management culture among workers</i> | <i>Lack of supervision and audit process on the project data</i> | <i>Not benefit from the successful experiences</i> | <i>Poor performance in project implementation</i> | <i>Lack of knowledge of the necessary resources properly</i> | <i>Focus on artwork and construction only</i> | <i>PM do not work as desired</i> |
| 2 | <i>Modest performance for project managers and teamwork</i> | <i>Lack of uniform procedures for project management</i> | <i>Make decisions individually</i> | <i>Failure to provide project managers with the required reports</i> | <i>Not to put specific methods for PM</i> | <i>Insufficient information available about the project</i> | <i>Failure to find advanced methods in project management</i> | <i>Lack of strategy and clear objectives</i> | <i>Weak reports system for doing tasks</i> |
| 3 | <i>Loss of business documentation</i> | <i>Lack of support levels</i> | <i>Environment project management is not effective</i> | <i>Lack of training project managers on how to deal with the management system documentation</i> | <i>The selection of projects to suit the potential of the company</i> | <i>Coordination random and unorganized</i> | <i>Non-management mode for each individual risk and common to all projects</i> | <i>The lack of criteria and indicators to measure</i> | <i>Database seems to be missing</i> |
| 4 | <i>The lack of reports on a regular basis and accurate</i> | <i>Regulatory options do not work properly</i> | <i>Lack of knowledge of the key actions for project management</i> | <i>The lack of updated information on a regular basis for previous projects</i> | <i>Not to take advantage from project management practices</i> | <i>Poor communication and lack of coordination of activities</i> | <i>Lack of central coordination to manage communications across projects</i> | <i>Little attention in the planning</i> | <i>PMs are not qualified</i> |
| 5 | <i>Lack of knowledge of the various procedures of the project</i> | <i>Knowledge gained from previous projects missing</i> | <i>Lack of reporting and not completed as required</i> | <i>Do not put a specific system for the management of rewards for workers</i> | | <i>Repeat failure with an inability to avoid them</i> | <i>The absence of base and supervisory guidelines for project managers</i> | <i>Lack of transparency and clear</i> | <i>Poor coordination and communication between all parties</i> |
| 6 | <i>Not to take advantage from previous projects</i> | | | | | <i>Slow in issuing decisions</i> | <i>Weakness of oversight of all schedules</i> | | <i>Entry in some type of projects outside their possibilities</i> |
| 7 | <i>Increasing the size and type of project possibilities</i> | | | | | | <i>Weak oversight of the financial aspects of the project budgets</i> | | |

3. HOW THE CONSTRUCTION FIRMS CAN SET UP THE PMOS IN THEIR PROJECTS TO INCREASE PROJECT SUCCESS

Throughout the search on how to set up PMOs, it is noticeable that thousands of hits will return. However, this paper is focused on the steps and procedures that can be worked to address the defined issues in the previous table 1 rather than repeating some information already available and it seems to be out of date. Table (2) summarise the international literatures of PMO establishment; as it can be discussed on the following points:

Firstly, the full agreement by all that the first step of establishing PMO should be used to identify and defined the PMOs tasks. To build a strong foundation for this concept, a full knowledge of its objectives is needed to be provided. This paper cannot overlook this important step and will place it as the basis for establishing this department.

Secondly, researchers as (Hizamul, 2010; ASPE, 2012; NHS, 2013) lacking the needs to fully acknowledge the importance of involving both senior management and stakeholders. This will result in increased pressure on PMs to highly benefits from the office and to gain the necessary support at the right time. This research is assumed the involvement of senior management as a second step for the PMOs to be successfully launched and achieved its objectives.

Thirdly, PMI (2009) and ASPE (2012) and CIO (2012) believe that provides on-going training and coaching program for PMs and staff will increase their interest and preparing the required competencies for the office. This would be appropriate in situations where this concept is prevalent. A good example can be the KSA where the PMOs try to appear on the surface by many construction firms as it will be seen in the methodology section. This could present some difficulties in practice.

Fourthly, some sources as the CIO (2012) fails to define the need for chosen suitable PMO's teams and to design efficiently its tools. This might provide some limitations with applying this in practice. An alternative explanation might be seen by Wilkinson (2013) argue to benefit from keeping monthly face-to-face meetings and regular reports. This can evaluate from time to time the effectiveness of PMO and its worth.

Finally, a further major criticism of all viewpoints is that the process is always concluded by identifying the importance of PMOs to be evaluated. At this stage organisation should use the evaluation process as the final stage of establishing PMOs, which must be accompanied with the presence of the office.

As a result, the following aspects can be summarised based on the previous discussion: provide and identify PMO mission, objectives, involve stakeholders and senior management, provide training and coaching programs to improve people skills, define and design PMO process, teams, tools, provide meetings, reports, and evaluate and update PMO. Table 2 below, is provided to explain the various procedures and steps of establishing PMOs:

Table 2: Procedures and steps of Establishing PMO (Alqahtani, 2015)

| | PMI (2009) | NHS (2013) | CIO (2012) | ASPE (2012) | Wilkinson (2013) | Hizamul (2010) |
|--|-----------------------|-----------------------|-----------------------|------------------------|-----------------------------|---------------------------|
| | | | | | | |

| | | | | | | |
|----------|--|--|--|--|--|--|
| 1 | <i>Identify the orientation of PMO</i> | <i>Identify what problems to be solved</i> | <i>Prepare the company for this new department</i> | <i>Define the mission-strategy-objectives</i> | <i>Define the purpose of establishing PMO</i> | <i>Prepare a strong foundation for PMO</i> |
| 2 | <i>Provide ongoing training</i> | <i>Identify PMO vision</i> | <i>Identify the PMO type</i> | <i>Provide PMO to support PM methodology</i> | <i>Support by senior management stakeholders</i> | <i>Identify PMO roles</i> |
| 3 | <i>Provide PMO process help desk</i> | <i>Define the objectives</i> | <i>Communication with stakeholders and senior management</i> | <i>Provide training & coaching</i> | <i>Define the PMO process & tools</i> | <i>Design PMO teams</i> |
| 4 | <i>Provide face-to-face meetings</i> | <i>Define how PMO can be operated</i> | <i>Allow time for getting the result</i> | <i>Design the PMO teams & common resources</i> | <i>Design the PMO group</i> | <i>Identify PMO policy & methodology</i> |
| 5 | <i>Provide communication</i> | <i>Identify teams & tools</i> | <i>Evaluate & communicate early wins</i> | <i>Updates & develop PMO</i> | <i>Communication with all parties</i> | <i>Provide metrics</i> |
| 6 | <i>Change PMO tasks as you go</i> | | <i>Develop and change through time</i> | <i>Evaluate PMO work</i> | <i>Keep monthly face-to-face meetings</i> | |
| 7 | <i>Client involvement in each step</i> | | <i>Provide training packages</i> | | <i>Keep regular reports</i> | |
| 8 | <i>Evaluate PMO work</i> | | <i>Design stages and delivery process</i> | | <i>Evaluate the PMO work</i> | |

4. RESEARCH METHOD

The data used for this study were collected by the questionnaire method as it gathers data, when other types of methods might cause some issues such as: the questions type seems to be sensitive or confidential to the respondents or they might need more time to consider their answers (Muller et al, 2013; Shahram et al, 2014). The questionnaire method is usually cheap as it is easy to access a large amount of data from different people. The analysing process in using closed questions can be straightforward, which is considered in this study (Saunders et al., 2009).

The sample was selected according to the National Anti-Corruption Commission (NACC, 2014), considering that there are around 400 large contracting or construction firms in the KSA back to 2014. Since this is an official statistic from the KSA government, the population size was 400. Approximately a number of 120 questionnaires have been distributed. The response rate was 44%, which is equal to 53 that have been completed.

The sampling method used was random sample method as it suits answering research question; What process do companies need to establish or evaluate unique PMOs? The random sample was distributed equally to two groups (Head Office group and Project Site group) and every individual in the population might be selected. The electronic mail surveys are used as a method of collecting the survey data. Individual participants had the chance to read, answer, and replay or send the completed survey through the survey Monkey program. The analysis of the collected data has been analysed statistically and statistics programmes (PSS) was considered to facilitate the analysis method. However, statistical analysis was used in this research to illustrate the data in a numerical value, which is computed from the sample to describe the mean and makes interferences about the population.

The questionnaires were sent to a number of 120 people who work in the PM department of five large construction firms in the KSA named as Ministry of foreign affairs, Jeddah Municipality, Saudi Electricity Company, Saudi Telecom Company, and Alarrab contracting company. The Experience of the participant in this research was selected based on two criteria: First, People who work in the PMO or deal with the office as PMs for no less than five years and have relevant information to the research. Second, People who are able, accessible, and willing to give the level of information that is needed. However, their roles in the project team and organisation it had to be within four areas; PMO leader, PMO administration, PMs and head department, and operators whether engineers or staff.

The justification of using questionnaire method as it deals with questions such as investigating the people's knowledge of PMO and issues involving the usage of PMO to be existed in the KSA construction sector. This method shall enable a greater number of people to give their different viewpoints on the PMOs and how participants in this survey understanding the role of the office.

5. RESULTS

Results presented undoubtedly that there is a significant lack of management attention to be paid for the important elements of executing projects in the KSA. Evidence to support this study can be found by evaluating five elements named as Time, Cost, Quality, and Customer and Staff satisfaction. These elements were examined by evaluating the extent of people's satisfaction of their experiences in previously implemented projects. In particular, the factors of Cost, Quality, and Time were evaluated with ranges from average to poor. This would not be appropriate in situations where the project size is very large and has a significant impact on large numbers of users. At this level PMOs can be provided to compete with those factors, as well as coming up by some solutions to increase their productivities.

The results of quality evaluation were poor performance but that did not prevent a large number of companies to increase their reputation and access to other projects with a percentage of 36% evaluated by good. In other words, this can give clear evidence that there is a boom in the construction sector in the KSA, which has increased significantly in line with government objectives. However, the poor satisfaction from both customer (34%) and staff (43%) can easily present people with a demand to change and accept new approaches to improve their happiness. PMOs currently can be used to deliver the level of information that the client needs and supporting staff to reduce the work pressure by distributing fair tasks.

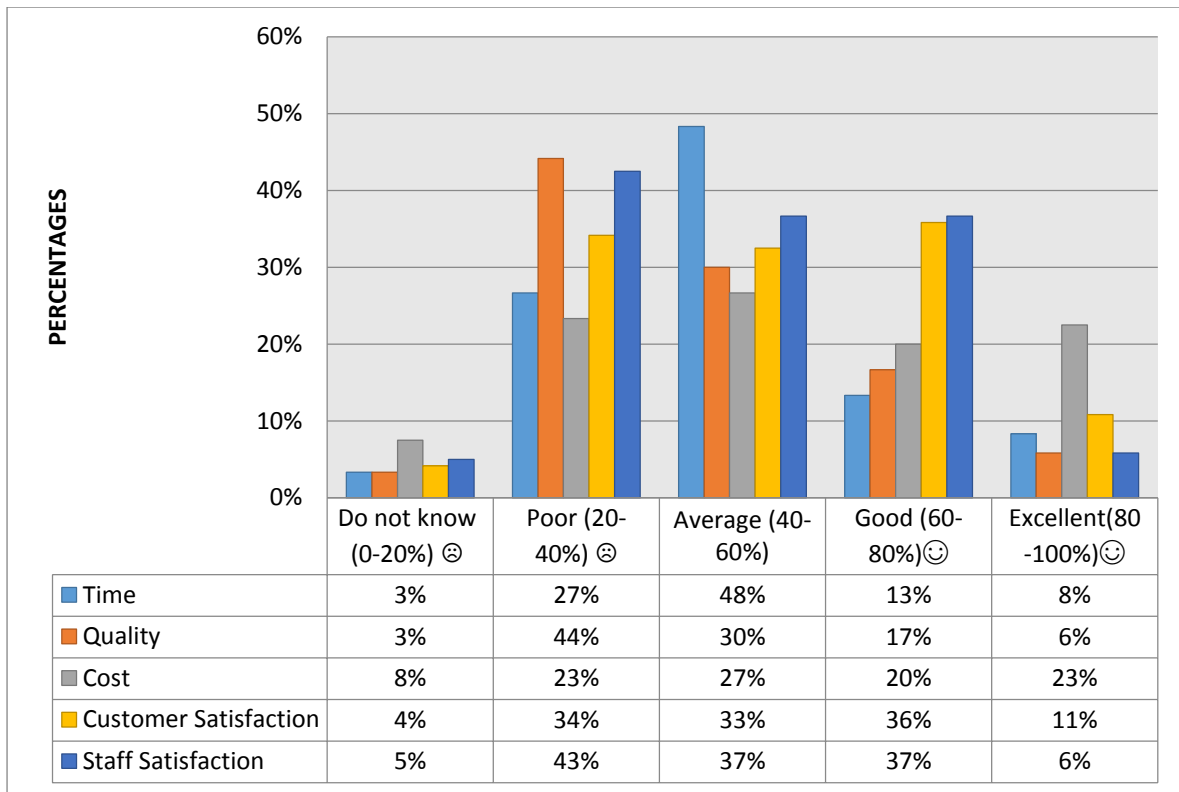


Figure 1: Evaluating the project elements in the KSA (Alqahtani, 2015)

The percentages show that about 42 of respondents describing their knowledge of knowing PMOs and understanding its roles as poor. While there are approximately 16% describing their knowledge as good. It can be asserted that this approach is attended to be new and the majority of people do not know significant detail about it. Figure 2 can illustrate the needs for this study to focus on establishing the office rather than developing it. The concept of PMO in the KSA seems to be not good enough while comparing with the evolution of this concept in other countries around the world.

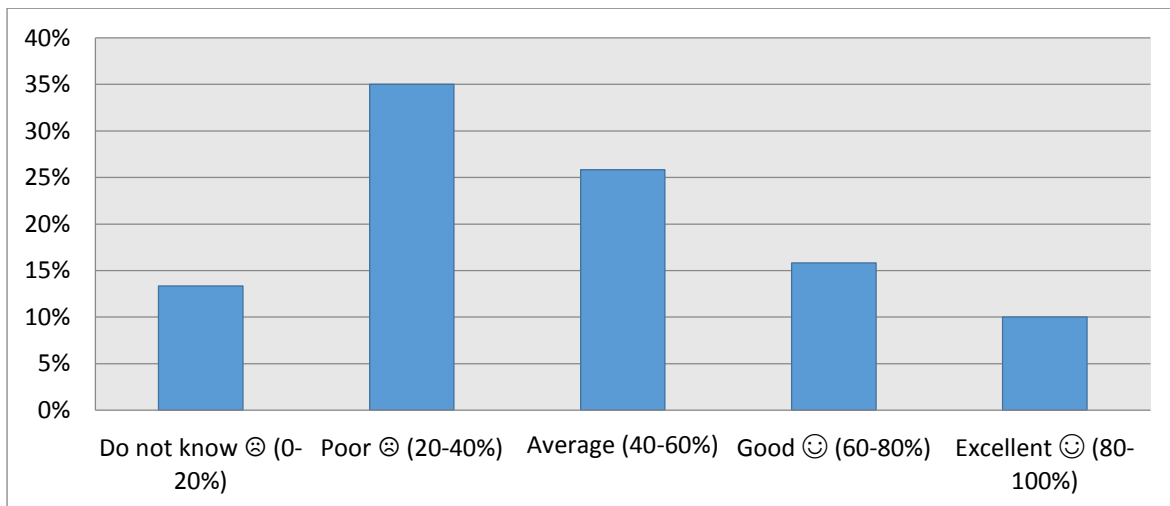


Figure 2: Evaluating People Knowledge of PMO (Alqahtani, 2015)

As the Project Management Office (PMO) approach is working to coordinate, support, and providing the best practice of Project Management. The extent to see the importance of its presence in the KSA have been evaluated through this survey. The result indicated, there is a

good incentive for the concept of the PMO to be established in the KSA. A great number of respondents (about 34% and 35%) agreed on the need for PMOs. While there are few respondents (2% and 8%) who disagreed. Furthermore, there are 22% with a number of 26 out of 120 who believe that this concept is natural. It is possible that there are a number of people who do not have enough information about this concept as confirmed on the previous statistics.

Against this, it could be argued that some programmes to increase people’s awareness of PMOs would be appropriate in cases where there are a number of people who do not understand this approach and it might assist this approach as required. A serious problem with this is, how do organisations establish a good environment for supporting new approaches to adopt this concept. One question that might need to be asked is, which parties should be responsible for supporting new ideas? And are they qualified enough? Those two questions can be challenged this new department to obtain the suitable support.

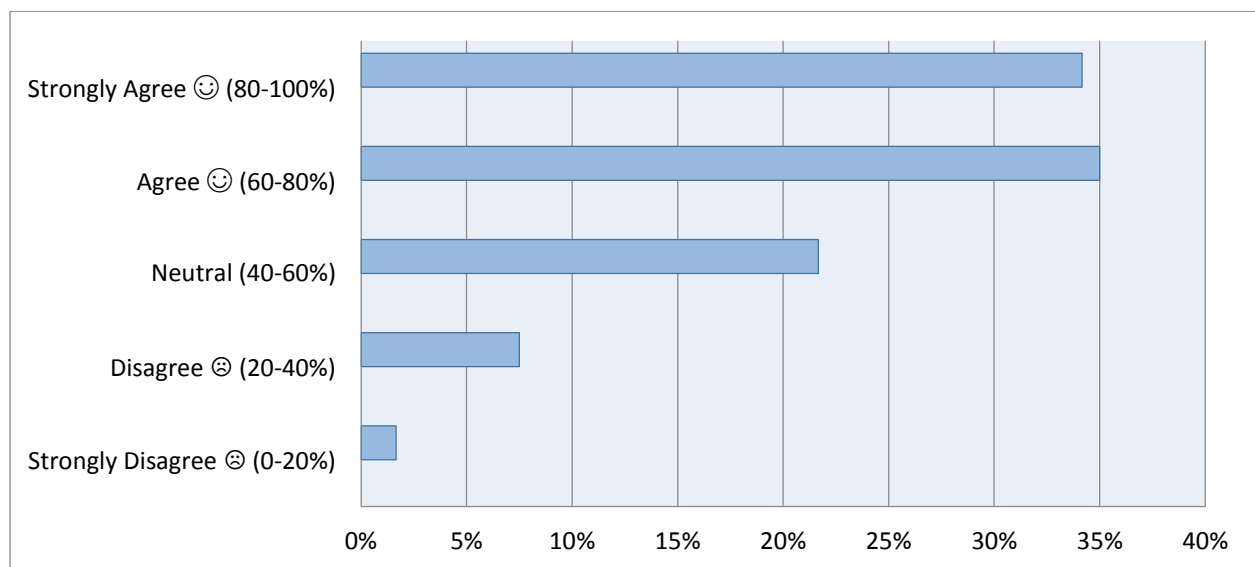


Figure 3: The importance of PMOs presence in the KSA (Alqahtani, 2015)

6. DISCUSSION

Based on the questionnaires, the figures highlighted a serious weakness on how people understand the PMOs approaches. Approximately 49% of respondents consider their knowledge of PMOs as poor. The figures also indicate a great deal of respondent agreement with the need of establishing PMOs with the percentages of 69%. In this case, the findings from literature reviews and questionnaires were used to provide advice for construction firms to establish the office to deal with the issues and challenges effect the execution of projects in the KSA; Figure 4 can suggest some steps and procedures for establishing PMOs:

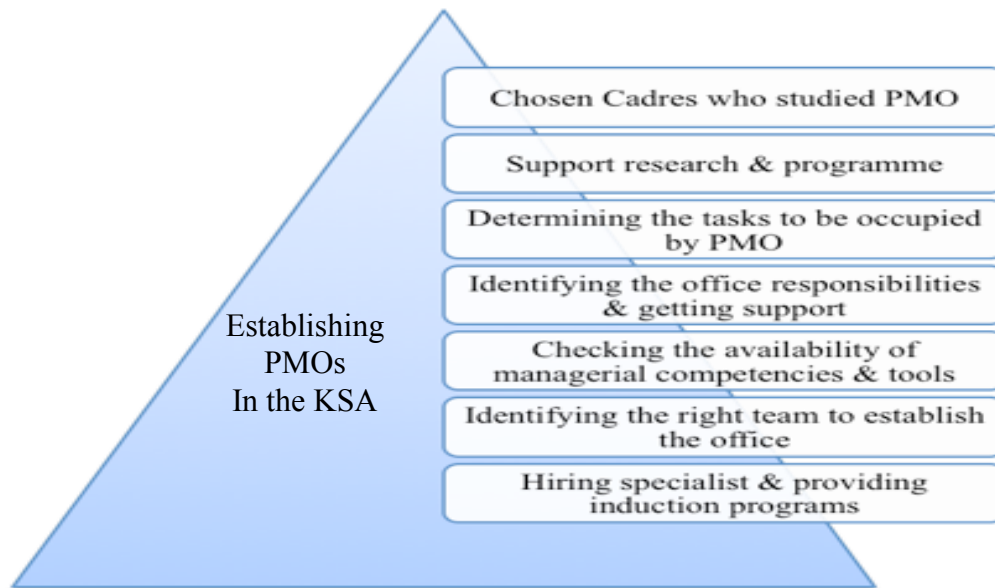


Figure 4: Steps and procedures of establishing PMOs (Alqahtani, 2015)

7. CONCLUSIONS

Project Management Office (PMO) is one of the most important phenomena that has spread widely to provide basic organisational means to construction firms. However, the uncertainty of its importance is still under debate by some researchers in this field or organisations in the KSA. Therefore, this research aims to develop the concept of PMOs in terms of understanding the reasons behind project to not completed and abandoned to allow the office to address them and achieve the desired administrative balance as well as increasing the success factors that mainly contribute to it. The research first discussed the reasons behind projects to not completed and abandoned and then identifies the appropriate steps and procedures for the establishment of PMO.

The findings confirmed the importance of creating this office to support senior management in terms of connecting them with all projects and providing permanent reports of the work's achievement and progress. The paper also considered assisting the PMs in terms of linking them heavily with other projects to enable the exchange of resources and expertise or developing the managerial skills of staff by giving opportunity for the office to adopt new courses and training programmes. Result shows the importance of the office work to achieve best practice PM and to be the main coordinator to monitor the various stages of the management of projects and to involve in its implementation. Finally, studies have shown that the KSA construction firms, according to the respondent's views and current complexity of projects do not mind supporting new approaches such as PMO, but on the condition that these global practices should be more realistic to be implemented in the KSA construction sector.

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CONSTRUCTION MANAGERS' CULTURAL ORIENTATION IN NIGERIA

K. Zakariyyah, J.O. Ameh and G.I. Idoro

University of Lagos, Nigeria

Email: zakaryyki@gmail.com

Abstract: Clients' tastes, innovation and changes in the construction sector demand prompt and efficient means of executing project. In order to stay afloat, construction managers and CEOs need to look inwards. The values and practices prevalent in an organisation, that is the culture, has been researched into as an underlying factor of performance improvement. This study therefore, investigates the practices (cultural orientation) that are prevalent among construction managers and CEO in Nigeria. Using stratified sampling technique, questionnaires were administered by personal contact among managers and CEOs in 113 construction firms in Lagos and Abuja. The questionnaires were analyzed using mean, percentages, ANOVA and Kruskal Wallis test. The results show that there is a high level of use of the cultural orientation presented. The most prevalent cultural orientation is conflicts and dispute orientation, which is followed by client service orientation. The research also revealed ownership structure, aside firm size and firm location as organisational characteristics that have significant effect on the cultural orientation adopted. The study concludes that the 8 orientation (conflict and dispute; client service orientation, production orientation, task and goal accomplishment, information communication technology, external, innovation and knowledge management and workforce) are all important in a construction firm. Recommendations were made on the need to acquire the necessary orientation and be able to review and renew it for optimal project execution and best practice.

Keywords: Cultural-orientations, Firm Age, Firm Business-structure, Firm Location, Firm Size.

1. BACKGROUND TO THE STUDY

Aside the contribution of the construction industry to nation's economy and development, the sector has a rippling effect on human development. Consequently, project and construction organisations failure, are not only disruptive to the industry but also, have significant multiplying negative effect on a nation's image and economy (Zahidy, Noor & Shahryar, 2015). An atmosphere of uncertainties and unprecedented technological revolution in the construction business and technical environment has reduced greatly the benefits to be derived from the built environment. Different factors have been adduced to this challenge. Prominent among which are performance problems, changes in organisational leadership and unrealistic growth of construction organisations (The Census Bureau's Business Dynamics Statistics, 2011). Overcoming the challenges amidst the innumerable risks and uncertainties is a major problem facing most countries, both developed and developing (Ofori, 2001). In the Nigerian construction industry, performance improvement of the indigenous construction firms has remained a lucid debate. Previous researchers have attempted to identify and evaluate different factors that affect performance. Success factors that contribute to construction project execution and organisational performance have been identified and evaluated; Success criteria for performance have also been accessed and investigated. Though, these attempts have given remarkable results, additional efforts are requested on improving performance significantly (Zahidy, et al., 2015; Abiola-Falemu, Ogunsemi, &

Oyediran, 2010), Considering the uniqueness of the construction industry and the intricacies of how construction stakeholders are meld; criteria like personnel, skills and capabilities, communication, relationship, decision-making, are ‘*soft*’ aspects relating to *attitudes* and *behaviours* of participants. In the management and organisational behaviour literature, these factors are captured under the ‘*organisational culture*’ construct (Ankrah, 2007). Organisational culture is a system of meaning that members share; it distinguishes one organisation from another. Organisational culture, affect performance through a complex interplay of leadership style; business strategy; and organisational structure and process (Lund, 2003; Yilmaz & Ergun, 2008; Wilder, van den Berg & Wireman, 2012). The dominant culture expresses the core values shared by a majority of the organisation’s members, while the cultural orientation depicts the perception of the key organisational members based on their experience, education and training.

Based on the importance of establishing competitive advantage and impacting on performance, organisational *culture* has been recognized as an important factor in analyzing organisations in various contexts (Dauber, Fink & Yolles, 2012). Success or failures of organisations are linked to the culture it apprehends, its conflicts management style, and its organisational effectiveness (Obinna & Farkas, 2011; Mariappanadar, 2005). This is imperative since culture and subculture mould employees’ values which in turn influence overall performance. Thus, Leaders and managers have thus been challenged to revolutionize organisational culture to address challenges within the firm (Rose, Kumar & Abdullahl, 2008). Tran and Tian, (2013) reiterate the importance of organisational culture, structure and strategy in construction businesses and firms’ success or failure. This study, therefore, is on the identification of cultural orientation of construction managers in Nigeria. The study identifies managers/leaders cultural orientation and the effect of organisational characteristics on cultural orientation of construction firms in Nigeria.

2. ORGANISATIONAL CULTURE AND PERFORMANCE

Culture is the aggregate of what a group sees as important. It is about the customs or beliefs that hold a group together and also distinguish one group from another. Organisational culture, is a system“ of shared values and beliefs that interacts with a company’s internal and .”external environment to produce behavioural norms Organisational culture affects project performance in a number of ways. Organisational culture affect project head mission and vision, which in turn influences the level of commitment of employees (Nongo. & Ikyanyon, 2012). In addition, organisational culture influences project planning and monitoring processes which includes works breakdown structure and scheduling. Culture affects how managers evaluate the performance of project teams, view projects’ outcomes and review lessons learnt. In balancing project’s deliverables and stakeholders’ relationship, the need for an understanding of culture and its relationship with projects is imperative. Leaders and managers have thus been challenged to revolutionize organisational culture to address challenges within the firm (Rose, Kumar & Abdullahl, 2008).

As a result of the fast and multi-faceted activities in construction, the ability to know the necessary applications and develop *strategies* to meet the exigencies and be well equipped to handle future challenges has been emphasized (Sexton & Barrett, 2003; 2004 ;Koota, 2003; Tabassi, Abdul Rashid & Yusuf, 2012). Table 2.1 presents a chronological definition of organisational culture

Table 2.1: Chronological Definitions of Culture

| | |
|---|---|
| Hofstede (1980) | The collective programming of the mind that distinguishes the members of one organization from another |
| Ouchi (1981) and Pascale and Athos (1982) | Culture is the philosophy that guides an organization's policies towards employees and/or customers |
| Sathe (1985) | The set of important assumptions, often unstated, that members of a community share in common. |
| Kotler and Heskett (1992) | Values that are shared by the people in a group and that tend to persist over time even when group membership changes as well as behaviour patterns or style of an organization that new employees are automatically encouraged to imbibe. |
| Spataro, (2005). | How individuals behave, what people pay attention to, how they respond to different situations, and how they socialize with new members and exclude those who do not fit in. |
| Poškien (2006) | The complex set of ideologies, traditions, commitments, and values that are shared throughout the organization and that influence how the organization conducts its whole performance becoming a potential source of innovation, advancement and advantage. |
| Wagner & Hollenbeck (2010) | An informal, shared way of perceiving life and membership in the organization that binds members together and influences what they think about themselves and their work. |
| | |

2.1 Cultural Orientation and Dimensions

Construction project performance is defined by a number of interrelated factors. Some of these factors include management's strategic position, the project external environment, interaction of project stakeholders, relationship with suppliers and sub-contractors, strength, weakness, opportunities and threats within project organisation, characteristics of the project, personalty of the stakeholders, effectiveness and completeness of project planning processes prior to tendering and construction, site management operations, project health and so on and so forth. (Giritli & Civan, 2008; Muller & Turner, 2007). The interplay among these factors and project outcomes depend on the ability and orientation of the owner (s) as well as that of the project manager. Cultural orientation is practices that are prevalent among the managers or founders of construction firms. These are compiled from the literatures on processes adopted by construction organisations. The artifact for cultural orientation, that is managers' or founders' cultural orientation, is to be measured based on a checklist. These include Production Orientation (PRO), Client Service Orientation (CSO), Workforce Orientation (WKF), Innovation, Learning and Knowledge Management (ILKM), Information and Communication Technology (ICT), Environmental/External Orientation (ENV), Task and Goal Accomplishment (TAGA) and Conflict/Dispute Resolution (CDR).

Goal and task accomplishment is task-related. It is about employees' degree of commitment to the task or work to be executed as well as the decisions on what is right (effectiveness). Factors such as planning, monitoring control, regulated working environment, and project benchmarking are considered.

Production orientation entails management leadership style in organizing and controlling the entire production process for maximum result. Issues relating to ethics, conformance, communications, safety, waste minimization and proper coordination between the different phases of construction are considered..

Environmental/ external orientation is about the external environments in which the organisation operates as culture has been defined based on external adaptation and internal coordination (Hofstede, 2001;Schein, 2004). Most of the uncertainties that an organisation encounters is rooted in the business environment. Factors such as global economics, life style changes, educational competencies, experience and skills of potential employees will affect how an organisation operates. An organisation has to scan its environment either formally or informally , in order to access and pick the relevant information and insight that will be useful *External orientation* thus, focuses on how firms operate in an external environment in relation with its clients/customers, markets and competitors. (Lemon & Sahota, 2004; Wilderom et al, 2012)

Client service orientation One of the challenges to performance is lack of commitment to quality improvement (Bello, Soynghe & Akinwamide, 2012) Client orientation is needed in order to examine an organisation's dispensation towards achieving overall improvement to achieve better results that often goes beyond the project completion stage. Under this orientation, inclusion of clients' objectives, clients' satisfaction, emphasis on client's interest and quality assurance are looked into.

Innovation, Learning and Knowledge management is chosen because of its importance in a project-based setting. **Innovation** is important in the rapidly changing environment. Knowledge repository development and maintenance is important to any form of organisation. Innovation, Learning and Knowledge Management are important in any rapidly changing environment. Through managerial actions, the need for innovation will not only be communicated, it will also be entrenched. Innovation, Learning and knowledge management is chosen because of its importance in a project-based setting. Knowledge repository development and maintenance is important to any form of organisation. Successful innovation may depend on organisational cultural norms that groups develop and the extent to which the group's cultural orientation aligns with, and is supported by the organisation's overall orientation (Poškien, 2006; Wiewiora, Trigunarsyah,, Murphy. & Coffey, 2013). The ability to accept changes, encourage innovative ideas for performance improvement and sustainable competitive advantage as well as taking reasonable risks in response to changes in the business environment cannot be overemphasized.

Information and communication technology: current knowledge on the status of information technology in the industry is paramount, availability of relevant information on materials, labour and technology cannot be undermined. Communication channels and media that are unambiguous, enhance what is valued and leading to knowledge and strategies on goal attainment is important in construction (Locke & Latham, 2002), availability of relevant information on materials, labour and technology adoption, sophisticated tools for computerization of office and site activities are reviewed

2.16 Conflicts and disputes resolution orientation: interaction, clearly defined and allocated functions, building of relationships, appropriate means of documentation are precursors to claims and conflicts management.

Workforce orientation :human resources has been identified as an important part of organisational culture construct (factors like commitment, training and development, rewards and recognition, teamwork , etc have been researched into by Zain, Ishak and Ghani, (2009); Hoegl, Parboteeah & Gemuenden, 2003;Ojo, (2010); Abiola-Falemu and Aje, (2013). Team building and supportiveness, reward and punishment, training and workshop for employees, employees' participation are discussed under this orientation.

Conflicts and Disputes Resolution

Harmonious relationship, interaction, clearly defined and allocated functions, building of relationships, means of conflicts resolution

In revealing organisational culture, it is important to delineate the perspective (the mindset or belief influencing different forms of cultural studies) adopted by the researcher. In an *integrative* culture-culture is shared across the entire fabric of the organisation. In these circumstances, one can talk of cultural strength or a strong culture. When culture is shared by a fragment of the units, that is *differentiation* and finally *fragmentation*, where culture may or may not be shared at all. The key aspects that distinguish the three cultural perspectives according to Martin (2002) are how culture is shared, how boundaries are conceived and how ambiguity is associated in the fabric of the organisation.

2.2 Determinants of Culture

So many factors dictate the type of culture. Handy (1985) is of the opinion that organisation's history, ownership and size; technology of production; goals and objectives; market; competitive scene; geographical and societal environment; and people are the factors that influence organisational culture. Johnson and Scholes (1993) considered the way culture drives organisational strategies, and emphasized that culture is influenced by external factors such as values of the society and organized groups, and by internal factors. Barron, West and Hannan (1994) argue that a strong positive correlation exists between the age, size and culture of an organisation. Furthermore, some researchers argue that privatization leads to significant changes in the culture of an organisation. Ang and Ofori (2001) believe that the implementation of an organisation's culture is influenced by the nature of the business environment, type of company, and special character of company and employees

Culture is created within an organisation when the leaders endorse certain values, beliefs and assumptions about the organisation (Kaiser, Hogan & Craig, 2008; Schein, 2010). In summary, the beliefs and attitudes that are noticeable in a group result from a shared or common environment, experience, stories, history, tradition etc, formed through association, and interaction, or observation and communication over a period of time. As a result, different cultures may develop as a result of different encounters. Organisational culture also changes with size, goals and objectives and purposes as well as ownership structure (Oluwattayo & Amole, 2012). Table 2.2 shows some of the determining factors for organisational culture.

Table 2.2: Determinants of Organisational Culture Development

Source: Adapted from Ankrah, (2007)

| | Hilderbrandt, 1991) | Johnson& Scholes 1993 | Handy, (1985, 1993) | Dobson,et al.,1993 | Kaiser,Hoga n, Craig, 2008 |
|---------------------|---------------------|-----------------------|---------------------|--------------------|----------------------------|
| People | * | | | | |
| The environment | | | * | * | |
| Internal factors | | * | | | |
| Size | | | * | | |
| Age | | | | | |
| History, crises and | | | * | | |

| | | | | | |
|---------------------------------|--|---|---|---|---|
| successes | | | | | |
| Technology and primary function | | | * | * | |
| Goals and objectives | | | | | |
| Structure and strategy | | | | * | |
| Leaders and ownership | | | * | * | * |
| Location | | | | * | |
| Work group | | | | | |
| Recruitment policy | | | | | |
| Macro culture/ societal value | | * | | | |

3. RESEARCH METHODOLOGY

The population for this study comprises registered construction firms listed on-line, for both Lagos State and Abuja. The sampling frame comprises construction firms stratified based on the 20 local government areas in Lagos State and the concentration of the construction firms in the Central Business District (CBD), in the Federal Capital Territory, Abuja. This was considered because most of the firms are skewed towards the Business District (CBD). The first 12 local government areas and the listed firms in the CBD were selected. The sample size was then calculated from these two lists with reference to Cochran, (1967) and Rose, Sprinks and Canhoto (2015) formulae. The formulae are based on calculating sample size from proportion and gave the construction firms as 113.

$$n = \frac{z^2 \times pq}{d^2}$$

Managers gave responses to the questionnaires on cultural orientation. The level of use of cultural orientation was assessed from 8 scales as follows: Production Orientation (PRO), Client Service Orientation (CSO), Human Resource Management or Workforce Orientation (WKF), Innovation, Learning and Knowledge Management (ILK), Conflicts and Disputes Resolution (CDR), Task and Goal Accomplishment (TGA), Information and Communication Technology (ICT) and External/Environmental Orientation (EVR) with 50 items that are self-developed based on literature review. Respondents are scored on a Likert scale of 1-5 starting from '1' for no use to '5' for very high use.

3.1 Respondents Profile

Table 4.1 shows the profile of the professionals that responded to the questionnaires.

Table 4.1: Respondents Profile

| Respondents' background | Frequency | Percentage | Respondents' background | Frequency | Percentage |
|-------------------------|-----------|------------|-------------------------|-----------|------------|
|-------------------------|-----------|------------|-------------------------|-----------|------------|

| Gender | | | Marital Status | | |
|----------------------------------|------------|------------|---|------------|------------|
| Male | 101 | 83.5 | Single | 32 | 26.4 |
| Female | 20 | 16.5 | Married | 89 | 73.6 |
| Total | 121 | 100 | Total | 121 | 100 |
| Educational Qualification | | | Professional Membership Cadre | | |
| HND | 31 | 25.6 | Graduate | 36 | 29.8 |
| B.Sc. | 34 | 28.1 | Corporate | 66 | 54.5 |
| M.Sc. | 52 | 43.0 | Fellow | 19 | 15.7 |
| Ph.D. | 4 | 3.3 | Total | 121 | 100 |
| Total | 121 | 100 | | | |
| Professional Affiliation | | | Years of Experience in the Establishment | | |
| NIA | 12 | 9.9 | 1-5 years | 22 | 18.2 |
| NSE | 28 | 23.1 | 6-10 years | 65 | 53.7 |
| NIOB | 52 | 43.0 | 11-20 years | 27 | 22.3 |
| NIQS | 25 | 20.7 | 21 years and above | 7 | 5.8 |
| NIESV | 4 | 3.3 | Total | 121 | 100 |
| Total | 121 | 100 | | | |

Table 4.1 shows the respondents' profile. Out of the 121 valid responses received from the construction organisations, more than 100 respondents (83%) are male while the remaining (7 %) are female. Over 70% are married. These figures indicate that the majority of the respondents are male and married. Hence, they are matured enough to address the questions that are put forward. From the demographic data, at least a quarter (25%) of the respondents have Higher National Diploma (HND), the percentages for Bachelor of Science (B.Sc.) , Masters Degree (M.Sc.) and Doctorate degree are in varying proportions. Hence, the respondents are academically sound to respond to the questionnaire. For professional affiliation, majority of the respondents (43%) have the Nigerian Institute of Building (NIOB) membership card, while the remaining 57% are shared among Engineers (23%), Architects (9.92%), Quantity Surveyors (20.7%) and others (3.3%) . At least, 25% belong to the Graduate membership cadre, while over 50% are corporate members of their various professional bodies, Regarding the years of experience, more than 50% have worked for at least 6 years. More than half of the respondents (59%) have major involvement in the organisation's development. This implies that a larger percentage of the firms are matured enough to give insights into their organisational variables. In addition, over 50% of the respondents have high involvement in the management of the organisations.

3.2 Organisational Demographics

Table 4.2 depicts the organisational characteristics. In terms of duration of organisational existence, most of the firms have been operating for over 5 years, thus, they can be said to possess the managerial resources and capabilities required for continuous existence and growth. 40 (33%) firms are within the span of 6-10 years. This group is taken as young firms (YF). Another 33.9% is in the class of 11-20 years. These are termed the intermediate firms (IF). The third group which comprises 25 firms (20%) is those that have spent over 21 years in existence. These are classified as old firms (OF) Majority of the organisations (72%) have employee capability that is less than 50; while 27% have above 50 permanent staff. This is an indication that three-quarter of the organisations surveyed belong to the small and medium size band with the employees' capacity of being less than 50. Over 45% of the organisations undertake both building and civil engineering works. This might be necessitated by 'survival of the fittest' syndrome, whereby each firm looks for easiest means of sustenance.

For the estimated annual turnover, there are 16.5% with estimated annual turnover of ₦1M to ₦10M, 50% is in the range of ₦11 to ₦50M, while 26% spans the ₦51- ₦199M band with the remaining 7% having over ₦ 200M. As regards the type of business undertaken, Sole proprietorship takes 37%, Partnership, 30%, Public Limited Liability, 3 (9.1%) are Corporations while 8 (24.2%) and 15 (45.5%) are Sole proprietorship and Private Limited Liability 29.7%. . This is an indication of each firm being able to take decisions as a single entity as over 60% are either Sole Proprietorship or Partnership.

On client types, most of the projects undertaken are for private owners. This should not have been otherwise as most of the respondents are sole proprietors.

Table 4.2: Organisational Demographics

| Respondents' background | Frequency | Percentage | Respondents' background | Frequency | Percentage |
|----------------------------|------------|------------|-------------------------|------------|------------|
| Number of Employees | | | Business type | | |
| Less than 10 | 35 | 28.9 | Sole proprietorship | 45 | 37.2 |
| 11-49 | 53 | 43.8 | Partnership | 37 | 30.6 |
| Above 50 | 33 | 27.3 | Private Liability | 36 | 29.7 |
| Total | 121 | 100 | Corporation | 3 | 2.5 |
| Firm Age | | | Total | 121 | 100 |
| 1-5years | 15 | 12.4 | Client type | | |
| 6-10 years (YF) | 40 | 33.1 | Private | 39 | 40.7 |
| 11-20 years (IF) | 41 | 33.9 | Government | 6 | 5.3 |
| Above 21 years (OF) | 25 | 20.7 | Governmentand Private | 46 | 34.5 |
| Total | 121 | 100 | Others | 22 | 19.5 |
| Location | 22 | 19.5 | Total | 113 | 40.7 |
| Lagos | | | | | |
| Abuja | 39 | 40.7 | | | |
| Total | 113 | 40.7 | | | |

3.3 Cultural Orientation

A mean score of above 3.00 for all the orientation shows that the level of use is high. Conflict and Dispute Resolution (CDR) has the highest mean value of 4.18. This is followed by Client Service Orientation (CSO) with a mean score of 4.03. Overall, the respondents agreed on the relative importance of all the orientations with the least mean value of 3.5 for Production Orientation (PRO) as indicated in Table 4.3

Table 4.3: Descriptive Statistics for Level of use of Cultural Orientation

| Cultural Orientation | Mean | Std. Deviation | Rank | Level of Use |
|--|------|----------------|------|--------------|
| Conflicts and Disputes Resolution (CDR) | 4.18 | .63782 | 1 | High use |
| Client Service Orientation (CSO) | 4.03 | .54096 | 2 | High use |
| Task/Goal Accomplishment (TGA) | 3.96 | .68146 | 3 | High use |
| External/Environmental Orientation (ENV) | 3.83 | .70987 | 4 | High use |
| Innovation, Learning and Knowledge Mgt (ILKM) | 3.82 | .61289 | 5 | High use |
| HRM/Workforce Orientation (WKF) | 3.77 | .71606 | 6 | High use |
| Information and Communication Technology (ICT) | 3.72 | .83693 | 7 | High use |
| Production Orientation (PRO) | 3.50 | .44952 | 8 | High use |

N=121: 1.00-1.49 For 1(No-use); 1.50-2.49 For 2(low -use); 2.50-3.49 For 3(moderate -use); 3.50-4.49 For 4 (high -use) and 5.50- 5.00 for 5(very high-use)

3.4 Effect of Organisational Characteristics on Cultural Orientation of Construction Firms

In order to determine the effect of organisational characteristics on the level of use of cultural orientation among the construction professionals, three organisational characteristics of firm age, firm size and firm location are selected. This is in accordance with other studies that have been conducted on culture across industries .This is necessary so that inferences can be drawn in relation to those previous studies (Noordin & Mohtar , 2014). However, to make the study more construction-industry specific, business types and client types are added. The means for the 8 scales of cultural orientation as shown in Table 4.4

Table 4.4: Effect of Organisational Characteristics on Cultural Orientation among Construction firms.

| | Firm Characteristics and Cultural Orientation | | | | | | | | |
|-------------------------|---|--------|-------|-------|-------|-------|-------|-------|-------|
| | N | PRO | WKF | CSO | ILK | ICT | ENV | TGA | CDR |
| Firm Age | | | | | | | | | |
| 1- 5years | 15 | 65.27 | 47.53 | 55.47 | 53.33 | 60.03 | 57.90 | 44.07 | 54.43 |
| 6-10years (YF) | 40 | 49.48 | 54.71 | 56.10 | 52.91 | 56.08 | 56.71 | 59.82 | 62.26 |
| 11-20years (IF) | 41 | 67.82 | 65.77 | 61.13 | 65.02 | 65.02 | 64.44 | 61.82 | 55.67 |
| >20years (OF) | 25 | 65.70 | 71.32 | 64.88 | 71.94 | 62.86 | 64.08 | 66.22 | 69.00 |
| Total | 121 | | | | | | | | |
| <i>Chi-Square</i> | | 6.583 | 6.472 | 1.314 | 5.854 | 1.423 | 1.356 | 3.950 | 2.910 |
| <i>Df</i> | | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| <i>Asymp. Sig.</i> | | 0.086 | 0.091 | 0.726 | 0.119 | 0.700 | 0.716 | 0.267 | 0.406 |
| <i>Remarks</i> | | NS | NS | NS | NS | NS | NS | NS | NS |
| Firm Size | | | | | | | | | |
| Small size | 35 | 62.54 | 61.41 | 59.70 | 59.11 | 64.14 | 63.94 | 54.45 | 63.78 |
| Medium size | 53 | 66.12 | 68.71 | 62.26 | 65.69 | 67.82 | 64.25 | 67.30 | 60.71 |
| Large size | 33 | 51.14 | 48.18 | 54.65 | 55.47 | 46.71 | 52.67 | 53.82 | 56.79 |
| Total | 121 | | | | | | | | |
| <i>Chi-Square</i> | | 3.834 | 7.030 | .968 | 1.881 | 7.835 | 2.670 | 4.328 | .703 |
| <i>df</i> | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| <i>Asymp. Sig.</i> | | 0.147 | 0.030 | 0.616 | 0.390 | 0.020 | 0.263 | 0.115 | 0.703 |
| <i>Remarks</i> | | NS | SS | NS | NS | SS | NS | NS | NS |
| Firm Location | | | | | | | | | |
| Lagos | 85 | 52.84 | 55.80 | 53.41 | 55.56 | 54.69 | 55.21 | 57.36 | 57.43 |
| Abuja | 36 | 80.28 | 73.28 | 73.36 | 73.85 | 75.89 | 74.68 | 66.10 | 67.65 |
| Total | 121 | | | | | | | | |
| <i>Chi-Square</i> | | 15.587 | 6.332 | 8.544 | 6.921 | 9.322 | 8.121 | 1.628 | 2.250 |
| <i>df</i> | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| <i>Asymp. Sig.</i> | | 0.000 | 0.012 | 0.003 | 0.009 | 0.002 | 0.004 | 0.202 | 0.134 |
| <i>Remarks</i> | | SS | SS | SS | SS | SS | SS | NS | NS |
| Client Type | | | | | | | | | |
| Private | 46 | 43.50 | 46.38 | 42.10 | 42.80 | 41.86 | 42.35 | 45.90 | 44.78 |
| Government | 6 | 36.92 | 43.42 | 47.33 | 50.33 | 51.33 | 60.33 | 40.58 | 54.08 |
| Individual & Government | 39 | 50.35 | 45.95 | 49.33 | 49.10 | 50.06 | 48.10 | 46.95 | 46.19 |
| Total | 91 | | | | | | | | |
| <i>Chi-Square</i> | | 2.192 | 0.068 | 1.634 | 1.384 | 2.323 | 2.997 | 0.306 | 0.683 |
| <i>df</i> | | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| <i>Asymp. Sig.</i> | | 0.334 | 0.967 | 0.442 | 0.501 | 0.313 | 0.223 | 0.858 | 0.711 |
| <i>Remarks</i> | | NS | NS | NS | NS | NS | NS | NS | NS |

| | | | | | | | | | |
|------------------------|-----|-------|-------|-------|--------|-------|--------|--------|-------|
| Business owners | | | | | | | | | |
| Sole proprietorship | 45 | 64.20 | 63.21 | 59.50 | 57.49 | 56.93 | 61.53 | 58.36 | 61.59 |
| Partnership | 37 | 67.82 | 68.43 | 64.61 | 70.55 | 76.95 | 63.47 | 63.12 | 54.89 |
| Private limitedL | 32 | 50.77 | 49.28 | 54.85 | 54.94 | 49.75 | 55.83 | 58.39 | 65.55 |
| Public limited L | 4 | 33.00 | 40.25 | 32.13 | 29.63 | 36.75 | 33.38 | 24.50 | 33.25 |
| Corporation | 3 | 75.33 | 88.83 | 91.75 | 102.33 | 77.67 | 114.50 | 109.50 | 96.17 |
| Total | 121 | | | | | | | | |
| Chi-Square | | 7.602 | 8.774 | 5.762 | 11.60 | 14.27 | 10.78 | 10.98 | 7.54 |
| Df | | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Asymp. Sig. | | 0.107 | 0.067 | 0.218 | 0.021 | 0.006 | 0.029 | 0.027 | 0.11 |
| Remarks | | NS | SS | NS | SS | SS | SS | SS | NS |

Table 4.4 depicts the effect of firm age, firm size, firm location, client type and firm business structure on managers'/CEO on cultural orientation. Firm age has no effect on all the cultural orientation. Firm size has effect on workforce and ICT at 95% level of confidence and on production and task and goal accomplishment at 90% level of confidence. Firm location has effect on all the orientations except on task and goal accomplishment and conflict and dispute resolution. Client type has no effect. Business ownership has effect on workforce (WKF), information and communication technology (ICT), innovation, learning and knowledge management (ILKM) and task and goal accomplishment (TGA) at 95% confidence level and on production (PRO) and conflict and dispute resolution (CDR) at 90% confidence level Business ownership has no effect on client service orientation (CSO). Succinctly, firm age and client type have no effect on cultural orientation of the firms surveyed. This was confirmed by the Kruskal-Wallis test as indicated in Table 4.4

3.5 Hypothesis 1: There is no significant difference in the level of use of cultural orientation among constructing firms in Nigeria.

H₁ : There is no significant difference in the level of use of cultural orientation among constructing firms in Nigeria

H₀ : There is a significant difference in the level of use of cultural orientation among constructing firms in Nigeria

Accept/Reject Criterion

Accept H₁ if p-value is greater than 0.05 (p > 0.05), otherwise accept H₀

In order to test for a significant effect of firm age, firm size, firm location, client type and business ownership structure on Cultural orientation among Constructing Firms, analysis of variance, (ANOVA) was conducted to examine the significant effect of firm age, firm size, location, client type and business ownership structure as depicted on Table 3.6 and 3.7 respectively.

Table 4.6: Effect of Firm Size, Age, Location, Client type and Business ownership structure on Cultural Orientation among Construction Managers/CEOs

| | | Sum of Squares | df | Mean Square | F | Sig. | Remark |
|-----------|----------------|----------------|-----|-------------|-------|------|-----------------------|
| Firm Age | Between Groups | 40.673 | 3 | 13.558 | .875 | .456 | Accept H ₁ |
| | Within Groups | 1734.956 | 112 | 15.491 | | | |
| | Total | 1775.629 | 115 | | | | |
| Firm Size | Between Groups | 90.603 | 2 | 45.302 | 3.038 | .052 | Reject H ₁ |
| | Within Groups | 1685.026 | 113 | 14.912 | | | |
| | Total | 1775.629 | 115 | | | | |

| | | | | | | | |
|---------------|----------------|----------|------------|---------|--------|------|-----------------------|
| Location | Between Groups | 148.048 | 1 | 148.048 | 10.370 | .002 | Reject H ₁ |
| | Within Groups | 1627.581 | 114 | 14.277 | | | |
| | Total | 1775.629 | 115 | | | | |
| Client Type | Between Groups | 2.501 | 3 | .834 | 1.237 | .300 | Accept H ₁ |
| | Within Groups | 73.484 | 109 | .674 | | | |
| | Total | 75.984 | 112 | | | | |
| Business Owen | Between Groups | 137.156 | 4 | 34.289 | 2.323 | .061 | Reject H ₁ |
| | Within Groups | 1638.473 | 111 | 14.761 | | | |
| | Total | 1775.629 | 115 | | | | |

“A one-way between subjects ANOVA was conducted to test the effect of firm age, firm size, location, client type and business ownership structure on Cultural Orientation among Construction Managers/CEOs. Firm size, location and business-ownership structure are significant. In terms of age, no significant difference was found among young, intermediate and old firms for cultural orientation. This finding is in not in agreement with Organisational life cycle theories in which it is proposed that more hierarchical and bureaucratic organisations evolve as firms grow and age (Greiner, 1988). The effect of firm size is supported by this study. This effect, however, is only partially significant. On location, the results is in line with the literatures that location has a significant effect on culture. For client type, no significant effect could be established. A significant effect of ownership structure was evident on cultural orientation. This in support of leadership as a direction to culture. This result implies that firm size, firm location and ownership structure have significant effect on the use of a particular culture among the construction firms in the study area. In summary, the null hypothesis, that there is no significant effect of organisational characteristics on the use of cultural orientation among constructing firms is thus rejected.

4. DISCUSSION OF FINDINGS, SUMMARY AND CONCLUSION

Organisational culture is regarded as a driver of performance in a number of industries. This paper investigated the level of use of cultural orientation of construction managers and the effect of organisational characteristics on the orientation. The study reveals conflict and dispute resolution and client service orientation as the cultural orientation with the highest priority among the construction firms in the study area. Conflict and dispute orientation is important in order to prevent any form of disruption to work processes. The significance of the clients is stressed as construction organisations are challenged to meet clients' need (Sexton & Barret, 2003). Despite the number of researches that agreed on firm age and firm size as determinants of culture, this study found that the age of the construction firms surveyed did not have a significant effect on the orientation of the managers. This paper shows that the orientation developed do not actually change as the firm becomes older. Firm size has significant effect on workforce and ICT and moderate effect on production and task and goal accomplishment. This implies that the workforce orientation, information and communication technology, production and task/goal accomplishment alter as the firm size changes. Firm location has effect on all the orientations except on task and goal accomplishment and conflict and dispute resolution. This is reasonable, as the production process must be planned and adhered to irrespective of the location of the project. Likewise, dispute has to be minimised for project objectives to be achieved. The characteristics of the client do not affect the orientation of the managers. Business ownership has effect on workforce (WKF), information and communication technology (ICT), innovation, learning and knowledge management (ILKM), task and goal accomplishment (TGA), production (PRO) and conflict and dispute resolution (CDR), except on client service orientation

(CSO). This result is in support of Cunha and Cooper (2002), Oluwatayo and Amole (2012) that ownership influences the culture of organisations. Lack of a significant effect of ownership on client service orientation reiterates that the quality of services rendered to the client must not be watered down.

5. RECOMMENDATIONS

Construction managers need to develop the right orientation, improve on it and be conversant with how it changes with project and organisational characteristics. This is needed to enhance optimal production process.

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TOWARDS A STAKEHOLDER RELATIONSHIP MANAGEMENT MODEL FOR CONSTRUCTION SMES IN BOTSWANA: AN EXPLORATORY STUDY

M. Taimu, A. Ngowi and B. Awuzie

Central University of Technology, South Africa

Email: mataimu@gmail.com

Abstract: The potential of Small Medium Enterprises (SMEs) to contribute to economic growth has been elucidated in extant literature. Accordingly, successive governments have sought to extend patronage to SMEs in various sectors to enable them to perform optimally and contribute to economic growth. However, such patronage notwithstanding, longevity, low value creation and profitability issues have continued to beleaguer these SMEs, hence rendering them incapable of achieving the expected goals. Construction SMEs appear not to fare better in this context as most of them have been unable to record significant growth, especially in developing countries like Botswana. The inability of these SMEs to effectively manage their relationships with other stakeholders in the industry has been cited as one of the reasons for their poor performance. The aim of this qualitative study was to explore the relevance of stakeholder relationship management (SRM) models for construction SMEs in Botswana and to identify the key elements of such models. Data was obtained through a juxtaposition of semi-structured interviews from SME project managers and review of relevant documents. Interviewees were purposively selected and data was analysed using thematic analysis. The results revealed that there is no theoretical and conceptual model relying on Stakeholder Management (SM) and Customer Relationship Management (CRM).

Keywords: Botswana, Construction industry, Customer Relationship Management, SMEs, Stakeholder Management.

1. INTRODUCTION

An SMEs competitive advantage essentially depends on stakeholder management with particular focus on the Customer Relationship Management (CRM). The absence of a structured approach for the management of project stakeholders by SME project managers within the construction industry has posed a significant challenge to the attainment of project success. This particularly so when the prevalence of SMEs within the industry is considered. Therefore, it is expected that the study's findings will contribute towards the amelioration of this imbroglio by putting forward a proposed model for the attainment of successful stakeholder management by SME project managers. The potential of Small to Medium Enterprises (SMEs) to contribute to economic growth has been explicated in extant literature. SMEs contribute to social, economic and industrial development given that they are entrepreneurial outlets (Ssegawa-kaggwa, 2008). SMEs are also a vehicle towards creation of competition and employment thus fostering economic growth and synergy with large enterprises. Kirchoff (1991) affirms that economic growth is dominated by SMEs which are characterized by innovative and high growth rates. Furthermore, OECD (2010) affirms global trends towards the knowledge economy, open innovation, global connections and non-technological innovation and the emergence of national and regional economic models and new types of social innovation that have increased the importance of SMEs. According to Ssegawa (1999) about 60.7% of the companies in the construction industry in Botswana are

small companies. While the construction industry in Botswana has been commended for developing the infrastructural landscape of the country, recent reports indicate a sub-optimal project delivery process (Ssegawa-Kaggwa et al. 2013). Ssegawa-Kaggwa et al. (2013) further add that the attributes of cost, time and quality are often vague. Moreover, construction projects in Botswana are riddled with cost and time overruns (Ssegawa-Kaggwa et al., 2013). Generally, the industry is replete with abandoned and incomplete, delayed and structurally defective construction projects which has led to unsatisfied clients (Adekunle, Ajibola 2015). Effective practices in the management of construction project stakeholders are indispensable to the success of projects. Concerns among stakeholders in the supply and demand side of project delivery chain have led researchers like Rwelamila et al., (1999); Ssegawa-Kaggwa et al., (2013); Palalani, (2000); Ssegawa, (2013) to investigate root causes of poor delivery of public construction projects in Botswana. The deficiencies in the construction industry in Botswana have been attributed to several factors; however, inadequacy of human resources, lack of project management best practices and inability to pay suppliers on time were cited as the leading causes of project delays (Ssegawa-Kaggwa et al. 2013). In order for reformation to take place in the construction industry there is a need to understand the flaws in the current project management theories and practices in place regarding the management and engagement of project stakeholders.

Yang et al. (2009) report that a stakeholder management model in the construction industry has not yet been fully developed. While scholars such as Littau et al. (2010), Rajablu (2014) have further developed stakeholder management mechanisms, these models are in their infancy stages and their efficacy is yet to be explored. A clear understanding of the project stakeholder management process in SMEs projects in the construction industry is a prerequisite to the development of a practicable mechanism for the successful management of project stakeholders and higher success rate in project delivery in the construction industry.

This study thus seeks to understudy the SME aspect of the construction industry and to elucidate the idiosyncrasies associated with relationship management skills of SME project managers and how they play out within the wider stakeholder network. This is imperative given that SMEs constitute a significant proportion of the entire construction sector. This model would contribute to the reduction in the degree of project failures and abandonment resulting from poor stakeholder management by SMEs within the construction domain.

2. CONCEPTUAL FRAMEWORK

The construction industry in Botswana has both internal stakeholders (Management, employees) and external stakeholders (suppliers, competitors, financiers, government). While each of these different stakeholders have different interests, they intermingle throughout the project life cycle to ensure project success. SMEs in Botswana work in alignment to the homogeneous forces in the construction industry in general, thereby limiting them to structure, strategies and practices in both Stakeholder Management (SM) and Customer Relationship Management (CRM).

The institutional theory will be used as a framework to analyse Stakeholder Management (SM) and Customer Relationship Management (CRM). Institutions lead to regularized or homogeneous behaviour within a group, but institutions can often underline differences across nations, as well as industries, firms, and individuals (Meyer, 2007). Scholarly work on institutional persistence for example, Zucker (1977) indicates that participants then become

used to working in alignment with these institutional forces present in their home environments and begin to take them for granted (Meyer, 2007). This then leads to the development of internalized institutionalized practices that are difficult to change. The external institutional environment in which organisations are embedded plays a critical role in shaping organisational structures and practices (Ju & Rowlinson, 2013). Such structures and practices include SRM and CRM in the construction industry. The line of research for institutional theory was initiated by the introduction of the concept of institutional entrepreneurship and has attracted a great deal of attention in recent years. Organizational researchers are particularly attracted to the concept because of their Institutional Theory interest in power and agency – the ability of organizations to strategically alter the institutional context could undoubtedly be a source of power and superiority for organizations (Lawrence, 2008).

This perspective suggest that practices and strategies for CRM and SRM in SMEs become accustomed to the environment that the SMEs is operating in and these are inevitable. From conception of the project to completion this behavior will be homogenous. Of significance among the plethora of obstacles may be the lack of structured approach to the management of external and internal stakeholders by these SMEs. Hence, this exploratory study seeks to explore the possibility towards a stakeholder management model for SMEs in the construction industry in Botswana. Exploring the current strategies and practices of CRM and SRM will give some light to what is the norm in the industry. Based on this the project managers in the construction industry may reflect on their policies and strategies and take steps to ameliorate these practices. The research community may also look at the study and further theorize strategies and practices of SRM and CRM.

3. LITERATURE REVIEW

3.1 Definition of SMEs in the Construction Industry of Botswana

In SMEs the importance of the owners and founders form the heart of the business. They play an important role in stakeholder management as well as customer relationship management. Continuity of the business will not be a guarantee if there are no strategies to ensure that the business will survive after their exit. For purposes of this study the employment levels will be used to classify the size of the SME. The SME that will be used will include the main contractor and subcontractor in the built environment. The table below shows Botswana SME thresholds

*Table 1: Botswana SMEs thresholds
Source: Expert Group Meeting (2010)*

| Item | Size category | Employment levels | Annual turnover in Botswana Pula | In US\$ dollar (equivalent) |
|------|-------------------|-----------------------|----------------------------------|--|
| 1 | Micro-enterprise | Less than 6 workers | Less than P60,000 | US\$ 10,000 |
| 2 | Small enterprise | Less than 25 workers | Between P60,000 and P1,500,000 | Between US\$ 10,000 and US\$250,000 |
| 3 | Medium enterprise | Less than 100 workers | Between 1,500,000 and P5,000,000 | Between US\$ 250,000 and US\$ 833,333.33 |

3.2 Stakeholder Management in the Construction SMEs

Buchholtz and Carroll (2008) define a stakeholder as an individual or a group that has one or more of the various kinds of stakes in the organization while Freeman (1984) defined stakeholders as the “ones who can affect or who is affected by the achievement of the firm’s objectives. Stakeholders may be affected by the actions, decisions, policies, or practices of the business firm, these stakeholders may also affect the organization in the same way (Buchholtz and Carroll 2008). In support of the management of project stakeholders, Gareis (2005) says that the ideal project oriented company has a specific management culture expressed in the empowerment of employees, process orientation and teamwork, continuous and discontinuous organizational change, customer orientation, and networking with clients and suppliers. The project stakeholders all play a vital role throughout the whole process of the projects and their management contributes to the success or failure of the project. Chinyio and Olomolaiye (2010) point out that, in most construction projects, there will be many stakeholders and their presence in itself is a potential conflict of interests. There is a need to manage this diversity proactively to forestall conflicts and even disputes (Chinyio and Olomolaiye, 2010).

(Karlsen, 2002) identifies the following as stakeholders; Financial institutions, End Users, Competitors, Suppliers/ Contractors, controlling organisations, consultants/ advisers, third parties, Labour Unions, insurance companies, line organization, public authorities, press/media, clients/ customers. In Botswana, the construction industry consists of several fragmented players who can be grouped into the four categories; **suppliers** i.e., those who provide services or supply materials and components to a project; **clients** (public and private); **regulators** (who regulate the project management process and the conduct of suppliers); and **facilitators** (those who facilitate the delivery of projects in various ways, but without having any contractual obligations on any aspect of the project) (Ssegawa-Kaggwa et al , 2013). Stakeholder management is about creating the most positive environment in which to develop a project (Vogwell, 2002). Successful project management is influenced by stakeholders and their capacity to impact the project outcome (Bourne & Walker 2006). In addition, Karlsen (2002) asserts that there is need to make more efforts towards developing new insights in project stakeholder management as there is a lack of formal and systematic project stakeholder management in most projects. Cleland, (1999) and Yang et al., (2009) further emphasize that in order to achieve project objectives, it is necessary to develop an effective framework to identify, clarify, manage, accommodate, and represent the often competing interests of stakeholders. Yang et al. (2009) additionally points out the need to develop a practical framework for managing Project Stakeholders in the construction industry. This framework can be further used to highlight the critical success factors in the management of the stakeholders who according to Verbeke & Tung (2013) forge enduring and ongoing ties of strategic importance with the firm that can contribute to its competitive advantage in the long term. These ties of strategic importance highlight the concept of Customer Relationship Management in the success of project stakeholder management.

3.3 Customer Relationship Management

The concept of Customer Relationship Management (CRM) is defined by Mohamad et al (2007) as a managerial strategy that helps firms to manage all information related to their customers through the utilization of information technology tools and techniques with the

purpose of satisfying customer needs as well as to create a long term and communally beneficial relationship. This implies that the definitive goal of CRM can be viewed as a means to help SMEs turn into customer-centric organizations that conduct business processes with the focus being on customers' satisfaction. The antecedents of CRM are encompassed in the following concepts; technological CRM Resources, relationship marketing, knowledge management, key customer focus and organizational performance which enhance organizational performance (Mohamad et al 2007). CRM is also defined by Baran et al. (n.d.) as a process that capitalizes on customer value through on-going marketing activity instituted on intimate customer knowledge established through collection, management and leverage of customer information and contact history. In addition, CRM is about perfecting relationships to maximize a customer's value over time (Baran et al. n.d.). CRM can thus be viewed as a very effective growth strategy that can yield significant benefits and changing both organizations and industries into customer focused entities (Sharp, 2003). According to Sharp (2003) CRM has twelve core strategies that have been proven to resolve many issues in a logical and efficient manner. These proven strategies are tremendously insightful and can be applied by SMEs in the construction industry that are often faced with dissatisfied customers due to cost over runs, delays or substandard quality of the projects delivered. While some mishaps are beyond the control of construction Project managers, their impact on the project success can be minimised with effective customer relations management skills. Table 2 highlights these twelve core strategies for CRM.

*Table 2: Twelve core strategies for CRM
Source: Sharp (2003)*

| Strategies | |
|-------------------|---|
| 1 | Develop a clear and consistent set of business objectives |
| 2 | Prepare a detailed Plan of Action |
| 3 | Build the system in stages, beginning with the most crucial area for meeting the first objectives |
| 4 | Provide strong leadership and mobilize the organization |
| 5 | Implement and follow through on a change in the corporate culture |
| 6 | Enlist a senior management member to support the project |
| 7 | Create an integrated business design |
| 8 | Establish a customer-driven product and service development process |
| 9 | Learn through action to jump-start development of organizational capabilities |
| 10 | Generate early wins and create a self-funding process |
| 11 | Focus on activities that create economic value |
| 12 | Establish a two-way flow of communications with customers |

Effective CRM and SM can be regarded as a plausible solution to the low success rates in the execution and management of construction project. Bourne (2009) points out that success is bound up in how well the organisation conducts its activities, be it strategically, operational or tactical, to meet their project requirements. 'Success is measured in part by reports of financial compliance, and in part by other less tangible aspects such as meeting expectations of its stakeholders such as the public, government, shareholders, customers, employees and lobby groups or voters' (Bourne 2009:11). Given that project success is positively correlated with meeting stakeholders' expectations; there is a need to firstly understand who the stakeholders are in any given project and subsequently determine each of their expectations with the intention of managing these expectations throughout the life of the project. Managing these expectations entails constant communication with the stakeholders, a process

which requires stakeholder relationship management skills. This paper thus explores the best strategies and mechanism that can be implemented by SME project managers to effectively achieve stakeholder management with the desired results yielding project success in the construction industry.

3.4 Nature of Stakeholder Management and CRM in the Construction industry in Botswana

Ssegawa (1999) states that one of the reasons behind Botswana's inadequate capacity is the ineffective structure and organization of the construction industry characterized by constraints such as unavailability, insufficient or inappropriate use of resources, functions and institutions (Khairuddin et al., 1998 and BOCCIM 1992). Ssegawa (1999) looks at some of the Vision's targets (the Botswana vision 2016) and reviews the current state of the economy in relation with the identified target. The extraordinary importance of stakeholders in projects has been clearly articulated in the field of project management by several authors such as Beringer et al. (2013); Cleland (1986); Freeman (1984); Littau et al. (2010), Savage et al. (1991) as cited by Missonier & Loufrani (2013). Additionally, Bourne and Walker (2006) allude that successful project management is influenced by stakeholders and their capacity to impact the project outcome. Lim & Yang (2008) points out that different stakeholders have different levels and types of investment and interest in construction projects and can be seen as multiple clients or customers for the project in which they are involved. Failing to acknowledge such dynamism, especially in an infrastructure project that involves various parties with vested interest would potentially jeopardize the project objectives and its smooth implementation (Lim & Yang 2008). Successful completion of construction projects is therefore dependent on meeting the expectation of stakeholders (Lim & Yang 2008).

3.5 Project Life Cycle

According to Malkat & Byung-GYOO (n.d.), construction stakeholders can be classified in different ways namely primary and secondary stakeholders. It is highly critical to ensure that the objectives set by the contractor meet the stakeholders' expectation. Furthermore, 'the extent to which the project objectives and the stakeholders' aims are aligned creates possible uncertainties, such as schedule deviation and conflicting stakeholders interests that project managers need not to underestimate.' (Malkat & Byung-Gyoo n.d.:79). Figure 1 illustrates the different stakeholders involved in any given construction project within the lenses of the different phases of the Project Life Cycle.

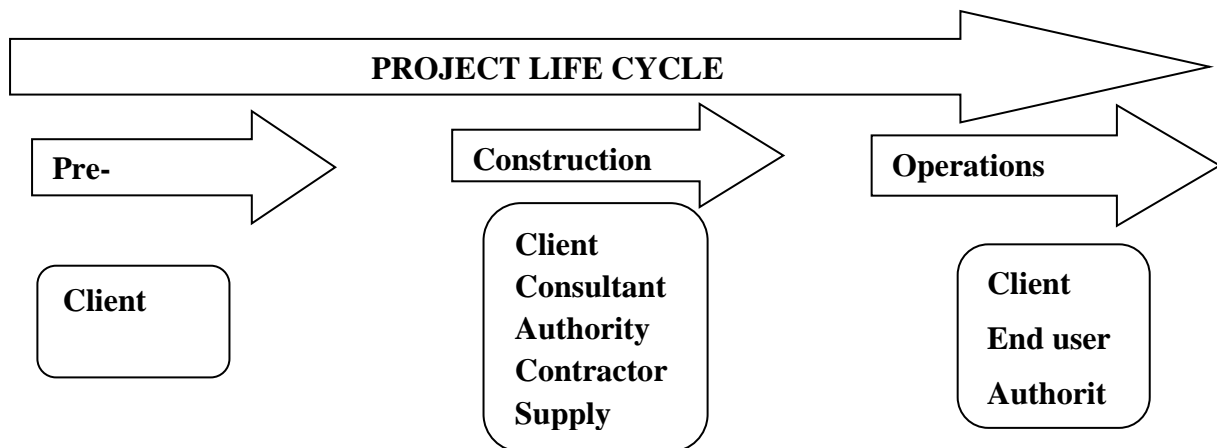


Figure 1: Project Life Cycle in Construction (Malkat & Byung-GYOO n.d.)

The involvement of the client in the three stages of the Project Life Cycle can be observed in Figure 1. The level of involvement of the client throughout the entire project life cycle illuminates the importance of Customer Relationship Management as a crucial technique in ensuring that the project objectives are well aligned with the customers (stakeholders') aims. This fusion of Customer Relationship Management and Stakeholder Management can be effectively incorporated to develop a Stakeholder Relationship Management Model for use by SME Project Managers.

4. METHODOLOGY

In order to address the gaps in literature, the study used qualitative data collection techniques to acquire emerging themes in view of the current practices in the construction industry by SME Project Managers. Specifically, 6 in-depth interviews were conducted with the aide of an interview guide which was designed within the scope of the aim of the study. The target for the interviews were expert project managers with a minimum of 10 years as these were considered to possess a wealth of knowledge about the industry in general and about project management in the construction industry. Specifically, main contractors and sub-contractors were interviewed. The qualitative approach was selected as the most suitable as it would allow a high level of data extraction from the respondents. From the qualitative data obtained concepts were derived using the deductive category development approach in thematic analysis. The findings of the study provide insights on the current practices in use by project managers as well as shed some light on the challenges and gaps in terms of capacity of the Project managers in managing Stakeholders in every project.

5. RESULTS

The study targeted 6 Project managers with at least 10 years' experience in the construction industry. They were asked about the construction industry in general and their current practices regarding project execution.

5.1 Market Situational analysis

The study sought to obtain the views of the project managers regarding the industry in general and to assess whether there existed any stakeholder relationship management models

or structures in place that would enhance the successful delivery of projects. As such, they were firstly probed regarding the construction industry in general. The project managers unanimously expressed that the industry is generally ‘difficult’. One of the managers described the industry as:

“Difficult and characterized by low rates and huge competition in the market. There are many players the smaller firms quote low prices so that they can get the project.”
(SME Project Manager – Contractor)

Similarly, another SME project manager stated that;

“The industry is quite difficult to operate in that there are few sheep but too many wolves” (SME Project Manager – sub-Contractor)

Their perception of the market being difficult emanates from the fact that while the industry is booming with a lot of development in built environment, the market is currently saturated with different players thus resulting in very high competition for few projects that are available. This therefore forces the SMEs to lower their rates in an effort to secure more jobs.

General perceptions in the market were sought regarding the critical factors that determine whether a project can be regarded as being successful. The following was indicated as key components; efficient supply chain; Timeous delivery, delivery within the budget; workforce with sound work ethics and quality of the finished product.

5.2 Continuity of SMEs in the Construction Industry

The project managers were prodded on the continuity and sustainability of SMEs as it has been observed that in most cases SMEs are owner managed in which case the owners forge relationships with their customers. In the absence of the owners and the lack of sound stakeholder relationship management models to follow, relationships previously forged are weakened thus compromising the smooth communication between organisations and their stakeholders which can affect successful project delivery.

In addition, it was articulated that the continuity and sustainability of smaller enterprises ends with the exit of the owner as in most cases the business and stakeholder relationships revolve around him or her. Furthermore, customers tend to cultivate personalised relationships with the owner. One of the small enterprise owner who also doubles as the project manager expressed that;

“The business is me, the moment I leave that will be the end of the business”
(SMEs Owner/ Project manager – sub- contractor)

5.3 Description of the industry

The study sought to get description of the industry with the aim of contextualising the environment within which they operate in. The description of the industry was captured through three key themes which are mainly “kinds of projects”, “Key players/ stakeholders” and lastly the “obstacles encountered.”

5.4 Kinds of Projects

The construction industry in Botswana is mainly characterised by government funded projects. This can be primarily attributed to the fact that the government finances most of the development in the industry. One of the project managers illustratively expressed that;

“Our projects are mainly commissioned by the government because it is able to pay and is more reliable as compared to private entities”

(SME Project Manager – Contractor)

Other kinds of construction projects mentioned include residential developments, office buildings and a few projects in the private sector. Clients in the private sector were cited as often facing difficulties when paying for projects undertaken and as such some contractors expressed their unwillingness to take on projects commissioned by such entities.

5.5 Key players

With reference to the key players in the construction industry, the following themes emerged; the players were grouped into two distinct categories namely “*Customers*” and “*other stakeholders*”. In these two categories the “*customers*” were described as the end beneficiaries of the projects for example the government, estate companies, big constructions companies, and the Regulators. The “*other stakeholders*” category consisted of the players that make the project possible through the different roles they play in the execution phase of the project. These are namely; employees and employers within the construction SMEs, the suppliers, financiers and other construction companies that are sub-contracted for other components of the project such as the electrical fittings. While the different stakeholders were perceived in different categories, the project managers solidly confirmed that all stakeholders were important in the successful delivery of projects.

5.6 Barriers to project success

While there are many factors that have been known to be barriers to the successful delivery of projects, the project managers stated the below as key barriers to project delivery in Botswana. The following themes emerged; “*Regulatory barriers*”, “*Human Resources barriers*” and “*environmental barriers*”. Regarding the regulatory barriers, the project managers articulated that the licensing procedures in the market are unclear and poorly articulated to the contractors. In addition, additional certification is required for industry players or entities that are foreign owned. One project manager highlighted the need to acquire an Economic Diversification Drive certification where the company is foreign owned. This process has been cited as barrier which at times causes delays that are then passed on to the project timelines resulting in possible project delays.

Human Resources related constraints were expressed as barriers that affect their ability to effectively and timeously deliver projects to their customers. The first issue highlighted was that of workmanship of the low level staff in the construction industry. The low level were reported to have a tendency of working irregular hours thus affecting the project progress.

This tendency is exacerbated by the labour and regulatory obligations of the companies which do not permit them to fire the employees without following the stipulated labour regulation protocols. In relation to human resource issues, the project manager further stated that they lose skilled labour after they have trained them. One project manager illustratively stated that;

“The company invests money in training workers in things like operating overhead cranes and once they are trained they demand higher salaries or they move to other companies or to more lucrative markets such as South Africa.”

(SME Project Manager – Contractor)

The third issue articulated regarding human resources was that of work permit processing for personnel working onsite in a case where they are none locals. This process was said to be long and usually impedes progress where the person involved is a key member in the project execution team. The last barrier stated by the project managers was that of the construction industry in general. Given the low population of Botswana, the market was viewed as being too small in relation to the number of players in existence. The market saturation was emphasized by one of the SME project managers who highlighted that;

“Most buildings are becoming white elephants there is market saturation.”

(SME Project Manager – Contractor)

6. CURRENT PRACTICES REGARDING STAKEHOLDER RELATIONSHIP MANAGEMENT

A key component of the study was to determine the current market practices regarding how project managers manage their stakeholders in order to ensure project success where the customer is satisfied with the delivery time and quality. As such, the project managers were assessed through three key components namely; maintaining a balance between all stakeholders, managing the interest of the stakeholders and their current practices regarding customer relationship management.

6.1 Maintaining a balance between stakeholders

This component was viewed as an important aspect during project execution as this was seen as a measure to avert project delays. Risk Management and Control were stated as measures that are put in place to ensure that the SMEs are well prepared for possible unforeseen mishaps that could potentially affect the project delivery. In addition, insurance was also pointed as a way to protect the interests of the SME and its customers.

6.2 Managing the interests of stakeholders

With regard to stakeholder relationship management, the project managers unanimously alluded to the fact that there is no documented model or structure in this regard. They further articulated that there is no formal strategy that is used to manage stakeholders nor is there a

structured approach to stakeholder management. While they fully appreciated the importance of managing stakeholder relationships to ensure project success, they were not practicing any set procedures to achieve this. Despite the absence of set standards some project managers highlighted some of their practices in an effort to manage stakeholder relationships. They reported that they are cognisant of the fact that they need to ensure that their customers are satisfied. Thus, some do follow ups with their customers to monitor their expectations and satisfaction levels. Similarly, they added that their customers are different and thus they require different levels of monitoring and management. They added that they are conscious of the fact that customer is king. In view of these assertions, the project managers were asked about their levels of understanding regarding Customer Relation Management in the construction industry.

6.3 Customer Relationship Management (CRM)

The perceptions of the project managers were sought regarding the concept of CRM. Although this concept was not widely used, it was not entirely foreign to the project managers. They expressed that project success that is typified by prompt delivery and high quality is meant to leave the customer satisfied with the work done. One of the SME project managers highlight how they actively use technology to improve their project delivery times. He further stated that;

“We use SAS Machines to bend re-enforcements to improve the project delivery through saving time”

(SMEP Project Manager – Contractor)

In contrast, CRM was not perceived as a very important task by some. This is evidenced by the lack of a high level personnel designated to manage customer relations. In this instance the receptionist was tasked with dealing with the customers. This highlights how CRM is not highly regarded despite its importance in ensuring greater chance of project success.

7. DISCUSSION

The main aim of the study was to assess the current practices in the construction industry in Botswana with particular focus on stakeholder relationship management as this has been perceived as a key factor in ensuring project success. The findings of the study clearly affirm the observations made in extant literature in relation to the inadequacy of stakeholder relation management models. Furthermore, the project managers all confirmed that they do not have any set measure that they implement when managing their stakeholders. Similarly, the concept of Customer Relationship Management in the construction industry was rarely used in its full capacity. At most, some project managers were seen to be concerned about the satisfaction of their customers as illustrated by their efforts in conducting follow ups with their customers.

Given that SME project managers are cognisant of the need to manage their relationships with their stakeholders as well as importance of ensuring customer satisfaction, one can conclude that the fusion of the two concepts can be coined to construct a Stakeholder Relationship Management model (SRM). The use of such a model can be further explored by

SMEs in Botswana to mitigate the poor delivery of projects that is attributed to their inability to effectively manage their relationships with other stakeholders in the industry thus inhibiting their growth and sustainability.

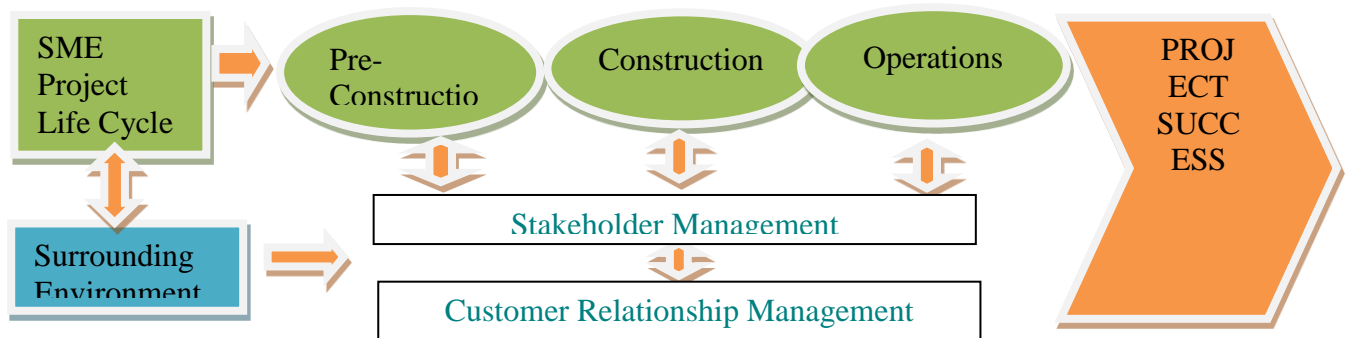


Figure 2: Proposed SME Stakeholder Relation Management Model

Figure 2 illustrates a proposed model of how stakeholder management and customer relationship can be used throughout the project life cycle to ensure that project objectives are well aligned with the customers aims (Malkat & Byung-GYOO n.d.).

8. CONCLUSIONS AND FURTHER RESEARCH

The findings of the study are indicative of the inadequacy of stakeholder relationship management capacity of the Project Managers as highlighted in existing literature. In addition, there is no formal structure for strategies in SM and CRM as standard practice in the construction industry in Botswana. Further to that, the homogeneous environment within which the SMEs in Botswana operate limits them to unstructured strategies and practices in both Stakeholder Management (SM) and Customer Relationship Management (CRM). This scenario has a negative effect on the growth, sustenance and continuity of the SMEs. From this viewpoint this study developed a model for stakeholder management and customer relationship management for use in developing countries such as Botswana. There is need for further research to ascertain the efficacy of the model.

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A QUANTIFIABLE METHOD OF ASSESSING THE RISK OF SELECTING THE LOWEST BIDDER IN CONSTRUCTION PROJECTS: A LITERATURE REVIEW

G. Eke, G. Wedawatta and J. Elgy

School of Engineering and Applied Sciences, Aston University, Aston Express Way, Birmingham B4 7ET.

Email: ekegue@aston.ac.uk

Abstract: Contractor selection is an important step in ensuring the success of any construction project. Failing to adequately select the winning contractor may lead to problems in the project delivery phase such as bad quality and delay in the expected project duration; which ultimately results in cost overruns. This paper reviewed the strength of existing studies on the link between contractor selection strategy and project outcomes, with a view of proposing an approach on how one might try to examine this relationship moving forward. There are research that try to establish a direct relationship between contractor selection strategy and the outcome of the construction project. There are also decision support tools such as AHP or ANP that help clients prioritise various factors when selecting contractors. However the majority of these research and tools are informed by self-perception questionnaires and surveys that makes it difficult to gauge the strength of the relationship between contractor selection and project outcomes. In other words, there are hardly any empirical research that tries to establish this relationship. Literature review on the sources of cost overruns did not entirely reveal contractor selection as a main source of cost overrun; although from the explanations given for causes of cost overruns, one would be able to see how wrong contractor selection does play a part. Literature review on the various approaches to contractor selection on the other hand, did little to show the effect of contractor selection on the outcome of construction projects. Hence, the future direction of the research is to help clients see choosing a particular contractor selection strategy; whether lowest bid, or best value, affects the outcome of a construction project: cost and duration.

Keywords: cost overrun, contractor selection, best value, lowest bid.

1. INTRODUCTION

In today's competitive construction environment, it is almost impossible to achieve project success without adequate selection of the winning contractor. Wrong contractor selection can lead to disputes, lengthy dispute resolutions, project or contractor termination, low quality work and defects. Selecting the lowest bid has long been the traditional method of choosing contractors in construction. As recent as 2015, the National Construction Survey for the UK industry found this as the most used strategy for awarding contracts (NBS, 2015). However, Palaneeswaran and Kumaraswamy (2001) have argued that basing the final choice of contractor based solely on the lowest price, does not guarantee the delivery of the required outcome in terms of cost, time and quality. This is due to the fact that, they believe, that most clients ignore the fact that the same contractor performs differently in a dissimilar environment. Furthermore, Kashiwagi and Byfield (2002) say that though lowest price criterion is an objective and transparent approach, it fails to guarantee the quality of the contractor's performance. Thus, the lowest bid price may not correspond to the most economic choice in the long term; in other words may not result in a lower overall cost. This is due to the fact that selecting contractors based on the lowest bid price motivates contractors to provide minimally acceptable construction products (Kashiwagi and Byfield 2002).

This has led to the introduction of the best value strategy, which is to select contractors on the combination of price and quality. But what is quality? This is the client’s discretion; the meaning of quality differs from client to client. Stilger et al. (2015) noted that there are over thirty-eight available formulas to calculate the best value contractor, all of which may provide a different winning contractor if used on the same project. Furthermore there are different methods that have also been developed to help select the best value contractor. Selecting on the lowest bid is objective and transparent, while selecting on best value is vague. Kashiwagi and Savicky (2003) say that owners are reluctant to pay more for best value if they do not understand what best value is. We are also seeing the use of selective tendering in the UK, particularly in the private sector, whereby clients have a list of preferred contractors; perhaps due to familiarity and trust, or because those contractors have passed a prequalification process, and from there select the lowest bid for any of their project. This is not a way of selecting on best value however, but how can one justify to the client to do otherwise? From the existing literature, there have been efforts to do so, though they may not be considered strong enough.

The idea is not to advocate for one strategy over another. Instead, it is to show clients the effects a contractor selection strategy; whether lowest bid or best value have on the outcomes of a project before they decide on the strategy to go for. Project outcomes can mean a number of things but the proposed study focuses on the outcome cost and duration due to its objectivity. There are existing studies that have tried to establish a link between contractor selection and project outcomes which will be critiqued in this paper. But first, it is important to understand the sources of cost overruns. By doing this, one will understand that although selecting a competent contractor influences project success, it is not the only antidote.

2. SOURCES OF OVERRUNS

In a construction project, whenever there is a budget increase, a cost increase, or cost growth, it means that the project has overran (Love et al., 2014). The reasons for cost overruns in construction projects are vast, however the ones that seem to come up the most stem from Flyvberg et al. (2008) and Cantarelli et al. (2010) studies.

Flyvberg et al. (2008) studied the cost performance of 258 transportation projects in 20 nations worth US\$90 billion and found that ninety percent of them overran their cost. The study grouped the reasons for this cost overrun into three groups: technical, psychological, and political-economic; explaining the meaning of these groups. The Cantarelli et al. (2010) study then added to the latter study by offering examples of these groups. Below are tables that summarise the reasons for cost overruns from Flyvberg (2008) and Cantarelli et al. (2010).

Table 1: Causes of Overruns Group and Examples/Explanation

| Group | Flyvberg (2008) | Cantarelli et al. (2010) |
|-----------|--|--|
| Technical | Inaccurate and unreliable data. Technical complications in project leading to increased costs. | Incomplete estimates, poor project design, scope changes, uncertainty, inappropriate organizational structure, inadequate decision-making process etc. |

| | | |
|--------------------|---|--|
| Psychological | Optimism bias; being overly-optimistic about the implementation of the project. | Optimism bias among local officials, cognitive bias of people, cautious attitudes toward risk. |
| Political-economic | Strategic misrepresentation; overestimate benefits and underestimate costs. | Deliberate cost underestimation, manipulation of forecasts, private information. Lack of incentives, lack of resources, inefficient use of resources, inadequate contract management etc. |

Source: Flyvberg (2008) and Cantarelli et al. (2010). Adapted by researcher

The technical aspect of cost overruns can be attributed to risk and uncertainty; the failure of managing them adequately leads to cost overrun. It is important to understand that, despite the fact that the two are used simultaneously, risk and uncertainty are two different things. Ustinovicius et al., (2007) say that the reason the two are used simultaneously is because “uncertainty” is used in most scientific literature concerning risk management, while uncertainty management is concerned as managing perceived threats and opportunities; including their risk implications, as well as managing the various sources of uncertainty which give rise to and shape risk, threat and opportunity.

Flyvbjerg (2008) offers optimism bias as a psychological explanation for cost overruns; this theory is primarily from behavioural studies and it is to do with the inclination for people to be overly positive when making predictions about the outcomes of future planned actions (Siemiatycki, 2010). Nicholas (2004) suggests that estimators usually have to rely heavily on their own experience and historical information when preparing initial estimates. Which also explains why Flyvbjerg (2009) refers to optimism bias as delusion in the following way:

"Delusion accounts for the cost underestimation and benefit overestimation that occurs when people generate predictions using the inside view. Executives adopt an inside view of the problem by focusing tightly on the case at hand, by considering the plan and the obstacles to its completion, by constructing scenarios of future progress, and by extrapolating current trends. In other words, by using typical bottom-up decision-making techniques, they think about a problem by bringing to bear all they know about it, with special attention to its unique details. There are two cognitive delusions the inside view facilitates: the planning fallacy and a heuristic rule-of-thumb called anchoring and adjustment."

Strategic misrepresentation alludes to suspicion of foul play and corruption (Flyvbjerg, 2008; Flyvberg, 2009) a situation whereby forecasters and planners knowingly overestimate benefits and underestimate costs in order to win the project or get approval and funding; this refers to its political-economic explanations. Flyvberg (2009) refers to this as deception which is described in the following way:

"Deception accounts for flawed planning in decision making in terms of politics and agency issues. The political and organizational pressures in executive decision making involve: the principal agent problem and the sources of strategic deception."

Though cost is an important factor that gauges whether a project was successful or not, it is not the only factor. The project duration is another important factor; and the causes of delay can also be seen in Cantarelli et al. (2010) and Flyvbjerg's (2008) study. From these studies we see that there are a number of reasons why a project is unsuccessful; contractor selection is one of the reasons but may not be the only reason why a project turns out bad. Nevertheless, this is enough reason to establish the link between contractor selection strategy and project outcomes: cost and duration. The next section reviews the various methods to picking a contractor on best value.

3. CONTRACTOR SELECTION METHODS FOR BEST VALUE

There are a plethora of tools developed to assist in clients in selecting the best contractors for executing a construction projects. This section will examine them.

Lo and Yan (2009) developed simulation models to analyse contractors' pricing behaviour and dynamic competition process under the qualification based system (QBS). The strength of this research is that it is possible to identify an unrealistic bid using the model. Furthermore El Asmar et al. (2009) used simulation to quantify criteria and combine them into a single score when assessing contractors. The major drawback to this research is the assumption that it could be used in all types of projects to assess contractors. Construction projects usually differ; clients' needs also differ and models should be able to take this into consideration. Having said that, there are methods that exist and were introduced a while ago that are being used as contractor selection approaches to account for the clients' needs or the specific needs of the project at hand. The AHP, being one, is a popular technique used for ranking and prioritising criteria used in selecting contractor; it is able to analyse multi-criteria problems according to pairwise comparison scale. According to Fong and Choi (2000) the technique identifies contractors with the best potential to deliver satisfactory outcomes in a final contractor selection process which is not based simply on the lowest bid. One of the main benefits of this tool is that it can be combined with other tools to assist decision makers such as fuzzy logic and ANP. The ANP in particular is an extension for the AHP to allow for interdependencies between criteria in selecting contractors (Cheng and Li, 2004). Abdelrahman et al. (2008) introduced a concept of best value modelling that was specific to each project. It combined the AHP and the weighted average method to quantify the qualitative effect of subjective factors in selecting the contractor. This particular study was relatively easy to understand and implement, however there is a high level of subjectivity to this study. The weights given to the criteria was the researchers discretion, even at that there is no real evidence that this criteria used to select the contractors will result in project success. Although it is fair to add, that the main purpose of their study was to assist in selecting the best value contractor not whether the best value contractor will be successful or not. Similar studies have also been undertaken like Kwong et al. (2002) and Bevilacqua and Petroni (2002), which used the combination of a scoring system and fuzzy theory for ranking the best value bids. Bendana et al. (2008) also developed a fuzzy logic assessment model both the qualitative and quantitative issues that influence whether or not a contractor is suitable to win the bid for the project. Zadeh (1965) first introduced the concept of fuzzy set, which basically transforms linguistic variables that are ill-defined into traditional quantitative terms (El Agroudy et al. 2009). In this type of study contractors are scored in each criteria as Low, Medium, and High (1, 2, and 3). Then depending on the number of criteria used to assess the contractors, let us say for example 5, this usually results in a final score for each contractor between 5 and 15. So if a contractors' score is between 5 and 9 they will be

considered Poor. 10 and 13 will be considered good, while 14-15 is Very Good. This is just an example of a scale used, each client can subsequently their own scale. However using this example, one can question how sensitive the scores are to subjectivity; with the fact that at 9 a contractor is considered Poor and at 10 Good. Assuming the choice of the contractor boiled down to 9 and 10 contractors, with the latter at a higher price. How can it possibly be justified to the client to select the contractor with the score 10 at a higher price, when it's supposed 'quality score' is just one above a contractor with a lower price? How much of a difference does that one point make in the project outcome? The strength of this technique however is that it can be tailored to the owners' requirement; the client should have the power to score contractors the way the like, but whether that results in project success usually remains unclear until the end of the project.

Other research have proposed the use of multi-criteria evaluation model for contractor selection; Topcu (2004) for one incorporated this method for construction contractor selection in the Turkish public sector. A major strength of these models is the capacity to allow more factors that are likely to influence a contractor's performance to be taken into consideration. Zavadskas et al. (2008) demonstrated this in its research by developing a contractors' assessment and selection based on the multi-attribute method. There are also models that have been developed to assess the contractors after project completion. Hancher and Lambert (2002) developed an evaluation system to evaluate the performance of contractors at the end of each year of project duration. Minchin and Smith (2005) also produced a quality based performance rating system model that generated an index for each contractor to represent contractor's quality over a specified frame. Despite the vague nature of quality really is, these research at least tries to establish a link between contractor selection and the outcome of the project by assessing the contractors. By doing so, clients can take these assessments into consideration for future projects.

It is also worth mentioning that the use of subcontractors in the construction industry has been steadily on the rise. Main contractors are now subcontracting majority of the works of a project which means that subcontractors should be assessed as well. Albino and Garavelli (1998) have proposed a neural network process for subcontracting rating. While, Arslan et al. (2008) developed a web based subcontractor evaluation system called WEBSES for the Singaporean construction industry that evaluated contractors based on combined criterion. Interserve Plc, also run a database that scores subcontractors performance on past projects for main contractors. With the increase in selective tendering; whereby a client has a preferred list of contractors, it makes it difficult for small to mid-size companies or companies in general who are not in the list to win work. Hence, these companies result to being subcontractors.

There are a plethora of research that are aimed to determine the best value contractor, whether they are mathematical models, or linear weighting models, or statistical approach; all of which include cluster analysis, simple weighting, AHP, fuzzy set theory, discriminant analysis, etc. (Waara and Bröchner 2006; Tsai et al., 2007; Lambropoulos 2007). However, these methods do little to show the effect of a contractor selection strategy: either lowest bid or best value, has on the outcome of a construction project: final cost and duration. El-Abassy et al. (2013, pp 766) recommends a further study:

“if the developed model determined the best contractor for a project whose submitted price is not the lowest price, then an analysis should be done to show what-if scenarios for the contractor with the lowest price if he/she is awarded the contract instead. The analysis can

include the response to claims for this contractor, the rework that may occur during the project because of inadequate past experience, for example, or any other weak points for the contractor with the lowest price that may result in an extra cost beyond the original price. These extra costs might include (1) rework because of bad quality, (2) delays because of incompetence, (3) short life cycle because of bad quality material, (4) operation and maintenance problems because of inadequate experience, and (5) many claims because of bad management.”

The research will aim to carry out this further study, but not by assuming that the lowest tenderer has all these problems. Rather by using historic data and analysing how they have performed in the past, to predict how they will likely perform in the future. Yu and Wang (2012) say that the market should dictate what strategy to go for; meaning that there are times when it is best to for the lowest bid strategy. The next chapters will now aim to provide a conceptual model that seeks to provide a quantifiable methods of assessing the risks of choosing the different basis for contractor selection for specific projects. Up to date there has been no quantitative assessment of the frequency distribution of the final outcome cost and duration of either selection method. The client may want to know not just the expected outcome cost of a particular strategy but also what would be the probability of a strategy leading to an extremely high final cost. In other words, is there a chance that one selection criteria would give the lowest cost on average but could, on occasions, give to outcome costs so high that bankruptcy may occur?

Therefore we see that there are many approaches and models that have been developed for contractor selection; some with a view of showing how they affect outcomes. However, the bulk of this studies have done little to justify to a client why he/she should pay more for a best value contractor over the lowest bid contractor. The lowest bid contractor can turn out to be the best value contractor after they have been ranked. But when the lowest bid contractor is not the best value contractor, how can it be justified to the client to go with the best value contractor especially when working under tight margins. A method should be developed that shows that if a contractor is picked whose price is not the lowest price, how will the lowest priced contractor fare if he/she is given the contract instead. The method proposed in the next section should be viewed as an extension to these various approaches of selecting the best value contractor not the replacement. Also establishing a link between contractor selection and project outcomes from the perspective of a main contractor picking a subcontractor is necessary, but a link between selecting the main contractor and the overall project outcome is more important. A main contractor, if it chooses to can subsequently subcontract all the works on a project, and not just to one subcontractor but a multiple of them. Therefore selecting the right strategy to go for is important. But due diligence must start from the beginning of selecting the main contractor. A main contractor picked on the basis of lowest bid will subsequently subcontract to the lowest bid, and this is the case with the best value contractor. The proposed method should not try to dissuade a client from going for the lowest bidder, instead to show the client the range of possible outcomes available if it does go with either the lowest bid or the best value bid.

4. PROPOSED METHOD

The proposed method is not seeking to select the best value contractor. The proposed method is one that seeks to use Monte Carlo simulation to produce frequency distributions of all the possible outcomes in terms of cost and duration when a client decides on a strategy: lowest

bid or best value. This method can be taken solely as a cost estimation technique, however the difference here is that the method does not just set out to purely estimate the cost or the duration of a project. Instead, it will incorporate the strategy; whether lowest bid or best value, by which the contractor was selected. Furthermore, it does not set out to predict the final cost or duration of the project, rather the range of outcomes that can be expected for a project depending on the strategy chosen. By doing so a direct link can be established on how contractor selection affects the outcome of a construction, if it does at all.

For this to happen historical data on projects will have to be analysed. The details and requirements needed to develop this model include:

- Details of the contract awarded (tender bids received from all the contractors that bid for the project; companies were anonymous)
- Selection criteria; (lowest tender accepted)
- The winning contractor: the eventual tender accepted
- Project outcome cost: initial tender cost, final cost, the expected duration, and actual duration.
- Same sector projects (e.g. educational facilities, hospitals etc.)

The study here is to whether awarding to lowest tender will result in a higher cost and project time than awarding to the best value tender. There is a pre-conceived notion that the best value tender whose price is not the lowest price will generally fare better in a project than the lowest bid tender. Hence, analysing historic data on similar types of project that selected the lowest tender, can give us a general view of how they might fare in a project that selected the best value tender.

From the details provided correlations can be derived from variables that will be inputted into the model:

- Bid price (BP, which in this case, is always the lowest tender)
- The difference between the final cost of the project and the tender bid (Diff)
- Delay
-

The correlation between these variables are then used to derive numbers that are inputted into the model. Which is then able to generate frequency distribution of the tender bids accepted (which will be instructed to always be the lowest tender), a Diff cost, and Delay time. Subsequent analysis will then be undertaken by the model to calculate the frequency distributions of the total cost and actual duration of the project. Therefore the idea here is that when a client is assessing tender bids, and it knows it best value tender, this model will be able to show how the lowest tender will fare.

Monte Carlo simulation technique is not new, this has been applied in various fields including construction. Below are a few examples:

Wall (1996) collected 216 office building from the BCIS database of RICS to outline the issues that should be recognised when using Monte Carlo methods. The study concluded that lognormal distributions are superior to beta distributions in representing a data set. Furthermore the result of this study show that the effect of excluding correlations is more

profound than the effect of choosing between lognormal and beta distribution to represent a data set.

Clark (2001) details another example of a Monte Carlo application provided by the Honeywell Performance Polymers and Chemical, which used the tool to estimate contingency on 47 projects ranging from US\$1.4 million to US\$505 million.

Moghaddam (2015) combined hybrid Monte Carlo simulation and goal programming to develop a method for supplier selection and order allocation in closed loop supply chain systems.

Vose (2000) highlights some of the main advantages to Monte Carlo:

- It does not require specialist knowledge in mathematics.
- Computer applications are commercially available and can be used to run the analysis.
- Monte Carlo simulation is a parallel process; i.e. iteration results are independent of each other.
- The model elements can be correlated for more reliable and realistic scenarios.

Furthermore there are tools available to carry out this technique. The @RISK software is a popular tool that is used for this analysis by both academics and practitioners. GoldSim is also another popular tool. There is also MATLAB, and Mathematica; therefore there are a number of software packages that can be utilised for this study.

The major challenge to this study is seeing whether client companies are willing to release such sensitive information, not only does this study need their consent, but the consent of the contractors involved in the project. The benefit to this study however, is the fact that results can be presented in different forms; most importantly in terms of financial numbers. Having said that, if companies are unwilling to release such sensitive information, there are databases that have the details and requirements needed to carry out this research. One being the Building Cost Information Service (BCIS) database from the Royal Institution of Chartered Surveyors (RICS hereafter). The downside to it may possibly only harbour projects that did well or not too badly, therefore result would be interpreted with a bit of caution. Nevertheless, it will be able to offer a practical example of the benefits of this study.

5. CONCLUSIONS

The approaches to contractor selection were analysed; there are essentially two strategies to selecting a contractor: lowest bid, or best value tender. The lowest bid is relatively straightforward and simple, the best value tender is not. The literature is rich with approaches and models for selecting the best value contractor; from simple weighting, to AHP, ANP, fuzzy theory etc. The literature is rife with models developed to select the best value bid. The proposed method is not one of them; the proposed method here should be seen as an extension. So if a best value tender is selected whose price is not the lowest price, there should be a method to justify to the client that the lowest tender would not fare better. The study is not advocating for one strategy over another nor is it a tool for selecting the best value contractor. Instead, it will show all the possible outcomes involved when a client decides on a strategy: lowest bid or best value. There are cases when it will make economic sense to go for the lowest bid strategy, while there are other cases where it is best to go for the best value bid. This proposed method of analysing historic data on how these strategies

have fared in past projects, in order to develop a model that will produce frequency distributions of outcomes of a strategy will help clients decide on what strategy to go for. The next step of the PhD research is to analyse sector specific projects, all of which have selected the lowest bid. This would be used to develop a model that will be able to predict the likely range of outcomes: final cost and duration of the lowest tenderer in future projects in that sector. Furthermore if a client's selection criteria is best value and it turns out that the best value contractor does not have the lowest bid, this model would then be able to show how the lowest bid amongst the tenders would have fared if he/she was given the contract instead.

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AN INTEGRATED BIM-IBS MODEL FOR IMPROVING PRODUCTIVITY IN CONSTRUCTION

R.H. Monib, Z.A. Adamu and W. Lord

School of Civil and Building Engineering, Loughborough University, Epinal Way, Loughborough Leicestershire, LE113TU, United Kingdom

Email: r.monib@lboro.ac.uk

Abstract: The construction sector plays a major role in the UK economy but its productivity has decelerated from 3% in 2014 to approximately 2% in the first quarter of 2016. Due to the impact of productivity and waste minimisation on the efficiency and sustainability of this sector, this issue has caused concern for both industry and government stakeholders. Recent research has tried to identify the causes and potential solutions and from these studies, two recognized systems and technologies that could impact on the industry's productivity include: Building Information Modelling (BIM) and Industrialised Building System (IBS). Although the singular benefits of BIM and IBS are well established, these technologies have rarely been studied in parallel and with synergy to each other. This paper has two main objectives. First, it identifies the key factors that affect productivity during the construction phase based on fundamental economic principles. Second, it uses a 'system of systems' theory approach to explore the feasibility of merging the delineated processes of BIM and IBS. In this regard, BIM was viewed as a socio-technical system. Data collected from pilot expert interviews were used to extract the opportunities for productivity enhancement as obtainable from both processes, including: dealing with tolerances and construction errors in IBS by using BIM's capability for appraising different construction schemes including the risks associated with variations; using BIM's 3D and data-driven capabilities to resolve interface issues between IBS components; reducing the volume of site activities by optimizing the number of modules required to achieve IBS-based connections and; using BIM's collaboration framework to harmonise the participation of project stakeholders. Subsequently, a proof-of-concept model for improving construction productivity is proposed through an integrated BIM-IBS productivity enhancement model. A validation roadmap was also developed to support the proposition that the summative productivity impacts of the integrated BIM-IBS systems are greater than the singular impacts of either system.

Keywords: BIM, IBS, Productivity, System of systems, Waste minimisation.

1. INTRODUCTION

Over the years there has been a great interest in the trend of construction productivity in United Kingdom. The European Association of National Productivity Centres (2005) defines productivity as "How efficiently and effectively products and services are being produced" (Pekuri, Haapasalo and Herrala, 2011). Efficiency in productivity refers to doing things correctly and getting the best use of resources to achieve a certain result (Pekuri, Haapasalo and Herrala, 2011) while effectiveness refers to the extent to which customer requirements are met (Pekuri, Haapasalo and Herrala, 2011).

The construction industry is one of the major sectors that has a significant effect on UK economic growth (CIOB, 2016). However, in the last few years, the sector has been suffering from a slow productivity growth (PWC, 2016). According to the Chartered Institute of Building (CIOB, 2016) growth in UK construction productivity has been slow since 1994 with 7% improvement over the last two decades (Rhodes, 2015, CIOB, 2016). Due to the

importance of construction sector productivity in UK, the slight growth of the sector comparing to other sectors in the industry drags down the performance productivity of UK as a whole (Rhodes, 2015, CIOB, 2016).

There are two technologies that could assist the construction industry to be more productive: Building Information Modelling (“BIM”) and Industrialised Building System (“IBS”) and. Although the individual benefits of BIM and IBS are well established, these technologies have rarely been studied together. Hence, there is a gap in the literature relating to the integration of IBS into BIM (Namini et al., 2012). Accordingly, this paper investigates the feasibility of integrating the two technologies as a solution for construction productivity improvement.

2. LITERATURE REVIEW

2.1 Productivity: Concept, Characteristics, and Challenges

There are several definitions for the term productivity. The Office for National Statistics (ONS) defines productivity as “The rate of output per unit of input” (CIOB, 2016). According to this definition, generating more outputs (measured in quantities and qualities) for specific and unchanged inputs could attribute to productivity improvement (CIOB, 2016). Thus, productivity could be improved either by reducing the inputs (i.e. material used, energy consumed, labor) to generate the same output, increase the output with the same level of inputs or a combination of the two (CIOB, 2016). On the other hand, New Zealand Statistics (2012) noted that increase in output produced could be due to increasing input (resources), utilization of resource inputs in a more efficient way or a combination of the two (Statistics New Zealand, 2012). Based on the above, it is clear that there is no agreed definition for productivity among researchers. However, for the purpose of this paper, the research will consider the ONS Productivity Handbook’s definition of productivity throughout the study. The study will aim to investigate and provide a solution to improve utilization of the resources inputs to its maximum and accordingly improve productivity during the construction phase.

There are several types of productivity measures. The choice between them depends on “the purpose and availability of data (Statistics New Zealand, 2012). This paper is concerned with construction productivity improvement at project /task level. The factors affecting single factor productivity needs to be investigated. Factors affecting productivity could be categorized into: environmental, group, individual and organizational factors (Ailabouni and Gidado, 2009). Environmental factors such as the level of technology used, weather conditions, site layout and project requirement. Group factors such as the different background of project stakeholders, labour and employee skills. Individual factors include labour, motivation, education and training. Organizational factors include contract used, working hours, the complexity of project and scope. However, these factors are not generic but context specific and are dependent on location, types of work or productivity levels.

New technologies such as BIM could have positive impacts on some of the mentioned factors. The same could be said of IBS. However, evidence from literature reveals that although there are key indicators linking both BIM and IBS with enhanced productivity, there is little evidence that the problem of low productivity could be solved by either BIM or IBS separately. Integrating both systems represents an important area of concern for this study.

2.2 Defining Industrialised Building System

IBS definition are more different and sometimes inconsistent (Vernikos et al., 2014). The term could be defined as building system, its components are produced in a factory or at site depending on the specification, transported and assembled at site location (Triakha, D. N., & Ali, 2004, Abdullah and Egbu, 2010). CIDB (2003) defines IBS as construction method in which the building components are manufactured in control environment onsite or offsite. There is no agreed definition of industrialized building system in the industry. However, For the purpose of this paper, the first definition above is used to refer to IBS throughout this paper.

2.3 Defining Building Information Modelling

BIM is a digital model that “represents building elements such as beams, columns, and walls as smart three-dimensional (3D) objects that include embedded data such as geometry details, energy use data, and life cycle cost information” (Karan et al., 2015). Although several researchers define BIM as a tool or technology (i.e. Teo et al., 2015, Davies and Harty, 2012), however, there are some studies that define BIM as a system. WSP (2013) define BIM as a sociotechnical system and multi-layered system. The model includes technical systems (i.e. hardware and software: 3D, 4D, nD) and also operational process and users (i.e. architect, structural, MEP engineers and other project disciplines) who utilize and interact with the technical system (Davies and Harty, 2012, Mourtzis et al., 2016). For the purpose of this paper, the latter definition is used to refer to BIM in the following sections.

2.4. System Integration

Review of Integration Concept

The term system is defined as “groups or combination of interrelated, interdependent, or interacting elements forming collective entities” (Arnold and Wade, 2015). System integration is defined as “a progressive and interactive cycle of melding technologies, human performance and operation processes together” (Myerson, 2001). From a technological perspective, system integration is melding of incompatible technologies, applications, and data into uniform information technology architecture and functioning working structure. Houser (2011) defined system integration as “assembling the constituent parts of a system in a logical, cost effective way, comprehensively checking system execution and including a full functional checkout” (Houser, 2011).

There are four stages of system integration. Each stage has its own characteristics, aspects and implications and application. *Stage 1 is the Integration technology*, sometimes called interconnectivity and is the mechanism in which data is transferred between two systems or conduct a common pathway between different components in order to initiate new systems. Data transfer could be achieved through manual data transfer, automatic data transfer, common database or process to process communication (Myerson, 2001, Nilsson, et al., 1990). *Stage 2 is the architecture or interoperability Integration*. In this stage, one technology or application functions with another in order to achieve the capabilities of both. Thus it is essential at this stage to distribute responsibility for data and functionality between systems so when the two systems are integrated, a total cohesive system is achieved. That could be through controlled redundancy, activating other systems, under this strategy, the

system that activate the other one should decide which function to activate, which data, how errors should be handled (Myerson, 2001, Nilsson, et al. , 1990). *Stage 3 is the Sematic Integration*, in which a standard database definition should be established to reduce any human errors during integration. common set of concepts should be used by all applications in the system and in the user interfaces of the system (Myerson, 2001, Nilsson, et al. , 1990). *Stage 4 is the convergent*, in which technology and knowledge, process and performance are integrated (Myerson, 2001, Nilsson, et al., 1990). This paper is concerned on achieving this stage in BIM and IBS integration.

Literature

The literature reveals that there have been few attempts trying to integrate BIM and IBS for different purposes. Namini, Meynagh and Vahed (2012) examined the integration from design perspective. The study aims to generate Industry Foundation Class standards for IBS components to be suitable for integration with BIM application. The study results show that among IBS Classification that the most suitable IBS categories could be integrated is Planar or Panel system (Namini et al., 2012). Although the study did not investigate the consequences of integration on site productivity, it rather identifies the limitation of the BIM model when integrated with IBS. On the other hand, other researcher considers the integration very beneficial to improve one of the main challenges of IBS i.e. the standardization of its components that attribute to low site productivity. A recent study by Isaac, Bock and Stoliar (2016) examines the opportunity to overcome this problem aided by BIM through the use of a graph-based analysis that decomposes the design into nonstandard modules. The module components should have common replacement rates and a restricted number of connections to each other. In order to achieve the optimum definition of the module, a clustering algorithm applied on the design data extracted from BIM (Isaac, Bock and Stoliar, 2016). The previous two researchers attempt to utilize BIM technology as a tool for better engineering efficiency. However, the research did not emphasize the importance of the integration during the construction phase.

The aim of this paper is to investigate the feasibility and opportunity offered by integrating BIM and IBS for enhancing on-site productivity. The literature reveals that few studies examine the two technologies together during the construction phase. A study conducted by Xie, Shi and Issa (2010) examine the opportunity of reducing the project schedule through improving the efficiency of the process of the project life cycle. The study proposed a framework that integrates the Radio-frequency identification (RFID) and BIM model to improve engineering, manufacturing, installation through more detailed consideration of alternative design that reduces the efforts required for the installation process (Xie, Shi and Issa, 2010). However, the research was specific to one type of structure i.e. steel structure beams or columns. Thus, there is a little evidence that confirm the results on other type of structures. Another study conducted by Rausch (2016) aimed to improve productivity in the construction phase, the research utilizes BIM model to improve the definition of the module components and accordingly facilitate the assembly process at site and reduce the rework and idle time in site (Rausch et al., 2016). The researcher proposed an assembly plan for modular components that could help in reducing the geometric deviation assembly type (Rausch et al., 2016). Although the later research utilize BIM model differently from the former, the study was also limited to only one type of deviation and the results were verified through a single case study.

The review above allows three general observations. First, despite the previous studies that evaluate different construction technology, utilizing the BIM model and integrating with IBS technology has not been studied together sufficiently in the last ten years to improve site productivity. Second, the framework proposed in previous research is presented in generic terms with little explanation about the type of construction projects. Third, there has been little or no in depth examination exploring the opportunity of utilize a BIM model to solve IBS problems in transportation and installation.

3. METHODOLOGY

This research is at its early stage. Thus the adopted approach in this paper is based firstly, on the analysis of the recent published studies investigating productivity growth, BIM, and IBS in construction projects. Secondly, the research develops a conceptual framework for integrating BIM and IBS using the ‘systems of systems’ theory. In order to explore the feasibility and opportunities of integrating these two systems in construction projects, four semi-structured pilot interviews were conducted with personnel from the industry. Two of the interviewees were a senior engineer and a project manager in consultancy companies and two interviewees were project managers in contractor companies. A peer review method was employed in this study, in which six invitations for an interview were submitted to in-house personnel and colleagues in the industry to participate. Due to the exploratory nature of this study, the selection of interviewees was based on two main factors: the interest from the respondent to be involved in an interview and their experience in BIM-IBS aspects of construction projects. The interview questions focused on two main areas which were: (a) productivity related issues and; (b) the drivers, opportunities and implications of integrated BIM & IBS to derive a hybrid system that could improve construction productivity. The qualitative data obtained from the interviews were analysed through content analysis, key data were recorded, coded and categorized into key themes to help identify similar and different consultant and contractors opinions.

4. RESULTS

4.1. Rationale and Benefits of Integrating BIM-IBS

As emphasized in section 2.1, there are several factors attribute to slow productivity in the construction phase such as material control, site orientation, environmental conditions and logistics. There has been few evidence confirm the possibility of solving some of these factors through utilizing IBS system and BIM technology separately (Table 1) (Abdullah and Egbu, 2010, Azhar, Lukkad and Ahmad, 2012).

Table (1) BIM and IBS Potential to improve productivity

| Factors | Impact on Productivity | BIM Potential | IBS Potential | References |
|--------------------------|------------------------|---------------|---------------|---|
| Design error | ✓ | ✓ | ✗ | (Abdel-Wahab, 2008, CEFRIO, 2011, Ibbs, 2015, Teo et al., 2015, Naoum, 2016) |
| Quality of work executed | ✓ | ✓ | ✗ | (Abdel-Wahab, 2008, CEFRIO, 2011, Ibbs, 2015, Teo et al., 2015, Ai et al., 2016, Naoum, 2016) |
| Site overcrowding | ✓ | ✗ | ✓ | (Abdel-Wahab, 2008, Chelson, 2010, Statistics New Zealand, 2012, Yi and Chan, 2014, Ma, Liu and Mills, 2016, Naoum, 2016) |

| | | | | |
|---|---|---|---|---|
| Complexity of site works | ✓ | ✗ | ✗ | (Chan, 2002, Kuykendall, 2007, Abdel-Wahab et al., 2008, Ibbs, 2015, Naoum, 2016) |
| Environmental conditions & Project location | ✓ | ✗ | ✓ | (Abdel-Wahab, 2008, Ailabouni and Gidado, 2009, The Modular Building Institute, 2010, Vernikos et al., 2013, Yi and Chan, 2014, Ibbs, 2015) |
| Inefficient Planning | ✓ | ✓ | ✓ | The Modular Building Institute, 2010, Poirier, Staub-French and Forgues, 2015, Teo et al., 2015) |
| Coordination of Subcontractors | ✓ | ✓ | ✗ | (Chelson, 2010, The Modular Building Institute, 2010, Statistics New Zealand, 2012, Ibbs, 2015, Naoum, 2016) |

✓ The technology has the potential to improve the factor
✗ little evidence that the technology could improve the factor

As mentioned in the above table, BIM and IBS technology has the potential to improve productivity separately in some areas. However, the gaps identified in the above literature are that there has been little research attempts to utilize the advantages of the two technologies to achieve optimum productivity growth. The first contribution of knowledge for this paper is to examine the possibility of achieving maximum productivity improvement as an outcome of integrating both technologies. Figure 1 presents an overview about the areas in which the integration of two technologies could be feasible.

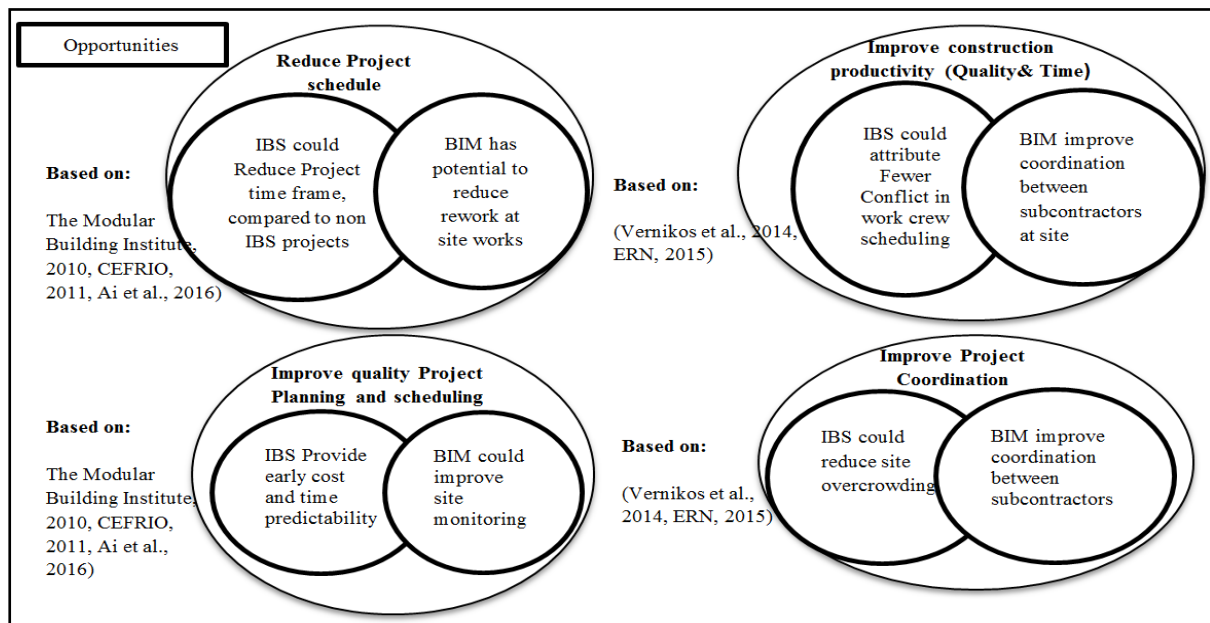


Figure 22: Potential BIM and IBS areas to optimise productivity in construction process

Despite the potential of the two technologies to impact on construction productivity, few studies emphasize challenges in implementing those technologies in the construction phase. Modular buildings require intensive planning for activities throughout the project cycle. Problems related to manufacturing, lifting, logistics (which includes: transportation regulation, arrangements with respect to modulus dimension, size, weight, height, coordination, permits for oversized module components) and connecting the modular components with site activities are one of the challenges that face contractors who use IBS. Lack of knowledge of IBS technology could attribute to improper structural analysis of modular components resulting in improper assembly during the installation phase. Coordination of modular design, material supply schedule is another obstacle that hinders IBS implementation. Due to the standardized of IBS components, issues such as low interface tolerances in between two components, interfaces between new and in situ components are likely to occur (Jabar, Ismail and Mustafa, 2013). Based on the literature, use of a BIM model

could have the potential to enhance some of IBS challenges during the construction phase and improve productivity. However, there has been little evidence to confirm the results. The second area of contribution of knowledge for this paper is to illustrate the feasibility of integrating BIM to IBS and areas that could require integration for productivity improvement to enhance the negativity of each technology when it works separately and eventually better productivity growth at project level, as illustrated in Figure 2 below.

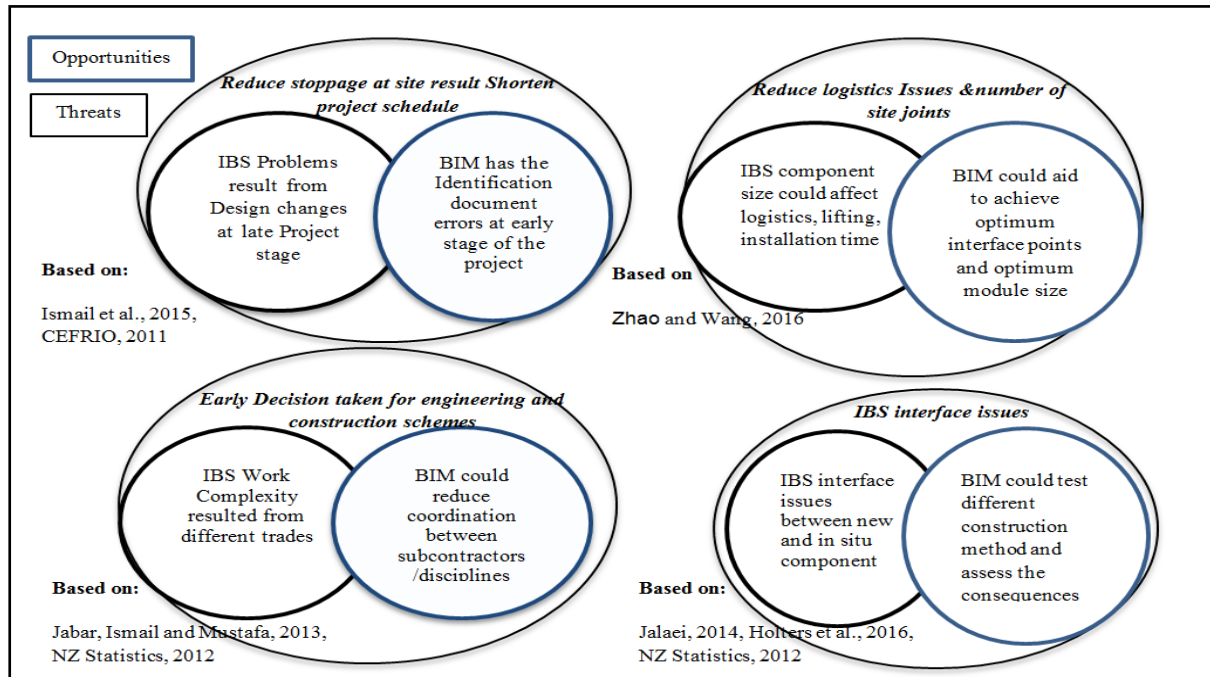


Figure 2: Identification of potential for Integration BIM and IBS technologies

4.2 Interview Results

Productivity: Findings from the interviews suggest that from a consultant's perspective, there are factors attributed to loss of productivity such as less site control, lack of supervision, inaccurate planning through the use of inadequate productivity standards, environmental conditions, material control and management. However, from contractor's perspective, factors that affect productivity include: insufficient or lack of material control; lack of construction equipment maintenance; changes in scope of work; imposed restrictions to site activities (e.g. hot work permits); climate and weather conditions; delays due to coordination between subcontractors as well as interfaces between stakeholders and authorities.

Integration: With regards to BIM and IBS drivers and the feasibility of integration, both consultants and contractors agree that system integration could be considered if there is a specific problem that cannot be solved using each system separately. However, the discussions revealed some questions as well as examples of how such integration could be achieved. An example of an emergent question is, whether integration could provide different scenarios for construction in cases where limited IBS components tolerances are difficult to achieve or where unexpected construction errors might exist. In this case, it is clear that BIM has the advantage of considering different construction schemes and risks of variation of IBS components orientation during construction phase, whereas IBS on its own does not have such capability. Further, the respondents thought that BIM could assist in optimizing the number of modules required to achieve the minimum number of IBS-based connections on

site and this could lead to reduction in number of site activities. Also, unlike IBS-based processes, BIM is a powerful mechanism for collaboration between project stakeholders, thus issues like: testing different design options at earlier stage of the project; accessing the project information; and taking decisions on the best design options are areas that could improve productivity at site. Finally, the respondents argue that BIM could have the potential to assist in solving interface issues of IBS with onsite works through of adequate and controlled management and planning system.

4.3 BIM and IBS Integration Model

System integration is melding two technologies, human performance and process together to achieve a specific task and functioning all together as one system (Myerson, 2001). Thus establishing a roadmap that provides step by step implementation of BIM- IBS integration as two systems is crucial as shown in Figure 3 below

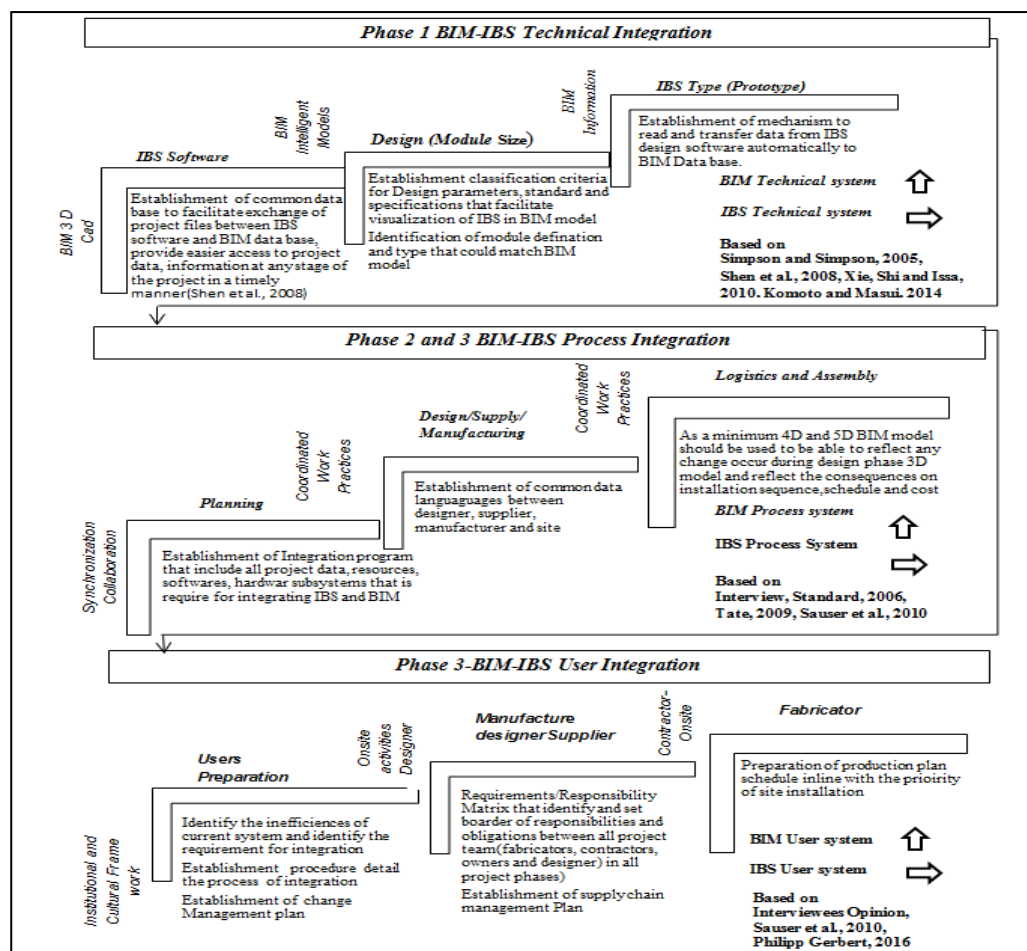


Figure 3: BIM-IBS implementation roadmap

5. DISCUSSION

Waste reduction and improved efficiency are required in order to help address the slowed growth in construction productivity as shown by CIOB (2016), which has seen only 7% improvement over the last two decade (Rhodes, 2015, CIOB, 2016). The key factors and

technologies that can be attributed to the issue of construction productivity have been examined and a novel solution that could enhance productivity requires integration of two essential systems (BIM and IBS). The systems thinking approach adopted for this integration provides a holistic way of understanding the advantages and implications of merging both systems via their technologies, process and users in construction processes. The feasibility of integrating BIM and IBS systems has been demonstrated in literature (Namini, et al. 2012) but there has been a lack of perspective on 'how' to use the merged system to improve site-based productivity. Based on the interview data collected from consultants and contractors, some examples of scenarios where integrating BIM and IBS could be beneficial include: (a) dealing with limited tolerances and unexpected construction errors in IBS by using BIM's capability for appraising different construction schemes including the risks associated with variations; (b) using BIM's 3D and data-driven capabilities to resolve interface issues between IBS components (c) reducing the volume of site activities by optimizing the number of modules required to achieve IBS-based connections; (d) using BIM's collaboration framework to harmonise the participation of project stakeholder.

It is clear from the scenarios described by both consultants and contractors that there are opportunities for integrating both systems. One explanation for the fact that such opportunities are largely unexplored is that BIM is mostly seen as a process (e.g. Karan et al., 2015) and driven from a technology perspective (e.g. Teo et al., 2015) and rarely from a whole 'systems' perspective (WSP, 2013). This is with the exception of when the 'systems' in BIM refer to the architectural, structural or mechanical systems, which are just sub-sets of the entire 'BIM system'. Literature suggests that the entire process and technology aspects of BIM qualify it to be a system, albeit a socio-technical system (WSP, 2013). The socio-technical nature of BIM lends itself to system integration which, according to Myerson, requires the fusion of different technologies, human performance and process that will function together and solve a problem as single system (Myerson, 2001). Consequently, the two frameworks developed in this study explore these potential areas where integration of both systems could be achieved. In addition, a preliminary road map for implementing the integration is proposed. However, evidence from the pilot interview respondents revealed that there are several risks associated with introducing a new system or paradigm to construction projects. Such risks will also be investigated.

6. CONCLUSION

This paper emphasizes the benefits of integrating two technologies BIM and IBS as two systems to improve construction productivity. A framework was used to illustrate the feasibility of integration using a systems thinking approach. This was followed by a road map describing the sequences and steps required for successful implementation of a BIM-IBS integrated system for the construction industry. This roadmap could provide some constructs to enable professionals in the industry to explore the feasibility and opportunities of integrating BIM to IBS. Further work is required to: (a) identify the risks of introducing systems integration to construction projects; and (b) develop a risk management strategy. The scope of this study has been limited mainly to infrastructure projects for the sake of clarity in understanding the factors and process of integration. The methods used were also based on a limited (pilot) number of interviews from professionals in the industry and more interviews (data) will be required to validate the integration framework and the road map proposed.

This research is still in its early stages. Thus the direction of future research is towards tailoring and verifying the framework and the road map presented.

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THE HOUSE BUILDING SECTOR: ARE CUSTOMERS CORE TO THE HOUSE BUILDING PROCESS OR JUST AN INCONVENIENCE?

C. Boothman¹, and N. Craig².

¹*School of Engineering; University of Central Lancashire, Preston UK.*

²*School of Engineering and Built Environment, Glasgow Caledonian University, Glasgow UK*

Email: jcboothman@uclan.ac.uk

Abstract: In 2005 the Home Builders Federation (HBF) developed a strategy to improve the overall level of customer satisfaction within house building in the UK. This was developed as a direct result of the findings of the Barker review (2004), which demanded that the sector improve its approach to customer satisfaction. This research examines how house builders use the data collected by the HBF to improve the service provided to the customers, the transition of any changes into practice and the overall management of the customer satisfaction process at all levels within the house builder's organisation. In order to explore how this data is utilised in practice, the changes implemented by senior/site management to improve the customer satisfaction and the transition of these changes to the sales, customer care and aftercare teams, ten semi structured in depth interviews have been carried out. Analysis of the exploratory data reveals a palpable divide between senior/site management and the sales and aftercare services provided by the developers. The research concluded that until developers address this apparent disconnect and make a paradigm shift to completely embrace customer satisfaction and customer care the overall service is unlikely to advance.

Keywords: Customer Care, Customer Satisfaction, Defects, Housing, Quality.

1. INTRODUCTION

For more than two decades the construction industry as has seen an unremitting furor from the government and homeowners alike to improve the quality of new homes built by the private house-building sector in the UK. As a direct result of the findings of the Mori/Constructing Excellence annual surveys completed between 2000 and 2003 and the Barker Review of Housing (2004) the National House Building Council (NHBC) in partnership with the HBF introduced a national survey of house builders, which launched in 2005 as a self-completion survey to the purchasers of new build homes at both eight weeks and nine months following legal completion. The annual survey is funded by the NHBC and the HBF undertake this survey on behalf of the NHBC. However, it should be noted that the members of the HBF (the house builders) are the same house builders that are registered with NHBC and therefore it may be argued that there is no separation between the two organisations or indeed the survey undertaken.

The results of the eight week (after taking ownership and moving in to the property) customer satisfaction surveys completed by the purchases of new homes over the past twelve years indicate that there has been a steady improvement in customer satisfaction across the sector, as commanded by Barker albeit the target of 85% for service quality was not met until 2010 and has only managed to exceed the target set for two of the twelve reported years (2012, 2013) for the “overall service provided”. The target of at least 85% still needs to be achieved for the “after sales service” provided by the builders to their customers. With the increase in demand for new homes and a decrease in both NHBC new home registrations and

completions over the twelve years the HBF Customer Satisfaction survey results published include a limited sample of the data collected from the eight week (not the nine month) customer satisfaction survey of new homeowners in the UK.

This study builds on previous work that explored how the senior management use the data collected by the NHBC to improve the service provided to the customers and the transition of any changes into practice within the developer's organisations. This paper seeks to investigate how the data collected from the NHBC is used by the house builders to improve the "overall service" (sales, aftercare services or customer care) provided to the customers and the transition of any changes into practice implemented by the house builders management team.

2. THE LITERATURE

2.1 Quality and House the Building Sector

Historically one of the most perplexing issues facing organisations in the construction industry is their inability to become quality focused, which is resulting in a substandard product or service (Love et al 1999). During the course of the last seventeen years following the findings of the Mori surveys (2000-2003), the HBF surveys (2005-2017), Barker (2004), the OFT (2007) and the APPG (2016), house building organisations have been more focused on managing quality as an attempt to improve their overall performance and competitiveness within the sector and thus has received a considerable amount of attention.

The principles of good quality in the house-building sector are encapsulated in legislation and standards such as the Building Regulations and NHBC Standards and it must be remembered that speculative developers will not respond unless it is imposed by regulations (Watts 2007). The volume of research specifically related, to the new speculative house building sector of the construction industry, is remarkably scant given the size of the industry sector and its overall contribution towards the construction industry. This research includes Bentley (1981), Bonshor and Harrison (1982), BRE (1988) and Harrison, (1993) which all focuses predominantly on regulatory defects i.e. contraventions to either building regulations or the warranty providers' standards. Auchterlounie and Hinks, (2001) suggest that the rest of the construction industry view house building as second division and private housing being lower than social housing with little literature regarding private house building and so little to measure quality against. It must be noted that the granting of a Local Authority Building control (LABC) "habitation certificate", a "final certificate" if the building control body is an approved inspectors (AI) or an NHBC "completion certificate" is not an assurance that the new home is of the required quality levels expected by the home buyer as the LABC, AI or the NHBC standards departments also have no control over many of the fixtures and fittings within a new home that are often the cause of many complaints, as these are not controlled or specified within current building standards or regulations within the UK.

Numerous academics and practitioners have researched defects, snagging, quality and rework within the UK house building industry including Sommerville and McCosh (2006), Sommerville et al (2006), Craig (2007), Sommerville (2008), Auchterlounie (2009) and Rotimi et al (2014) with the majority of these focusing on defects in terms of numbers created. It is generally acknowledged that the number of defects at the completion or handover stage (completion of the end-product) of a building appears to have a positive or negative influence on the satisfaction of the client or customer, however over the last two

decades the construction industry has become obsessed with the attainment of quality through the measurement and use of defects as a proxy. This is demonstrated by Craig et al (2010) whose research analysed over 199,000 defects related to technical and functional quality and established the issues and problems associated with snagging and the house-building sector.

Prior to the introduction of quality assurance (ISO9000 & 9001), the primary measure of quality was the finished product and in the private house building sector the finished product is still the end indicator of overall quality although the house building sector has been inherently slow to adopt the principles of ISO 9000/1 whilst one of the main recommendations of the APPG report (2016) was that house builders should 'instigate a new quality culture by adopting quality systems to ISO standards'. Macdonald & Piggott (1990) state that the 'customer's perception of quality includes more than the satisfaction obtained from the primary product or service, quality is delighting the customer by continuously meeting and improving upon the agreed requirements'. Furthermore Forsythe (2015) emphasizes that the tone of the quality debate has gradually shifted from a predominantly supply-side perspective of quality, to one that increasingly aims to deliver customer value, service and satisfaction. The overall problem is that quality is a subjective issue and positively correlates with overall customer satisfaction. Craig et al (2010) indicate that the customer is "perceived simply as a buyer who purchases the final product and as the "customer" they have no control over the finished product or the quality of the product".

2.2 Customer Satisfaction in the House Building Sector

Stephenson & Carrick (2006) comment that the purchase of a house is likely to be the largest single investment an individual/family may make and the industry is facing a more informed client. They further suggest that the construction industry still has a poor reputation and image with regards to house building, customers are becoming increasingly more aware and savvy and this has forced the industry to review the way it views the customer or home buyer. Dulaimi (2004) suggests that the emergence of the customer as the champion for change has increased the pressure on the construction industry to provide the higher quality and better service to satisfy customer needs and expectations.

Karna and Sorvala (2004) postulate that customer satisfaction can be seen as either a goal or a measurement tool to aid in the development of quality within the construction industry. The literature indicates that there is no commonly accepted method of measuring customer satisfaction in the construction industry (Auchterlounie and Hinks 2001) and it has been acknowledged that customer satisfaction has become an essential part of performance criteria in the construction sector, particularly house-building. Satisfaction can be viewed as a post purchase affect and its measurement therefore naturally reactive. The heart of the satisfaction process is the comparison of what is expected with the product or service performance, which Vavra (1997) describes as the confirmation or disconfirmation process. Furthermore customer satisfaction can be determined by either subjective (e.g. customer needs, emotions) or objective factors (e. g. product and service) (Oduro 2012).

The constant media attention on defects, the resulting quality issues in new homes ensures that the issue continues to be a subject of popular debate. Many prospective house buyers deem they are investing in top quality housing developments only to move into their new home and discover it is riddled with faults. The negative manner in which the problem of quality and customer satisfaction has been reported over the years (Kelly, 1998; Dyson, 2004;

Barrie, 2006; Linning 2015) is an indication that the house building industry has done little to address ‘customer issues’ within the new homes arena as customers still feel that the quality standards that have been achieved are low and not to their overall satisfaction.

2.2 NHBC/HBF Customer Satisfaction Surveys

For more than two decades the construction industry as has seen an continuous tumult from the government and homeowners alike to improve the quality of new homes and as a result of the findings of the Mori/Constructing Excellence surveys (2000- 2003) and the Barker Review of housing in 2004 the HBF in partnership with the NHBC introduced a national survey of house builders, which launched in 2005 as a self-completion survey to the purchasers of new build homes at both eight weeks and nine months after legal completion. Figure 1 highlights the results collected and reported by the surveys undertaken since 2000. It was expected from the launch date that the overall “service quality” would significantly improve and rise from 65% to at least 85% by 2007.

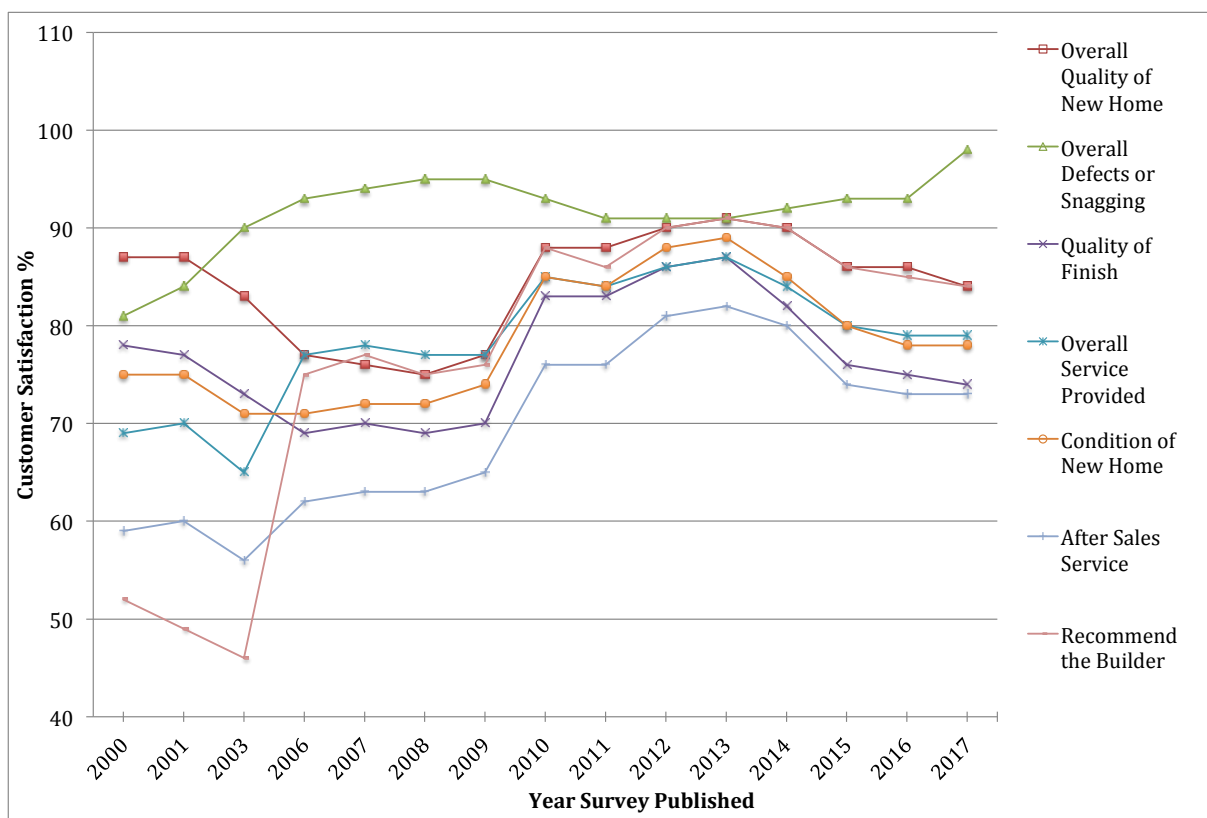


Figure 1: Levels of Quality & Service Provided 2000 – 2017 (adapted from Constructing Excellence 2000, 2001, 2003 and the HBF 2006-2017).

The target of 85% was not met until 2010 for the “overall service provided” and has still to be met for the “after sales service” the builders provide to their customers, which both demonstrate a downward trend as the number of NHBC registration and completions rise. Heath’s (2014) findings following “The Barker review” a decade on state that all the three levels highlighted within the Barker’s review are still to be achieved and the last decade may have been a lost one in terms of the service quality provided to the customers.

Further analysis of the published results indicates that there has been a steady improvement across the sector as commanded by the Barker review 2004. Taking into account all the four aspects that determine the “quality of a home” the data displays an upward trend in customers reporting defects or snagging, this rising significantly and remaining over 90% reaching an all-time high of 98% in 2017 and downward trends in the “quality of the finish”, “condition of the new home” and “quality of the new home” which, all significantly reduce until 2006 and then fluctuate for a three year period until a sharp improvement in 2010 which was throughout the years when a significantly lower number of homes were completed and registered with the NHBC. This comes as no surprise as the number of registrations fall the reported results improve, as the number of registrations was significantly lower than the 200,700 registrations in 2007, which further reduced in 2008 to 106,900 and bottomed out in 2009 with 88,080 registrations. However as the number of registrations started to rise to 146,359 in 2014, 156,140 in 2015 and 153,430 in 2016 the recorded results decline to the lowest levels since 2009, hence the published figures illustrate that as the number of completions and registrations increase the overall quality, service and customer satisfaction levels are reducing and the overall defects and snagging are increasing.

The literature reveals that the construction industry and specifically the housing market predominately concentrate on defects as an indication of quality when considering customer satisfaction. Albeit the HBF/NHBC customer satisfaction completed over the twelve-year period demonstrates that the house-building sector met some of the improvements commanded by Barker there are other improvements that have still to be met. None of the academic or practice lead research undertaken to date has explored how the data collected by the HBF is used in practice to improve the “overall service” (sales, aftercare services or customer care) provided to the customers or the transition of any changes into practice implemented by the house builders management team.

3. RESEARCH DESIGN

The research reported in this paper sought to explore how the data collected by the NHBC is used in practice by speculative house builders to (i) improve the overall service (sales, aftercare services or customer care) provided to the customers (ii) the transition of any changes into practice resulting from the data received following the satisfaction surveys and (iii) the overall management of the customer satisfaction process by the house builder(s).

To meet the objectives of the study, a qualitative research approach was implemented with semi-structured interviews used to collect data from a range of developers within the North West of England (small, medium and large). The criteria for the size of the house builder is based on the total number of units built per annum with the small <500, Medium >500 but < 2500 and the large builder >2501 units per year. This approach is supported by Creswell (2009) who states that it is an unfolding model that occurs in a natural setting that enables the researcher to develop a level of detail from high involvement in the actual experiences, allowing the researchers to gather data for the social phenomenon being investigated from the participant’s viewpoint (a Phenomenological Study).

To ensure reliability with the data collection the interview sample was selected using 'discriminate sampling' to maximise the chances of collecting relevant data from a small sample. A total of ten developers/house builders (selected from “Buildings” top 25 list of house builders) were identified within the North West (NW) of England who have been

involved with all HBF customer satisfaction surveys published to date (2003–2017). Initially invitation emails were sent to the top ten NW house builders outlining the purpose and background of the study and asking them if they would be willing to participate prior to sending the finally invitation. A total of (4) companies and (10) individuals agreed to participate in the study as displayed in table 1.

Table 1: Interview Participant profile.

| Respondent | Role | Type of organisation |
|------------|-----------------------|----------------------|
| A | Sales Consultant | Medium Developer |
| B | Sales Manager | Medium Developer |
| C | Sales & Customer Care | Small Developer |
| D | Sales Consultant | Large Developer |
| E | Customer Care Advisor | Large Developer |
| F | Sales Manager | Large Developer |
| G | Sales Manager | Large Developer |
| H | Sales Consultant | Small Developer |
| J | Aftercare Team | Medium Developer |
| K | Sales Consultant | Small Developer |

Each of the participants was invited to take part in a 30 - 45 minutes face-to-face interview, held at their offices between October 2015 and April 2016. The interviews were transcribed before being thematically analysed based on a theoretical framework developed from the researchers' previous analysis of the NHBC customer satisfaction surveys.

4. RESULTS

4.1 Improvements to the Service Provided to the Customer

The initial area explored during the interviews sought to determine how the differing sizes of builder/developers manage the service provided to the customers both post and pre legal completion.

The sales consultants/executive from both the large and medium size developers all indicated that the service provided is in line with either the developer's policies or the seven-step training they received from an independent recruitment company who specialises in training sales consultants for the house-building sector. The data revealed that the various developers are very focussed on the service they provide to the customer and are aware of the importance of the results of the NHBC customer satisfaction survey results and the impact that it can have on the company's future sales and success in the sector. The data revealed that the builders concentrate on the seven areas that make up the quality and the service provided elements of the satisfaction questionnaire (see figure 1) will all the interviewees agreeing that customer satisfaction is the number one priority.

The interviews revealed that the large builder concentrates on all aspects of the service they provide to the customer both pre and post legal completion until the new home owner is happy with their new home;

“Within reason we just give the customer what they want. If it's in the lead up to the eight weeks NHBC survey it becomes a priority for the aftercare team to ensure that we get a

positive response and favourable result to retain are star rating.” (Customer Care Advisor E).

They all agree that there are inconsistencies in the way that the process operates which has an impact on the overall service they provide to the customer and causes numerous unnecessary challenges for the sales, customer services and aftercare teams. The interviewees are of the same opinion that the management within their company primarily only concentrate on the build process and completing homes on time;

“The senior management don’t recognise or understand the customers and their needs, they don’t see the customer as the main priority, not core to the business and basically an inconvenience. They only see the building of the houses to programme to meet the targets set as their main priority.” (Sales Manager F).

The interviews further revealed that;

“the sales process, customer care and aftercare is considered by the management to be the separate part of the company that takes a back seat when it comes to meeting quarterly or yearend targets, this causes problems as it has an impact on the aftersales as quality reduces, the aftersales department becomes over loaded, they can’t keep up and complaints rise.” (Sales Manager G).

The medium size builder is very proactive in respect of the service provided to the customer, they ensure that the customer care and aftersales service they provide is as good as it can be however;

“When the yearend targets are to be met we are own worst enemies as the aftercare service we provide will be practically non-existent, we will only deal with emergencies, which causes a substantial reduction in the service provided to the home owner, resulting in a small issue rapidly escalating .” (Aftercare Team J).

The small builder differs in relation to the service provided as the sales, customer care and aftersales are dealt with by the one person who liaises with the site manager;

“providing the customer one point of contact from the initial reservation to legal completion and the aftercare service they receive. This empowers me and giving me the authority and ability to ensure that all issues are dealt with in a reasonable period of time” (Sales and Customer Care C).

4.2 Changes into Practice

The next area investigated through the interviews sought to establish how the builders implement any changes highlighted by their results of the HBF customer satisfaction surveys to improve the service provided and the overall satisfaction of their customers. Once again the interviews revealed that both the large and medium builders implement changes to improve the service they provide to improve their results.

The sales consultants/executives are of the same opinion and agree that they are very restricted and have no input or influence in any changes implemented within the sales, aftersales or customer care process. The management team without consultation implements all the changes as they are precluded from the whole process. Furthermore the consensus of opinion is that they would be able to improve and ultimately provide a service provided if they had the opportunity to contribute to the changes made within the developers companies.

4.3 Managing the Customer Satisfaction Process

The final area explored during the interviews revealed that the large developer is more customer focussed and commercially aware of the importance of the service they provide to the customers as this directly affects the overall satisfaction of the customer, therefore they are very proactive in contacting the client over the first two - three weeks through there dedicated customer services department.

“the aftercare department will contact the client seven and fourteen days after legal completion to see if they are experiencing any problems or issue since they moved in enquiring and if the site manager has completed the minor issues highlighted either at the home induction or issues highlighted within 14 days of legal completion. This allows the team to arrange for the outstanding issues or defects to be completed, at six weeks they are again contacted to ensure that all the issues have been completed to their satisfaction.”
(Sales Manager B).

The medium sized developer is not proactive in the follow up service they provide and they are much more reliant on site staff to rectify issues, which can result in delays to remedy the outstanding issues this having a negative effect on the company. They employ the same external company to complete a satisfaction survey providing them with a similar data set as the large builder, which acts as a trigger point to complete any outstanding issues or defects if not already complete prior to the customer receiving the eight-week NHBC customer satisfaction survey.

The interviews further revealed that both the large and medium builders offer a range of incentives to the staff if they (i) meet the quarterly sales targets, (ii) the overall HBF results relating to the service provided and customer satisfaction improve or (iii) sales and completion on star plots (hard to sell plots). The Sales consultants, executive, and sales managers actively encourage the customers to complete the HBF satisfaction survey, canvassing the customer in relation to the importance of a favourable outcome for the “recommend the builder to a friend” question.

5. DISCUSSION

It has been established within the review of the literature that there is a lack of research in relation to the quality of new build homes within the UK house-building sector. The current role of the HBF/NHBC surveys proscribes the discussion of the findings of this research directly with prior work completed within this area. Albeit the previous studies and research in associated areas identified the major sources and causes of quality issues, whilst this work is centred on new housing, a full-scale industry wide research effort is required to investigate the wider issues to provide a wider range of conclusions.

As there continues to be a fissure between the customer's expectations and what the house-building sector delivers in terms of quality, there is limited evidence that the industry is responding to the needs and concerns of their customers within the house building sector to bridge this obvious gap. The various reports produced over the last thirty years, highlighted the quality issue as an area of concern however this appear to have been ignored or disregarded by the house builders leaving them and the construction industry open for comments and investigations.

6. CONCLUSIONS

This paper sought to explore how the data collected by the NHBC is used in practice by speculative house builders to (i) improve the overall service (sales, aftercare services or customer care) provided to the customers (ii) the transition of any changes into practice resulting from the data received following the satisfaction surveys and (iii) the overall management of the customer satisfaction process by the house builder(s). The literature revealed that the HBF customer satisfaction survey results demonstrate that the house-building sector has met some of the improvements commanded by Barker but still need to meet the others. The results published by the HBF neglect to look at the long-term satisfaction of the customer, due to the published statistics and figures being solely based on the eight-week satisfaction survey.

The analysis of the exploratory data provided by the interviews revealed that there is an apparent disconnect between the senior management team, sales, aftersales and the customer care departments. The house building industry needs to address this apparent disconnect and make a paradigm shift to completely embrace customer satisfaction and customer care, if this is not the case the overall service provided to the new home owners is unlikely to advance. The recent parliamentary recommendation to make the annual customer satisfaction survey "independent" should be implemented by central government to collect an unbiased survey providing a more reliable data set and results for service, quality, and customer satisfaction for the house-building sector. The surveys currently conducted by the HBF are unlikely to reflect the true experiences and opinions of the customer as the sales team are actively encouraged by senior management to try to influence the customers prior to the completing the NHBC eight-week customer satisfaction survey to attain a favourable outcome for the survey.

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KEY SUCCESS FACTORS OF TOTAL QUALITY MANAGEMENT AND EMPLOYEES PERFORMANCE IN IRAQI OIL INDUSTRY

A. Aletaiby, U. Kulatunga and C. Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: a.a.aletaiby@edu.salford.ac.uk

Abstract: In times of the business world, under globalisation and overlapping variables, the concept of total quality management (TQM) as a philosophy to excel organisational performance is growing in significance. Many companies across the globe including oil and gas companies employ TQM, as its effectiveness has been observed to improve business performance in various aspects. The oil industry has a critical impact on the economy of Iraq as it represents the backbone and the major source of income to this country. The main aim of this paper is to developing a conceptual framework to improve the employee performance in Iraqi oil industry through applying key success factors of TQM. Therefore, the researcher conducted an extensive literature review on the TQM studies in order to identify and evaluate the key success factors of TQM in addition to the key measures of employee performance. The results of this paper find that there are nine TQM key factors: top management commitment, customer focus, continuous improvement, process management, training and developing, quality culture, employee empowerment and participation and communication. Moreover, three measures of employee performance have been investigated in this study: employee satisfaction and improving work climate. The main finding of this paper is a proposed conceptual framework which contains key success factors of TQM and their impact on employee performance. The proposed framework validate by interviewing ten decision makers in one of the most significant oil company in Iraq which is Iraqi oil company.

Keywords: Total Quality Management, TQM Key Factors, Employee Performance, Iraqi Oil Industry.

1. INTRODUCTION

In recent times, companies face continuous and massive changes in its business environment. Technological and economic levels are affected by the rapid development of globalisation, information technology, increased competition and modern management approaches. Thus, maintaining successes has become more challenging as companies face an environment that has become more complex, dynamic and challenging (Al-Khalifa & Aspinwall, 2001). TQM considered being one of the most long-lasting management innovations in the recent decades. TQM views an organisation as an integrated process that should be constantly improved by merging employees' knowledge and experience in order to attain organisational aims. It must be accomplished by management and employees in all company's activities (Hashmi 2004). Successful implementation of TQM assist the companies to run their activities more efficiently. It has been suggested that implemented TQM leads to better organisational performance (Nilsson et al, 2001). Abusa & Gibson (2013) argued that many multi-national companies especially Oil Company have already boosted up their organisational performance by effectively utilising the practices of TQM. The organisational performance is achieved by key indicators including customer performance, employee performance, financial performance, operational performance and environmental performance. However, according to Alsaidi (2014), the success to achieve TQM standards in many oil companies in the Middle East still lower than expected. Brah et al., (2002) stated within the context of TQM

implementation, there is increasing recognition of the significant role of employees in achieving the success.

In Iraq, the oil industry plays a critical role in the economy as it represents the major source of income for the economy. However, Iraqi oil companies are at the very initial stage of TQM development, despite its benefits and results on employee performance, even the quality management and developing performance was only developed in Iraq in early 2008 (IMOO, 2013).

From what has been mentioned previously, what is the impact of TQM implementation on the employee performance and does TQM practices and key factors provide benefit for the employees? This paper is seeking to enhance the literature review through highlighting the relationship between the key success factors of TQM and the employee performance in the context of the oil industry.

2. RESEARCH METHODOLOGY

This paper depends on conducting an extensive literature review as a method to identify the relevant book, journals, articles websites that describe, examine and concentrate on the key success factors of TQM in addition to the measures and indicators of organisational performance in general and employee performance in particular. A comprehensive literature search based on the keywords search method was conducted using the search engines like Solar, Scopus and Google Scholar. The keywords searched for “TQM”, “oil industry”, “employee performance”

3. TOTAL QUALITY MANAGEMENT

TQM is a term that was initially coined by the Department of Defence in the United States (Evans & Lindsay, 2001). TQM is considered as a new managerial concept; it took place in the USA in the early 1980s as a result of poor manufacturing product quality compared with their Japanese competitors (Talha, 2004). By 1982, American corporations were in a near panic due to the high productivity of Japanese companies who spread their products throughout America and they gained a high market share as a result of low labour costs in Japan, the Japanese work ethic, conflict between labour and management and burdensome government regulations in the USA (Mele and Colurcio, 2006). The spread of the TQM philosophy is expected to be accompanied by greater sophistication in the implementation of tools and techniques and extra emphasis on people. The process will also extend beyond the organisation to include partnerships with suppliers and customers. Activities will be reoriented to focus on the internal and external customer (Dale et al., 2013). By the 1990s quality programmes for productivity and innovation had been intensified to respond to new, often harsh, world conditions and contingencies. Quality management provided the basis for “a new approach in business management for the turn-around” (Mangelsdorf, 1999). Lau & Tang (2009) mention that the complex and dynamic technology, resources and task environment, and customer expectations and orientation are the primary factors behind adopting TQM in today's organisations. They add that TQM has shifted management style away from traditional thinking in terms of process control and organisation aims to giving more attention to the organisational culture as the essential driver of process control. TQM approach is now seen essential to long- term survival in business and a key factor that everyone in the company should be involved and committed from the top to the bottom of the

organisation. The successful total – quality-managed company ensure that their goods and services can meet their following criteria: (Harris et al., 2013)

1. Be fit for purpose on consistency reliable basis.
2. Delight the customer with the service that accompanies the supply of a good.
3. Supply a quality of the product that is so much better than that of the competition that the customers want it regardless of price.

Therefore, TQM can have a transforming impact on an industry that is in a state of substantial structural change and facing increased competition by raising performance. Invariably, the implementation of TQM by the Iraqi oil industry could result in the provision of overall high-quality standard that contributes effectively to improving the entire performance.

4. KEY SUCCESS FACTORS

The identification of key success factors of TQM assist the companies to understand more regarding the dynamic and active nature of this approach. For achieving successful TQM implementation within any company, thus, the characteristics prominent in these factors consider as essential elements that influence the implementation of TQM within any company. According to Najeh (2006), key factors there can be the production of two logical statements. Firstly, quality philosophers and empirical researchers. Secondly, there is no agreement observed on the sacrosanct critical factors of quality. Therefore, the majority have cited various factors that are common. For instance, leadership has always been included. Therefore, ‘near-universal’ acceptance has been expected by some of them whilst the rest are secondary or just marginal. Communication, teamwork, training and education are some examples of ‘nearly-universal’ quality factors. Labour-union relations are an example of marginal factors. Researchers such as (Flynn et al., 1994; Yasamis et al. 2002; Koh & Low 2010; Kumar, et al., 2011; Hietschold et al., 2014; Neyestani and Juanzon 2016) have contributed to the examination of the key factors of TQM implementation where they came up with more or fewer factors but of the same ground. Forming a general conclusion from these studies is that, there is a range of factors which have to be considered by each organisation for TQM implementation process to be precise and sure. The TQM concept is enforced by key factors which differ from each other as they are determined by the specific company. Table 1 reveals the numerous TQM factors that can be identified as being significant to the successful TQM implementation.

Table 1: Comparisons of TQM key success factors Propositions by different authors

| Flynn et al., 1994 | Black and Porter 1996 | Yasamis et al. 2002 | Lewis et al., 2006 | Kohl and Low 2010 | Kumar et al., 2011 | Gherbal et al., 2012 | Hietschold et al., 2014 | Dedy et al., 2016 | Neyestani & Juanzon 2016 |
|------------------------|--|----------------------------|-------------------------------|--------------------------------|-------------------------|--------------------------------------|---------------------------|-------------------|-----------------------------|
| Top management support | people and customers | Leadership | Customer satisfaction | Top management leadership | Management commitment | Communication to improve quality | Human Resource Management | Top Management | Customer focus |
| Quality information | Management supplier partnerships | Customer focus | Human resources utilisation | Customer management | Customer satisfaction | Organisation management | teamwork | Leadership | Leadership |
| process management | communication of improvement information | Employee empowerment | Management of process quality | People management | Continuous improvement | Training and development | Top management commitment | Communication | Process management |
| Product design | customer satisfaction orientation | Partnership development | Training and education | Supplier management | Teamwork | Employee involvement and recognition | process management | Customer focus | Supplier quality management |
| Workforce management | external interface management | Information and analysis | Management commitment | Quality information Management | Employee training | Culture | Customer focus | Teamwork | Employee involvement |
| Supplier involvement | strategic quality management | Project management process | Continuous improvement | Process management | Feedback | | Supplier partnership | Training | Information and analysis |
| Customer involvement | Teamwork structures for improvement | Continuous improvement | Leadership | Organizational learning | Effective communication | | Training and learning | | Training |
| | Operational | | Strategic | Continual | | | Information | | |

| | | | | | | | | | |
|--|--|--|---|-------------|--|--|----------------------------------|--|--|
| | quality planning | | quality planning | improvement | | | and analysis | | |
| | Quality improvement measurement systems | | performance measurement | | | | Strategic quality planning | | |
| | Corporate quality culture | | Customer focus | | | | Culture and communication | | |
| | | | Suppliers professional Associates | | | | Benchmarking | | |

An extensive review and analysis have been conducted on the above-mentioned studies by several industries worldwide. Based on professionals, researchers and experts findings and supported by the writing of quality pioneers, empirical surveys, case studies and quality awards and models, Eight factors have been identified which form the basis of the most significant factors to be considered as the key success factors of TQM. According to the nature of quality management implementation within the Iraqi oil industry, the identified eight key factors of TQM expect to be more relevant in the Iraqi context.

4.1. Top management commitment

With respect to its vital role in implementing TQM top management commitment considered as the initiation point in which quality activities stems from it (Hietschold et al., 2014). Top management commitment represents the main driving force behind the TQM thus, it is a responsibility to create an appropriate environment for TQM implementation. According to Seetharaman et al. (2006), an organisation cannot be transformed into a TQM if the TQM practices have not performed in the organisation by the top management. Having said that, the essential task of the top management is to guarantee this transformation and ensure its commitment towards the TQM activities.

4.2. Customer Focus

The main factor of TQM, in accordance with Richards (2012), is customer focus. Richards emphasizes that quality is defined by the customer but not by the organisation or the product or service manufacturer since quality is what the end user desires. Brah et al., (2002) claims that the success of any organization in near future would depend upon the satisfaction of its customers' needs efficiently and effectively on a continuous basis. In the same regards, Zhang (2000) stress that customer focus is the extent to which an organization continuously satisfies customer needs and expectations. Thus, it is one of the major means of TQM for improving and enhancing business performance.

4.3 Quality Culture

Quality is not a process that can be operated through evaluation and assessment only, but it is also a set of values and practices shared by the organisation environment and community and should be undertaken by all the organisation levels. The employees' roles in the success of quality culture in an organisation. These are considered as the asset of an organisation and its success depends on how the employees are treated (Watson & Howarth, 2012). The activities and efforts of employees are affected by the dominant culture in a working environment. Gherbal et al., (2012) stated, within the TQM culture an open and co-operative culture has to be established by the management in which all the employees regardless their managerial levels or positions have to be made to feel that all of them are responsible for achieving the organisation's objectives.

4.4 Continuous Improvement

Continuous improvement is the planned, organized and systematic process of continuing, incremental and company-wide change of current practices meant to enhance company performance (Boer & Gertsen, 2003). According to Dean and Bowen (1994), this key factor refers to an organization's ongoing quest for better work methods and organizational processes. A commitment to continuous improvement is ideally recognizable at the work unit and employee level. Moreover, continuous improvement is able to elevate the performance of an employee who is engaging in the TQM implementation.

4.5 Training and Development

Effective training and development of employees have been observed as an important part of human resource management. Training considered as a vehicle for applying and reinforcing TQM practices (Dedy et al., 2016). Training and developing lead employees better understand quality-related issues and improve their role within the quality management approach (Hietschold et al., 2014). Thus, effective training and development equipped employees with knowledge, skills and abilities for constructive contributions to quality.

4.6 Employee Empowerment

The success of TQM implementation is facilitated by employee empowerment and involvement in the company. Additionally, it stimulates employees to offer better job quality and contribute more in the new business process and therefore observed to be a crucial factor (Hietschold et al., 2014). Therefore, managers should motivate and encourage employees to take responsibility, authority and communicate effectively to improving the quality at all aspects of work. This will enhance the belongingness feeling of employees to their company.

4.7 Process Management

Process management as stated by Ibrahim et al. 2011), includes the set of behavioural and methodological practices that emphasis on companies activities and actions rather than achieving results. Kanji, (2012) reveals in a TQM organization, the focus is not on formal systems or structures. Rather, the focus is placed on setting up process management teams to solve the organization problems. The essential point, in this case, is to alight employees and their responsibilities with the organization and the processes in it. The success of an organization is based on its focus on the processes i.e. activities and tasks themselves rather than on abstract issues

4.8 Communication

Effective communication is established starting with communicating the values, policies and measures of the organisation to its employees. Thus, the organisation should communicate to its employees about its goal and quality policies without any doubt. To have an effective administrative system with least bureaucratic, all employees should be clarified with their own roles and responsibilities (Li et al., 2000). Kanji (2012) pointed out that without

communication, organisations would not function. If communication is diminished the entire organisation suffers. When communication is thorough, accurate, and timely, the organisation tends to be vibrant and effective.

Having discussed the above eight key success factors of TQM, it can be concluded that applying the TQM key success factors has a significant advantage on the entire organisational performance. The success of TQM implementation depends heavily on employees who will be directly involved in the implementation process. According to Ibrahim et al. (2011), TQM implementation depends mostly on employees' attitudes and activities in the company. Therefore, TQM must focus not just on the quality of the product but also on the quality of its employees to remain an effective management approach.

5. THE EFFECTS OF TQM ON EMPLOYEE AS A MEASURE OF COMPANY'S PERFORMANCE

Employees are the most important asset for any organisation as they provide support in productivity and performance enhancement. In order to become more successful and competitive, companies must consider their employees as the main engine towards achieving their goals in both short and long term (Mehmood et al., 2014). Performance improvement is approached as an operational philosophy that management adopts to benefit customers, employees, suppliers and shareholders alike in a context where quality improvement is a major organisational strategy to achieve competitive advantage. The performance improvement programs cannot be ignored in a company as they directly benefit the bottom line while providing a competitive advantage (Gharakhani et al., 2013). Considering the focus of TQM improving and empowering employees as well as conferring them with autonomy and authority, results in employees are likely to manifest in different dimensions. Among the various employee benefits to be gained by implementing TQM this study has been focused on Employee satisfaction and improve work climate as the most significant indicators that influenced by the eight key success factors of TQM.

5.1 Employee Satisfaction

Employee satisfaction is one of the primary cornerstones of TQM and is included as one of the quality goals, as satisfied employees are prerequisites for a desirable business result (Dedy et al., 2016). According to Alsughayir (2014), a strong link is expected to exist between an organization adopting TQM practice and employee job satisfaction with TQM giving emphasis on the significance of teamwork in facilitating the ability of employees in working together in getting a job done. Furthermore, Peris-Ortiz et al., (2015) advance that the tendency of TQM philosophy to let employees to control the quality of their work, to be more autonomous and to suggest improvement actions contribute in contributing to ensure that employee experience the benefits of job enrichment. From these, it can be derived that TQM is designed in a manner that employee satisfaction is one of the results of implementing TQM practices in companies.

5.2 Improve Work Climate

A key aspect in TQM in the workplace includes teamwork, which prospers when the different factions share the same vision of the organisation and which influence the roles they assume in the organisations. As quality is influenced by the environment which the employees operate in, TQM has to give attention to fostering the necessary work environment and endeavour to manage it with a view of achieving its conformity with the company's product requirements (Kaynak, 2013). According to Anvari et al (2011), the leadership informed by TQM provides the tools for working effectively and the work environment fostering productive work. With the workers satisfied and having the feeling of being part of the organisation, the employees are likely to work harder towards achieving organisational goals. Furthermore, the focus given to quality by TQM promotes a work climate that encourages learning to take place among employees while in the workplace and this further fosters improvement in quality and productivity. As it emerges, the workplace environment promotes in companies implies that those companies that adopt TQM exhibit improve work climate favourable for employee performance.

6. THE PROPOSED CONCEPTUAL FRAMEWORK

The above discussion is conceptualised in (figure 1). The conceptual framework illustrates the overall links between the main issues discussed in the theoretical and empirical literature review. In other words, the conceptual framework suggests the impact of eight key success factors of TQM and its implementation on improving the employee performance. Having said that, in this study top management commitment, customer focus, quality culture, continuous improvement, training and development, employee empowerment, process management and communication represent the key success factors of TQM.

In order to reflect the resulted eight KSFs from the literature to adapt to the oil industry practice in Iraqi, validation process was conducted through interviewing 10 leading executives in one of the significant Iraqi oil company which is Iraqi drilling company IDC. Thus, the proposed framework with the eight KSFs reflects on practitioners of the oil industry in Iraq through improving the employee performance particularly in terms of achieving employee satisfaction and improve work climate.

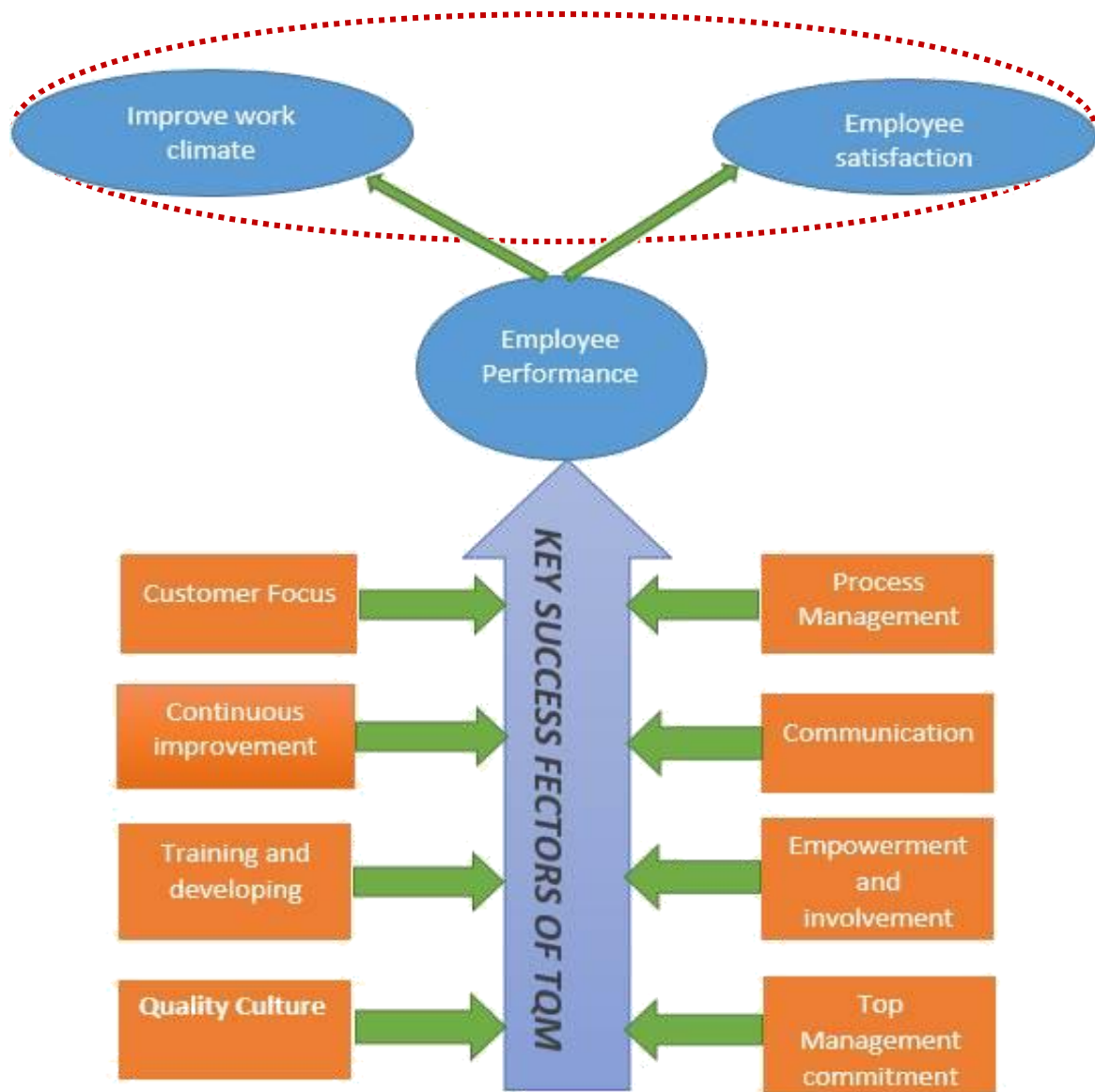


Figure 1: The proposed conceptual framework

7. CONCLUSION

This study reveals the importance of adopting TQM and its benefits/impacts on employee performance. Although there are several studies have been conducted to identify the required key factors of successful TQM implementation, however, there is still a lack of studies to examine the relationships between key success factors of TQM and employee performance, particularly in Iraqi oil industry. This mainly attributed to the fact that Iraqi oil companies are at the very initial stage of TQM journey. Therefore, this study has been identified and emphasised eight key success factors of TQM among many others in various studies. The study attempts to contribute to employ these key factors of TQM to achieve utmost results of employee performance in the context Iraqi oil industry. Therefore, the study proposed a conceptual framework that links the eight key success factors of TQM with the employee performance that directed by employee satisfaction and improved work climate.

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THE EFFECTIVENESS OF PROJECT RISK MANAGEMENT: A STUDY WITHIN THE LIBYAN OIL AND GAS INDUSTRY

R. Elhoush and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: r.elhoush@edu.salford.ac.uk

Abstract: Oil and gas projects are large, complex and risky, as they involve a considerable number of stakeholders, are technologically difficult and must adhere to tight budgets and schedules. Many of these projects are not delivered on time and within budget. The literature indicates that this failure is a result of improper project risk management practices. The literature also shows that although some scholars doubt the effectiveness of these practices, according to others, a positive relationship exists between applying these practices and project outcomes. This paper aims to explore the effectiveness of project risk management practices within the Libyan oil and gas industry. This paper follows a single case study approach. The data collection method adopted for this study was thirteen semi-structured interviews with experts. Results show that even though there is no written procedure for project risk management practices within the Libyan oil and gas industry, participants believe that applying these practices can increase overall project performance. This paper concludes that establishing an organisational culture to support the creation of a written risk management guideline, project manager leadership and familiarity of the individual with the project risk management concept supports the effectiveness of project risk management within the Libyan oil and gas industry, increasing project performance.

Keywords: Libya, Oil and gas, Project management, Project performance, Project risk management.

1. INTRODUCTION

Oil and gas projects are challenging, as they are complex, risky, involve a considerable number of stakeholders, are technologically difficult and must adhere to tight budgets and schedules (Briel, Luan, & Westney, 2013; Deloitte, 2015; EY, 2014, 2015). The continued need to ensure projects are managed properly and efficiently across the oil and gas sector has led both the industry and academia focusing on the development of reliable project management strategies to reduce project failures. Project risk management has been identified as a strong factor in need of careful assessment to ensure project failures are minimised (Al Subaih, 2015; Carvalho & Rabechini Junior, 2015; Rabechini Junior & Monteiro de Carvalho, 2013; Rogers & Ethridge, 2013; Salazar-Aramayo, Rodrigues-da-Silveira, Rodrigues-de-Almeida, & de Castro-Dantas, 2013). Briel et al. (2013) believe that, in these challenging environments, experienced project managers and the available project management best practices are not enough; instead, project managers should follow a coherent reference framework based on, but not limited to, official project phases and stage gates, the constant monitoring and reviewing of project risks and a strong integrated project team. To increase project performance, companies have committed to implementing effective project management and project risk management strategies. These strategies are meant to help companies remain competitive, while improving value creation among the company deliverables (Denney, 2006). The oil and gas industry has been subject to recent fluctuations in oil prices. In 2015, the price of oil fell to the lowest rate in almost four decades

(Baumeister & Kilian, 2016; Cagianelli, Michelez, & Nava, 2015a; Zhao, Hwang, & Gao, 2016), leading to project performance uncertainties, especially in regions affected by other additional risks, such as the uprisings and wars affecting the Middle East and North Africa (Khatib, 2014).

In Libya, the oil and gas sector is the economic backbone of the country, contributing significantly to the nation's income. According to the International Monetary Fund (IMF) (2013) and (2014), Libya's economy depends on oil and gas production. Hydrocarbon production contributes approximately 96% of the total government revenue. With the current risky and unsecured situation in Libya, the study of issues related to risk management in the oil and gas sector should be prioritised. Given the importance of project risk management as a factor in improving the performance of oil and gas projects, this paper aims to explore the practical effectiveness of project risk management in the Libyan oil and gas industry. The aims of this paper are as follows:

- Reviewing the relevant literature on reported project failures within the oil and gas industry and critically reviewing project risk management and the benefits and limitations of the tools and techniques used to support the process. This paper investigates the relationship between project risk management and project performance.
- Addressing the methodological choice followed.
- Presenting and discussing primary data collected for this study.
- Drawing conclusions, while also theorising about the way forward.

2. LITERATURE REVIEW

2.1 Oil and Gas Project Failure

Despite the importance of oil and gas projects, these projects still fail. In a recent universal study on the performance of 365 oil and gas projects conducted by one of the big four audit firms, Ernst & Young (EY) (EY, 2014), EY determined that a high percentage of projects failed to adhere to their approved time and budget. The study also revealed that project delivery success is declining when compared with the long-term industry outlook. The same study identified that improper project risk management practices are a primary reason for schedule delays and cost overruns. The study concluded with the recommendation that applying project management tools and techniques could improve project performance and reduce the risks of schedule delays and cost overruns. Aligned with these findings, according to Merrow (2012)—the founder of Independent Project Analysis (IPA) Inc. (IPA is a widely known for being a respected research organisation on project analysis including analysing projects within the oil and gas industry)—78% of oil and gas projects suffer from real problems with cost overruns and schedule delays.

Long (2015) identified several problems related to the improper project risk management that causes oil and gas projects to exceed their budget and have major delays. The author summarised the main problems as follows:

- Inadequate project definition during early project stages.
- Insufficient documentation.
- Lack of experienced workforces.
- A large number of change orders.

- Inadequate camp size facilities, leading to additional cost and time in construction for additional facilities to fill the gap.
- Incorrect cost estimates.
- Not clear contract documents.
- Poor baseline schedules.
- Poor production design.
- Insufficient project management teams to manage change orders.

2.2 Project Risk Management

It is believed that the word ‘risk’ originated from the Italian word *risicare*; a literal translation for this word is ‘to dare’. Therefore, risk is seen as an option rather than a destiny (Massingham, 2010). In recent years, the topics of risk and uncertainty have drawn the attention of many researchers and practitioners (Besner & Hobbs, 2012; Marle & Vidal, 2011; Rabechini Junior & Monteiro de Carvalho, 2013; Zwikael & Ahn, 2011). The topic of risk and risk management has been studied by different disciplines; the literature concludes there is no clear or standardised definition of these terms, and that different fields, such as economics, management, strategic management and project management view the concepts differently (Ehsan, 2013). Despite these differences, risk management is increasingly vital because the uncertainty surrounding many businesses continues to rise (Becker & Smidt, 2016).

According to the Project Management Institute (PMI) (PMI, 2013), project risk management is a significant area of project management. The PMI’s Project Management Body of Knowledge (PMBOK) considers project risk management one of 10 knowledge areas. Their belief is that if a project manager complies with these 10 areas, the success of the project is guaranteed (PMI, 2013). However, the literature shows that there is no standardised definition of project risk management. Ghosh and Jintanapakanont (2004) define risk management as a *‘tool for managing projects effectively through their life cycles’*. Variations in the definition of project risk management exist even among professional project management bodies such as the Association for Project Management (APM) and the PMI. APM defines project risk management as *‘a process that allows individual risk events and overall risk to be understood and managed proactively, optimising success by minimising threats and maximising opportunities.’* (APM, 2004), while PMI says, *‘Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, and controlling risk on a project. The objectives of project risk management are to increase the likelihood and impact of positive events, and decrease the likelihood and impact of negative events in the project’* (PMI, 2013).

Project risk management is a valuable component of project management, as it augments the worth of the other project management processes, offering support when employed with good practice values (Benta, Podean, & Mircean, 2011; Besner & Hobbs, 2012; PMI, 2013). The current practices of project risk management aim at recognising project challenges and multicultural environments, particularly those associated with increasingly global and complex environments (Thamhain, 2013). In the view of Besner and Hobbs (2012), project risk management is an organised practice to effectively manage project risks. Scholars and professional bodies, with slight differences in the level of detail, generally agree that the project risk management process consists of five steps: risk identification, risk assessment, risk classification, risk mitigation and risk controlling. Figure 1 (below) demonstrates these steps.

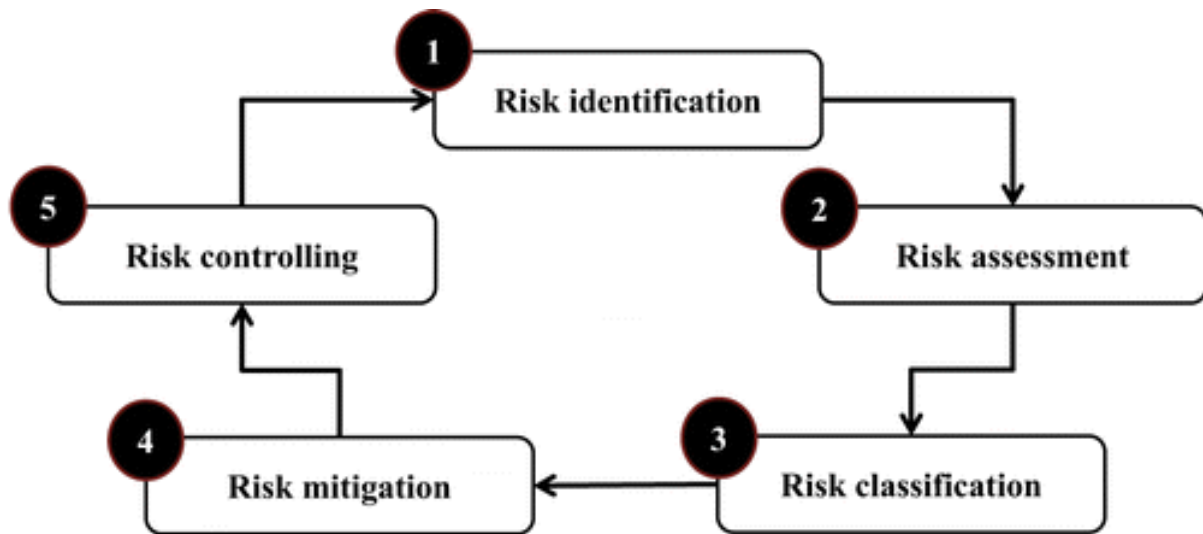


Figure 23: Project risk management process (Firmenich & Firmenich, 2017)

2.3 Different tools and techniques that support project risk management process

There are currently over 30 risk management techniques in the literature supporting project risk management activity, with varied applications and suitability depending on the nature, size and complexity of the projects (Cagliano, Grimaldi, & Rafele, 2015; Salazar-Aramayo et al., 2013). Such risk techniques require the utilisation of specific tools, so some projects may combine more than one set of techniques (Suslick & Schiozer, 2004). The following list shows the different practices in risk management as summarised by the extensive literature review done by Cagliano et al. (2015).

- | | |
|--|--|
| Checklist | Incident Reporting |
| Brainstorming | Pareto Analysis |
| Risk Ranking/Risk Probability and Impact | Monte Carlo |
| Change Analysis | Preliminary Hazard Analysis |
| Decision Tree Analysis | Sensitivity Analysis |
| Fuzzy Logic | Swift Analysis |
| Cause and Effect Diagram | Strengths, Weaknesses, Opportunities and Threats |
| Expert Judgement | '5' Whys Technique |
| Fault Tree Analysis | What-if Analysis |
| Event Tree Analysis | Risk Breakdown Matrix |
| Delphi | Risk Breakdown Structure |
| Expected Monetary Value | Event and Causal Factor Charting |
| Hazard and Operability | Failure Mode and Effect Criticality Analysis |
| Human Reliability Assessment | (FMECA) |
| Hazard Review | |
| Interview | |

2.4 Limitations of project risk management tools and techniques

The current tools utilised to assess and manage project risk have certain limitations, as outlined in this section. The literature underlines that there is a problem with the current risk management tools within the project management environment (Benta et al., 2011; Besner & Hobbs, 2012; Thamhain, 2013; Zwikael & Sadeh, 2007). The tools and techniques do not provide strong answers and have limitations based on a number of presumptions and assumptions (Aven, Vinnem, & Wiencke, 2007). According to Zwikael and Ahn (2011), although risk planning tools are popular within the project management discipline, the literature identifies many disadvantages regarding risk planning practices. These include: a limited variety of tools used, the poor quality of tool use and the high complexity and the perceived low effectiveness of existing tools.

Although many tools for assessing risks in projects are available, the majority of project risk assessments are limited to using risk-ranking tools only (Cagliano et al., 2015; Mojtahedi, Mousavi, & Makui, 2010; Osabutey, Obro-Adibo, Agbodohu, & Kumi, 2013; Whitfield, 2015). Evidence shows that effective risk assessment has gone beyond ranking the risk of projects and into developing an integrated and sustainable approach to risk management (Brandt, Sarif, & Mohd, 2013; Cagianelli, Michelez, & Nava, 2015b). Such models of risk assessment have two obvious shortcomings: the subjective nature of judgment and interpretation of data inputs, as human actors are likely to either underestimate or overestimate the frequency and chance of possible risks occurring; and the incompleteness of the analysis related to an assessor's failure to identify all relevant sources of risk. The main issue here is that while the calculation of risk through probability analysis may appear scientific in nature, it may be misleading and inaccurate in evaluating the true nature of risks (Carter & Hancock, 1994, p. 116; Harris, 2009).

2.5 Selecting an effective project risk management tool/technique

Choosing an effective risk management technique/tool is one of the key steps in ensuring guaranteed project performance. Considering how projects differ in nature, location, size or even complexity (Cagliano et al., 2015; EY, 2015; Salazar-Aramayo et al., 2013), projects may require different risk assessment tools to ensure project performance in different cultures (Liu, Meng, & Fellows, 2015). The selection of an appropriate risk assessment tool is a function of three important dimensions: the risk management phase, the project phase and the corporate maturity of the project team towards the risk (Cagliano et al., 2015). The following subsections discuss these three dimensions in detail.

Risk phases

Risk assessment is established by first understanding the nature and sequence of events around the risk. Risk is characterised by the sequence of three events: the cause, occurrence and consequences (Hillson & Murray-Webster, 2007). These three events have been converted into the phases of the risk management process, involving planning, identification, analysis, monitoring, response and control of the risk (Cagliano et al., 2015). The way they derive the risk assessment and management is provided in Table 1.

Table 1 Risk management phases and actions

| Risk management phase | Action towards risk management |
|------------------------------|---|
| Planning | Identify objectives, resources and approaches to risk |
| Identification | Causes of risk |
| Analysis | Probability of occurrence and impact of the risk |
| Response | Actions to develop opportunities and reduce threat |

Despite the clarity of the risk phases and their corresponding action plan, identifying the objectives, causes and even the probability of risk occurrence due to the individual knowledge and understanding of a particular risk is complex (Cagianelli et al., 2015b; Cagliano et al., 2015; Rabechini Junior & Monteiro de Carvalho, 2013). Many project failures, are due to the risk assessment team’s inability to understand and identify possible sources of project risk (Zwikael & Ahn, 2011), and their inability to accurately score the risk for a variety of projects, especially in the Middle East and North Africa (MENA) region (Aven et al., 2007; Liu et al., 2015; Srivastava & Gupta, 2010). Although the sequence risk phases are conducted in differs, the early part of the risk assessment, i.e. planning, is a crucial step in ensuring a project’s success during its implementation (Salas, 2015; Ward & Chapman, 1995).

Project life cycle phases

A project’s life cycle is demarcated by four distinct phases—conceptual, planning, execution and termination (Cagliano et al., 2015; Ward & Chapman, 1995)—which enables the management of a project’s schedule with distinct deliverables at each phase. The possible sources and causes of uncertainties are identified in the conceptual and planning phases (Cagliano et al., 2015).

Risk corporate maturity

Tackling and mitigating risk is different for every project and company. Risk corporate maturity requires an understanding and awareness of risk by considering that risk scope data are required to ensure the systematic implementation of the measures to mitigate risk (Pitsis, Kornberger, & Clegg, 2004). Perhaps some projects’ risks are managed based on an informal risk management approach, which tends to manage risks as they occur (Cagliano et al., 2015; Lyon & Hollcroft, 2012; Suslick & Schiozer, 2004; Ward & Chapman, 1995).

2.6 Project Risk Management and Project Performance

Several scholars have debated about the relationship between performing project risk management process and project success. Some believe applying these these practices has a strong positive relation with desirable project outcomes, while others believe the complete opposite. Elkington and Smallman (2002) stress the importance of earlier (e.g. project brief stage) project risk management in the project and consider the amount of project risk management used increases the level of project success. A recent comprehensive study conducted by Zwikael and Ahn (2011) examines the effectiveness of current risk management practices to reduce project risk. In their study, they used a multi-industry, multinational survey during the 2002–2007 period covering 701 project managers in seven

industries in three countries, including Japan, New Zealand and Israel. They found that the country and industry of the executed project has an important impact on the level of the perceived project risk and the risk management process adopted. The authors conclude that even a reasonable or moderate quantity of risk management helps minimise project risks, increasing the project's level of success. De Bakker, Boonstra and Wortmann (2012) agree that project risk management has a significant positive influence on project success, emphasising the risk identification stage as the most important factor contributing to project success. Baloi and Price (2003) and Zou, Zhang and Wang (2007) also found a strong relationship between performing project risk management and project success.

While numbers of authors support the idea that project risk management has a positive impact on project performance, other scholars do not seem as optimistic. For example, Raz, Shenhar and Dvir (2002) did not find a relationship between project success and risk management, stressing the need for more training, better tools and techniques, promoting the effectiveness of project risk management and the development of more tools specific to types of projects. Bannerman (2008) claims that, in practice, risk management methods lag behind the understanding and recommendations of the research literature. The author insists that, even if a project is successful, it can be challenging to relate that successful result to project management practices, believing instead that success is often credited to good luck or the efforts and exclusive skills of the individuals involved in the project.

Therefore, it is evident that many oil and gas projects still fail because of poor project risk management. As the relationship between project risk management and project performance is still ambiguous, this paper aims to investigate this phenomenon within the Libyan oil and gas industry.

3. METHODOLOGY

This paper aims to explore the practical effectiveness of project risk management in the Libyan oil and gas industry. Therefore, the National Oil Corporation (NOC) of Libya was chosen as a case study for this research. The NOC is fully responsible for all oil and gas activities (upstream, midstream and downstream) in Libya. The context of this research is limited to the oil and gas upstream projects within the Libyan oil and gas industry.

To gain full understanding of the phenomena, semi-structured interviews with 13 experts were conducted. All participants were chosen carefully to add value to the research and avoid any bias in the results. This research's participants include six department heads, three senior project managers, three project engineers and one board advisor. This research includes interactions between different people and technological influences in real-life situations. Different perspectives regarding risk management within the Libyan oil and gas industry were investigated during the research. This research largely follows the social constructionism (interpretivism) philosophy, the ontological position of subjectivists and the axiological view of being value-laden.

First, participants were asked about the availability of a written project risk management framework or procedure within the company. Then, they were asked to identify the tools and techniques most currently used to support the management of project risks within the Libyan oil and gas industry. Finally, they were asked about their views on the effectiveness of these tools and techniques related to project success.

4. FINDINGS AND DISCUSSION

Project risk management is a significant area of the project management discipline. The PMI's PMBOK considers project risk management one of its ten knowledge areas; their belief is that the project manager complying with these ten areas guarantees the success of the project (PMI, 2013). Yet, according to Cervone (2006), not all project managers appreciate the true value of risk management, and in many cases it is not given the attention it deserves. This may be because some authors doubt the effectiveness of project risk management practices related to the project's performance (Zwikael & Ahn, 2011). As mentioned in section 2.3, many tools and techniques support the project risk management process. Participants were asked to identify the most currently used tools and techniques within the Libyan oil and gas industry. When interviewees were asked about the availability of a written framework or procedure to perform project risk management, all answers revealed the lack of a structured framework or policy to follow. Instead, they mainly focus on identifying and assessing risks related to health, safety and environment. Therefore, all the tools and techniques used are solely based on the prior knowledge and experience of the project manager or engineer and his or her team. All interviewees were shown various tools and techniques used to evaluate project risks including brainstorming, risk matrix, Hazard Identification (HAZID) and Hazard and Operability (HAZOP), lessons learned, expert judgment, workplace risk assessment, Quantitative Risk Assessment (QRA) and Monte Carlo simulations. According to participants, the most frequently used techniques are brainstorming sessions and risk matrix. The other techniques are less commonly used, especially Monte Carlo simulations. This finding echoes the findings of the academic literature, as many scholars believe that, despite the many tools available project risk assessment, the majority of project risk management practices are limited to using risk-ranking tools (e.g. risk matrix) (Cagliano et al., 2015; Mojtahedi et al., 2010; Osabutey et al., 2013; Whitfield, 2015). Only simple techniques are used to evaluate risks within the Libyan oil and gas industry. This could be because the industry does not appreciate the value of having proper project risk management practices in place. One reason for this, according to Ahlemann, El Arbi, Kaiser, and Heck (2013), is that risk management applications are considered to have several issues, such as non-acceptance in practice, limited effectiveness and vague application situations. In addition, Ibbs and Kwak (2000) and Zwikael and Globerson (2006) identify a gap in the area, confirming that risk management practices are infrequently applied in many projects. Surprisingly, even in large and complex projects, their application rates are still very low.

When participants asked about the effectiveness of the current tools and techniques they used to identify and evaluate project risks, most of the participants believed that applying these techniques could enhance project performance. One participant mentioned, '*Of course it [applying the tools and techniques to evaluate project risks] does improve the success rate of the project because you will have a plan in advance*'. De Carvalho and Rabechini (2015) argue that applying project risk management practices can have a positive influence on project success, emphasising the importance of having a risk manager available for the project, as this could have a positive impact on the project outcome. Only two interviewees did not seem very optimistic about these tools and techniques. They did not think they are very effective. One respondent stated, '*...I do not think they are very effective*'. One reason for this was mentioned by one of the interviewees: '*All of the available techniques rely on the input data, so if people involved with the data input process have accurate readings, then the results will be accurate, as this is strongly related to the truth level of the input data*'. Another reason could be that the accuracy of the data depends on the person's own experience and knowledge. To this end, de Carvalho and Rabechini (2015) emphasise the

importance of soft skills in performing the project risk management process, stressing the significance of combining both soft and hard skills as a crucial factor in increasing project success. According to Grabher (2004) and Söderlund and Maylor (2012), soft skills are defined as the management of interpersonal relationships allowing the different people involved in the project to work together, while hard skills are mainly centred on administrative activities and the available toolsets to facilitate them.

Therefore, it is evident from the opinions of the participants that project risk management could improve project performance; however, within the Libyan context, it is also evident that no clear written framework guiding the project manager or his or her team to follow or facilitate the process currently exists. One possible reason for not implementing an efficient project risk management process could be as a result of the organisational culture. Different scholars (see Crawford, Morris, Thomas and Winter (2006); Sharma and Gupta (2012)) point to the influence of organisational context on risk management. These contexts include organisational culture, climate and demographics. Other factors that can influence the project risk management process, according to Gladwell (2012) and Söderlund and Maylor (2012), include the beliefs, power conflicts, judgement and trust of individuals. One would argue that to achieve an effective project risk management strategy, strong leadership is required to enforce these practices. According to Thamhain (2013), in order to establish a strong and effective project risk management process within an organisation there must be comprehensive participation and collaboration throughout all divisions of the project team and its setting. Thus, to ensure the effective implementation of project risk management within the Libyan oil and gas industry, making use of the value of its supportive tools and techniques, there should be a strong relationship between all team members including the decision-makers and top managers.

5. CONCLUSION AND WAY FORWARD

The aim of this paper was to explore the effectiveness of project risk management practices within the Libyan oil and gas industry. Ensuring that risks are identified, assessed, controlled and mitigated are the key steps of the project risk management process because unmanaged risks can cause significant issues throughout a project's life cycle, potentially affecting overall project performance. This paper identified a positive relationship between performing risk management and project performance, although some scholars noted in the academic literature do not support this argument. Different tools and techniques are available to support the process of conducting project risk management practices. Although there is no structured written risk management framework or procedure within the Libyan oil industry, most participants strongly believe that applying project risk management practices with the help of available tools and techniques could increase the project performance in the Libyan oil and gas industry. However, findings also showed that, even though there are different tools and techniques, only the simple ones are used (namely brainstorming and risk matrix). This paper concluded that establishing an organisational culture that supports the founding of a written risk management guideline or procedure, supports project manager leadership and ensures the familiarity of individuals with the project risk management tools, techniques and concepts, will increase the effectiveness of project risk management and project performance within the Libyan oil and gas industry.

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A STUDY OF BARRIERS TO ACHIEVEMENT OF VALUE FOR MONEY IN PUBLIC CONSTRUCTION PROJECTS PROCURED UNDER THE NIGERIAN PUBLIC PROCUREMENT ACT (2007)

I. D. Obieje and G. Wood

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: i.d.obieje@edu.salford.ac.uk

Abstract: In 2007, the Nigerian legislative arm of government enacted an Act of Parliament known as the Public Procurement Act (PPA 2007) to govern the public-sector procurements. The PPA (2007) amongst other objectives, aim to achieve value for money from government procurements. However, the reality for public construction procurements would suggest that this aim for value for money is not being achieved. Review of existing body of knowledge indicate apparent lack of in-depth qualitative understanding why this problem is occurring and how it may be improved. Adopting a qualitative research method design, and following a case study strategy, this study attempts a contribution to what is currently known about the problem. Data was collected through semi-structured in-depth interviews of construction project participants, targeting their experiences, reflections and opinions on case project procurement. Analysis was via thematic content analysis technique. Preliminary findings indicate that the causal factors why achievement of value for money was limited in scope was mainly due to excessive government bureaucracy, contractual disputes, rushed pre-contract period, scope variations, poor facility management planning, and lack of PPA (2007) compliance monitoring by external organizations. Addressing these factors could help public procurement practitioners make future improvements.

Keywords: Nigerian Public Procurement Act (2007), qualitative research, value for money.

1. INTRODUCTION

Nigeria has witnessed series of public sector reforms especially since 1999 when the country returned to a civil democratic system of government after many years of military dictatorship. Notable is the reforms on government procurements which culminated to an Act of parliament known as the Public Procurement Act of 2007 or PPA (2007) for short. Ude & Ahmadu (2013) suggests that the policy objective of this Act could be inferred from section 16 of the Act which states that:

“all public procurement shall be conducted ... in a manner which is transparent, timely, equitable for ensuring accountability and conformity with this Act and regulations deriving therefrom; with the aim of achieving value for money and fitness for purpose; in a manner which promotes competition, economy and efficiency”.

Therefore, it could be concluded that one of the basic aim of the PPA (2007) is to help achieve value for money in government procurements.

However, many years after the enactment of the PPA (2007), there are evidence in literature which suggest that this aim is not being achieved especially in construction procurement. What is not evident in literature however, is why the implementation of the Act to construction procurement is achieving limited success in terms of achievement of and how

achievement of value for money may be improved. Review of literature indicates that the PPA (2007) is faced with many challenges which mitigate its effective implementation. However, there are no empirical evidence linking these challenges to PPA (2007) underachievement as regards value for money. In addition, evidence from current literatures mainly relied on secondary data sources and/or quantitative assessment of practitioners' collective opinion and experiences across a number projects.

This paper contends that profound rich picture understanding of the challenges limiting the achievement of value for money based on in-depth qualitative investigation would be a valuable addition to what is currently known and can lead to suggestions on how future improvement could be made. It therefore presents evidence of challenges limiting the scope of achievement of value for money on public construction procurement based on in-depth qualitative study of the implementation of the PPA (2007) from a real-life construction project context. These are preliminary findings from an on-going doctoral research study aimed at developing a framework for implementation of the Nigerian Pubic Procurement Act (2007) that will improve achievement of value for money on public construction procurement.

2. LITERATURE REVIEW

2.1 Value for Money Concept

Value for money (VfM for short) is a phrase in common use, but for practical purposes, attaching a precise meaning to it has been described as inconsistent and problematic (MacDonald, et al, 2012; Glendinning, 1988). Various definitions of value for money exist in literature, for example, Glendinning (1988), HM Treasury (2006), Barnett, et al (2010), DFID (2011), National Office Audit (2013), etc. However, MacDonald, et al (2012) suggests that the more considered meaning of VfM recognize that value has many dimensions beyond the conventional economic rationalization perspective and includes social and environmental objectives and other intangible deliverables such as relationships, leadership, learning, reputation and trust. Accordingly Dewulf, et al, (2012, p.122) submits that VfM is not a unitary concept but a social construct which has become institutionalized in terms of what public auditors do in its name.

From the PPA (2007) point of view, no express definition of VfM was provided in the document, but the Director-General of the Nigerian Bureau of Public Procurement (BPP) defined VfM from the "Bureau's perspective" as:

"the term used to gauge whether or not an entity has derived maximum benefit from the goods, works and services it acquired and/or provides, within the resources available to it. Not only a measure of cost of goods and services, but also taking into account the combination of Quality, Cost, Resource utilization, Fitness for Purpose, Timeliness and Convenience to judge whether or not, when taken together, they constitute good value" (Ezeh, 2012).

The BPP is a public agency created by the PPA (2007) to oversee the implementation of the provision of the Act and formulate general policies and guidelines relating to public sector procurement.

2.2 Value for Money in Public Procurement of Construction

Public procurement of is the process through which the State acquires goods, works and services needed to fulfil its social and economic functions. VfM in public construction procurement, going by the forgoing definitions of VfM, would imply the explicit commitment to ensuring best results possible are obtained from money spent in acquiring construction works. Public construction projects fulfill strategic needs. According to Watermeyer (2013), construction of public infrastructure creates value through the economic and social activities the infrastructure support. Staples (2010) also suggests that the public sector might decide to spend more than is economically rational to achieve better whole-of-government outcome such as development of Small and Medium Scale Enterprises (SMEs), training of Apprentices or providing employment for at risk unemployed youths. Therefore, it could then be inferred that public-sector construction delivers value both as an end product as well as a means-to-an-end. Arrowsmith, et al, (2011, p. 5) opines that the objective of achieving value for money is a central to most public sector procurement.

However, the reality for public construction projects in Nigeria, would suggest that there is a limited scope of achievement of value for money as the PPA (2007) has aimed. Symptoms indicating that there are problems with public sector construction procurements in this regard which are evident in literature includes: high cost of construction works, construction cost over-runs, construction time over-runs, poor quality of works, increasing cases of re-work, use of in-efficient procurement strategies, and abandonment of projects (Bima, et al, 2015; Ajayi & Oyeyipo, 2015; Adegboye, 2014; Ekung, et al, 2013; Ade-ojo & Babalola, 2013; Shittu, et al 2013; Shwarka & Anigbogu, 2012; Onyema, 2011; Ibrahim & Musa-Haddary, 2010; Ayangade, et al, 2009; Olatunji, 2008).

2.3 The Nigerian Public Procurement Act (2007)

The Nigerian Public Procurement Act (2007) is an Act of parliament enacted by the Nigerian legislative arm of government. Williams-Elegbe (2012b, p.346) described the Act as a comprehensive statute, which created new institutions, new obligations for procuring authorities and strengthened existing ones, instituted the use of competitive procurement procedures; created a system of supplier remedies; a debarment mechanism and also created several procurement related offenses. It is made up of sixty-one sections divided into thirteen parts, covering the steps for procurement process, from procurement planning to contract award, and these are to be supplemented by the regulations issued from time to time by the Bureau of Public Procurement (BPP) (Udeh & Ahmadu, 2013). All procurement by the Nigerian public sector and other sectors where public contribution to funding is up to 35% of the total fund must follow the provisions of the Act (PPA, 2007).

The enactment of the PPA (2007) was a response to the deficiencies of the public procurement regime which existed before it. This regime was characterized with allegation of abuse and irregularities, loss and diversion of public fund due to inflated contract sums, over invoicing, “white elephant” projects, award of contracts to friends and cronies, use of primordial considerations in procurement decisions, non-transparent and flawed processes that yielded incompetent contractor which were linked to project failures, endemic corruption, poor service delivery, denial of social amenities to the people and collapse of local industries and infrastructure (Olatunji, 2008; Ezeh, 2011; Aladeloba, 2012; Shwarka

and Anigbogu, 2012; Olatunji, et al, 2016). It could be summed up that the public sector's procurement expenses in those days did not deliver value for money to the public.

The PPA (2007) is a decent of 1994 UNCITRAL Model Law on Procurement of Goods, Construction and Services which according to Udeh & Ahmadu (2013) is representative of international standard and best practices. The minimal impact of the law may very well lie within its implementation or lack of it. Amemba, et al, (2015), suggests that poor performance of public sector procurement results from non-adherence to laid-down process and procedure.

2.4 Challenges with PPA (2007) Implementation

There are compelling evidence in literature on challenges with public procurement implementation generally in Nigeria. These can be grouped under procurement personnel competence issues, organization and management issues, ethical issues, ambiguity or misinterpretations of PPA (2007) provisions, etc. For public construction procurement, Familoye, et al, (2015) identified sixteen (16) of these challenges and assessed them to determine the most significant by quantitative survey of practitioners' opinion. It concluded that procurement practitioners ranked 'Size and Complexity of procurement', 'Political interference' and 'Shortage of public procurement practitioners' as the top three (3) significant challenges facing the effective implementation of PPA (2007). It did not however, provide evidence towards what can be concluded in terms of the ability of the PPA (2007) in achieving its stated aim for achievement of value for money on account of these implementation challenges.

Generally, most literature on application of PPA (2007) to public procurement lack evidence based on in-depth qualitative understanding of the implementation of PPA (2007) to construction; why the PPA (2007) is having limited scope of achievement in-terms of value for money and how improvements could be made. This can be inferred from Table 2, a summary of literatures sources on application of the PPA (2007) to government procurement and their sources for evidence.

Overall, evidence from existing literature mainly relied on secondary literature sources and on practitioners' collective reflections and experiences across a number projects over some period of time based on a quantitative survey. There is need therefore to deepen current understanding of the problem through a more in-depth study to get richer qualitative assessment and interpretation of experiences on a project by project basis.

3. RESEARCH METHODOLOGY

The purpose of this study is to investigate the issues limiting the achievement of VfM in public construction procurement under the rules of the Nigerian Public Procurement Act (2007). Opinions in literature suggests that the judgement about achievement of value for money is subjective and depends on viewpoint of the assessor, varying from one individual to another and also form one point in time to another (Glendinning, 1998; Erikshammar, et al, 2010; Dewulf, et al, 2012; MacDonald, et al, 2012). Also, literatures focusing on the implementation of the Nigerian PPA (2007) in construction mainly relied on positivist quantitative analysis of primary data across a number of projects over some period of time

(see Table 2). There appears a knowledge gap mainly due to the lack of in-depth constructivist qualitative understanding based on a contemporary project context. For a more complete understanding of the problems that affect construction performance, Love, et al, (2002) & Dainty (2008) advocated for investigations that consider all philosophical viewpoints. Therefore, this study adopted an in-depth qualitative research method design, following a case study research strategy. The objective is to gain rich picture understanding of the implementation of the PPA (2007) from a real-life construction project.

Table 2: Summary of literature sources on implementation challenges

| Author | Publication type | Methodology/Data type & Sources |
|----------------------------|-------------------------|--|
| Bodunrin (2016) | Article in a Journal | Literature Review; of secondary sources of Data – Journals, Articles, etc |
| Achilike & Akwudike (2016) | Article in a Journal | Survey; quantitative data from a structured questionnaire |
| Olatunji, et al, (2016) | Article in a Journal | Literature Review; of secondary sources of Data – Journals, Articles, etc |
| Familoye, et al (2015) | Article in a Journal | Survey; quantitative data from questionnaire survey |
| Nwogwugwu & Adebayo (2015) | Article in a Journal | Literature Review; of secondary sources of Data – Journals, Articles etc |
| Bima, et al, (2015) | Article in a Journal | Survey; quantitative and qualitative data from semi-structured questionnaire |
| Ekung, et al, (2015) | Article in a Journal | Survey; quantitative data from questionnaire survey |
| Adewole (2014) | Article in a Journal | Literature Review; of secondary sources of Data – Journals, Articles etc |
| Williams-Elegbe (2014) | Article in a Journal | Literature Review; of secondary sources of Data – Journals, Articles etc |
| Jibrin, et al, (2014) | Article in a Journal | Literature Review; of secondary sources of Data – Journals, Articles etc |
| Ade-ojo & Babalola (2013) | Article in a Journal | Survey; mainly quantitative data from questionnaire survey |
| Ameh & Ogundare (2013) | Article in a Journal | Survey; quantitative data from a structured questionnaire |
| Aladeloba (2012) | Conference Proceedings | Survey; mainly quantitative data from questionnaire survey |
| Onyema (2011) | Article in a Periodical | Literature Review; of secondary sources of Data – Journals, Articles etc |
| Anago (2011) | Conference Proceedings | Literature Review; of secondary sources of Data – Journals, Articles etc |
| Ezeh (2011) | Conference Proceedings | Literature Review; of secondary sources of Data – Journals, Articles etc |

Implementation challenges common with the PPA (2007) found in literature were used to formulate ideas that were then investigated further through semi-structured interviews. Due to

the nature of the phenomenon being investigated, the study relied mainly on socially constructed reality of what value for money mean to the practitioners involved, through their experiences, reflections and opinions. To get to contemporary issues, the study selected three 'common case' public sector construction projects, one each from Nigeria's main three geo-political regions of North, South-East and South-West. Semi-structured in-depth interviews collected data from project participants about their experiences in-terms of achievement of VfM, reflecting on the project. Participants sampled for interview include representatives of the employer, project consultants, representatives of the contractors and the project beneficiaries, all with direct involvement with the case project and conversant with the PPA (2007) as in Proverbs & Gameson (2008).

Data analysis was done by Content analysis technique. The procedure was approached by first sending all interview recordings to a professional transcriber for accurate verbatim transcription. Interview transcripts were then formatted and uploaded into Nvivo 11 for Mac software to facilitate coding. Thematic coding technique was used to group excerpts from the interviews into themes following the interview agenda and other themes emerged during the coding process. Coding at each theme was studied for similarities, contrasts and contradictions. Deliberate search of specific data from project documents was done to confirm findings from interviews, resolve contradiction or to gain additional insight on an issue already raised from the interviews. Extensive use of direct quotations was used in presenting findings and are indented and italicized for clarity. The objective was to stay as close as possible to the data, and to avoid or minimize bias of reliance on latent content which according to Robson (2002) is a matter for inference or interpretation.

4. FINDINGS

The following are preliminary findings of the study from one of the selected case projects, involving six project participants.

4.1 Barriers to Achievement of Value for Money

A number of challenges faced during the procurement process of the case project became barriers that limited the achievement of value for money in various ways. When asked why the case project did not meet expectation on some key VfM metrics as earlier assessed by the respondents themselves, opinions given based on their reflections are presented under the following subheadings.

Prolongation

The respondents were concerned that the value for money achieved by the Case project was limited in scope due to the time it took to complete the project. Construction of the project was initially contracted for complete within two years, but it lasted over six years in the end. There were concern about the time value of money lost due to prolongation, and the loss of use or benefits of the facilities all through the years of delay.

“.... And I think if you were going to measure the opportunity cost in the loss, or in the unavailability of the project, of the building, of the facilities for the beneficiaries to use in

the past four years; if you put that into monetary terms, then, maybe you would say it did not have value for money, because it took too long”

Prolongation cascaded the project into deeper problems which further limited the scope of VfM achieved on the project in-terms of increased cost due to market price volatility.

Cost escalation

When asked to assess the cost performance of the project, respondents were unanimous that the project had not performed to expectations, although for some reasons. One reason cited was the macro-economic realities that unfolded during project execution, which of course were beyond the control of the project management in some sense.

“... also taking into account the volatility of the economy, fluctuations here and there which added to the cost of the project. I think the cost performance of the project (I wouldn't say it is spectacular) is a derivative of other things that occurred”

However, another respondent made a point to suggest that the prolongation of the project meant that it was vulnerable to the realities that continued to unfold.

“... the project was taking longer and you're sure, too, prices were changing on us”.

Then again, from the perspective of the Contractor Organization, expectations were not met on the cost dimension, in-terms of losses or reduced profits.

“... also, we had to execute works in the later part of the project based on the rates we had at the beginning of the project. ... because of the delay, we found that a lot of money was actually lost”

Changes in project scope or variations

Variations are common to construction projects. However, respondents were concerned about the limiting effects variations had on achievement of value for money. Some changes in design caused in-efficiencies and wastages resulting from re-work.

“... well, many of the re-works we did were not because of bad workmanship, but it was, maybe, because the Architect or the Client had a re-think...”

There were changes that impacted the contractor's ability to proceed diligently with the works and these had impact on the overall project delivery time. One respondent cited an example:

“... there was a requirement from the client that we do an extra basement because of the general topography of where the hostel block was located. So, that actually held down the project, in terms of time delivery ...”

Some of the changes were attributed to external realities that became emergent or issue that came up due to additional information that were not available during the design phase of the project.

“... as technology changed we too, we changed too, to meet the state-of-the art technology.”

Notwithstanding the desirability or inevitability of this sorts of change, they had their disruptive impact on progress as they have on budget because it appeared that Client Organizations’ express approvals were required; and those approvals were not easy to come-by.

There was also a suggestion that some changes encountered on the project were because of late involvement of the Contractor in the procurement process. When asked to give an assessment of the project delivery process in-terms of achievement of value for money, one respondent pointed out the non-early involvement of contractor deficiency of the traditional method of procurement adopted for the project.

“I think the traditional way of procurement delivery of design, bid and build have a lot of inefficiency in it, a lot of these variations are things that, naturally, wouldn’t have come up if the contractor was involved in the design process.”

However, this negative perspective of the traditional method of procurement was not shared by most respondents. Most believe the procurement method was not a problem. However, one respondent, albeit with a positive view of the traditional method, supported that some variations would have been averted had the Contractor been involved early.

“I would say on the strategy for this project, the strategy has proved to be very efficient and effective. However, we can’t go without saying that there were little conflicts between the contractors and the consultant on the terms of buildability, construction method and, you know, output in terms of availability of some of the materials that were specified”

Occupancy and maintenance issues

Another challenge that is viewed as a barrier to achievement of VfM by some of the respondent bordered on effective facility management of the completed project, putting the prior whole-life-cycle consideration of the project into question. Having delivered a facility which in the opinion of most respondents, is a high quality state-of-the-art facility that is fit for purpose, there are skepticism about the appropriate usage and maintenance of the buildings that will guarantee the building will continue to maintain the quality standard achieved during construction.

“.... it’s a highly-sophisticated building with sophisticated air-conditioning systems, you know, and security systems, and all of that, in place. ... it is of concern how this project is going to fare in the next five years.”

Insufficient pre-contract period

Insufficiency of the time allocated to the design development and information documentation phase of the procurement process was pointed out as one of the reasons that caused the delays which contributed to the prolongation of the project. After the construction contract was awarded, some design detailing were still ongoing and certain decisions were yet to be finalized. One respondent recall the pre-contract phase as follows:

“I remember it was a very, very frantic rush.”

Bureaucratic bottlenecks

When asked about their experience with government bureaucracy on the project, most respondents were unanimous on the prevalence of delays on project activities due to bureaucracy in the Client Organization. According to the respondents, these delays affected the contractor’s cash flow negatively and led to slowing down of the works, and sometimes outright stoppage of works by the contractor.

“I remember one re-curing decimal where the contractor would stall work on site, reduce their manpower and say, oh, they are unable to work because they haven’t been paid for three months”.

Some delayed decisions by the Client Organization also had its impact on completion program on items which stood on the critical path.

“.... bureaucratic bottlenecks occurred in terms of getting approvals for changes and variations that stood at critical path and it took, sometimes, several weeks to get approvals” “.... major reason why the time performance expectation was not met was the delay in the approval process [of the Client Organization] ...”

Disregard of contract terms

While recounting the reasons why the case project failed to meet completion time, one respondent suggested that not keeping to some key contractual terms by the Client Organization led to disruptions to the work program that resulted in project prolongation.

“... also, an incident where the advance payment was amortized very quickly, very suddenly, contrary to the terms of the contract, and all of this led to the situation where the contractor says, I can’t deal with this, and they shut down the site”

Lack of PPA (2007) compliance monitoring

Compliance monitoring implementation by civil society groups, professional bodies, etc. is one of the requirements of PPA (2007). This appear not to have been fully complied with as the respondents could recall outside organizations attending the bid opening during tendering, but cannot not recall any visits to site during the construction phase.

When asked how compliance monitoring can help improve achievement of value for money, some respondents were quite optimistic that oversight compliance monitoring by an agency outside the Client organization would help mitigate some of the challenges that became barriers to achievement of value for money experienced in the project.

5. DISCUSSION OF FINDINGS

5.1 Causes of Barriers to Achievement of Value for Money

Generally, evidence so far appear to indicate that the primary reasons why the project had limited achievement in the scope of value for money are due to project prolongation, cost escalation, variations in scope, occupancy and maintenance concerns and in –efficient project implementation process. It could be inferred that these are mainly management and organizational issues and don't seem to directly relate to Familoye, et al, (2015) three most significant challenges facing the effective implementation of PPA (2007) of 'Size and Complexity of procurement', 'Political interference' and 'Shortage of public procurement practitioners'. By applying Ishikawa diagram, Figure 24 is an attempt at cause-and-effect analysis of why achievement of VfM was limited in scope for the case project, based on current preliminary findings.

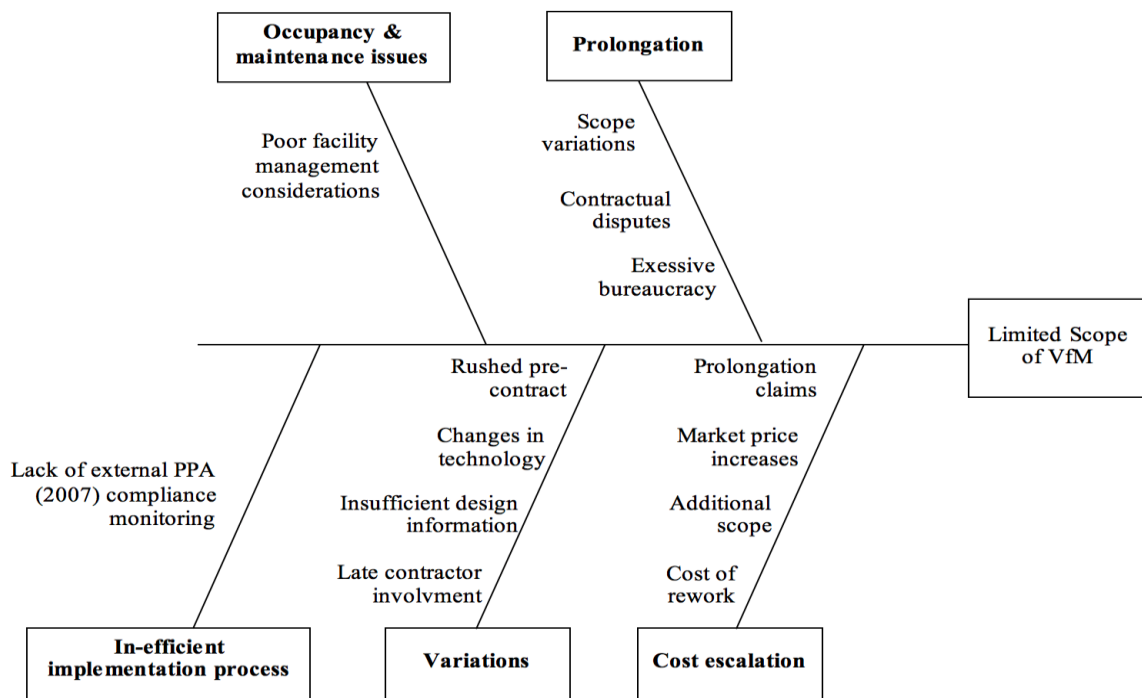


Figure 24: Barriers to achievement of value for money

Prolongation limited the scope of value for money achievable in more than one way. The completed facility was not ready for use as expected by the stakeholders, thereby deferring the benefits accruable or the need that the facility was meant to mitigate continued to be endured for extra four years. Also, prolongation had a contributing effect on cost escalation, another reason for limited scope of VfM, in the form of prolongation claims. Again, as the project prolonged, market prices of basic materials were also escalating due to macro-economic reason.

In addition to the cascading effect of project prolongation on cost, findings indicate that cost escalation was also caused by scope variations that led to wastages, progress disruption and rework. Although, it could be argued that benefits of changes in project scope that targeted increases or improvement of the project's value proposition but had negative impact on the other value for money dimensions is much of an individual's judgement. In terms of a Public-sector project, involving several and diverse individuals, this judgement could become complicated (Glendinning, 1988).

Respondents also believe that the project would have performed better in terms of achievement of value for money if there were PPA (2007) compliance monitoring by an external organisation and adequate whole-life approach to procurement planning that will consider facility management issues during the project design phase. Bello, et al (2013) had argued that ensuring value for money on a whole-life basis has been only a presumption of the PPA (2007).

6. CONCLUSION

This paper has presented barriers to achievement of value for money on public construction procurement under the Nigerian Public Procurement Act (2007) based on in-depth qualitative investigation on a contemporary public construction project context. These are however, preliminary finding from an on-going doctoral research study. So far, findings indicate that the compelling reason why the project has limited achievement in the scope of value for money is because of the undue project prolongation caused mainly by excessive government bureaucracy, contractual disputes, insufficient pre-contract period, variations to scope, poor facility management planning, and lack of PPA (2007) compliance monitoring by external organization. Therefore, it would appear that success factors for improving the scope of value for money achievable for public-sector procurement under the regulatory framework of the PPA (2007) will include the following: allocation of sufficient time for pre-contract activities, minimization of scope variations, measures to mitigate or minimize payment delays, Measures to mitigate or minimize approval delays, reduction of contractual disputes, adequate advance planning for facility management of completed facility, PPA (2007) compliance monitoring by external organization.

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AN ASSESSMENT OF CRITICAL SUCCESS FACTORS FOR IMPLEMENTATION OF CRITICAL INFRASTRUCTURE PPP PROJECTS IN GHANA

J. Tchorly and A. Higham

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: j.t.tchorly@edu.salford.ac.uk

Abstract: Owing to the growing demand in critical infrastructure in Ghana and a decrease in public sector investment as a result of serious fiscal constraints, it has become necessary to encourage private sector revenue generation through participation in critical infrastructure delivery in order to offset public cost. The continuous call by the government to create an enabling environment for private capital in critical infrastructure delivery and the need to not only introduce but successfully implement the PPP model cannot be overemphasised taking into consideration other differing approaches. Despite the attraction to the PPP model around the world, its implementation has not been void of difficulties. The paucity of knowledge as a result of its novelty requires the identification of context-specific Critical Success Factors as Ghana is in its initial stage of adoption and implementation of PPP as a financial model. Major parameters critical for successful implementation are identified through literature and semi-structured interviews engaged amongst stakeholders both in the public and private sector key in the implementation of PPP to investigate the significance and efficacy of these parameters: Whole Life Cycle Costing; Risk Management and Competitive Advantage.

Keywords: Competitive Advantage (CA), Critical Infrastructure (CI), Public Private Partnerships (PPP), Risk Management (RM) Whole Life Cycle Costing.

1. INTRODUCTION

The significance of the Ghanaian Construction Industry (GCI) like other countries, is such that an investment in the industry by way of capital expenditure or a disinvestment affects not only all the other sectors of the economy but the entire citizenry. However, Ghana is faced with serious infrastructure gaps as a result of the ailing economy, adverse macro-economic conditions such as major depreciation of the currency, high inflation and interest rates aggravated with the overwhelming population growth: making growing needs steeper. Its infrastructure deficit requires a total of \$2.5 billion spend annually to meet the existing infrastructure demand (MoFEP, 2014) even as a high of 99.4 per cent of its total revenue (GDP) in 2016 constituted only: public sector wage-bill, statutory payments and interest payments on loans (Ofori-Atta, 2017). The remaining 0.6 per cent of GDP is woefully inadequate to support government activities let alone develop critical infrastructure as the \$2.5 billion required to meet the infrastructure gap annually represents circa 15 per cent of average GDP. The intractability of the public sector wage bill which is currently a high of 73 per cent of total government revenue, mandatory statutory payments necessary for government operations and interests on loans taken by the government to advance development and other government activities leaves no fiscal space for economic growth. Ghana's prospects are at risk as there are serious fiscal and external imbalances with an over-blown wage-bill (IMF, 2015). Set against this background of fiscal constraint, the total debt stock till date stands at a high of about 73 per cent of the country's GDP (MoFEP, 2017). The economy therefore continues to shrink with a decreased growth rate annually as further

borrowing is unsustainable because of the nations' debt to GDP ratio (IMF, 2015). Although paradoxically, borrowing for an investment in the ailing construction industry for instance will reduce lapses in demand and supply of critical infrastructure and help develop the economy in the long term in terms of GDP growth and the like.

High interest rates coupled with the significant fall in oil revenue resulted in a fiscal deficit slightly above 10 per cent in 2014 (World Bank, 2015). These structural imbalances led to the depreciation of the cedi, high inflation rates and a decline in the financial reserves (Bank of Ghana, 2016). Inflation rates recorded a high of 17 per cent in December 2014 compared to 13.5 per cent in 2013 (Ghana Statistical Service, 2015). The cumulative cedi depreciation increased from 14.5 per cent to 31.2 per cent in 2013 and 2014 respectively (Bank of Ghana, 2015). It is however argued that expenditure over-runs are usually on recurrent budgets as capital expenditure in particular is reduced (ibid). The government tends to resort to the domestic banking system, divestiture proceeds and external sources to mitigate these issues which cripple private sector growth in terms of their access to credit and the like. Also, the government has had to depend on several short-term domestic debts with high interest rates as well as other important monetary financing in order to arrest the ailing economy (Bank of Ghana, 2016). These fiscal challenges provide a clear indication of the significance of adoption and implementation of PPP as a financial model which utilises private capital to bridge the gap in the demand and supply of public goods and services. Ghana's initial stages of PPP implementation requires that CSFs be identified and considered to mitigate challenges from best practice which is the underlying motive of this paper. Private sector participation in terms of finance, operation, maintenance and the like will go a long way to ease the government of fiscal constraints such as infrastructure capital expenditure. It will deliver critical infrastructure for social and economic development as the provision of this infrastructure will provide an environment for GDP growth. This paper therefore investigates major parameters identified from literature which have been refined through best practice for successful implementation of PPP projects in Ghana. The knowledge of these parameters, its applicability in Ghana and the extent to which they are being considered are investigated amongst key PPP implementers in Ghana both in the private and public sector.

2. PUBLIC-PRIVATE PARTNERSHIPS

Khanom (2010) maintains that there are globally recognised concepts of PPP but there is still no accepted definition of the phenomenon. William (1997) postulates the insignificance of an accepted definition since PPPs are commonly defined as a cooperation between the public and private sector. Hodge and Greve (2007) argue the need to re-examine the distinct meanings and concepts attributed to PPPs to investigate the use of the idea for empirical studies. PPPs are typically touted as a collaboration between parties of the public and private sectors to achieve a common goal or a series of goals as the term literally expounds (Eaton, 2013; Mouraviev, 2013). The researcher simply describes Public-Private Partnerships as a definite binding contractual arrangement between parties of the public and private sector where most often private capital is used in delivering a public product or service for a specific period of time. The Government of Ghana (GoG) has sought to stir policy and legal restructuring, finance mechanisms and institutional backing to promote private sector involvement in public sector infrastructure provision (World Bank, 2015). The World Bank (WB) has also been instrumental in the call for private sector participation in public service delivery and is very well involved in the creation of a strong PPP policy that will bring mutual benefits to the parties involved (MoFEP, 2015). The WB therefore provided a US\$ 30

million credit over a four-year period between 2012 and 2016 for capacity building at various levels for a more comprehensive programme available for the adoption and implementation of PPP from 2017 (World Bank, 2015). On June 3, 2011, GoG approved a National Policy on PPPs as a foundation to build on structured PPP contracts in Ghana. For this reason, a legislation has been put before the Parliament of Ghana to be promulgated which will provide the essential legal framework pursuant to the National Policy (MOFEP, 2015). With regards to this policy document, PPP is defined as a contractual arrangement between a public entity and a private sector party, with clear agreement on shared objectives for the provision of public infrastructure and services traditionally provided by the public sector.

2.1 Critical Success Factors (CSFs)

PPPs have made significant impacts worldwide in public infrastructure development. PPP implementation around the world have spurred researchers into the determination of CSFs particularly in mature PPP jurisdictions like the UK, Canada, Australia among others (Babatunde, 2015). Since the inception of PPPs as a procurement route, it has been important for researchers and respective implementers of this policy to engage CSF modalities in the development of infrastructure. Indeed, the concept has been engaged in diverse sectors of PPP arrangements and all infrastructure sectors including transportation, telecommunication, energy and housing (Ozdoganm & Birgonul, 2000; Askar & Gab-Allah, 2002; Jamali, 2004). Again, Meng et al. (2011) investigated the CSFs in the water sector where projects in the Chinese industry were developed under a transfer operate transfer model (Osei-Kyei & Chan, 2015). CSFs are therefore defined as the few aspects of activity where favourable results are absolutely necessary for project success or achievement of goals (Qiao et al., 2001). It is important to determine CSFs responsible for successful implementation of PPPs in different countries (Stonehouse et al., 1996; Tiong, 1996; Gupta & Narasimham, 1998; Qiao et al., 2001; Jefferies et al., 2002; Zhang, 2005; Li et al., 2005; Cheung et al., 2012) to inform implementation in Ghana. In the PPP/PFI procurement model, the main features that ensure an effective and sustainable process are the identification of the WLCC perspective, the introduction of RM and appropriate risk transfer, VFM features and the capability of introducing new sources of Competitive Advantage (CA) (HM Treasury, 2003; NAO, 2001). Li and Akintoye (2003) opine that RM is core to the implementation of PPPs around the world as it is one of the mutual benefits of the model. The efficient RM is one of the pillars of PPP implementation and it ensures VFM (ibid). A study by Akbiyikli (2005) finds that to ensure effective implementation and sustainability of PFIs, CA should be considered among RM and WLCC. Parameters critical to implementation of PFI projects are WLCC, RM and CA (Akbiyikli & Eaton, 2006). Therefore, CA will be considered as a major CSF concept for intents of this research. A pedagogic perspective of these key parameters as major concepts for CSFs necessary for successful implementation is illustrated in Table 1.

*Table 1-Key Parameters and brief description
Adapted from Akbiyikli, 2005; Eaton, 2005; Meng et al., 2011*

| KEY PARAMETERS | BRIEF EXPLANATION |
|---------------------------------|---|
| Whole life Cycle Costing (WLCC) | Opportunity for full integration under the responsibility of one party (SPV) of up-front design and construction costs with on-going service delivery, operation and maintenance costs that will provide VFM. |

| | |
|----------------------------|---|
| Risk Management (RM) | Risk retained by the public sector in owning and operating infrastructure typically carries substantial, and often unvalued cost Transferring some of the risk to a private party which can better manage it can substantially reduce the overall cost to public sector. |
| Competitive Advantage (CA) | PFI deal focuses on output specification, providing wider opportunity and incentives for bidders to develop innovative solutions in meeting these requirements. PFI incentivises SPV to take a longer term approach to design and construction PFI incentives allow SPVs to deliver the built asset to budget and on-time Payments are fixed in the Project Agreement (PA), which encourages accurate assessment of costs and risks. Private sector providers are motivated to develop opportunities for revenue beyond the public sector payment stream and this is used in part to reduce the cost of services to the public sector. |

3. METHODOLOGY

It was prudent to use a qualitative research design to collect data from the key stakeholders of PPP implementation in Ghana to meet the aim of this paper. This survey entailed the vigorous engagement of semi-structured interviews to seek answers of relevant questions that would bridge the gap or confirm related CSF subjects identified in literature. The semi-formal interaction dismisses certain sensitive issues and in the case the inefficiencies, mishaps etc. that will otherwise not be expressed on a questionnaire. A total of eight semi-structured interviews were conducted amongst the public and private sector players: two key government players in the Ministry of Finance; three major players of a major advisory firm; two instrumental legal experts and a private investment banker. The rationale for this was to provide a strategic approach to a pertinent population for better and quality results. Also, the Ministry of Finance in Ghana is solely responsible for PPP undertakings in the country and drives all government agenda regarding PPP. It serves as an intermediary for the government and private sector entities rolling out trainings, policies etc. (Apenteng, 2013). The international advisory firm handles all major PPP projects from the Expression of Interest (EoI) stage through pre-feasibility and feasibility stages etc. The legal experts were also instrumental in formulating the draft PPP bill in Ghana and so are on top of all legal issues regarding PPP implementation in the country. The head of a private investment company responsible for funding for the major public sector deals from the potential private sector participants in major PPP undertakings was also interviewed. This sample reflected a true representation of all stakeholders in the implementation of all PPP projects and potential projects in the pipeline. See table 2 for profile of participants.

*Table 2 - Respondents' profile
(Developed by Author)*

| RESPONDENT'S CODE | BACKGROUND | SECTOR |
|--------------------------|---|---------------|
| CI 1 | Finance | Public |
| CI 2 | Accounting and Finance | Public |
| CI 3 | Transport Engineer | Private |
| CI 4 | Infrastructure Economist/ Transport Modeller | Private |
| CI 5 | Project Finance-PPPs | Private |
| CI 6 | Government Business & Policy Reform in Law, Banking & Finance, PPPs and Procurement | Public |
| CI 7 | Construction, PPPs, Procurement, Banking & Finance, Energy, Oil & Gas | Private |
| CI 8 | Business Consultant/ Investment Banking | Private |

All interviews were transcribed to enhance efficient analysis via the NVIVO software. The decision to use the qualitative software minimised dependence on personal bias, avoids an analysis via arrangement of pieces of paper and increases the accessibility of the data for interpretation by other researchers. It also enhanced the transparency and reliability of the analysis and provided a more structured approach in the analysis of the interviews. Before the start of each interview, the participants were told of the academic-purpose driven semi-structured interview and the confidentiality of their data. They were given a right to withdraw from the interview at any time as per the code of ethics. The duration of the interview was between forty-five and sixty minutes. This allowed time for rendering the interview questions based on the guideline, asking supplementary questions for clarification and soliciting more details if necessary without interrupting respondents chain of thoughts. The most important advantage of these semi-structured interviews was its flexibility and the fact that it allowed the researcher to probe deeper into the questions when required in order to gain valuable information from the participants. Questions were kept open ended and were designed to gather the respondents' views thorough responses surrounding the topic. Their responses were then identified and generated into prominent themes and triangulated with the literature.

4. RESULTS AND DISCUSSIONS

The following are the emerged themes from the semi-structured interviews based on the objective set out in this paper and the CSF parameters identified in the literature review. All parameters are interrogated on their merits, benefits, applicability in the context of Ghana, recommendations in their enhancement amongst others.

4.1 Whole Life Cycle Costing (WLCC)

Whole Life Cycle Costing (WLCC) is considered in all major projects especially as PPPs is a long term project relative to traditional projects. All costs including maintenance, operation costs are considered during the feasibility stages. These have to be considered before any

form of finance is introduced in the project. All respondents recognised the importance of WLCC and to a large extent alluded to its consideration in any PPP project. Value for Money and affordability was however deemed as an important factor of WLCC and was also discussed appropriately.

“Feasibility reports entail all these costs, because feasibility report includes the financial model, your economic assessment, your risk assessment, your engineering, technical, what kind of design they want to do and the costing”. [CI 3]

“So all that go into technical and the cost. And then sometimes they give you an idea of what the operational cost would be, maintenance cost would be, so all those gives you the whole life cycle cost. So it’s not just only the cost that you need during the construction but also during the operation. You need to know what the cost would be when you do the operations as well. So all that goes into your financial model”. [CI 5]

“The financial model has a spreadsheet. So if it’s a 30-year agreement, you have year 1, year 2, year 3, year 4, year 5, year 6 all the way to 30. Then you have other costs like the capital costs and others so you work out the operation cost. Your financial model is the last thing after the technical guys have done their work, they know the cost and all that. After all that, you start considering your ratios where you will be looking at NPV, the debt service cover ratio etc. Those are the things that are performance indicators. Those are indicators that more of the banks even look forward to see”. [CI 4]

“There is a spreadsheet that allows a calculation of the Net Present Value or the internal rate or return, auditing is done per year and you looking at all that up till the end of the concession. Sometimes after multiple calculations, the first 15 years records a loss, then maybe after 15 years, that is when you will end up making a bit of profit. So they want to see the cash flow before the bank would support the project. So if it doesn’t look good, they know what to do. There are certain simulations and financial modelling approaches that are engaged to make the project attractive and viable which is presented to the client. So most of the time, when a certain fixed amount like a toll charge is being determined, the number of years in the concession, the total cost of the project etc are all taken into consideration. So maintenance, operation etc. are all considered which forms part of whole life cycle costing”. [CI 7]

In Ghana major projects surpassing a total cost of about GH¢ 100 million need a Value for Money assessment carried out before the loans are passed in parliament so all huge projects are outsourced mainly to crown agents, a company in Ghana that does most of these audits. It has however been of concern to most technocrats and experts, how value for money is assessed in smaller projects or any project costing less. It is also important to note that Value for Money in PPP projects in the public interest and are critical in the determination of the viability of the projects and its attractiveness. However, in the National Policy of Public-Private Partnerships in Ghana one of the major objectives stated is to encourage and facilitate investment by the private sector by creating an enabling environment for PPPs where value for money for government can be clearly demonstrated.

“The government is very aware of the importance of Value for Money in PPPs and welcomes it any day. When you look at the National Policy, you realise its strong presence all over the document and in fact it is the first guiding principle of the document”. [CI 1]

“The Project and Financial Analysis Unit (PFA) under the Ministry of Finance is mandated amongst other things to ensure financial viability and economic soundness that is Value for Money of PPP projects in the country. There are unsolicited projects and solicited projects. Unsolicited projects are projects which are identified by a private sector person and then they write to the ministry of their intention to undertake that project with their own proposals, if the project is viable then they go ahead with the financial assessment stage which is also submitted to the ministry. In order to ensure Value for Money, the project is listed and other private entities invited to bid so that other costs are brought forward for comparison. If another party wants to undertake the project for a lesser amount, we go back to first entity and tell them another company wants to undertake the project for less taking into consideration other project factors or deliverables. They then have a choice to review their cost or leave the project. On the other hand, solicited projects are the ones identified and sought by the government and then it invites bidders. The Government of Ghana (GoG) is to establish a Project Development Facility (PDF) in line with the upcoming PPP programs. It will operate according to standard operating procedures to finance upstream investment appraisal, value for money assessments and other feasibility and safeguard studies”. [CI 2]

Value for money is paramount and PPPs should give greater value for money than the best realistic public sector project designed to achieve similar service outputs. Achieving value for money is a key requirement of government at all stages of a project’s development and procurement and is a combination of the service outcome to be delivered by the private sector, together with the degree of risk transfer and financial implications for government. Value for money is the driver for adopting the PPP approach, rather than capital scarcity or the balance sheet treatment. This is therefore shown in different stages of the procurement process and is set as a requirement in some cases before advancement to the next stages. VFM is widely accepted as essential and incorporated in the procurement route.

“In the pre-feasibility reports submitted to the Public Investment Division (PID), all documents are required to demonstrate the anticipated Value for Money to be achieved by the PPP project so all projects at an early stage require a VFM assessment. Similarly, after the evaluation of bids, but prior to appointing the winning bidder, the Contracting Authority must submit an evaluation report for review and recommendation by MOFEP-PID demonstrating how the criteria of affordability, value for money and substantial technical, operational and financial risk transfer were applied in the evaluation of the bids as well as demonstrating how the criteria of affordability, value for money, and risk allocation were satisfied in the winning bid, and including any other information as required by MOFEP”. [CI 1]

Affordability is key in VFM assessments and the government or public sector must still be able to afford to pay for the project, regardless of whether it is a traditional public project or a PFI. Full analysis of this service must be performed to benchmark current performance levels and compare with not only traditional procurement methods but competitive outside bids to ensure affordability and better value for the public money. It is also important throughout the concession period as maintenance and other post construction charges need to be considered.

“Value for Money Analysis is still needed after any PPP contract is signed to ensure that the actual performance delivered does not drop below planned & contracted output levels. To ensure the PPP projects continues to provide value for money, we should avoid ambiguity that can lead to unnecessary delays and disputes”. [CI 7]

“There is no doubt about the importance and benefits of value for money. It is actually critical to the successful achievement of PPP objectives and is also a key component of the evaluation of PPPs. However, it requires diligent management of project risks during the execution phase of PPP projects hence the monitoring and supervision functions must be integrated into PPP processes to achieve value for money”. [CI 5]

It was revealed that VFM needed to be more standardised in terms of determination so as ensure transparency and an unbiased assessment. It is also necessary for efficient time management when assessments are being done.

“In the United Kingdom for instance, the Public Sector Comparator is used, I think we need something like that in Ghana and I understand the Ministry of Finance is developing a template for quantities in construction so as to have a standard that can be referred to in determining or having an idea of how much some projects should cost. PPP value for money should be evaluated against the Public Sector Comparator. The most important thing however is to compare the value for money of implementing the project as a PPP or through public procurement”. [CI 2]

4.2 Risk Management (RM)

Risk Management is a key component of Public Private Partnerships as equal risk sharing and effective mitigation are core to this model and provides an enhanced implementation. This notion was shared by all respondents interviewed. General risk category including site risks, pre contract risks, operational risks, force majeure risks etc. are outlined by the National PPP Policy in accordance with the World Bank policies which are adhered to by all interested parties of any PPP undertaking. However, it was argued that rather than a template or generic categories to be looked at, a more tailored risk register should be developed for all PPP projects.

“Each PPP project is unique. Thus a model list of typical PPP risks can only cover a portion of the risks for any given project. Customised risk identification is necessary”. [CI 7]

“Model PPP Risk Matrixes can greatly help foster a culture of PPPs with a common vocabulary when it comes to identifying, analysing and allocating PPP risks. However, we need to avoid broad, vague categories like political risk. We need to be very specific”. [CI 8]

Even with clear, detailed institutional & regulatory frameworks, government decision-makers often do not follow their own procedures & regulations (political interference & non-transparency). It is important regulations are put in place not fully necessitate a fully robust analysis.

Too few proposed PPP projects are being fully analysed and structured by the government before they are offered to the private sector. Many are offered based only on traditional technical feasibility studies without detailed PPP risk allocations or bankable contract structures”. [CI 6]

As expected, risk should be allocated to the party best able to control the likelihood of the risk event occurring, the impact of the risk on project outcomes and one that is best to absorb

the risk at lowest cost. All projects require a risk management assessment and is done through workshops for the identification, analysis and mitigation etc. of the risks.

“All PPP projects require a workshop that involve all stakeholders which will list the potential risks of all categories and discuss them. This is done to allocate the risks to the best parties ready to control or manage it. Let’s say for an environmental bid of a road or rail way, issues regarding right of way and compensations of land issues are best managed by the public sector which is government than the private sector. The government can give an order and make sure they clear the land etc. The risk is on government. On the other hand, the risk is on the private sector with regards to finance”. [CI 6]

“With all the reports we have worked on, we list all the risks under construction, the things you think need to be addressed and who has to manage it. Whether the private or the public entity. If the risk is too high on the private sector party, for instance, when the private sector takes over a poorly functioning utility network, there is a higher risk of unknown condition of assets so then you come out with ways of mitigating that. Then if it’s low to the government since every risk is firstly likely to be pushed to the private sector, then both parties will take the risk but one person takes definitely takes more than the other. This is usually done after the workshop where the risks are identified etc.”. [CI 7]

Apart from what is being done at the moment in terms of labelling risks and attaching parties best able to mitigate or control them, there is the need to also consider perceived risks when talking about risk management. This is usually related to the political risks etc. which poses some loss of confidence in PPP undertakings. The absence of sovereign guarantees and the lack of tight and specific policies does not provide the right platform for effective implementation of PPPs.

“Government Department agencies in charge of education collects any school fees from students and families and pays a unitary payment or availability payment to the private partner as long as it meets performance standards. The private partner therefore does not face a risk of change in demand for the schools and is not bothered if there is enough confidence from the government. Also, private investors usually will not be willing to bear many commercial and demand-based risk which require more public financial supports when there is not a clear level playing field hence the need for specific policies binding both parties”. [CI 3]

PPP projects requires more forms of public risk-sharing and supports, both contingent and non-contingent to become bankable. The government must develop systematic frameworks for analysing, approving, funding and monitoring public sector risks in PPPs.

“In addition to budget allocations, the government may make further contributions, such as providing land; contributing existing assets; or providing various forms of guarantees that enable risk to be shared effectively between the government and the private company”. [CS 5]

The cost to the Government under the most likely outcomes (modal value) should be estimated and assessed in especially conducting sensitivity analysis (at minimum scenario-based) to estimate how the cost to the Government could change if assumed risks changed and assessing the likely cost and risk scenarios against fiscal priorities and existing commitments.

“Risk mitigation strategies should be cost-benefit justified”. [CI 3]

The two concepts of Risk Management (RM) and the enablers are linked to each other, hence a careful assessment of one of these concepts leads to a substantial mitigation of the other.

“I strongly believe that as discussed earlier the enablers are interlinked to risk management. When they are considered carefully less threats will be seen”. [CS 3]

4.3 Competitive Advantage (CA)

All interviewees indicated that very little was being done about competitive advantage as far as they were concerned. It was a rather new issue as PPP in itself was a relatively new procurement approach. They agreed that it was important all the same and it was worth looking at in the mean time.

“This is something we have not really considered to be honest, we are currently looking at how to implement PPP effectively”. [CI 2]

“I am not sure whether that is being considered at the minute, I don’t know if it is competitive advantage with regards to the public sector that is the government itself or the private sector but we still not to consider this issue as early as possible so that we can maximise efficiency and also promote value for money and sustainability”. [CI 7]

On the contrary some respondents decided to elaborate on what is being done about competitiveness or their personal experience on competition which they believed was also imbibed in the competitive advantage concept especially for the fact that they both have a common goal of enhancing efficiency. These have been detailed below.

“When Selecting Appropriate PPP Candidates, there are certain things that one needs to consider. Firstly, the size of the project counts because the larger the project the higher the risk construction cost overruns, which a PFI can better manage. Scope of construction should be clearly defined to enable a more detailed assessment. As PPPs are typically long term in nature, the project requires important levels of on-going maintenance & measurable performance so the best parties should be considered”. [CI 4]

“Competition is critical because if we don’t have that, there’s no value for money. You can’t undertake a right assessment; you don’t know whether you getting value for your project by giving it to one person. So it’s always good to throw it out there and get people to submit proposals, you know. You assess everybody’s bid that says how their technical submission, what they are bringing on board, whether they have come to give us new designs, innovations etc. Some of the things that are considered are environmental issues and how they intend to deal with them. Like replacement of trees when they are uprooted for some construction work”. [CI 6]

PPPs should already have clear technical, economic & environmental feasibility. PPPs cannot on their own make technically or environmentally risky projects become feasible. An advantage of this is to encourage efficiency and innovation.

“You assess technical, environmental, financials. So the competition is very important. So those are all the things that you want to check whoever submits their bids has really addressed all your issues, all your criteria you looking to assess them. So by bringing different people on board as a matter of bidding, it creates some competition which makes every party innovative because they want to win”. [CI 8]

“One of the objectives of the National PPP policy though is to set up efficient and transparent institutional arrangements for the identification, structuring and competitive tendering of PPP projects. So that is written there, at least it is being recognised, if only it will be followed. It also brings about Value for Money and Competition”. [CI 5]

“Attracting multiple bidders will definitely maximize value by creating competitive tension in the bidding process”. [CI 7]

Competitive advantage explained by some respondents, all of whom were from the private sector, were based on their knowledge on the concept and the research they did prior to this interview based on the emails sent to them as stated by themselves.

“Competitive Advantage is vital to any construction firm or organisation’s performance and the way that one firm satisfies other people by performing better than another. It is the isolation and exploitation of areas of superiority over competitors that stems in construction from the strategic management of both companies and projects. Competitive advantage is attained from the firm’s ability to control its internal sub-systems and exploit opportunities and lessen or avoid threats from its external environments. Determining areas of Competitive advantage requires an analysis of the value activities of the private company when competing in a particular industry”. [CI 4]

“Competitive Advantage will only remain an advantage for a period of time before it becomes replicated within co-operating organisations. Hence the principle of sustainable competitive advantage is that the sources of CA are continually evolving”. [CI 5]

“The successful SPVs to a large extent demonstrate their competitive advantage through the incorporation of innovations during the procurement phase. Selections include the appraisal of the innovativeness of the proposal. The contract awarded to the consortium, SPV will always step up to the next level of innovation. The product, which is the constructed asset and the corresponding service are then sustainable over the concession period. This is a major source of competitive advantage. The creation of a series of short term competitive advantages during the concession period in order to deliver a superior service and reduce whole life cycle costs which enables competitive advantage to be appropriated over the entire concession period”. [CI 3]

“Competitive Advantage is not only in product and processes but also strategy, structure, system and behaviour. CA in PPP projects is a holistic phenomenon that concerns all stakeholders in the deal”. [CI 7]

5. CONCLUSIONS

The study which engaged public and private officials who are the stakeholders of PPP implementation in Ghana ascertained the significance of the CSF parameters adopted for this research in this particular context. The findings were generally in tandem with previous studies in the literature review with particular regards to state of PPP and the relevance of the key parameters set for investigative purposes in this thesis. However, CA was a concept that participants had very little knowledge about but asserted the importance of competition amongst bidders and the entire PPP process that will ensure VFM, affordability as well as quality. One of the major findings of the study which is necessary for effective infrastructure development on a steady basis was the set up of a central PPP unit. A number of institutional

investors and commercial lenders have highlighted that they have the necessary funds and mandate to invest in or lend to infrastructure in the region, but, what is lacking is a pipeline of well-structured, bankable projects in which to invest or lend their funds. Undeniably, extra funds will not necessarily guarantee a solution or a curtailment of the infrastructure gap in the country and even in the world but a prudent and effective implementation of the model to ensure success is a means.

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EXAMINING THE KEY LEADERSHIP ATTRIBUTES THAT LEAD TO SUCCESSFUL DELIVERY OF COMPLEX CONSTRUCTION PROJECTS IN THE UK

J. Picken and C. Liyanage

The School of Engineering, University of Central Lancashire, Preston, PR1 2HE, UK

Email: JPicken@uclan.ac.uk

Abstract: Whilst there is a plethora of literature on the topics of leadership and complex projects, there is limited research, correlating these two aspects of complex construction projects. This paper presents the findings of a 12-month study, which examines the key leadership attributes that lead to the successful delivery of complex construction projects. The methodology adopted for the study is a questionnaire survey targeted at construction leaders and managers in the UK. Corporate and Fellow Members of the Chartered Institute of Building (CIOB) provided an appropriate sample for the study. The sample comprised 1805 CIOB Fellows and Corporate Members. “*Survey Monkey*” online facilitated questionnaire distribution and collection of responses. The response rate was 10.52%. SPSS 22 statistical software enabled coding and analysis of the data. Findings firstly provided clarification of the definition of a complex project, confirming that high project value need not necessarily reflect project complexity. The findings identified attributes of leaders in respect to teamwork, planning, monitoring and controlling of projects and decision making associated with dilemmas. These attributes reflect current trends in leadership styles with increased team empowerment.

Keywords: Complex projects, Decision Making, Leadership, Planning, Teams.

1. INTRODUCTION

In a continuously evolving construction sector, the professional institutions, governments and construction clients (BIS, 2013) are setting strategic expectations to increase productivity, reduce project durations, reduce project costs and increase exports. The Egan Report (Egan, 1998:14) comments that in 1998 there was “*a lack of a burning commitment of leaders in construction to improve quality and efficiency through change of organisational culture*”. Constructing Excellence (2015) consider leadership to be a significant contributor to the construction sector’s performance and as such have formed a “G4C” forum for leadership development. Müller and Turner (2010) are amongst the few authors who correlate the attributes of vision, influence and motivation provided by leaders to the success of complex projects. Kerzner and Belack (2010) argue that three critical requirements for the successful outcome of a complex project are clear project objectives, user involvement throughout the project life (cradle-to-cradle), and clear governance. The National Audit Office and the Office of Government Commerce (OCG, 2012) consider that factors contributing to the failure of projects include lack of agreed measures of success, lack of clear leadership, lack of engagement with stakeholders, and the lack of project management and risk management skills.

Lack of clear senior management leadership, lack of effective engagement with stakeholders, and lack of clear links between the project and agreed critical success factors or key strategic priorities are common causes of project failure (Morgan and Gbedemah, 2010; The Office of

Government Commerce (OGC), 2012; Chartered Institute of Building (CIOB), 2014). Data analysed by The Chartered Management Institute (CMI, 2016) identifies that economic productivity in the UK ranks 6th in the G7 (Group of seven) countries, which includes the USA, Canada, UK, France, Germany, Italy and Japan. UK economic productivity is ranked 17th in the Group of Twenty (G20), whose countries represent 85% of global GDP. CMI suggests that poor leadership is to blame for the poor productivity record. This reflects findings identified in the Construction 2025 Strategy document particularly in complex projects.

Whilst Pickervance (2011) considers complex projects to be those above six storeys, those with extensive ground works, or those with extensive mechanical and electrical services, Li *et.al.* (2011), Sage *et.al.* (2011) and Ireland (2014) consider complex projects to be those that involve a broad and diverse range of stakeholders, with unclear and changing boundaries. This latter view may explain some of the challenges in UK projects such as the HS2 & HS3 high-speed rail links or new nuclear power stations. “Complicated” projects are challenging, but tend to be linear and predictable. On the other hand, complex projects tend to be unpredictable, often leading to cost and schedule overruns. BS 6079 – Part 1 (2010) recognises that complexity of a project is associated with risk to project outcomes, (project success) and identifies factors, which contribute to complexity. The standard requires leaders to manage the complexity, but appears to be simplistic in linking leadership and project complexity. The Global Alliance for Project Performance Standards, (GAPPS), (2007) has a thread of “leadership” throughout their standards for project managers, and suggest that complex projects require a level of project manager performance beyond that of the Global Level 2 Project Manager, which itself certifies an accepted level of competency to manage complex projects. There is a plethora of literature, which considers leadership in projects. However, there is a clear gap in extant literature, which links leadership attributes specifically to complex construction projects. The paper fulfils this gap by identifying a relationship between leadership attributes and complex construction project delivery. In doing so, it consists of three (3) main sections. Firstly, detailed discussions on complex projects and leadership are given in section 2, using an in-depth literature review. Secondly, the methodology adopted to identify the relationship between leadership attributes and project delivery in complex construction projects is presented in section 3. Finally, the findings, which emerged from the questionnaire survey, are evaluated in section 4.

2. LITERATURE REVIEW

2.1 Definition of leadership

Rickards (2015) cites two definitions of leadership provided by Bryman (2011) and Rost (1993): “*The leader gives a sense of direction and purpose through the articulation of a compelling world view [the defining characteristic of which is] the active promotion of values which provide shared meanings about the nature of organisation*”, (Bryman, 2011). “*Leadership is an influence relationship among leaders and followers who intend real changes that reflect their mutual purposes*”, (Rost, 1993). These definitions would support commonly accepted views that 21st century leaders need to have clear vision together with an ability to develop a team culture, with high moral and ethical values. Grisham (2010) defines leadership as “*The ability to inspire the desire to follow and to inspire achievement beyond expectations*”. It could be argued that this definition favours not the coercion of staff members into meeting targets, but rather provision of the charisma that promotes the evolution of “superteams”. This might provide further support to the previous definitions.

The CIOB code of practice for project management (2014) cites Shackleton's (1995) definition of leadership as being "*The process in which an individual influences other group members towards the attainment of group or organisational goals*". It could be argued that the CIOB has adopted a definition that is concise yet clearly defines the influence of the leader upon a team or stakeholders in meeting successful construction project outcomes. The definition may suggest active promotion of values, which provide shared meanings about the nature of the organisation as proposed by Bryman. The definition may also consider the intention to make real changes for mutual purposes as proposed by Rost (1993). Cooke-Davies (2002) also affirms that it is not the processes or systems that deliver projects but the human interactions that undertake those processes and systems. It is the decision-making process of the teams involved, which ultimately lead to adequacy, and success of a project.

Extant literature concerning leadership identifies commonly used terminology such as traits, characteristics and attributes when discussing approaches to leadership. The English Oxford Dictionary (2017) defines a trait as a "*genetically determined characteristic*"; a characteristic is defined as "*typical of a particular person*", and an attribute is defined as "*regards something being caused by*". Sometimes it may appear to readers that different authors use these varied terminologies in an interchangeable manner to mean the same or similar things relating to leadership. Traits are considered by Müller and Turner (2010), Clarke (2012), Chamorro-Prezumic (2013), Chartered Institute of Building (CIOB) (2014) and Chartered Management Institute (CMI) (2015). Characteristics are considered by Ireland (2008), Toor and Ofori (2008), Müller and Turner (2010), Clarke (2012), Chamorro-Prezumic (2013) and Chartered Management Institute (CMI) (2015). Attributes are considered by Global Alliance for Project Performance Standards (2007), Toor and Ofori (2008) and Müller and Turner (2010). In operational or organisational contexts, personality traits are usually exhibited in terms of the personal behaviours of leaders, (Van Eeden *et al*, 2008). These personal behaviours are referred to by many authors as leadership characteristics (Hay, 2006). Simply, traits or characteristics are the ways that leaders behave in their efforts to ensure that followers follow. To differentiate between a characteristic and a trait, a characteristic refers to the distinctive qualities that make up an individual. A trait on the other hand, is a feature of an individual that is inherited. The main difference between a characteristic and a trait is while a characteristic need be built by a person and absorbed, a trait comes genealogically. In the transactional style of leadership, the leader clarifies what followers need to do, with the leader looking for deviation from standards and taking corrective action. On the other hand, in transformational leadership, the leader shows dedication, a strong sense of purpose and perseverance, and confidence in purpose. These are attributes that provide followers with a sense of empowerment and ownership, and encourages intellectual stimulation. For this reason, this study has focused on "leadership attributes" which may be considered a collective approach to traits, characteristics and attributes displayed by leaders. Chamorro-Prezumic (2016) identifies that popular culture embeds "charisma" as an attribute of famous leaders, (apart from Angela Merkel). Charisma can help persuade and inspire followers. However, consideration is given to charisma disguising incompetence, which in turn leads to unsuccessful outcomes. It is arguable that for complex projects the probability of success is likely to be higher when attributes previously identified are in place rather than reliance on charisma. It is arguable that a leader need not be charismatic as long as he or she has the appropriate knowledge and skills to meet the feelings and requirements of stakeholders. Typical methods of meeting those stakeholder requirements are likely to include effective selection and management of experienced and qualified teams, and the ability to deal with dilemmas as they arise during the course of a project.

2.2 Definition of a complex project

Complex projects tend to be unpredictable, often leading to cost and time overruns. Kerzner and Belack (2010) reflect upon the difficulty in defining a complex project, arguing that projects are defined as being complex, if they have a combination of any number of factors that might include size, value, uncertain scope, uncertain requirements, uncertain deliverables, complex interactions, uncertain staff competencies and geographical location. Pickervance (2011) defines a complex project as any project with “*extensive work below ground, more than six storeys in height, or with complicated services*”. This contrasts with Li *et al*’s (2011) suggestion that complex projects “*involve elements showing highly complex multiple relations, (both formal and informal)*”; and Sage *et al*’s (2011) definition of “*the unpredictable, multi-actor and emergent nature of project work*”. Ireland (2014) defines a complex project as “(a project) *which includes autonomous independent systems which have a life of their own outside of the (particular) project*”. What Ireland attempts to demonstrate in this definition is that every stakeholder is likely to be an independent organisation or entity. Each of these organisations or entities are likely to have their own agendas. The challenge for the project team is to integrate these agendas, for a project outcome that will be considered satisfactory to the majority of stakeholders.

2.3 How leadership attributes contribute to successful complex construction projects

Many authors provide different elements of project delivery in wider literature. Synthesis of the literature provided by Gadeken (2005), Remington (2011), Giles (2016) and Tremaine (2016) suggests that there are four different elements that leaders focus on when it comes to successful delivery of complex projects, i.e. teamwork; planning; monitoring and control; and decision making. Accordingly, Table 1 provides a summary of leadership attributes that relate to each element.

Table 1 –Different Elements of Project Delivery and Leadership Attributes

| Different elements | Leadership attributes relating to key elements of project delivery | Sources of Reference |
|---------------------------|---|--|
| Teamwork | Leaders recognise that they cannot possess all the expertise necessary to micro-manage a complex project, and select teams of appropriately qualified and experienced personnel | Gadeken (2005); Hay (2006); Back et al (2012) |
| | Leader promotes empowerment and ownership in team members, and allows the team to solve their own issues | Li et al (2005); Hay (2006); Grisham (2010); Back et al (2012); CMI (2016) |
| | Each member of the team can be a leader on some occasions | Bigley and Roberts (2001); Friedrich et al (2016) |
| | Leaders place total trust in the team | Gadeken (2005); Zenger and Folkman (2014); Giles (2016) |
| | Leaders will remove team members who underperform or who lose focus on the end result | Machiavelli (2008) |
| | A leader must be charismatic | Chamorro-Prezumic (2016); Friedrich et al (2016) |
| | Leader will demonstrate clear authority and will coerce the team into strict compliance | Machiavelli (2008) |
| | Leader sets the team to work on the project then is absent, leaving the team to progress alone. | Judge and Piccolo (2004); Back et al (2012) |

| | | |
|------------------------|--|--|
| Planning | A leader breaks a task down into "manageable" packages | OCG (2012) |
| | Leaders understand the requirements of all stakeholders | Gadeken (2005); Machiavelli (2008); Toor and Ofori (2008); Sutton (2009); Müller and Turner (2010); Kerzner and Belack (2010); Bucculo et al (2012); Clarke (2012); OCG (2012); Chamorro-Prezumic (2013 & 2015); Zenger and Folkman (2014); CMI (2015); Kennett (2015); Williams (2016) |
| | Leaders need to reflect on their own performance | Gadeken (2005); Ovolio and Gardner (2005); Back et al (2012); Räisänen et al (2015); Tremaine (2016) |
| | Leaders focus on the end result | Ovolio and Gardner (2005); Machiavelli (2008) |
| | Leaders can identify problems before they arise | Bigley and Roberts (2001); Gadeken (2005); Machiavelli (2008); Back et al (2012) |
| | Leaders are optimistic and hopeful | Ovolio and Gardner (2005); Back et al (2012) |
| Monitoring and Control | Leaders recognise that they cannot micro-manage a complex project | Gadeken (2005); Back et al (2012) |
| | Leaders can identify problems before they arise | Bigley and Roberts (2001); Gadeken (2005); Machiavelli (2008); Back et al (2012) |
| | Leaders should instil strict adherence to procedures and rules | Remington (2011) |
| | Leader monitors the team continuously to check for deviations to instructions given | Gadeken (2005); Back et al (2012) |
| | Leader does not monitor the project, leaving the team to progress alone | Judge and Piccolo (2004); Back et al (2012) |
| Decision Making | Leader focuses on timely resolution of issues | Bigley and Roberts (2001); Gadeken (2005); Machiavelli (2008); Back et al (2012) |
| | Leader demonstrates dedication, perseverance and strong sense of purpose | Gadeken (2005); Hay (2006); Remington (2011); Back et al (2012); Zenger and Folkman (2014) |
| | Leaders need high moral and ethical standards | Back et al (2012); Giles (2016) |
| | Leaders understand the requirements and feelings of all stakeholders | Gadeken (2005); Machiavelli (2008); Toor and Ofori (2008); Sutton (2009); Kerzner and Belack (2010); Müller and Turner (2010); Bucculo et al (2012); Clarke (2012); OCG (2012); Chamorro-Prezumic (2013 & 2015); Zenger and Folkman (2014); CMI (2015) Kennett (2015); Pryke et al (2015); Williams (2016) |
| | Leaders focus on the end result | Machiavelli (2008); Back et al (2012) |
| | Leaders attempt to satisfy most of the stakeholders most of the time, but acknowledge that total satisfaction of all stakeholders is beyond the power of mortals | Gadeken (2005); Machiavelli (2008); Toor and Ofori (2008); Sutton (2009); Kerzner and Belack (2010); Müller and Turner (2010); Bucculo et al (2012); Clarke (2012); OCG (2012); Chamorro-Prezumic (2013 & 2015); Zenger and Folkman (2014); CMI (2015) Kennett (2015); Pryke et al (2015); Williams (2016) |
| | Leaders will remove underperforming team members | Machiavelli (2008) |
| | Leaders are aware of flattery from others | Machiavelli (2008); Back et al (2012) |

3. METHODOLOGY

The purpose of the paper is to examine the role that the leadership attributes play in successful delivery of complex construction projects. This was fulfilled using a questionnaire survey. The generation of a questionnaire survey based on prior knowledge of the author, as a

Fellow of the CIOB (being an experienced practitioner in the construction industry for over 20 years), together with views offered by extant literature, justified the use of a quantitative research methodology. This argument is further justified when considering the very experienced nature of the sample selected for the questionnaire survey.

There is a total membership of over 50,000 in the CIOB (CIOB, 2016). Within this population, only corporate and fellow members in the UK were selected for this study. It was considered that these groups would have an increased probability of having experience in complex projects compared to members within the Incorporated, Associate or Student grades of membership. Based on members' willingness to share their email contact details on the CIOB "*search a member*" forum, finally, a purposive systematic sample of 1805 was chosen for the questionnaire survey. The sample represented most of the regions within the UK (refer to Appendix 1), in order to ensure objectivity of the data collected. Initially, it was not practical to categorise the specific professional specialisms of the survey recipients. However, the questionnaire survey was designed to allow categories of professional specialisms to be identified from the responses. This approach was taken to identify any bias arising from any specialisms within the CIOB membership.

Based on the literature review, the questions for the quantitative survey were developed and it consisted closed questions. The aim of the questionnaire was to capture information linking complex projects to leadership attributes. The general questions concerned matters such as job role, level of experience in the industry, level of experience of complex projects, and experience of projects. A small number of dichotomous or binary questions prompting a response of yes or no were used to simplify what may have been considered complex questions. A range of multi-chotomous questions, that is, questions where a range of alternative answers is presented for consideration were generated. For this, a 4-Likert scale of responses was chosen, prompting a non-neutral response by not having a "neither agree nor disagree" option. Care was taken to restrict "don't know" responses to questions where respondents may genuinely not know the answer. The survey questionnaire made use of the format provided by "*Survey Monkey*" online. The reasoning behind this was the relatively low cost and provision of a template, which allows easy building of a questionnaire. The questionnaire can then be tested, and is received by the sample in a format that is easy to navigate.

A total of 186 responses were received providing a response rate (RR) of 10.52%. The use of a large survey sample was intended to enable the categorising of respondents into categories of experience in complex projects. Data was recorded, coded and analysed using SPSS 22 statistical software making use of UCLan's software provision. Whilst this method required manual inputting of data received, using *Survey Monkey* into SPSS this task was undertaken to minimise costs. As identified previously, the sample chosen for the quantitative questionnaire survey concerned a selection of Corporate and Fellow Members of the CIOB. Ninety-seven percent (97%) of respondents confirmed that they undertake a leadership or management role within the construction sector. This confirms the reliability of this sample of which the greater majority have extensive leadership experience in a range of project values across the sector. Statistical inference validity is provided when the statistics of the sample reflects the statistics of the population, Fellows and Liu, (2015). This demonstrates that the sample provides a good representation of the target population. The use of SPSS 22 statistical software enabled access to validity and reliability testing for parametric and non-parametric correlation of data variables. The Chi-Squared test was specifically favoured due to its ease of use in establishing a 95% significance value of the data collected.

4. FINDINGS

It was clear from the study that most construction professionals do not consider that the value of a project reflects its complexity, but rather that complexity reflects the diverse nature of stakeholders, interactions, uncertain scope and deliverables, staff competencies and geographical location. This was confirmed by the respondents' response to a survey question asking respondents to select from a choice of four definitions of a complex construction project. Analysis of the findings provided positive correlation of links between leadership influences and the success of complex construction projects. Table 2 presents a summary of the questionnaire survey findings.

Table 2 –Leadership attributes that lead to successful delivery of complex projects

| Elements | Leadership attributes that relate to different elements of project delivery | Mean | Ranking |
|-------------------------------|---|------|---------|
| Teamwork | Leaders recognise that they cannot possess all the expertise necessary to micro-manage a complex project, and select teams of appropriately qualified and experienced personnel | 3.77 | 1 |
| | Leader promotes empowerment and ownership in team members, and allows the team to solve their own issues | 3.44 | 2 |
| | Each member of the team can be a leader on some occasions | 3.17 | 3 |
| | Leaders place total trust in the team | 2.99 | 4 |
| | Leaders will remove team members who underperform or who lose focus on the end result | 2.82 | 5 |
| | A leader must be charismatic | 2.74 | 6 |
| | Leader will demonstrate clear authority and will coerce the team into strict compliance | 2.55 | 7 |
| | Leader sets the team to work on the project then is absent, leaving the team to progress alone. | 1.61 | 8 |
| Planning | A leader breaks a task down into "manageable" packages | 3.48 | 1 |
| | Leaders understand the requirements of all stakeholders | 3.45 | 2 |
| | Leaders need to reflect on their own performance | 3.44 | 3 |
| | Leaders focus on the end result | 3.20 | 4 |
| | Leaders can identify problems before they arise | 3.17 | 5 |
| | Leaders are optimistic and hopeful | 3.02 | 6 |
| Monitoring and Control | Leaders recognise that they cannot micro-manage a complex project | 3.43 | 1 |
| | Leaders can identify problems before they arise | 3.04 | 2 |
| | Leaders should instil strict adherence to procedures and rules | 2.87 | 3 |
| | Leader monitors the team continuously to check for deviations to instructions given | 2.86 | 4 |
| | Leader does not monitor the project, leaving the team to progress alone | 1.58 | 5 |
| Decision Making | Leader focuses on timely resolution of issues | 3.55 | 1 |
| | Leader demonstrates dedication, perseverance and strong sense of purpose | 3.53 | 2 |
| | Leaders need high moral and ethical standards | 3.52 | 3 |
| | Leaders understand the requirements and feelings of all stakeholders | 3.30 | 4 |
| | Leaders focus on the end result | 3.21 | 5 |
| | Leaders attempt to satisfy most of the stakeholders most of the time, but acknowledge that total satisfaction of all stakeholders is beyond the power of mortals | 3.15 | 6 |
| | Leaders will remove underperforming team members | 2.82 | 7 |
| | Leaders are aware of flattery from others | 2.75 | 8 |

(* 4-point Likert scale used = 4 -Strongly Agree, 3 – Agree, 2 – Disagree, 1 – Strongly Disagree)

When considering factors associated with teamwork in complex projects, the highest-ranking attribute in respect of leadership was “*Leaders recognise that they cannot possess all the expertise necessary to micro-manage a complex project, and select teams of appropriately qualified and experienced personnel*”. This question was considered essential for the recognition of key attributes that influence the formation and management of project teams. The ranking of these results suggests that there is a tendency of leaders of project teams to recognise that they cannot micro-manage complex projects. The study shows that these leaders are inclined to promote empowerment of teams, and their ownership of the project, with team members taking their own leadership roles on occasions. This relies upon placing trust in appropriately qualified and experienced team members. The extant literature suggests that these might be attributes appropriate to a democratic style of leadership. The lower ranking responses were indicative of an autocratic style of leadership, which might encourage selection of charismatic leaders who maintain authority and coerce teams into strict compliance with procedures. The Laissez Faire style of leadership with a characteristic of leadership absence, having the lowest ranking would suggest that this leadership style has no place in complex construction projects.

It may be argued that when considering how leaders contribute to the planning of complex projects, all related attributes identified in Table 2 are essential. Similarly, when questioned about attributes influencing decision-making from questionnaire participants, particularly associated with project dilemmas, the responses suggest that all related attributes are considered essential in an effective leadership style. What is particularly evident is that leaders need high moral and ethical standards, which is currently a topic of discussion amongst construction professionals. This is considered important and so is having a strong sense of purpose and timely resolution of issues.

In respect to monitoring and controlling, Table 2 suggests that, whilst leaders accept that they are unable to micro-manage a complex projects, they will attempt to identify problems before they arise and be willing to allow deviance from procedures. Careful examination of the findings suggest that, for successful delivery of complex projects (i.e. mostly projects valued above £250m), all highly ranked attributes in different elements of project delivery lean towards a flexible but controlled style of leadership, especially due to the high possibility of the changing nature of complex construction projects.

5. DISCUSSION AND CONCLUSIONS

Morris (2013) and Müller & Turner (2010) are cited in many authoritative texts, providing an overview of the history of leadership. The trait models developed from the 1930’s; and the behaviour models of the 1940’s, which led to the belief that leadership could be taught. The contingency models of the 1960’s, considered leaders being selected based on their task expertise. The visionary and charismatic models of the 1980’s distinguished between transactional and transformational leadership styles. The emotional intelligence models developed from 2000 based leadership styles on empathy. Reflective practice is now becoming a common topic being introduced into construction higher education, (Räisänen *et al*, 2015). It is arguable that fostering self-awareness and self-criticism through reflective practice is a key tool for leadership development.

The CIOB (2014) identifies the differing styles of leadership to be coercive, authoritative, affiliative, democratic, pace setting or coaching, with each style being appropriate for the

situational requirements and context. In recent years, (Friedrich *et al*, 2016) the trend towards forms of “collectivistic leadership” have been studied under the topics of “shared leadership”, “distributed leadership”, “collective leadership”, “emergent leadership” and “team leadership”. It is certainly arguable that there has been a trend that moves away from the leader who uses a charismatic hero style approach to one who uses a collectivistic approach, particularly for projects requiring high levels of creativity in complex environments. However, Friedrich *et al* (2016) justify the need in any collectivistic approach to leadership to have a “focal leader” to facilitate the emergence of informal leaders in teams. Back *et al* (2012) agree that the extant literature generally concurs that for project success effective leadership needs to be visible at all phases of a project’s execution. Another approach to leadership is the authentic leadership style. Avolio and Gardner (2005) define authentic leaders as: “those who are deeply aware of how they think and behave, and are perceived by others as being aware of their own and others’ values, knowledge and strengths; aware of the context in which they operate; and who are confident, hopeful optimistic, resilient, and of high moral character”. In Avolio and Gardner’s study, comparison is made between authentic, transformational, charismatic, servant and spiritual styles of leadership based upon the reasoning that each has some similarity. The extant literature considers the autocratic leadership style with absolute power of the leader, and compares this approach to the democratic leadership style where employees contribute to the decision-making process, with the leader making the final decision. Bureaucratic leadership concerns adherence to rules and procedures. Transformational leadership is associated with leaders recognising a need to refocus on important changes required, and communicate this to employees. This is contrasted with transactional leadership concerned with constructive and corrective styles of management. Another approach is the *Laissez-Faire* style of leadership, but many practitioners would agree with Judge and Piccolo (2004) that this is avoidance of leadership; with leaders being absent when needed, avoiding making decisions and hesitance in taking action.

Ireland (2008), Toor and Ofori (2008), Sutton (2009), Müller and Turner (2010), Buccolo et al (2012), Clarke (2012), Chamorro-Prezumic (2013), CMI (2015), Chamorro-Prezumic (2015), Haughton (2015), and Kennett (2015) confirm that organisations need to respond to changing customer or stakeholder expectations. It may be considered that project teams be considered as organisations in the context of complex construction projects. The changing styles and values of leaders such as those from the next generation of “millennials” are advised to display attributes associated with emotional intelligence and shared leadership/democratic leadership styles. Leaders should have visionary strategies, but also able to communicate those visions to their operational management teams, particularly in times of dilemma or crisis. Moreover, leaders should possess the attributes of honesty, vision, direction, flexibility, communication, resilience, empathy and delegation. It appears from extant literature that there is convincing reasoning to change ‘leadership attributes’ according to the project context and it’s changing nature, especially when it’s a complex construction project.

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7. APPENDIX 1: SURVEY SAMPLE SUMMARY BY REGION

| Centre/Region | Number of members and fellows |
|-------------------------------|-------------------------------|
| Aberdeen | 10 |
| Bedfordshire | 44 |
| Birmingham & Solihull | 55 |
| Cambridgeshire | 16 |
| Cardiff | 66 |
| Cheshire | 22 |
| Cornwall | 16 |
| Coventry & Warwickshire | 34 |
| Cumbria | 10 |
| Devon | 39 |
| Dorset | 39 |
| Dundee | 16 |
| Durham & Wearside | 16 |
| East of Scotland | 32 |
| Essex | 109 |
| Gloucestershire | 40 |
| Greater Manchester | 112 |
| Hampshire | 80 |
| Herefordshire & Worcester | 40 |
| Hertfordshire | 130 |
| Highlands & Islands | 10 |
| Humber York & North Yorkshire | 52 |
| Isle of Man | 6 |
| Kent | 116 |
| Lancashire | 39 |
| Leeds & West Yorkshire | 82 |
| Leicestershire | 36 |
| Lincolnshire | 24 |
| Liverpool | 50 |
| London | 233 |
| North Wales | 30 |
| Sheffield & South Yorkshire | 38 |
| Staffordshire | 36 |
| Tyneside | 38 |
| West of Scotland | 89 |
| | |
| Total | 1805 |

THE NEED FOR QUALITY CULTURE IN IRAN'S OIL AND GAS PROJECTS: A CRITICAL REVIEW

M. Maleki Sadabad and C. Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: m.n.malekisadabad@edu.salford.ac.uk

Abstract

Quality is an approved management concept in the twentieth century and an intense catalyst for driving organisational competitiveness and effectiveness. The cornerstone of any type of quality enhancement includes cultivating a 'quality culture' in the target organisation and incorporating it all through the organisation. 'Organisational culture' is characterised as the collective views, standards, outlooks, and behaviours that represent the staff in a company. As a management system, Total Quality Management (TQM) initiated in the 1950's and has persistently progressed and has become more widespread since the early 1980's. TQM is considered as an improvement to the conventional commercial methods and is an established strategy securing survival in the worldwide rivalry. Project Management (PM) is the field of utilising recognised standards, procedures and policies to deal with a project from origination to completion. It is frequently abbreviated as PM and entails organising and connecting the company's resources to accomplish a specific activity, event or responsibility. Different organisations and project teams possess exclusive features, value structures and manners of performing objectives to be successful. A project leader is supposed to comprehend the notion of culture; in turn, he can receive support from the organisation members and lead the project efficiently. The aim of this paper is to stress the necessity of quality culture in PM teams within Iran's oil and gas industry. Therefore, a critical review of the related literature is performed to clarify challenges in conventional PM structure in Iran's oil and gas industry, current practices in TQM and methods with which quality culture can enhance the performance of PM teams. A critical literature survey and review of existing published data is carried out to explain the needs of quality culture in Iran's oil and gas projects.

Keywords: Oil and Gas Industry, Project Management, Quality Culture, Organisational Culture

1. INTRODUCTION

Quality is an approved management concept in the twentieth century and an intense catalyst for driving organisational competitiveness and effectiveness (Butler, 2009). As of late, research interests have moved from the implementation aspect of quality and subsequently the formation of organisational and local culture that drive quality through consistent change and optimisation, towards the emerging concept of sustainable organisational excellence.

According to Goetsch and Davis (2014), quality is defined as a dynamic condition connected to products, procedures, setting, services, and individuals that satisfy customer desires and needs and assists in generating higher value. These authors also state that to differentiate Total Quality (TQ) method from conventional methods of business, attempts must be made to amplify the competitiveness by consistent enhancement of the quality of products, procedures, setting, services, and individuals.

According to Oakland (2014), TQM is a management system that initiated in the 1950's and has persistently progressed and has become more widespread since the early 1980's. TQM is considered as an improvement to the conventional commercial methods and is an established strategy securing survival in the worldwide rivalry (ibid). The culture and activities of an organisation can be modified by transforming the management activities. Oakland (2014) continues to state that TQM is an inclusive and organised way to deal with organisational management that attempts to enhance the quality of services and products by means of progressing improvements in light of constant feedback. The three words are broken down in the following section:

- Total: construction of an entirety;
- Quality: Amount of superiority a service or product offers; and
- Management: Action, skill, or method of managing, controlling, coordinating etc. (Oakland, 2014).

As a result, TQM is the skill of dealing with the entirety to achieve superiority. TQM is also characterised as an attitude and an arrangement of standards that embody the establishment of a ceaselessly enhancing organisation (Oakland, 2014). It is utilisation of quantitative strategies and human resources to enhance the whole procedures in an organisation and surpass customer needs at the present time and also in the future. TQM combines essential management methods, current modification endeavours and specialised apparatuses under an organised approach.

A critical review of the related literature is performed to clarify challenges quality culture faces in Iran's oil and gas PM teams. The paper starts with the notion of quality and then quality culture constituents are discussed. Afterwards, quality culture within PM and Iran's oil and gas is briefly discussed followed by addressing the challenges of quality culture in PM. Further, the connection between these challenges and the impact on Iran's oil and gas performances is discussed.

2. QUALITY

Chandrupatla (2009) believes that different individuals view quality in their own specific ways; however, everybody can realise what is referred to as 'quality'. As an example, a customer using a specific product views the concept of quality in the form, performance and function of that product. The extent of satisfaction by the customer indicates the quality of the received service. In the dictionary, quality is defined as the amount of superiority. Nevertheless, the definition is not considered as absolute because of the relative nature of the definition. The evaluation procedure is eventually done by the customer. Every service or product should reflect customers' requirements in the form of quantifiable features. After these specifications are set, it is necessary to find ways for assessing and observing the target features. Indeed, this procedure leads to constant enhancement in the service or product with the end goal to persuade the customer to buy the service or product. This persuasion brings about profit for the service provider and creates a strong relationship between the customer and the service provider. Establishing and maintaining this relationship is contingent upon the reliability of the service or product.

2.1 Quality Culture

Business owners, who start organisations, or managers in charge of controlling the company, regularly develop organisational cultural frameworks which reflect their own logic. The applicability of these frameworks in finding opportunities and facing limitations reflects the organisation's success or failure (Bass & Avolio, 1993; Dellana & Hauser, 1999). Thus, the culture of an organisation can be considered as the source of business attitude and value and it is this culture that defines guidelines, techniques and activities within an organisation (Batten, 1994; Dellana & Hauser, 1999, Malhi, 2013). As Malhi (2013) puts it, Quality Culture includes the coordination of shared principles, philosophies and standards that concentrates on delighting customers and constantly enhancing the quality of products and services. Thus, in an organisation that possesses quality culture, quality is deeply rooted in almost every facet of organisational life.

A border not clearly defined is the one between TQM as an organisational culture and TQM as a management agenda. A large portion of the TQM categorisations entail individual aspects or components that have a place in organisational culture. Definitely, one may contend that the essence of TQM is culture modification and that TQM activities are only instruments for cultural change (Flood, 1993; Zeitz, Johannesson, & Ritchie, 1997). The answer to this riddle can be found in organisational culture. Culture comprises of the convictions, standards and fundamental assumptions that support behavioural items and patterns (Ott, 1989; Zeitz et al., 1997).

2.2 Quality Culture in Iran Context

It is significant for this study to inspect levels of adoption of quality, but also to analyse the presence of quality cultures in Iran and the oil and gas industry. Gershman (2016) believes that the relationship between culture and economic growth is by no means a new subject. In addition, Prajogo (2007) also states that there is a strong relationship between quality, strategy and competitiveness.

In the Middle East, quality or TQM is viewed as a profitable management approach. Nevertheless, culture change in Iran appears to be misjudged, yet in the West, organisations have developed business cultures that positively affect benefit and financial improvement. In the Middle East, associations are likely to lack a long-term view (Zairi, 1996). Business goals are in general short term and concentrated on fulfilling immediate social needs of the business owners. Moreover, the practices set up frequently fulfil the social needs of the business owners, and thus there is occasionally little concentration on consumer satisfaction as required in TQM.

The poor work practices, high degrees of self-satisfaction, distrust among groups of workers, doubt, trivial jealousies, demonstrations of treachery, nepotism, dishonesty, passive outlooks, absence of eagerness to coordinate, 'them and us' syndrome, and numerous other unsuitable work habits are found in Iranian organisations. These issues should be handled and tested immediately if success with quality is to be sustained.

In 1997, Aly carried out a study which analysed TQM execution in the Middle East (a territory which entails Iran). At that point, he set up that the need to research quality and TQM was 'very worthwhile'. Additionally, it was found that the quantity of associations

utilising TQM as a means through which to deal with their organisations was ‘very limited’. There were also issues with perceiving the significance of setting objectives, besides goal arrangement and measuring results. Aly deduced that his investigation had ‘indicated that there is a poor level of understanding of TQM as a total concept. Most perceptions still seem to be focused on product related issues and cost efficiency issues.’

The approval of TQM as a management philosophy for developing organisational competitiveness and efficiency has left the growth of experimental research behind and this issue is reflected specially in developing countries where awareness and recognition of TQM is still in the embryonic stages (A1-khaliti & Aspinwall, 2000; Baidoun, 2003). Organisations in the majority of Middle Eastern countries are not aware of the effect of their Quality Management (QM) on efficacy, competitiveness, and productivity (Abusa, 2011). Indeed, the driving forces of Quality Management Practices (QMP/s) in the Middle East are globalisation and the fluctuation of oil and gas prices in the world. This fluctuation has made oil and gas producers to implement QM in businesses including the oil/gas, private, public, and industrial businesses (A1-khalifa & Aspinwall, 2000).

3. PROJECT MANAGEMENT

PM is the field of utilising recognised standards, procedures and policies to deal with a project from origination through completion. It is frequently abbreviated as PM. PM entails planning of an organisation's resources to carry out a specific task, event or responsibility (PMI, 2015). It regularly comprises a one-time project rather than a continuous one, and resources entail human and monetary capitals. A project manager can assist in describing the aims of the project and deciding when the various project segments should be carried out and by whom this must be done. The project manager generates quality control observations to ensure completed segments meet a particular standard (Siakas, Georgiadou, & Balstrup, 2010).

A well-known group of constraints regularly utilised represents that PM achievement is evaluated by the capacity of the project team to deal with the project in a manner that the anticipated outcomes are generated yet controlling budget and time (Ahmed, 2014). "PM Triangle" or "PM Triple Constraint" (Figure 1) is the expression commonly used for these elements.



Figure 1: The PM Triangle (Ahmed, 2014)

A limitation is indicated on every side of this triangle so that change in one side influences the other sides. These sides include 'Cost', 'Scope', and 'Time' while 'Quality' is placed in the centre of the triangle as the forth limitation (Kerzner, 2013).

3.1 Quality Culture in Project Management

Suda (2007) suggests that any project team or organisation has its own exclusive characteristics, value structures, and the manner they perform their tasks to succeed. In order to lead and support the target project to success, the project leader should have a clear picture of the notion of culture. Many of these projects include business with various cultures at the same time. These project leaders usually perform their duties based on the core culture of their organisation; indeed, they also consider the subcultures of different departments such as research and development (R & D), sales, and etc. Project managers also take into account the customers and the core cultures related to them. For accomplishment of the project, comprehension of immediate culture is also a must as this is the key for developing time-honoured plans. Subsequently, practices that disturb the end goal and principles of the client organisation must be bypassed. To form a focused project culture, many chances are provided for project leaders contingent upon the fact that this culture be consistent with the lead culture of the target organisation. In order to have a team with a healthy atmosphere and to improve the project team, all the factors mentioned above must be taken into consideration.

4. RESEARCH METHODOLOGY

This paper is based on secondary data analysis that characterises and clarifies the needs of quality culture in Iran's oil and gas projects. The data have been collected from peer reviewed journals, and some books and conference papers. At this stage of research, a qualitative content analysis will form the key research tool to analyses the secondary data. At this point, the primary data gathering and analysis has not yet been completed, which will be collected by interviewing relevant expert views regarding the impact of quality culture in Iran's oil and gas projects. This present study will, therefore, purely adopt a qualitative data gathering method, and consider various secondary sources accessed via Internet and academic databases.

5. CHALLENGES OF CULTURE AS AN INFLUENCE ON QUALITY

A fundamental element distinguished in the literature is the failure of numerous organisations to adapt TQM properly to the particular cultural setting in which it is being applied. This turned into a significant theme in the TQM literature alongside the developing realisation that 'soft' behavioural and cultural aspects of TQM are in any event equally as essential to its prosperity as the 'hard' aspects, such as particular instruments and techniques (e.g. Dale & Cooper, 1992; Katz, 1993).

Culture influences individuals' beliefs and indirectly affects performances. The socio-cultural condition, in which the association exists, specifically influences organisational culture and functioning of organisations (Siakas et al., 2010). The execution and adequacy of quality management practices could also be emphatically affected by the national culture (Tata & Prasad, 1998). Noronha (2002, 2003) contended that quality management programmes ought

to be culture-specific and the effective adoption requires understanding the fundamental national cultural variables. Cultural change is progressively being perceived as a vital part of total quality development (Adebanjo & Kehoe, 1998).

The cultural impacts on business and organisational exercise generally, and on TQM implementation specifically, can be partitioned into national cultural influences and organisational culture influences, which frequently overlap, however are not necessarily the same.

6. CHALLENGES OF ORGANISATIONAL CULTURE IN PROJECT MANAGEMENT

The culture of an organisation is connected to the degree of success of the projects in various regions, including processes, administration style, time controlling and training. Organisational culture includes the potentials and performances of that organisation's employees. *A guide to the PM body of knowledge (PMBOK® Guide)* (2008) summarises these elements as:

- General quality of the staff experience
- Collective perspectives, duty declarations and expectations
- Encouragement and payment procedures
- Work principle
- Manners of behaviour
- Atmosphere
- Social standards
- Risk-taking procedures

The PMBOK Guide notes that these attributes assume a significant part in deciding whether objectives of the project are accomplished. The point of view of employees about their role in the project and in the organisation is a crucial aspect of organisational culture. Projects that are viewed as adjusting to organisational culture may have smoother application and higher achievement rates contrasted with tasks that contradict with those cultural standards. Tasks that comply with the elements of organisational culture may have better application and greater achievement than the activities that are not in line with those elements.

Comprehension of organisational culture along its connection to PM can assist organisations in figuring out which activities are considered as effective to tackle. Inserting PM mind-set in organisational culture can bring about long-term advantages in competition with other organisations. This is based on a research carried out by PM Institute (PMI®) in 2015: *Pulse of the Profession: Capturing the Value of PM*.

The research recognised a number of ways for developing a culture that grasps PM such as recognising the significance PM offers; involving project patrons at administrative levels; and adjusting tasks to organisational plan (Bradley, 2017). Companies with such credits will probably indicate greater amounts of accomplishment in PM.

7. OIL AND GAS SECTOR IN IRAN

The Anglo-Persian oil organisation discovered oil in 1908 at Masjid-i-Suleiman located in the southwest of Iran and thus put an end to the seven-year ailment and debts (Kent, 2015). The finding established the backgrounds for the organisation called BPPLC and the mounting of a huge oil power.

During the previous century, Iran has had the opportunity to be one of the world's most powerful oil producers despite its recurrent difficulties with Saudi Arabia's oil lobby (Kent, 2015). Iran started opening up before the beginning of the new century, seeking the skill of worldwide oil organisations to assist in increasing production. European oil organisations put billions of dollars in the nation, enthusiastic to access Iran's boundless reserves regardless of tough terms (Raval, 2015). As Stevens (2015) reports:

- The oil and gas sector in Iran is vital for the nation's financial outlook. The future of this country is dependent upon how restrictions are removed and also upon arrangements Iran has made to offer to the international oil companies (IOCs).
- Innovation and capital are what Iran requires which can be accessible from IOCs. Although Iran has indicated a great interest, the IOCs will probably be attracted if the condition is profitable.
- The trade of liquefied gas has been offered from Iran to Europe to eliminate over-dependence on Russia. Various pipeline courses have also been proposed (Stevens, 2015).

In May 2014, Zanganeh, Iranian minister of petroleum, expressed that Iran has been always ready to export liquefied gas and gas to Europe. At the same time, Ali Majedi, the representative oil minister for international trade affairs stated that 4 million cu m and 50 million cu m of natural gas can be transferred to Europe every day through a pipeline in Turkey. Also, alternative lines can go through Iraq, Lebanon, Syria, Armenia, Georgia and the Black Sea (Stevens, 2015).

8. QUALITY CULTURE CHALLENGES OF OIL AND GAS INDUSTRY IN IRAN

Ranked first for oil and gas reservoirs, the National Iranian Oil Company (NIOC) is in charge of studying, planning and performing hundreds of projects per annum. While managing these projects, the anticipated consistency and efficiency should be met; otherwise, considerable losses of money, time and other resources is inevitable (Brumberg & Ahram, 2007). Thus, the notion of founding an appropriate PM procedure in NIOC seems essential. Furthermore, the top management highly endorses any novel and applicable solutions regarding this issue. Unfortunately, improper PM has led to failure in achieving goals on time in many NIOC projects (Kerzner, 2013). This scenario becomes worse when lessons learned from previous or present projects are not collected and utilised in the form of an official, unified and comprehensive system.

Knowledge of essential tools, tactics and methodologies within TQM is a necessary skill for project managers with which most are not professionally familiar. As a result, already solved problems in other projects or those that could have been easily avoided waste a great deal of time and effort to be resolved (Umble, Haft, & Umble, 2003). As an example, an ordinary and not large oil production plant in NIOC (50,000 bpd) will bring about \$100 million loss

for a one-month delay which could be easily avoided by using a proper TQM system (Moghaddasi, 2013).

The Iranian Oil Company is not only the largest organisation in the Middle East but also a major member in oil companies around the world (Karimi & Kadir, 2012) which plays a prominent role in the economy of the country. Many helpful activities have been initiated in the domain of quality management, quality enhancement of products, and economical progress by this company. The ISO standard is held by the majority of oil and petro chemistry companies; other companies have also won the EFQM prize. In order to achieve the maximum customer satisfaction, a number of companies have created suggestion systems to improve TQM. However, the key question addresses the amount of success companies have achieved with pre-planned quality agenda. The review of the related literature reveals that no studies thus far have been conducted in this domain. Therefore, the present research aims to address this gap and thus help eliminate shortcomings of the aforementioned issues. It is necessary to conduct research on the effect of TQM on the level of quality, enhancement of production quality as well as performance of the oil industry particularly in their operational performance.

As Sharafedin (2016) reports, in the past decades, many incidents have happened within oil and gas industry of Iran, ranging from \$40 Million oil rig collapse into the sea to fire incidents in Iranian major petrochemical plants because of lack of quality. For example, in 2016 a fire at Iran's Mobin Petrochemical refinery complex located in Assaluyeh left 4 employees injured and \$66 Million damages to the plant.

9. DISCUSSION

PM includes organising different parts of a project to yield a satisfactory outcome. This organising entails various factors as employees, resources, facilities, and techniques (Amalraj, Hernani, Ladouceur, & Verma, 2007). Unfortunately, project managers have encountered major challenges during the past ten years. Quality, agenda, and cost are variables that have made PM a challenging issue along with a number of mitigating factors over which the project manager can have no control. Occasionally, these external variables can affect PM in a way similar to controllable variables. Amalraj et al. (2007) suggest that quality is the part of PM that can cause problems in this domain and project owners view quality as a challenge. The owner representatives usually do not concentrate on the notion of quality as required since they devote most of their time to supervising managers.

Culture includes a group of developed behaviours that individual have within a society. To E.B. Taylor, an anthropologist, culture is a multifaceted whole that entails information, faith, art, ethics, regulations, conventions and all the other habits and behaviours people in a society might acquire. Organisational culture entails the principles, customs, information, performance and the predictable practices of a specific social group (Cleland, 1988). People create organisations and each organisation has its own distinctive features which connect these people to each other while providing a group of values and principles for working and living.

The general cultural climate of each organisation is reflected in its policies which is also the case with PM. In a nuclear project, for instance, culture can have a great impact on the connection between efficacy and different controlling bodies. When efficacy is not in line with the Nuclear Regulatory Commission (NRC) guidelines, quality reassurance turns into a

piece of paper instead of a managing instrument (Cleland, 1988). On the contrary, cultural climate can also influence projects in a constructive manner.

The effect of cultural difference on business productivity is not a new concept in oil and gas industry of Iran, yet has increased because of globalisation. Nonetheless, the correspondence among different social groups and effective control of emotions has not received enough attention. The technical challenges have also made the situation more complicated and strong determination is required to tackle these problems (Weijermars & De Jong, 2008). Traditionally, the oil and gas sector has concentrated on managing economic, political and methodical uncertainties and risks connected to them. Bringing an intelligible perspective to cultural risk management assists in preventing undesirable results from happening in discussions and implementations of PM in oil and gas business. The oil and gas industry is usually multifaceted and includes a great diversity with regard to different cultures professionals of the field come from. Since human behaviours and activities are partly influenced by emotions instead of logic, it seems reasonable to stress the part emotions and cultural obstacles play and thus measure their potential effect on oil and gas industry internationally. This critical review research not only extends previous research on quality culture, but also enables project managers to be aware of key challenges and barriers that exist in oil and gas projects especially in Iran. As this paper is critically reviewing quality culture issues in Iran's oil and gas industry, critical literature survey and review of existing published data is carried out to explain the needs of quality culture in Iranian oil and gas projects.

10. CONCLUSION

The impact of culture to a project team has received various answers in the literature: a) it creates social standards to control behaviour; b) it conveys messages to both insiders and outsiders about the organisation objectives; c) it assists in connecting people, organisational objectives and standards; and d) it helps regulate, supervise, and develop views and activities in the organisation. The purpose of this study is to understand the necessity of quality culture in PM teams within Iran's oil and gas industry. Therefore, a critical review of the related literature is performed to clarify challenges in conventional PM structure in Iran's oil and gas industry, current practices in TQM and methods with which quality culture can enhance the performance of PM teams. A critical literature survey and review of existing published data is carried out to explain the needs of quality culture in Iran's oil and gas projects. As a contribution to the existing body of literature, the present study will make an attempt to provide a comprehensive perspective to project managers in oil and gas sector. These managers will also be able to perceive the role of different factors in executing oil and gas projects. Consequently, a more extensive and multi-faceted image of quality culture in project management will be created. This can indeed enhance their performance and effectiveness as the so called project managers and give their companies the needed boost.

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EXPLORING THE EFFECTS OF PERFORMANCE MEASUREMENT PRACTICES IN OIL AND GAS PIPELINE MAINTENANCE

C. Aduku¹, C. Liyanage² and G. John³

School of Engineering, University of Central Lancashire, PR12HE, United Kingdom

Email: Caduku1@uclan.ac.uk

Abstract: This paper defines manager's job performance in pipeline maintenance and how performance usage practices enhances capabilities in pipeline maintenance. This study was conducted through a multiple case studies using three multinational oil and gas companies in Nigeria. Comparisons are made between performance measurement usage practices in pipeline maintenance, focusing on managers' job performance, their influence in pipeline maintenance. Clear value and importance of performance measurement usage and usage situation perspective for identifying and solving problems in pipeline maintenance is the main findings of this study. In the interpretative perspective, managers' job performance is multidimensional. This study focus on managers' job performance, the interactive nature of performance measurement usage practices, future research will applied a holistic approach to observe all personnel involved in pipeline maintenance, which will allow a richer picture of the impact of performance measurement in pipeline maintenance. This paper outlined the importance of performance measurement usage and situation usage in pipeline maintenance in the Nigeria O&G industry, by amalgamating performance measurement and pipeline integrity management, an innovative way of improving integrity management practices in the Nigeria O&G industry.

Keywords: Condition based maintenance, Oil and Gas, Performance measurement, Pipeline maintenance, Pipeline integrity management

1. INTRODUCTION

Pipeline undoubtedly is one of the influential components in the production of Oil and Gas (O&G), also in the sales of O&G in the world market today. It is also a highly valued component of the extractive industry. Its functions involved exploration, extraction and transportation of O&G to costumers. Many countries energy requirements solely depend on the regularity of service of pipelines

The Nigeria government also depend on the uninterrupted supply of O&G through pipeline in order to generate revenue and electricity. To maintain constancy in the production and distribution of O&G, the O&G companies operating in Nigeria have adopted maintenance performance measurement (MPM) strategy. The adoption process was to optimise the efficiency and effectiveness of the maintenance function. A clear focus in optimising the internal effectiveness and external effectiveness as pipeline integrity affects customers demand at all time. The industry perceived that MPM can be used to improve the existing pipeline integrity management (PIM) program- a means of improving all activities concerning the integrity of pipeline and to ensure pipeline safety values are up dated at all times to avoid catastrophic pipeline failure that may damage companies reputation. However, despite the use of MPM strategy in pipeline maintenance, several challenges have been found dwindling the benefits of MPM in fulfilling its purpose in the Nigeria O&G industry. Hence, this paper thoroughly and carefully reviews MPM elements for pipelines maintenance

improvement by identifying the factors leading to the efficiency and effectiveness of MPM in pipeline maintenance projects in the Nigeria O&G industry.

2. LITERATURE REVIEW

2.1 MPM Issues and Challenges in Pipeline Integrity Management

Several high-profile pipeline accidents and breakdown considered damaging to the environment has been recorded in local communities of the oil bearing Niger Delta region in Nigeria (Aroh et al. 2010; Agbakwuru 2011; Omodanisi et al. 2014). The high profile pipeline incident recoded have served to substantiate the relevance of MPM as a mean of improving the PIM operation and ensuring the set target are met. Maintenance managers have also identified MPM as a mean by which the appropriate people selected to perform an excellent work. They also acknowledge MPM as a mean of realising the full benefits of maintenance. Top management also known that MPM enable users to identify risk and hazards associated to a certain pipeline maintenance project, they know it help in the formulation of a workable maintenance strategy and it is also called a versatile management tool used for the implementation of maintenance strategy. However, MPM success depend on the user's capability and ability to discover and use the relevant key performance indicators (KPIs) that can inform in the area that require attention for improvement at all time. Kutrowski (2013) identify that some PIM systems focus attention on a single problem at a specific location in the pipeline, rather than taking a more global look at the integrity of the entire system. As a result, some areas of the pipeline are not adequately maintained. This can eventually lead to pipeline ruptures that damage the company's reputation cost much more in repairs, clean-up and fines levied by regulatory agencies. Aroh et al. (2010), Bonvicini et al. (2014) and Ebrahimi (2015) identify PIM system issues and challenges, which led to the adoption of MPM as follows:

Risk management: the process for identifying the cause and effect of pipeline failure is slow and management often takes more than the required time before conducting corrective maintenance and clean-up of oil spill in the region.

Operation control: managers hardly use MPM during maintenance operation to provide strategic planning, vital information that is intended to be useful to managers in performing their jobs and to assist their company in developing and maintaining viable patterns of behaviour that is matched with working according to the established parameters. MPM also help to build a robust system where manager may well be responsible for elements of strategy, management control and operational control. In addition, Eti et al. (2006) observed that weak link in the management control systems framework are intentional. This attitude and behaviour also propagate need for management of change.

Management of change: operators deliberate avoid MPM usage in identifying areas that require management attention in constantly changing situation. Top management deliberately ignore the critical success factors (CSF) which agree that the integrity of the pipeline infrastructure are to be maintained at all times, contractors staff must be contactable, responsive and sensitive to company's needs, maintenance service shall ensure a safe and stimulating environment for stakeholders, pipeline operators must be satisfied and motivated. In addition, management must responsive to pipeline maintenance needs, and experiencing changing needs and goals as the situation changes in order to maintain company's reputation in the operating environment.

Incident management and investigation: operators hardly report accurate incident for the sake of fear of being punished for their offence, unless when such incident result to huge O&G spill. Vital information concerning human error are hindered and there is no data to educate people about the event that led to failure.

Emergency response: In the event of oil spillage, the company often experience slow emergency response. In most cases, the community are aware of the pipeline leak before the company could identified or traced the area where oil spill.

Communications plan: the communication link or gap between top management staff and the contractor staff often hindered pipeline issues that requires urgent top management attention in the region.

Competency, awareness and training: management are more concern with the bottom line figure (i.e. benefit and profit) than coordinating training or awareness program. They understand that MPM activities involve recruitment, hiring experts, providing education for employees and ensuring that all pipeline operators possess the multi-skills or functional knowledge and skills, right attitude and behaviour that represent the company image in the course of maintenance.

Good recordkeeping: management hardly use lessons learned, as a result people hardly document events or occurrences.

Quality control plan: some workers have mitigate quality control plan for self-benefit (corrupt practice) as a result are often undermined.

Furthermore, relative benefits of CBM depends of organisational commitment and support. Organisational commitment also means leadership commitment and attitude that describe the linkage and relationship between the pipeline operators and the company they represent, and a set of behaviours that operators follow to manifest that relationship (Aladwan et al. 2013). Furthermore, this context observed that human factors in pipeline maintenance, maintenance performance, pipeline performance and MPM are uniquely interconnected. Nevertheless, existing literature concerning PIM does acknowledged human factors in pipeline maintenance, however, very few PIM framework incorporate theses human factors as measureable indicators using MPM approaches (Zardasti et al. 2017).

According to Peach et al. (2016) human factors or top management commitment can be seen as a leading indicator that can predict the quality of maintenance tasks, predict compliance with set standard, predict compliance with pipeline safety and policies, and the desire to meet performance target. Prediction of pipeline performance and other maintenance related matters also aligned with CBM methodologies, as asserted by de Jonge et al. (2017) companies that are interested in implementing CBM must also consider the risks related to the lack of experience. From the construction industry perspective, Detsimas et al. (2016) emphasis the need for workplace training, a means for developing operators performance and experience. Another factor that may affect maintenance performance is the decision-making processes in the company (Bazrafshana and Hajjari 2012).

Maintenance decision may vary from day-to-day decisions to strategic decisions, particular, when management perceived community violent or attack on pipeline workers. On the other hand, Aragónés-Beltrán et al. (2017) says that stakeholder's influences, stakeholders demand,

and individual group's interest are major problem maintenance manager's encounter in the industry. The ability to understand the often hidden influence of the various stakeholders is a critical skill for successful maintenance project managers (Aragonés-Beltrán et al. 2017). In this course, maintenance manager's duty is to select key performance measurement indicators (KPIs) pertinent for the particular business situation. However, it is not possible to monitor or measure all of the available indicators due to the increase in number and type of measure (Horenbeek and Pintelon 2014). According to British Institute of Facilities Management (BIFM 2014), the main reason for measuring performance is to learn to improve maintenance performance, report internally and externally, demonstrate compliance to company set pipeline safety and operating requirements or regulation, provide information to help managers make better informed decisions and to comply with external reporting regulations and information requests.

Therefore, measuring human performance is paramount in achieving effective PIM activities in the O&G industry. Insights on how the various characteristics influence MPM in pipeline maintenance are lacking. Even with the fact that real usage of MPM often help to set agreed-upon performance goals, allocating and prioritising resources, informing managers to either confirm or change current policy or programme directions in order to meet those goals, and sharing results of performance in pursuing those goals (Amaratunga and Baldry, 2003; Parida et al. 2015; Sheikhalishahi et al. 2016). Yet, pipeline maintenance and management activities still undergoes frequent failure in the Nigeria context. It is also important that operators be involve in the formulation processes. Yasin and Gomes (2010) view that improvement of any project always rely on the participation and involvement of all related personnel throughout the planning, implementation and feedback stages.

Top management support also enforce the process of ensuring that the set PIM objectives are achieved as the deliverables are measured according to KPIs (Steenhuizen et al. 2014). Typically, MPM also serves three functions, which are (1) formulation/implementation of workable maintenance strategies using situation report, (2) coordinate PIM operations involving maintenance, (2) motivate employees to do their assigned task, (3) monitor performance and to identify areas for improvement in pipeline maintenance. In this course, workplace performance, effective commitment, and work motivation are key area that requires managers' attention. In the Nigeria context, pipeline problems are expected but not prevented in advance, as asserted by Eti et al. (2006) that such attitude and behaviour lies within maintenance culture is that problems occur due to factors beyond practical and resource control: it is accepted that something will always go wrong and nothing much can be done about it in advance. In the overall, PIM requires effective commitment, in terms of organisational commitment, top management support, and team commitment to ensure that MPM function adequately and without intentionally weakening the purpose, which MPM stand for.

3. METHODOLOGY

In order to understand the reason behind the incessant breakdown of pipeline in the Nigeria context, qualitative strategy of enquiry was selected for this research. Literature review suggested that there are broad categories and guidelines on how performance measurement could be used but information about specific usage and usage situation is yet to be revealed in pipeline maintenance. As a result, this study employed the case study methodology to better understand the use of performance measurement systems as it emerges from the data. In this

case, the study is absorb in theory building approach in which a key variables and their linkages are identified (Nenonen and Sarasoja, 2014; Bryman, 2016; Yin, 2014). The propositions of the conceptual model provided the theoretical foundation that guided the data collection aspects of performance measurement for this study. Three multinational O&G companies were used for this study. The chosen case design is multiple embedded design (Yin, 2014), in which pipeline maintenance process of the company is the main unit of analysis and the field service units are the embedded units of analysis (Tätilä et al., 2014; Yin, 2014). Managers answered the research questions primarily from the perspective of a field service unit because the bulk of activity in the use of the performance measurement system in this case takes place at the field unit level. Instead of a single design, the researcher chose multiple case embedded design “multiple sources of evidence”. That is data from three different sources (interviews, observations and focus groups) these three sources of data strengthen the findings (Bryman, 2016; Yin, 2014). The convergent validity helps to establish construct validity when using three different measurement procedures and research methods mentioned above to collect data about a construct (e.g. task performance) (Hosie and Nankervis 2016)

An in-depth interviews regarding MPM usage in pipeline maintenance was conducted in order to gain a fuller understanding of the research context. The interviews also focused on factors affecting performance measurement usage (Pekkola et al. 2016). The participants interviewed were a senior manager in charge of decision making in pipeline maintenance. The case study lasted for two months intensive data gathering process. In each company, five managers were interviewed in different locations. Each of the five meetings lasted for about an hour minimum (45 minutes). Field written notes on observation and focus group centred on the research topics for subsequent analysis and for guidance in the research process. In addition, semi-structured interviewed was used. The purpose of the semi-structured interviews was to identify individual companies’ maintenance formulation strategy, performance measurement involvement in pipeline maintenance, usage practices, usage situations, and purposes for performance measurement in pipeline maintenance. In general, interviews were audio recorded and transcribed, coded with a unique label for easier identification during the analysis. The study employed QRS NVivo qualitative data analysis software to analyse the transcribe data. Analysis process assume the following (1) data reduction to separate the important pieces of data; (2) data display to highlight and present reduced data in a cognitively easy form; and (3) Conclusion drawing and verification to explain what the data mean (Tätilä et al. 2014).

Equally, observation was conducted in order obtain an understanding of context-specific circumstances pertaining to MPM practices, site visits were made to enable observations of situated social interaction amongst operators which involve field-note taking (Gluch and Räisänen 2012). Observation study enable the researcher to see the deviation in operators’ behaviour when executing prescribed tasks, workers also divulge the high level of management inconsistency and lack of total support for contractors staffs in charge of pipeline maintenance. Through the observation, the researcher noticed impact of militants’ activities in the region, delay at work and inconsistency in the use of MPM due to conflict between the companies and the communities’ youth seeking for casual employment. External interference (e.g. community youths) violence are predominant in the region. Operators are through the community youth or groups’ informal standards.

Focus group study was conducted, it involve extensive discussions, and the researcher was able to collect some archival materials relating to the development of the PIM. The

participants presented issues for improvement based upon their most relevant concerns. In general, information gathered in this case studies were put in different arrays, the research make a matrix of categories and placing the evidence within such categories, this led to data display and creating flow chart via QRS NVivo and other graphics to examine the data. The frequency of the event was tabulated and information are then put in chronological order (Yin, 2014). Finally, result are discussed according to cases, and findings from the three case studies involve triangulation, that is, the convergence of data collected from different sources, to determine the consistency of a finding. Coding for participants are as follow:

MM1: for participant one on case study one (CS1)

MM2: for participant two on case study two (SC2)

MM3: for participant three on case study three (SC3)

In the overall, fifteen (15) participants were interviewed during the case study (i.e. in each company five participants were interviewed).

4. FINDINGS

4.1 Company A

Top management commitment is the main finding in the study. The result extracted from the QRS NVivo analysis is shown in Table 4.1. This tend to be the leading problem effecting pipeline maintenance project in the company.

Table 4.1 Top Management Commitment in MPM

| Parent Node: Theme | Total number of respondents | Word References Count |
|--|------------------------------------|------------------------------|
| Top management commitment impact in pipeline maintenance | 5 | 57 |

The Table 4.1 above also provide the number of participant interviewed and the frequency query result captured in the case study. Participant MM1 acknowledged that top management commitment as a factor affecting PIM in the Nigeria context. This aligned with Pennanen et al. (2005) concerned about top management commitment, a value and requirements that inspire people to perform better at work. As identified by Pennanen that affective commitment is concerned with personnel attachment and involvement to improved maintenance culture. Participants MM1, MM4, MM7, MM10 and MM13 agreed that individual work experiences, attitude and behaviour also play a significance role in the development of commitment toward a commitment target in pipeline maintenance. The same level of commitment to PIM and maintenance is responsible for the current and ongoing conflict between the company and the host communities. Participant MM 1 state that people hardly comply with the recommended practice and standard due to lack of commitment at the top management level.

Participant MM 4 explain that some top management are mainly concerned with bottom line figures (i.e. profit oriented) as long as O&G are flowing, need for maintenance are deliberately suppressed unless when unexpected happened. Participants MM1, MM4, MM7, MM10 and MM13that CBM involving condition monitoring is an essential maintenance strategy that allows operators to understand the various situations and the corresponding

elements that requires maintenance attention. Participant MM1 state that the existing pipeline maintenance policy incorporate internal and external measures that help the company to reflect on the need for inspection, the need to comply to statutory or legislative requirements at all times. As asserted by Peach et al. (2016) in the literature review, the quality, efficiency, and effectiveness of maintenance work are solely dependent on top management commitment and the maintenance worker executing the maintenance tasks.

One of the participant said that top management commitment also influence maintenance culture, an attitude and behaviour that led to the underperformance of some pipelines and other government O&G infrastructures in the country. Clearly, the company policy expect all pipelines operators to maintain focus and persevere, even in the face of obstacles. Also to use time efficiently, and adapts plans when changes occur. Participant MM 3 state that people no longer adhered to stringent instruction in the maintenance of pipeline in the remote location due to insecurity, militants attack on pipelines, and coupled with lack of top management commitment to addressing the root causes of the problem.

4.2 Company B

A clear value and importance of organisational structure is the main finding in this company. There are many pipeline maintenance project facing and the causes of the problems were traced be poor organisational structure. The result extracted from the QRS NVivo analysis concerning organisational structure is shown in Table 5.1. poor organisational structure often cause delay in funding pipeline maintenance project. Particularly, delay in carrying out corrective maintenance caused by militants attack on pipeline infrastructure.

Table 5.1 Organisational Structure

| Parent Node: Theme | Total number of respondents | Word References Count |
|---------------------------|------------------------------------|------------------------------|
| Organisational structure | 5 | 46 |

Participants MM2, MM5, MM8 MM10, and MM14 agreed that the existing organisational structure affect MPM usage in pipeline maintenance. Participant MM8 said that organisational structure should be should be reorganised in such a way to serve performance measurement strategy and strategic priorities. With this, managers should be able to transmit long-term maintenance strategy. Participant MM 14 state that MPM cannot function solely it required human effort to utilise its concept. It is quite unfortunate that some group of people have chosen the wrong part and they would not make things work the way it should be.

Current the three refineries are not operating and people suffer fuel shortages due to corruption, militants' attack on pipeline for selfish interest 'a get rich quick syndrome is collapsing the system so fast' lack of commitment. Even the multinational O&G companies are not exempted, poor management and infrastructure problems is what we get due to corruption. Nevertheless, change can be created planned and managed as asserted by Marie-Anne (2013) it involve collecting and applying valid data using MPM problem solving methods will lead to change. Participant MM8 believe that MPM have the capacity to influence employees' behaviour in the organisation towards greater success. With a responsible person, it would have the capacity to transform organisational cultures and the employee's willingness to participate in change processes.

Equally, contingency theory concept regards organisational structure as a contingent variable, which implies that managers face maintenance situations, which vary and they must choose whatever structural arrangement are most appropriate in the prevailing context. The proper role of maintenance organisation theory is not to seek one best way to manage, but to provide insight and guidance for managers to help them formulate responses in the complex situations of maintenance organisational decision-making (Finchman and Rhodes, 2005 pp. 473-474). The general model implicit in contingency theory assumes that, for organisation to be effective, there must be an appropriate fit between structure and context. Figure 5.2 depict a model suitable for the reformation of organisational structure. In accordance to contingency theory.



Figure 5.1. Organisational structural model for pipeline maintenance

Similarly, a theory of individual differences in maintenance task and contextual performance has been researched by many performance measurement authors (Borman and Motowidlo 1997; Hosie and Nankervis 2016; Marques-Quinteiro et al. 2015). As asserted by participant MM2 that organisational structure relates and guide individual performance in maintenance operation. One implication of the functional approach to prosocial behaviour is that if one knows the motives that are most important to an individual, one can maximise the effectiveness of attempts to elicit prosocial behaviours by developing persuasive appeals that target the motives most important to the recipient of the appeal (Borman and Motowidlo 1997).

4.3 Company C

The main finding in this company is commitment to work. This tend to be the major problem mitigating the benefit of MPM usage in pipeline. Table provide result extracted from the QRS NVivo analysis.

Table 6.1 Commitment to work

| Parent Node: Theme | Total number of respondents | Word References Count |
|--------------------|-----------------------------|-----------------------|
| Commitment to work | 5 | 35 |

Participants MM3, MM6, MM9, MM12, and MM15 agreed that performance measurement usage in CBM and usage situation promotes commitments, interconnection, consistency and friendliness at work. In particular, participant MM9 agreed that MPM enable managers to assess individual contribution in CBM activities. Participant MM 15 state that operators have been trained on how to use MPM framework in their operation. Participant MM3 state that MPM have the organisation to maintain focus in O&G business and monitoring of pipeline performance. The company CBM strategy also aligned with the IAEA-TECDOC-1551 (2007) CBM concept shown in Figure 6.1. Participant MM6 state that the major problem the company have is external influence such as militant attacks on pipeline integrity and this have caused social disengagement and lack of commitment among workers in the remote location.

The fear of kidnappers and community conflict. Several high profile oil spill have led to the current social attack on pipeline issues in the region. This aligned with Zardasti et al. (2017) concerning reputation loss due to oil spillage. They proposed viable indicators for redeeming company's image. According to Zardasti, reputation loss can be identified based on the consequence assessment of O&G pipelines. Participant MM3 state that MPM can effectively reduce working pressure, promotes interconnection, supporting onsite learning, and motivate workers to do their job according to set target. MM15 said that the company uses MPM to address internal and external effectiveness. The internal effectiveness is addressed in terms of internal efficiency, education, training, communication, collaboration, quality health safety and environment QHSE that is reflected in terms of O&G production in right way, using the right quality material in maintenance work. Participants MM3, MM6, MM9, MM12, and MM15 agreed that correct usage and usage situation always bring job satisfaction. Such model is set out as follows.

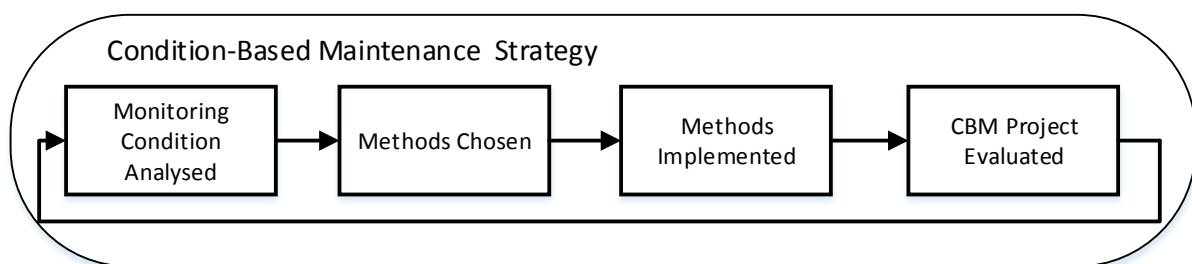


Figure 6.1 Performance measurement model for pipeline maintenance

Participant MM12 state that MPM model should be feasible, coherent for adoption and usage. A feasible model attract operators, it helps managers in identifying the relevant improvement factors. It also help in regulating and communicating the useful information that will improve operators' performance.

5. OBSERVATION AND FOCUS GROUG FINDINGS

There is common issue between the three case studies. The most critical issue appears to be management's commitment/support and operators' behaviour. Observation and focus groups results combined using a restructured effects matrix: organisational change after application of performance measurement program Miles et al., (2014). The effect matrix is supporting the deployment of performance measurement in pipeline maintenance and in advancement.

Table 6.1: Observation and Focus group results

| Company name | Factors | Case comparison |
|----------------------------------|--|---------------------------------------|
| Case A | 1.1 Maintenance culture, 1.2 Management commitment 1.3 Operators behaviour | 2.3; 3.1; 3.3. |
| Case B | 2.1 Environmental factors, 2.2 Organisational structure, 2.3 Operators behaviour | 1.1, 2.2; 1.3. there is a correlation |
| Case C | 3.1 Commitment to work, 3.2 Operators behaviour, 3.3 Maintenance culture | 1.1; 1.3; 1.2 and 2.3 |
| Total no: of influencing factors | 9 | |

| | | |
|---|--|--|
| mentioned | | |
| Most frequent performance measurement issue | Maintenance culture, Operators behaviour, and Management/operators commitment to work. | |

6. SUMMARISING THE FINDINGS

Precisely each company have similar problem. Problem in these cases can be resolved using Figure 6.1 below. Time for adoption, time for agreement, time for planning and time for the implementation of the planned maintenance, should involve top management commitment and support, which is the key finding in this study. In general, the uptake and implementation of MPM in pipeline lies on management understanding and willingness to change. Figure 6.1, present key issues and challenging factors explored in the study.

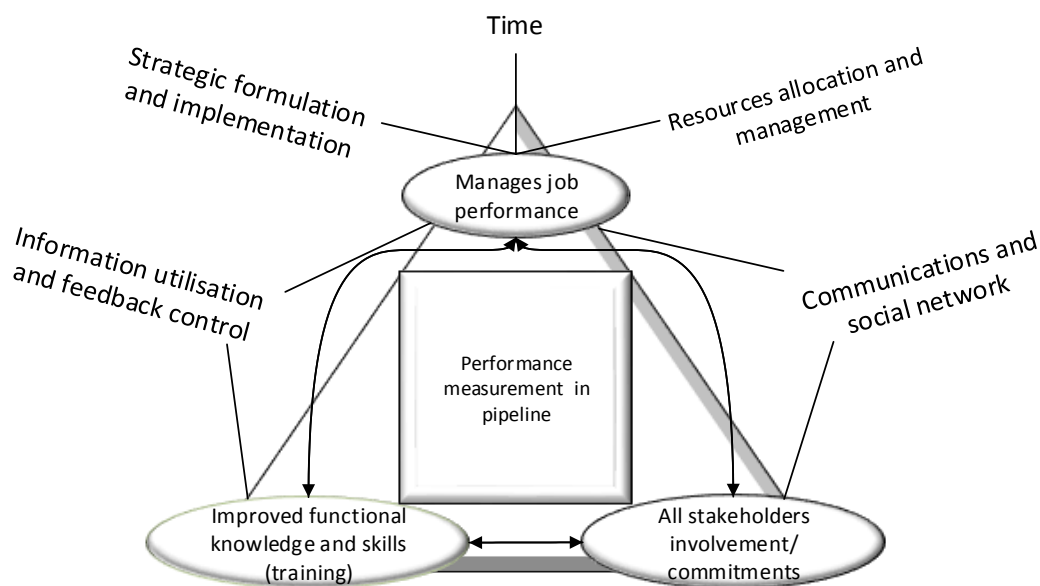


Figure 6.1 Major factors between the three case studies

The above factors in Figure 6.1 required urgent management attention to enable the industry utilise the benefits of MPM. In this case, the above factors can be used measurement indicators to improve the PIM program.

7. LIMITATION

Pipeline is a critical infrastructure that requires management attention and commitment because breakdown in pipeline correspond to breakdown in O&G production. The current militants' activities and attacks on O&G installation, social conflict due to O&G spill. Participants somehow withhold some key MPM information due to stringent company policy and culture that does not permit them to discuss pertinent information regarding their core MPM strategy. In addition, the researcher was not able to visit some key area where the companies are facing pipeline maintenance challenges to observe workers performance due to issues of insecurity in the remote locations.

8. CONCLUSIONS

This paper emphasis on performance measurement effect in pipeline maintenance. Findings have established performance usage and usage situation. The three case studies used solely depend entirely on the performance of operators to achieve their production and O&G transportation objectives. However, the quality of operators work in the maintenance services cannot be measured directly. Knowing individual experience, qualification, education, training and skills is essential to measure adequately the result of the work performed. In few occasion they measure the excellence of their human factor; nor do they include this factor in their assessment of the performance of the maintenance function (Kumar et al. 2013). In addition, measures of organisational performance are often selected based on convenience. Measures are too complex due to third parties interferences.

There are future research opportunities in building on the findings to expand the understanding of performance measurement usage and situation usage in a broader way. In particular, motivational, leadership use and the motivation induced with use have been dominated by the strategic control views in current literature (Enshassi and El Shorafa 2015; Eaidgah et al. 2016). Findings suggest that these areas are important to capture the potential of performance measurement usage and practices for some organisations. Another direction for further research is the beneficiary of performance effect that stem management actions from the deployment of performance measurement in pipeline rather than its use. Future research is needed to specify how the emergent understanding of the operational use of performance measurement can contribute to the body of knowledge on pipeline integrity management design and implementation of performance measurement processes.

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SUSTAINABILITY AND ENVIRONMENTAL SYSTEMS

IMPROVING THE REGULATORY FRAMEWORK OF FLOODPLAIN MANAGEMENT AND DEVELOPMENT IN THE UNITED KINGDOM

B.Alam¹ and C.Pathirage²

¹ School of the Built Environment, University of Salford, 43 Crescent, M5 4WT, United Kingdom

² School of the Built Environment, University of Salford, 43 Crescent, M5 4WT, United Kingdom

Email: B.Alam@edu.salford.ac.uk

Abstract: Flooding is a natural disaster that most commonly impacts the United Kingdom. The frequency of flooding makes it an important focus for a researcher. The scope of flooding is wide-ranging as it can affect people, society and the economy. A particular location vulnerable are the floodplains as these are naturally prone to flooding. Such developments suffer from varying degrees of risk during times of flooding. In the United Kingdom, floodplain developments have risen leading to added risk to occupants. Property owners are thus exposed to risk with flood regulation coming into effect through planning, defences, insurance and taking precautionary measures. A deep understanding of flood response and management will be needed for this research. For this project, each stage of the regulatory process involving flooding and floodplains in the United Kingdom will be examined to provide an overview of current flood management practice. Current findings show that there are regulatory gaps with regards to flood resilience in relation to aspects such as flood insurance and though a unified strategy exists there is a disconnect with flood response. An extensive literature review will be used to showcase the challenges and barriers to flood response on the floodplains. This is with the aim of better improving the existing regulatory framework of floodplain management in the United Kingdom.

Keywords: Disaster Management, Flooding, Floodplain, Floodplain Development

1. INTRODUCTION

Flooding is a natural disaster that is ranked as the most common the affect the world. It is held as the worst threat to the UK with the danger posed by it set to increase in the future (Defra, 2015). Their frequency makes it an important focus for research. Guha-Sapir et al. (2010) noted floods being the most common natural disaster worldwide. Thus, their effect is wide ranging and communities are more likely to be affected by it. Floodplains are particularly vulnerable as they are ecologically connected to a body of water making them naturally prone to flooding. In England, rivers and coastal floodplains have been populated for centuries with floodplains making 12% of the country and 8% of those having property developments (CCC, 2012). Flooding also impacts infrastructure such as energy, water and communications (EA, 2009). Thus, damages to affected regions can be extensive with floodplains being particularly vulnerable. The Environment Agency (2015) states that floodplains, “*would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas*”. In 2009, an estimated 2.4 million properties were already situated in a floodplain (NAO, 2014). The damage can include disruption in the community, damage to structures and the loss of human lives.

For methodology, an exploratory based research has been used to highlight improvements to the existing framework with qualitative methods being utilised through the use of an extensive literature review.

2. FLOODING

Flooding is a natural hazard that can come from a variety of sources including river or ground water. The United Nations stated, “*flooding can arise from overflowing river, heavy rainfall over the short period or an unusual inflow of sea water onto land, such as storm surge, tidal flooding, seismic events (tsunami) or large landslide*” (Proverbs and Mambretti, 2012; pg. 156). Floods impact human life with them being a growing risk to populations, particularly those in floodplain areas. It has the greatest potential for damage among the natural disasters and affects large numbers of people (UN, 2004). The dangers posed by it are widespread with it capable of devastating entire communities. Fleming (2002; pg. 15) stated, “*floods are a natural occurrence and the risk they pose is wide ranging. However, for society, the main focus is the risk to people and property.*” Thus, floodwaters can destroy both residential and commercial properties. It also affects; transportation, communication, agricultural developments and damages the environment. In addition, the after effects can lead to health risks from pollution and water-borne diseases (Marriott et al, 1999). The frequency of flooding makes it the most common of the natural disasters with its effects illustrated in **Figure 25**.

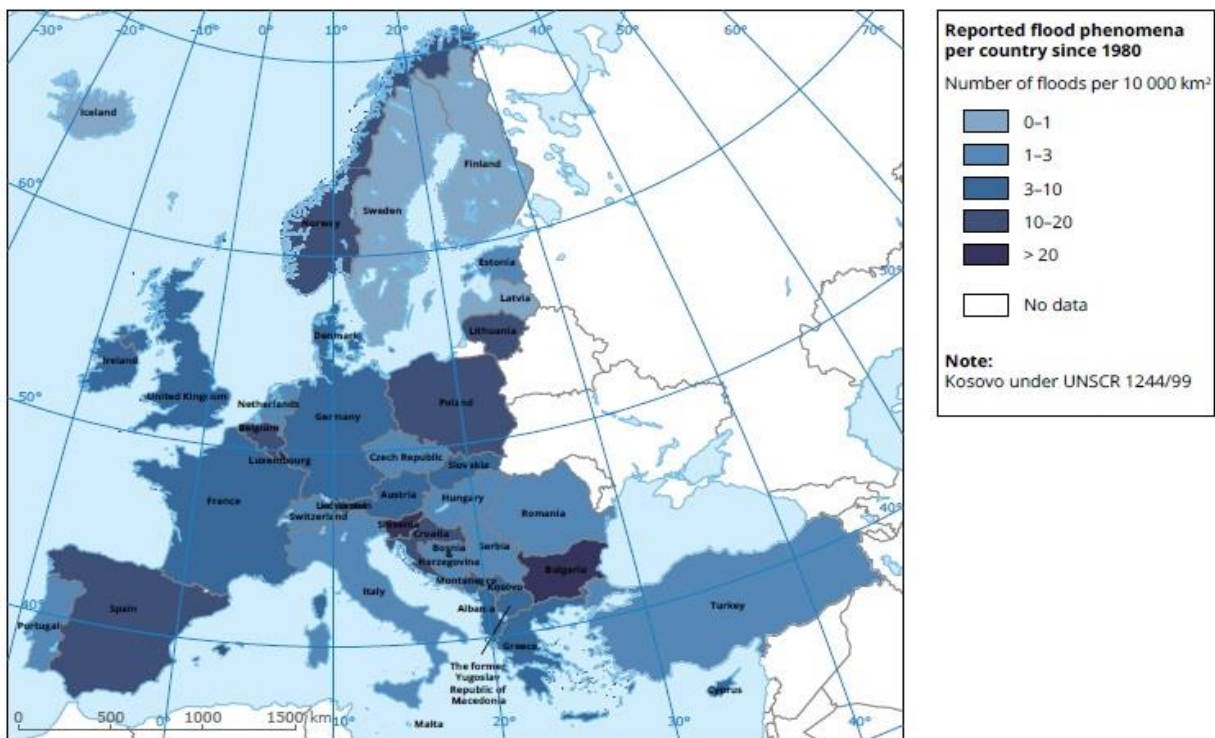


Figure 25: Reported Flood Phenomena (number of floods per 10,000 km), per country (since 1980) (Source: EEA, 2015)

A Climate Change Committee (2012) report noted that flood damage is expected to increase across the UK in the future. Flood damage amounts to £1.1 billion per year in costs in England (Bennett and Hartwell-Naguib, 2014). In 2000, 10,000 properties in England and Wales suffered from flooding and weather-related insurance claims totally to around £1 billion (POST, 2001). There are an estimated 5.8 million (nearly 20%) of properties that suffer from the risk of flooding in the UK (Defra, 2013). As such, the effects of flooding are wide-ranging in the UK. Research has indicated that the effects of flooding may be more extreme than previously estimated when taking into account the potential increases in rainfall

volume and intensity and risk of extreme sea level rise (Evans et al., 2008). Thus, the danger posed by flood risk is only set to increase in the future.

2.1 Floodplains

An area prone to flooding are regions known as floodplains. These are, “*the land next to, or hydraulically or ecologically connected to, the flowing river*” (Freitag, 2009; pg. 44). These areas are naturally prone to flooding and therefore suffer from a higher degree of flood risk. However, Freitag (2009) noted human developments on floodplains can bring about a quick and deadly response from the river. Such areas are subject to urban development but suffer from extreme floods making them contested regions. Annually, extreme floods create enormous and mounting damage on floodplains (Hartmann, 2011). The IPCC (2007) noted human development on floodplains and inadequate flood response plans have led to greater potential for damage caused by flooding. Despite the dangers, there have been developments in floodplain areas (Hartmann, 2011). This is due to factors such as growing population pressures and the land being viable for development. Floodplains are among the most densely populated areas in the world with these being particularly well suited for development (Kron, 2005). However, environmental changes alongside wider societal changes can potentially alter the likelihood of human exposure to hazards and the susceptibility of people to their impacts (Few, 2007).

In England and Wales, there were approximately 1.85 million homes, 185,000 commercial properties, around 5 million people and half of agricultural land suffering flood risk (Few, 2013). In 2009, the Environment Agency (EA) noted that 2.4 million properties were situated on the floodplains in the UK (EA, 2009). A CCC (2012) report stated that floodplain development grew faster in England over the past ten years. Many developments were deemed protected but one-in-five suffered from significant flood risk. It is for this reason a framework is necessary to better manage new developments in floodplain regions and prevent inappropriate constructions. These developments expose inhabitants to the danger of flood risk as floodplains are more vulnerable to hazards. During floods, such areas can experience disruption in the community, damage to property and possible loss of life. However, due to their nature, floodplains serve as sites that are subject to development.

2.2 Floodplain Developments

Floodplain developments hold many advantages but unrestrained development is noted for being costly and dangerous (Owen, 1981). Marriott (1999) noted that many of the worlds densely populated areas resided on floodplains. Such sites face an ever-present danger as they are prone to flooding. In 2004, a consultation with the Association of British Insurers (ABI) stated a need for stronger and more transparent planning systems to curtail developments on floodplains (ABI, 2004). It recommended the EA be made a statutory consultee on all planning applications in flood areas. However, there have been a number of developments on floodplains. The CCC (2012) noted floodplain development had grown at a fast rate compared to the past ten years. Whilst 80% of floodplain development were in well-protected locations, one-in-five properties built in such areas suffered from significant flood risk (CCC, 2012). On the approval process, the report stated that it was ‘*not sufficiently transparent or accountable*’. Furthermore, the EA stated that they only knew the outcome of 65% of planning applications that they objected.

The CCC (2012) report also were concerned on whether local authorities considered alternative developments before agreeing to construction on floodplains and whether long-term effects of climate change with regards to flooding had been considered. In 2013, local councils allowed 87 planning developments that saw 560 homes built in areas of high flood risk in England and Wales (RIBA, 2014). In 2009, an estimated 2.4 million properties were already situated in a floodplain (EA, 2009). Floodplain development had grown at a fast rate compared to the past ten years with one-in-five properties built in such areas that suffered from a significant flood risk (CCC, 2012). The number of homes stated to be built in flood risk had risen by a third in 2013 as compared to the previous year (RIBA, 2014). Despite the risks, such developments are only increasing and exposing their occupants to danger from flooding. The CCC (2014) noted that continued floodplain development leads to an increasing reliance on the use of flood defences. As such, the regulation of floodplain developments can reduce the burden placed on flood defences through the use of an effective flood risk management system that seeks to avoid inappropriate construction in these areas.

3. REGULATORY FRAMEWORK

Parliament, regulatory authorities and courts have recognised the dangers of flooding and have attempted to address this through regulatory frameworks. To combat these risks, efforts are made in order to mitigate their impact. Such mitigation takes the form of disaster management that seeks to either avoid or reduce the potential losses from the hazard. To mitigate their impact, disaster management aims to either avoid, adapt or control the hazards effect. Wisner (2003) stated that disasters are a, "*complex mix of natural hazards and human action*". The UNISDR noted that disaster risk is composed of multiple factors that include the occurrence of an extreme hazard event caused by natural forces/natural forces alongside human interference and that this affects something or someone (Holt, 2012).

The approach adopted by the courts established in the case of *Arscott v. The Coal Authority* (2004) referred to flooding as a '*common enemy*' that needs to be prevented. This involves taking steps to reduces likelihood of flooding and mitigate its impact. The strategic overview and management of flooding lay with set regulatory bodies such as the EA (Defra, 2014). Legislation such as the Flood and Water Management Act (2010) provides the framework for flood management. Ultimately, flooding cannot be avoided though the general approach is to manage the risk (Schanze, Zeman and Marsalek, 2006). In the UK, the EA operates as the statutory consultee on all new developments within floodplains (RIBA, 2009). It offers guidance and operates as part of the regulatory framework in managing the risks in floodplain developments. It is a requirement that Local Authorities consult with the EA during planning applications when a proposed development can suffer from a risk of flooding. Despite these measures, the UK has experienced flooding on numerous occasions as detailed in the following section.

3.1 Flood Regulations

Flood risk is the combination of probability/hazard and consequence/impact (Sene, 2008). Thus, flood risk management operates by mitigating the extent of the flood damage. To combat flooding, regulatory systems are used to create a system to implement and manage flood defences. As a result, through management and organization it seeks to better respond

and cope with hazards/disasters. The tools created as part of this framework include; flood risk assessments, hazard maps, management plans, improved strategic coordination and public participation. This creates an element of flood defence with the goal of protecting human lives and property from flooding events. Developments in the international landscape have also led to incorporation of such frameworks into the UK as highlighted in **Figure 26**. Through law, a system is introduced through which guidance and enforcement is produced to implement such a framework with the aim of mitigating the impact of flooding hazards.

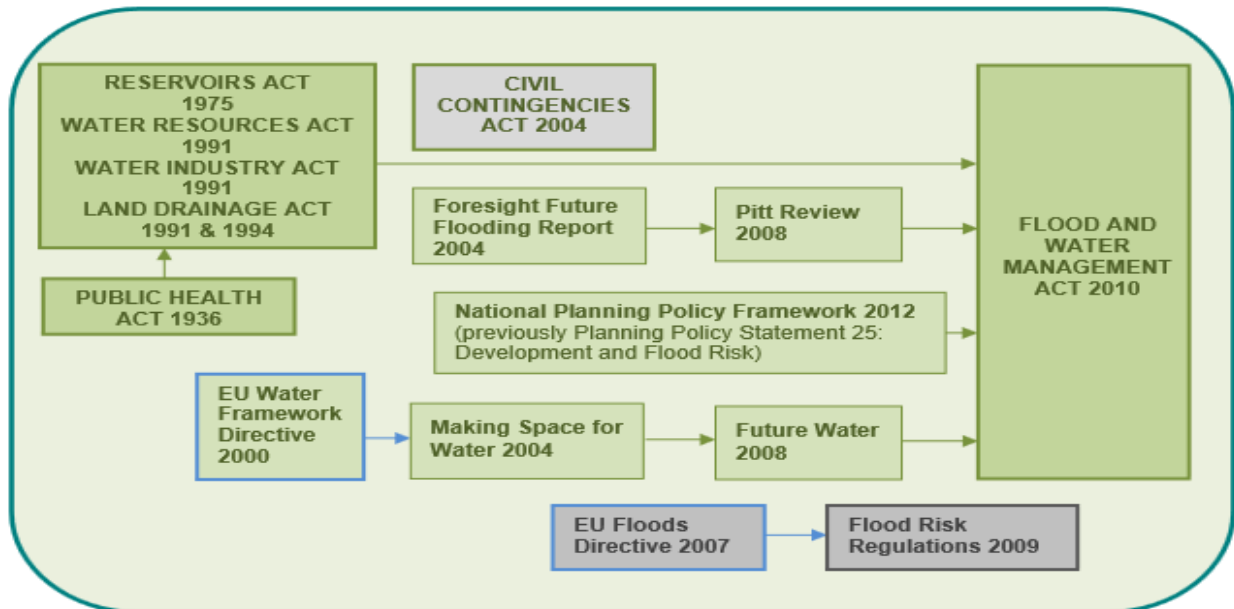


Figure 26: Flood Legislation in the United Kingdom (Source: Devon County Council, 2015)

Within the UK, the EA operates as a regulatory body who provides guidance on measures needed to protect homes from floods. Effective flood risk management offers an important role for the UK in the defence against hazards and protects communities, businesses and infrastructure (NAO, 2014). Legislation is the basis through which regulatory bodies can enforce/implement means to combat flooding. Under the Climate Change Act (2008), there is a general duty to adapt and mitigate the dangers from climate change with Local Authorities taking part in ‘active strategies’ to achieve this goal. As climate change can increase flood, these strategies seek to promote a policy of adaptation. As a result, the regulatory framework operates with the goal of empowering flood management by providing guidance, policy and regulations.

3.2 Regulatory Bodies

In the UK, flood management involves a complex framework of institutions that are responsible for its administration, finance and service (Brown and Damery, 2002). Defra and the EA take the leading role in developing strategies to mitigate the effects of flooding. The EA operates as the primary authority and has a supervisory duty on matters of flood defence (Brown and Damery, 2002). Legislation such as the Environment Act (1995) confer investigatory powers to the EA in the commission of its duties. The Flood Risk Regulations (2009) placed duties on the EA and local authorities to prepare flood risk assessments, flood risk maps and flood risk management plans (Defra, 2009). Though operating in the role of flood defence, legislation also imparts on it a duty as a flood risk management authority.

Cooley (2006) stated that, “*land-use management is among the most effective mitigation measure available*”. Thus, proper control over its management is deemed as the best approach in managing flood risk. The Environment Agency (2009) noted that developing in such areas means being exposed to flood risk. It is for this reason that their guidance is to avoid developing in such areas as this eliminates the risk.

4. DISCUSSION

Flood risk management was identified as a national priority area of development (HM Government, 2012). Floodplains suffer from added risk of flooding that can be mitigated by implementing regulations to reduced its impact and manging the flood risk. According to Hall et al. (2003), flood risk management uses a strategy that seeks to review prior decisions made with the aim to “*reduce, control, accept, or redistribute risks of flooding*”. Thus, it distinguishes itself from flood defence as it seeks to mitigate the impact rather than avoid it entirely. Flood risk management has been noted as moving towards a continuous holistic approach that emphasized the need to analyse, assess and mitigate risk on a catchment scale (Sayers et al., 2013). Despite such features, there have been significant cases of damage to properties as a result of flooding. The EA stated that one-in-six properties among 5.2 million such residences in England experience a risk of flooding (Abbey and Richards, 2016). In both residential and non-residential properties, expected annual damages are estimated to be more than £1 billion that are at risk from flooding (Bennett and Hartwell-Naguib, 2014). Similarly, flooding has led to 2.4 million properties at risk from river/sea, 3 million suffer from risk of flooding from surface water and 1 million are exposed to flood risk from both (Law Society, 2016). In 2007, the summer floods resulted in heavy downpours that caused 55,000 properties to be flooded (Defra, 2009; Jha et al., 2012). Similarly, the Bonfield Report has shown that sustained rain in 2016 led to extensive damage across the country with 17,000 properties being flooded and costs expected to amount to £1.3 billion (Defra, 2016). Reports indicated further research could bring about better management in order to reduce flood events (Efrac, 2008).

There exists a need from policy and law to regulate and mitigate flooding due to it being an ever-present danger. The UK Climate Projections (2009) noted floods being among the extreme events to affect the country, with greater frequency in the future (Defra, 2009). A Climate Change Risk Assessment (2012) indicated the UK being already vulnerable to extreme weather changes from flooding and heatwaves. This highlights the key goal of avoiding developments should they be made in areas designated as being inappropriate due to flooding. However, it highlights that developments could be made if safety measures, such as adaptations, were made in case of flooding. An Environmental Audit report highlighted, “*planning system also has a flood defence role to play by minimising development on floodplains and maximising the use of 'sustainable drainage' techniques*” (House of Commons, 2015). This system attempts to steer such developments away from areas of risk. It was noted that crucial changes in flood risk management came in two aspects; a shift from reliance on physical power to social power and that no single organisation has the power to affect change (Pender, 2011). Thus, a holistic approach combines the various organisations power for the use of effective floodplain management that can only occur through regulatory influence.

Insurers have sought better control of floodplain development and increase spending on flood defences (Crichton, 2012). This shows that better regulations and guidelines are needed to

control flood risk management including those in the floodplain areas. Crichton (2012) noted floodplain developments have become easier through a succession of planning policies and due to reduced flood defence spending. As such, rules come into effect as they create the boundaries on the use of power. According to Pender (2011), “*legal frameworks are the archetypal system of formal rules, whilst governments are the archetypal setters of formal rules*”. A research gap identified from literature shows a lack of a coordinated strategy towards managing flood risk. Pender (2011) noted holistic approaches to managing flood risk is needed to better cope with impacts of flooding and climate change. The OST Future Flooding project sought to develop a holistic thinking approach to flood risk (Pender, 2011). Similarly, Surminski and Eldridge (2015) noted that there does not exist a long-term strategy to managing flood risk with flood insurance affordability being a short-term perspective. In conclusion, they said insurance was simply, “*tool amongst the many that are required for a holistic strategy on flood risk management*” (pg. 12). Insurance operates by covering unexpected losses but it does not prevent the risk of flooding from returning. Thus, they noted that risk reduction operates as an important element in combating flooding with the use of effective planning policy along with flood risk management playing an even more important role.

5. CONCLUSION

Whilst floodplain management has faced increased improvements over the years, research has indicated that the danger posed by flooding is set to increase in the future. Floodplain development has increased according to research and literature has shown that goal of a holistic approach towards floodplain management is in need of further improvements. Aspects such as insurance and flood adaptations operate independently from that of Flood resilience. Thus, this misses the goal of improving flood resilience, response and management. Such a gap can be better resolved through the use of regulation, legislation and policy to address this missing link. By linking policy and regulations flood resilience with a long-term strategy this could see a more holistic approach to being adopted with regards to floodplain management in the UK.

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IMPROVING PRODUCTIVITY OF ROAD SURFACING OPERATIONS BY USING VALUE STREAM MAPPING AND DISCRETE EVENT SIMULATION

R. M. Qasim and Z. Aziz

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: m.qasim1@edu.salford.ac.uk

Abstract: The Highways Infrastructure is one of the most valuable assets owned by the public sector. Road construction projects suffer from tight schedules, heavy traffic volumes, low budgets and environmental constraints that affect the productivity as well. Guaranteeing smooth traffic services demands preservation and improvements of the best criterion. Existing optimisation approaches are based on manual procedures, are fragmented and not making the best use of computer-aided methods to improve processes. This research highlights a synergistic relationship between applications of Value Stream Mapping (VSM) along with Discrete Event Simulation (DES) methods to enhance the productivity of the delivery of road maintenance (resurfacing) processes by gaining higher utilisation rates and least road closures. Research plan included the use of primary data that was obtained from interviews, direct observations, productivity databases and review of archival records. Process maps and value stream maps were developed using this data that were finally used to create discrete event simulation models, to explore different optimisation scenarios. A simulation model was used to run various what-if scenarios that are not possible in real life and efficiency of equipment and the over all process was improved dramatically using this DES-VSM integration. This research demonstrated that current maintenance operations are not efficient enough and could be enhanced to a great extent using simulation techniques and this study can be replicated as a best practice as well.

Keywords: Paving, Process Improvement, Simulation, DES-VSM framework, Productivity.

1. INTRODUCTION

Road surfacing is a major component of Highways Development and Maintenance. Highways construction sector, in general, is characterised by its slow pace of change, low productivity, waste, fragmentation, and long-established processes and ways of doing business, that has not evolved over decades (Aziz et al. 2017). Efficient running of the road network has the success of national and local economies as well as the quality of public life, dependent on it (INRIX & CBR 2014). Increasing volumes of traffic require maintenance and improvements of the highest standard. A key challenge is to deliver major road schemes in resource-constrained environments while maintaining safety, cost efficiency, sustainability and minimal impact on road users (Qasim et al. 2017). Enhancing productivity of existing processes is a key to operating in a resource-constrained environment.

Recent reviews of the construction productivity performance, specific roadworks, indicate that the industry fell short in comparison to manufacturing and services-based industry sectors (Changali et al. 2015; Graham Ruddick 2016; Houghton 2017; Moore et al. 2015). Some of the key factors restraining the productivity of construction are related to quality, use of project controls, and proper levels of supervision. Similar observations were made in the annual UK Construction Industry Performance Report (Anon 2015), indicating that majority

of construction projects continue to fail to meet their time and cost targets. These observations are often coupled with falling profitability and client dissatisfaction with regards to product quality, service and value for money.

Considering above findings, there is an urgent need for improving the productivity of road works projects within the construction industry to deliver ongoing and future projects, with maximum efficiency and minimum waste. Discrete Event Simulation (DES) along with Value Stream Mapping (VSM) has been recognised as a technique that can improve the overall process as well as some specific key areas. Manufacturing, process, construction and healthcare sectors have advanced their operations and benefitted from either simulation, value stream mapping or the integration of both.

2 LITERATURE REVIEW

The literature review discusses the relationship between DES and VSM and how they both complement each other and its relevance to support highways operations.

Table 1 Showing synergic relation of DES and VSM and its popular applications

| References | Industry | Findings | D E S | V S M | DES-VSM framework |
|------------------------------|-----------------------|--|-------------|-------------|----------------------|
| (Marzouk et al. 2011) | Highways, Resurfacing | This paper only uses simulation for improvement in traffic flow while resurfacing happens under lane closure condition. It does not mention VSM or the holistic view of the overall process. | X | | |
| (Xie & Qingjin Peng 2012) | Healthcare | Integration of simulation and VSM can analyse alternatives for problems of capacity planning and schedule control and improve health care operations. | | | X |
| (Mcdonald & Aken 2002) | Manufacturing | DES can be a vital part of VSM to complement the future design. | | | X |
| (Lian & Van Landeghem 2007) | Manufacturing | Integration of DES with VSM improves information for process design. | | | X |
| (Agyapong-Kodua et al. 2009) | Manufacturing | Transforming static VSM models to dynamic DES increases validity and reliability of the future design. | | | X |
| (Marvel & Standridge 2009) | Manufacturing | DES provides validation and visualisation of VSM future design. | | | X |
| (Singh & Sharma 2009) | Manufacturing | VSM is a powerful tool for lean manufacturing and allows firms to understand and continuously improve its understanding towards lean. | X | | |
| (Huang et al. 2009) | Construction | The combination of DES and VSM increases understanding of the behaviour of the future design. | | | X |
| (Gurumurth | Construction | DES validates, approves and visualises the VSM | | | X |

| | | | | | |
|------------------------------|--------------|---|---|---|---|
| y & Kodali 2011) | | future design. | | | |
| (Jarkko et al. 2013) | Construction | VSM is unable to evaluate the performance of the future state design analytically without the help of DES. | | | X |
| (Labban et al. 2013) | Construction | Although research into simulation of construction continues to advance and thrive in the academic world, application of simulation in the construction industry remains limited | X | | |
| (Abdulmalek & Rajgopal 2007) | Process | Data obtained from DES evaluates and validates VSM process design. | | | X |
| (Seth et al. 2008) | Process | VSM serves as a starting point to help management, engineers, suppliers, and customers recognise waste and its sources. | | X | |

The synergic relationship between Value Stream Mapping (VSM) and Discrete Event Simulation (DES) has been tested and applied before in Manufacturing and construction industry. However, its usage has not been adequately explored within resurfacing and asphalt industry. Table 1 above presents a summary of key previous literature published within road resurfacing context. Published literature focuses on logistics involved in resurfacing operations and do not adequately cover hybrid VSM-DES relationship in resurfacing of road pavement. This paper tries to fill this gap and utilise this integration in highways maintenance for process improvement purposes.

VSM was formed from Toyota production system and Lean manufacturing principles (Womack et al. 1990) It is defined as an iterative method to map and analyse value streams, and its goal is to evaluate and communicate production process aspects, such as material and information flows as well as non-value adding actions (Lasa et al. 2008; Rother & Shook 2003). It is used in improvements schemes like increasing throughput and for reduction of Lead time and works in progress (WIP) (Álvarez et al. 2009). VSM is made up of three components; a) Current State Gap that visualises value adding and non-value adding activities in a process, b) Future State Design, a value stream that solves the identified problems of current state and c) Yearly Value Stream Plan, that creates the operational plan to reduce gap between present and future state (Martin & Osterling 2014).

Value Stream Mapping cannot provide hard facts for decision making and simply points toward a direction. It lacks the ability to forecast the effects on future performance of a system analytically, hence the need for simulation arises to experiment and evaluate the future behaviour of a scheme (Jarkko et al. 2013). Basic lean tools, including VSM, are sufficient for analysing straightforward and linear processes with relatively consistent demand patterns. Static approaches are incapable of investigating methods that incorporate volatile demand dynamics, mix product complexity or the shared use of resources. In such scenarios, time dependencies are necessary as a process simulation model can accurately describe and visualise the dynamics of the process, its performance, and the required resources (Aziz et al. 2017).

Simulation is the process of modelling a real world situation and developing a framework within which the system can be analysed (Law & Kelton 2000). Application of simulation in construction operations has many advantages including estimation of possible delays, productivity determination and improvement. In addition to resource management and optimisation, stochastic system response to unexpected conditions, and ability to respond to random and dynamic features, while the system is operating (Labban et al. 2013). Simulation is also defined as a “controlled statistical sampling technique (experiment) that is used, in conjunction with a model, to obtain approximate answers for the question about complex, multifactor probabilistic problems (Ulrich 1991).

Simulation is used by many industries to model real-life and hypothetical situations, due to its dynamic nature and complex scenarios. This was acknowledged as well by (Bhasin 2015), stating that as an integral part of a lean activity, companies spend much time designing new processes layouts, producing CAD drawings and building process maps en-route. The cost of these activities can run into significant amount while none of these outputs will indicate whether the new process will succeed or not. That is the job of process simulation which can examine the capability of the new design and provide vital implementation support to decision-makers that they are on the right path or not.

The combination of Simulation and Value Stream Mapping is more dominant in manufacturing industry than construction. Simulation-based VSM makes it possible to investigate complex systems and interpret the simulation results in a language that lean recognises (Solding & Gullander 2009). Both DES and VSM provide a holistic assessment of system and DES also adds a fourth dimension, time, to VSM. This combination offers insights that may have been missed if VSM alone had been used (Donatelli & Harris 2009). It has been noticed that DES can enhance VSM and a process can benefit incredibly with the integration of both (Jarkko et al. 2013; Flores 2015). The fundamental purpose of using their combination is to boost the productivity of resurfacing process, reduce waste and maximise the efficiency of resources involved in the process.

3. CASE STUDY WORK

The case study about road improvement project is related to a section of a road in the United Kingdom, carrying 108556 vehicles annually (2013 data), including 20% Heavy Good Vehicles and it required re-surfacing. The motivation of improvement project was to deliver efficiency by maximised output and use of resources, improved utilisation of road space and by benefiting travellers through fewer road closures. There were inefficiencies noticed in the process and due to the incompetent working style of subcontractors, an enormous amount of resources were wasted, and traffic was disrupted on a daily basis.

All types of road work processes, whether new constructions or maintenance work, are classified into two broad categories i.e. surfacing and resurfacing. Every road surface has its diverse characteristics, which vary according to its geography, location, surrounding terrain, speed related parameters, intended use, and type of pavement. Key constraints that must be addressed before the start of pavement process include setting up of Traffic Management (typically 15 minutes), material call-off and planer mobilisation (typically 30 minutes), and planning a head start (usually 45 minutes), leading to a total non-value adding the pre-paving time of 1 Hr 30 minutes.

Key post-pavement process constraints include rolling (usually 30 minutes), cooling and curing (typically 75 minutes) and Traffic Management removal (typically 30 minutes). This means a total of 2 hours and 15 min post is paving shift period. A safety margin of around 1 Hr 30 Mins is left for safety related activities. Installation and removal of Traffic Management has an average duration between 30 minutes to 45 minutes and depend on a broad range of variables including use of different designs and types of TM, delays and operator/process related variables.

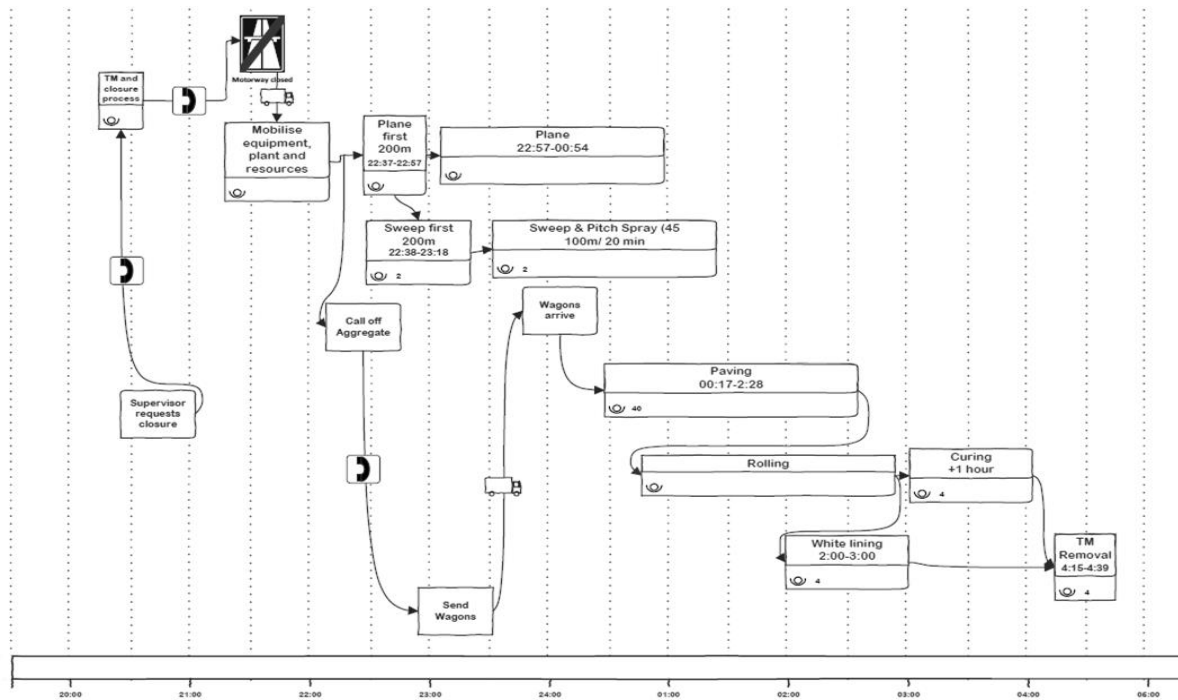


Figure 1 above shows the Value stream map of As-is operation

Based on this value stream map, various opportunities for waste reduction can be identified. Firstly, planning process starts at 22:37, given site access, has been granted at 22:08, this signifies a delay of 29 minutes after access to the area for surfacing has been issued. Secondly, main value adding activity paving starts at 00:17. This highlights a paver sitting idle for over 2 hours, awaiting material arrival. Thirdly, while working window is till 6 am, workers are off-site about 1 hour 21 minutes before allocating period, highlighting another area for improvement. Fourthly, there is a possibility to extend working window by obtaining an early access to work.

4. ROOT CAUSE ANALYSIS

This Section presents root cause analysis from 6 different perspectives, with an end objective to improve the total production per shift. Figure 2 below helps to give an understanding of the current issues of a surfacing operation system as well as to provide project strategy ideas to improve the output. Fishbone (Ishikawa) Diagram shows many constraints identified in road surfacing process review and their cause (Vertex42 2013). The fishbone diagram was chosen due to the need of studying and analysing the possible reasons that can negatively affect the process output target (Yazdani & Tavakkoli-Moghaddam 2012). The four W's questions should be answered and considered to explain the fishbone diagram. "What" refers to issues related to objects such as materials and machines, "Why" is used to answer questions

concerned with work conditions such as motivation of manpower. Moreover, “When” refers to problems related to time sequence in operation such as time needed in production. Finally, “Where” is concerned with effects related to the place, production line, loading area, and so on. Figure 2 below shows different factors that were regarded as constraints and were considered responsible for low productivity.

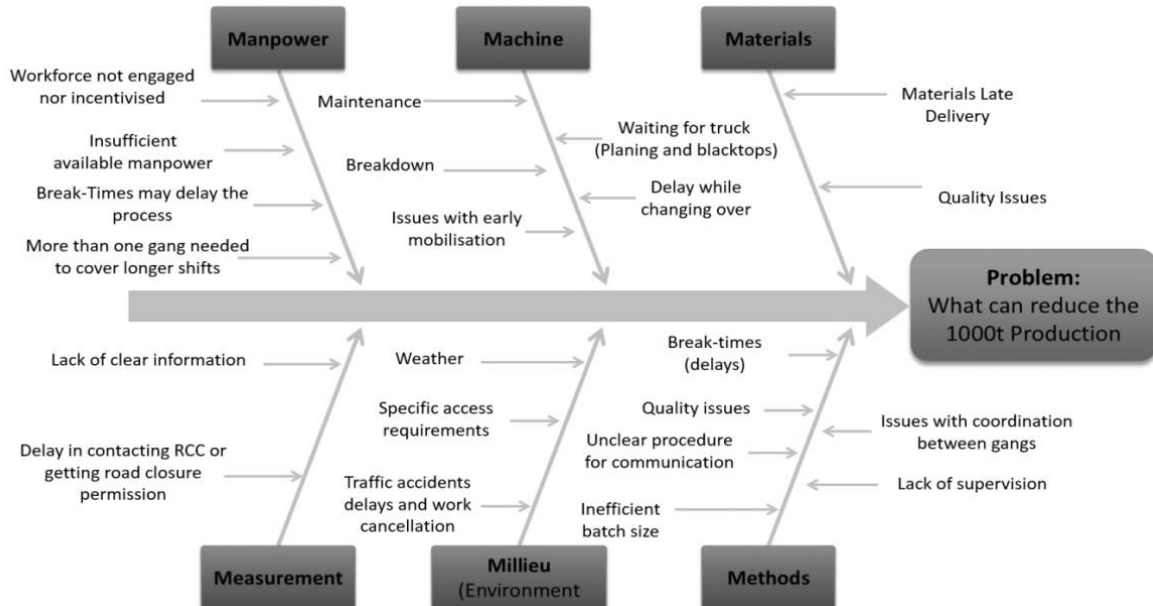


Figure 2 Showing Fish-Bone analysis of as-is situation

4.1 Steps to Create a Simulation Model

For the purpose of this research, the DES was chosen due to the flexibility and precise state fluctuation within the process. While multiple DES software applications were introduced to the market by different developers, such as *FlexSim*, *Simio*, *Anylogic*, *JaamSim*, *MASON*, *Sim.JSS*. *Simio* was selected to carry out the intended simulations considering it is one of the most popular simulation software applications for its ease-of-use, rich functionality, and its capabilities of tracking different data points such as throughput, content, machine state, and utilisation. According to Manuj et al. (2005), there are seven major steps in the methodology of creating a simulation of a real life situation applying it back to the system. These include:

1. Problem formulation
2. Specify dependent and independent variables
3. Develop and validate conceptual model
4. Collect data
5. Establish and verify computer-based model
6. Validate model
7. Perform simulations

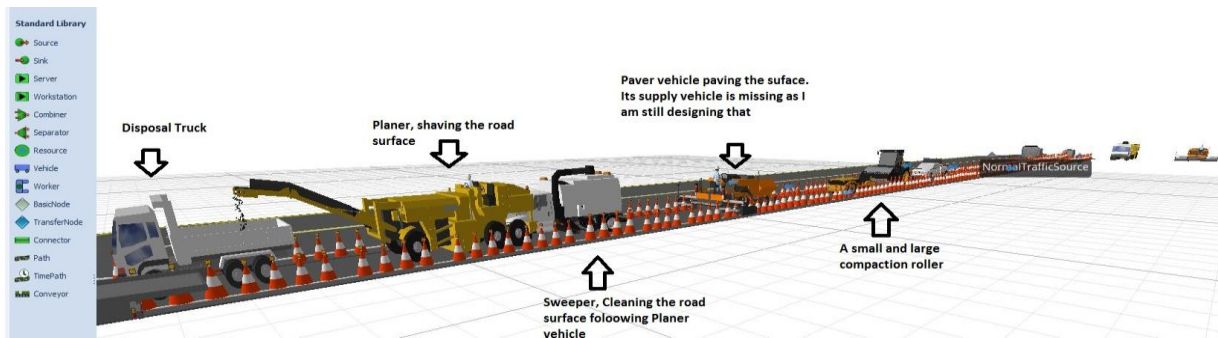


Figure 3 Showing the simulation model drawn up in Simio software

To perform different what-if scenarios to improve the as-is processes, various experiments were conducted in the computer based environment as it can be seen in figure 3. These experiments tested by changing variables that are otherwise not possible to modify in real life environment due to cost, health and safety and other physical conditions. Some of the scenarios tested are explained:

4.2 Scenario No.1: Creating Zones within the job site and increasing the number of Planers and Pavers.

The first scenario assumes dividing the job site into two (2) equal zones (Zone A & B.). Each zone has its planers, one for each lane, while maintaining two (2) lanes closed for resurfacing and two lanes open to public traffic. Both zones share two (2) pavers, five (5) sweepers/pitch-sprayers and four rollers. In the same time, the scenario maintained the same working window. Key expected outcome is increased production in laying asphalt. Figure 4 below shows the arrangement of vehicles that was performed in the software called Simio.

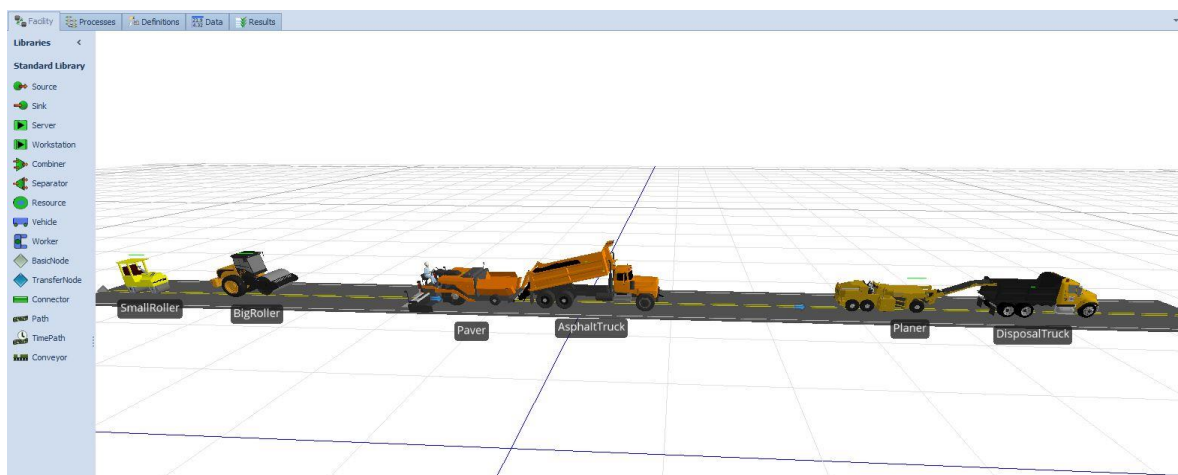


Figure 4 Showing the Simulation of Resurfacing vehicles in computer based environment

Simulation output is illustrated in Table 2, with total production rate increased up to two times (i.e. 276.9 Tonne/hour) the standard production rate. The simulation shows that the utilisation of pavers through the working window remains the same, despite added machinery with an average usage rate of 65.3%. As a result, an increment in the values of total production and production rate was expected, and the outcomes of simulation met these expectations. Even though production output has increased, the added cost because of additional machines should also be taken into account.

Table 2 showing results of Scenerio1

| Scenario 1: Using Two pavers and closing two lanes together | | | |
|---|-------------------|---------------------|---------------------|
| Paver total output | Paver Avg. output | Paver 1 utilization | Paver 2 utilization |
| 1892 Tons | 276.9 Tons/hour | 65.3% | 65.3% |

4.3 Scenario No.2: Providing a 30 min break from 2:00-2:30 am

This scene focuses on measuring the impact on production rates of a 30-minute worker break from 2:00 am to 2:30 am. Single paver operations are assumed. A 30-minute break resulted in a decrease in total production and production rate. A 30-minute break leads to total asphalt laid reducing to 865 Tonnes in comparison with the previous scenario of 1892 Tonnes output. The production rate was recorded as 126.6 Tonne per hour, respectively. The utilisation of Paver through the working window shrank by 5.6%. A 30-minute break could lead to significant delays in larger projects. As a result, staggered break times are suggested, in which each team takes its break in a manner that does not affect the flow of work.

Table 3 showing results of Scenerio2

| Break from 2:00-2:30 am | | |
|-------------------------|-------------------|-------------------|
| Paver total output | Paver Avg. output | Paver utilization |
| 865 Tons | 126.6 Tons/hour | 59.7 % |

4.4 Scenario No.3: Using two Pavers in parallel (shut) lanes

3rd Scenario assumes limiting motorway closures to a 6 km stretch. Two lanes at a time are closed to public traffic, and a 45mm thick asphalt is to be overlaid as shown in Figure 5. Each closure interval (2 lanes) requires one (1) extra hour to complete resurfacing of the closed lanes. The additional hour is needed for the paving operation. Thus, a further investigation of the paving operation is required in order to accelerate the process and reduce the necessary time for one hour instead of adding one hour to it. Finally, resurfacing of the entire closure area requires an hour to be added or eliminated from each shift.

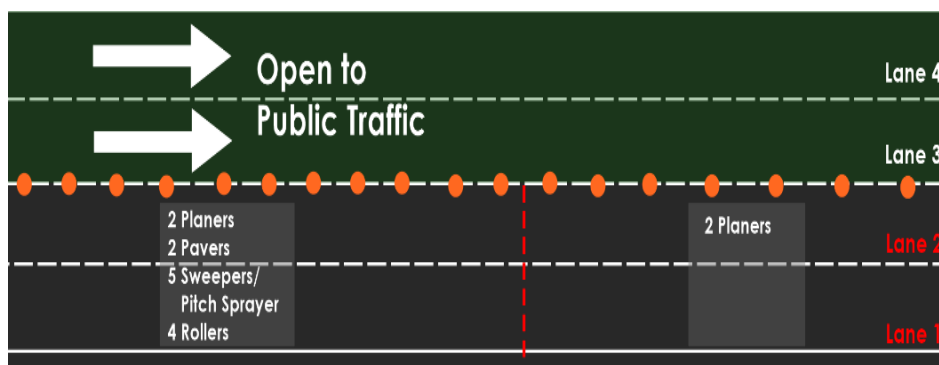


Figure 5 showing 2 lanes shut and 2 open for the public in Simulation Environment

Table 4 showing results of scenario 3

| Scenario 3: Closing two lanes at once | | | |
|---------------------------------------|-------------------|---------------------|---------------------|
| Paver total output | Paver Avg. output | Paver 1 utilization | Paver 2 utilization |
| 1892 Tons | 276.9 Tons/hour | 65.3 % | 65.3 % |

5. CONCLUSIONS

The literature review indicated that while there is an uptake of lean concepts and tools within the manufacturing, process and construction industry; there are very few examples and limited use of value stream mapping and process simulation within road transportation context. There is a need for integrated approaches that allow for a comparison between the performances of such practices to the existing systems (Detty & Yingling 2000). An Integrated Value Stream Map and Discrete Event Simulation Framework based on the review of literature presented a precise description of how future VSM can be validated before implementation and achieve benefits. McDonald and Aken (2002) explained how the integration might be able to predict the outcomes of dynamic situations that VSM is not capable of addressing alone.

The most significant activity in resurfacing operation is paving, where the paver machine lays asphalt on the road. It was noticed in the case study that paver was being used for only 2.5 hours out of the 8 hours' working window which reduces its efficiency to only 33%. It can be seen that paver utilisation can be maximised from 33% to 65% by implementing the scenarios described above. In the UK, resurfacing operation is usually carried out overnight, and two lanes are shut for operation, and one paver operates in one lane at a time. During simulation trials, it was noticed that using two pavers in two different lanes is also a do-able scenario that can double the amount of work done in same time.

The factors that can affect this experiment are weather, traffic volume, working styles and planning. The maximum paver efficiency achieved in the UK is 65% that was performed only once during the 1000-ton case study and has never been replicated afterwards. On the other hand, it is common to have more than 70% paver productivity in the USA due to different working window and working style. In California, the roads are shut for the whole weekend (55 hours), and alternatives are provided, but it pays off well at the end of the day.

The purpose of this research was to investigate the relationship between DES and VSM and then apply it in Highways operations perspective to achieve higher production rates and minimum road closures. Value Stream Map was created after obtaining the primary data, which helped in understanding and mapping the complicated process. VSM is used to gain the in-depth understanding of the process to eliminate any waste and then a simulation model can be created using this.

Various possibilities can further be experimented in the simulation model to suit the needs of a particular environment. Different scenarios have been performed in the simulation to optimise the process, and the best practice can be chosen after validating it through focus group discussions or workshops, etc. It has been seen in the case study that just by changing the working style, huge benefits can be achieved.

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SUSTAINABLE BUILDINGS AND POST-OCCUPANCY EVALUATION: AN END-USER BEHAVIOR BASED APPROACH FOR CERTIFIED OFFICE BUILDINGS

E. Tezel¹ and H. Giritli

¹ *Department of Architecture, Istanbul Technical University, Taşkışla Campus, Istanbul, Turkey*

Email: tezele@itu.edu.tr

Abstract: After recognition of sustainable development theme in late 1900s worldwide, construction sector was adapted itself into this concept in many ways to limit its negative impact against nature. Sustainable building certification systems was one of the adaptation tools, which have been basically summarized as categorization of buildings according to certain criteria; and such practice is becoming widespread day by day from its firstly start as almost three decades ago. However, as researches indicate that, even constructing a building according to sustainability rules is vital, there is more to be considered to reach higher success level in sustainability.

This study focuses on the connection between sustainability perceptions and pro-environmental behaviours (PEBs) of end-users in sustainable buildings and their effect on such buildings' operational phase. Findings of current research highlights the importance of user and its interaction with sustainable building, in terms of building's actual performance that sustainability professionals in construction industry need to consider. In the conclusion part of the study, a framework has been suggested in order to minimize current performance gap of sustainability certified office buildings through concentrating not only on building's technical characteristics determined in sustainability policies, but also its major actors as users during its occupational process.

Keywords: post-occupancy evaluation, pro-environmental behavior, sustainable buildings.

1. INTRODUCTION

Sustainability and sustainable development are two significant themes, which have been discussing more than a-quarter century all around the world. Even though different definitions of sustainability and sustainable development have been put forward and discussed, the most widely used one is from the Brundtland Report by the World Commission on Environment and Development (1987), which defined sustainable development as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs." However, this definition does not provide any specific pathway to sustainability.

Since the Brundtland Report in 1987, awareness of sustainability issues is increasing in the construction industry. This attention for the construction industry arises from its exploitation of natural resources. Evidence shows that the construction industry is responsible for high energy consumption, solid waste generation, global greenhouse emission, external and internal pollution, environmental damage and resource depletion (Chan et al., 2010). There is reason to believe that, construction industry has an enormous influence on the environment when compared to other industries (Khalfan et al., 2003). In fact, the World Watch Institute estimated that by 2030 the world will run out of several raw materials for construction

(Gorgolewski, 2006). For this reason, green or sustainable building concepts are gaining popularity to serve as a standard to mitigate the environmental impact of new and existing building stock.

Scanning the literature reveals that, most of the global research on sustainable construction has been focused on environmental issues (Seoung-Wook and Kim, 2015). However, it is only through the successful integration of environmental, economic and social issues to achieve sustainable development. Despite lack of given importance to user actions during sustainability assessment of buildings (Monfared and Sharples, 2011), user behaviours, that have direct effect on buildings' operation maintenance process, are crucial for buildings' sustainability scores (Hei and Yu, 2014).

This study aims to evaluate environmentally oriented behaviours of end-users during operation phase of buildings to enlighten the relationship between pro-environmental behaviours and sustainability characteristics of certified buildings. With this aim, two groups of occupants of certified and traditional offices in Turkey were contributed to the self-report based survey. Outcomes of the survey is expected to widen the perspective of sustainability applications in construction industry.

2. SUSTAINABLE BUILDING TERM AND BUILDING ASSESSMENT SYSTEMS

In a general review of literature “sustainable building”, “sustainable design”, “environmentally-friendly building” and “ecological architecture” are seen as the most preferred terms to explain sustainability in construction. Withal, “sustainable building” and “green building” are two concepts that have been used in terms of each other. However, the critical difference between sustainable building and green building has been indicated by Raymond J. Cole (1999) as; green building achieves one or more ecological features, while sustainable building includes environmental, social and economic dimensions. Similarly, Berardi (2013a) argues that, sustainable buildings have economic and social roles in addition to green buildings' ecological attributes. Considering the definition and characteristics of sustainable building; “the primary goal of sustainable design is to lessen the harm poorly designed buildings cause by using the best of ancient building approaches in logical combination with the best of new technological advances” by Barnett and Browning (1995), “creating a healthy built environment based on ecologically sound principles” by Kibert (2002), “buildings whose loadings on global environment are manageable enough to maintain the sustainability of the ecosystem” by Mukarami (2007) or “creates required performance and functionality with minimum adverse environmental impact, while encouraging improvements in economic and social aspects at local, regional and global levels by ISO 2008 in Häkkinen and Belloni (2011) are seem to provide a clear understanding about the sustainable building subject.

Researchers Barnett and Browning (1995), expects sustainability as a standard operation in construction industry within two decades. U. S. Environmental Protection Agency (EPA), the institution that is responsible for protection of human health and environment, also emphasizes sustainability as a practice rather than a theoretical approach (2008). Thus, for almost 30 years, sustainable building assessment tools are considered as an unignorable movement displayed by construction sector in terms of sustainable development. According to İltter and İltter (2011), sustainable building certificates are the initial and concrete step of sustainability practice in construction industry. Such that, a number of national and

international organizations are still working to generate a systematic and comprehensive road map to improve the industry's environmentally responsible identity (Xiaoping et al., 2009).

In year 1990, BREEAM of Building Research Establishment in United Kingdom was released as the first building assessment tool and followed by many other tools from different countries. LEED in United States (1998), Green Star in Australia (2003), Green Globes in Canada (2000), DGNB in Germany (2009), CASBEE in Japan (2004) and Green Mark in Singapore (2005) are other widely known sustainable building certification systems all around the world. Despite these tools generally rooted from BREEAM and LEED systems, they were developed according to each countries' local conditions and regulations. Basic principle behind these systems and tools is to evaluate buildings according to certain sustainability criteria defined and accepted by governmental and/or commercial accredited institutions and categorize or label buildings accordingly.

According to Kamali and Hewage (2015), there are almost 70 sustainability certification system are available all around the world. Even they all have their own systematic approach for building sustainability evaluation; energy efficiency, water efficiency, materials and resources and indoor environmental quality are the four major principles that play active role in many tools (Say and Wood, 2008). On the other hand, according to the World Green Building Trend Report, most of the sustainable building projects are implemented especially with the expectation of energy consumption reduction, rather than natural resource conservation or water consumption reduction (Dodge Data & Analytics, 2016).

3. EVALUATION OF SUSTAINABILITY TRAIT OF BUILDINGS

Despite sustainability practices during the design and construction phases of buildings is a significant action, targeted decrease in the negative impact of construction activities against nature has not been fully achieved yet (Monfared and Sharples, 2011; Whitfield, 2014). Some researchers emphasize the lack of adaptation of environmentally oriented approaches in construction industry due to certain barriers such as; high initial cost of sustainable building projects, insufficient site conditions and incompatible building regulations (Williams and Dair, 2007); lack of knowledge of owners, affordability issues and lack of planning policies (Pitt et al., 2009); high design/construction and material/product costs, lack of knowledge of contractor and lack of awareness about sustainability of owners (Ahn et al., 2013), etc. However, many of these barriers are argued to act as accelerators, for instance; environmentally oriented features of sustainable buildings provide decrease in operation and maintenance cost and increase in productivity, which refers ten times more monetary gain against their initial costs (Kats, 2003); building regulations including investment and tax benefits improves owner awareness and demand (Pitt et al., 2009) and announcement of productivity level increases of commercial buildings enhance corporate image in society (Ahn et al., 2013).

Another approach to understand the unsatisfactory success level of sustainability in construction sector is believed to be the social dimension of sustainability. Although sustainability has three complementary aspects in economic, ecological and social context, according to Berardi (2013b), social extent of sustainability is the most disregarded aspect. Monfared and Sharples (2011) indicate that, most of the building assessment tools focus on ecological and economic aspects of sustainability, while not focusing on social dimension which includes operational process of buildings. However, as Cotera (2011) indicates that,

most of the sustainability certificated buildings exceed their calculated consumption values during occupational process due to their users. Thus, environmentally oriented behaviours of end-users during operational phase should be considered while evaluating buildings' sustainability performance, in addition to buildings' environmentally oriented features in design and construction phases (Kirk, 2010; Hei and Yu, 2014; Hassan et al., 2015). Through integrating end-user factor into evaluation criteria of building assessment tools, a better sustainability practice in construction industry may be achieved.

Since human actions are the most important cause of environmental problems, searching for solutions of those problems through considering individual's environmentally responsible behaviours are accepted as a reasonable approach (Steg and Vlek, 2009; Nag, 2012; Greaves et al., 2013). In literature, "pro-environmental behaviour" term is used to refer environmentally responsible activities (Kurusu, 2015) and it is indicated that, sustainability can be evaluated according to individual level behaviours (Turaga et al., 2010; Nag, 2012). Pro-environmental behaviours (PEBs) are explained by various researchers as; "behaviour that consciously seeks to minimize the negative impact of one's actions on the natural and built world" (Kollmuss and Agyeman, 2002); "behaviour that harms the environment as little as possible, or even benefit the environment" (Steg and Vlek, 2009) and "purposeful and effective actions that result in the conservation of natural resources" (Tapia-Fonllem et al., 2013). In United Kingdom and United States, organizations perform studies about pro-environmental behaviours recently. As a result of those studies, a comprehensive list of pro-environmental behaviours was provided by Department for Environment, Food and Rural Affairs-DEFRA in UK and Environmental Protection Agency-EPA.

Despite existing awareness about global warming or environmental problems, most people fail to act in environmentally responsible way (Tsarenko et al., 2013) or sustain their ecologically sound behaviours (Lynn, 2014) for certain reasons, such as; difficulty of behavioural changes in older ages (Cottrell, 2003), expected satisfaction from the outcomes of individual's behaviours and efficacy (Barr and Gilg, 2006) or lack of sufficient conditions (Kurusu, 2015). Therefore, Lynn (2014) emphasizes the importance of understanding the influential factors that affect pro-environmental behaviours and interaction among them.

Studies focusing on the prediction of PEBs and influential factors on them have been maintained for almost five decades. In the early years of research, direct relationship between environmentally oriented behaviours and environmental concern has been claimed and high level of concern has seen as the most important element of pro-environmental behaviours (Bamberg, 2003). After the recognition of low-to-moderate effect of environmental concern on PEBs (Bamberg, 2003), the Value-Belief-Norm Theory has been developed by Stern et al in 1999 that focuses on the personal norms as predictors of pro-environmental behaviours (McDonald, 2014; Kurusu, 2015). According to the theory, "value" factor refers to individual's approach related with environmental problems and categorized into three sub-factors as; egoistic, altruistic and biospheric values, while "belief" factor contains awareness about negative impact of individual's behaviours on nature, awareness of consequences about adverse results of natural problems and ascription of responsibility about individual's ability of increasing environmental threat. Finally, with the effect of personal norms, individual's environmentally oriented behaviours are generated (Stern et al., 1999).

Considering existing behaviour theories, Hines et al. prepared a meta-analytical model to explain PEBs that was based on detailed literature review. According to the model, environmentally responsible behaviours are generated according to the balance between

intention to act and situational factors. Researchers also explained the influential factor behind intention to act as; personality factors, action skills as individual's ability to act, knowledge issues about nature related problems and knowledge of action strategies against those environmental problems (Hines et al., 1987).

Similar to Hines et al., Kollmuss and Agyeman and Bamberg and Möser also developed two different and comprehensive meta-analytical models in early 2000s, in order to understand influential factors underlying PEBs. According to Kollmuss and Agyeman's model, environmentally responsible behaviours are generated according to the synergy between personal (internal) and environmental (external) factors and effected by lots of criteria such as; old behavioural patterns, lack of external possibilities or lack of environmental conscious level (2002). In addition to this explanation, researchers indicated that, they only considered the most influential factors that effecting PEBs in order not to decrease practicality of their model (Kollmuss and Agyeman, 2002). Finally, Bamberg and Möser applied Structural Equation Model on all influential factors of PEBs argued in various theories and provided another meta-analytical model in 2007. In their model, the direct relationship between intention and behaviour has been strongly emphasized and the importance of moral norms, attitude and perceived behavioural control on intention has been explained in detail (Bamberg and Möser, 2007).

However, longitudinal studies showed that, none of the theories work better while explaining the reasons of PEBs than others (Cordano et al., 2011) and it is not feasible to explain all predictors of PEBs with a single model (Kollmuss and Agyeman, 2002). Thus, most of the studies about PEBs focus on to prediction of certain behaviours like; energy consumption, recycling or ecological travelling recently.

4. RESEARCH METHODOLOGY

According to the World Green Building Trend report in 2016, almost one of each two commercial building projects are expected to be green (Dodge Data & Analytics, 2016). Starting from this point, conducting a research with commercial buildings' occupants is believed to be the most coherent way in order to minimize the current knowledge gap about buildings' environmental performance. Different from the countless numbers of researches related with sustainable buildings, this study focuses on occupational phase of buildings and evaluates the environmental performance of both certified and traditional office buildings through their end-users' perspectives and actions.

As it is seen in Figure 1, current study examines pro-environmental behaviours of occupants through environmental values, beliefs about sustainability in office buildings and awareness of building's sustainability aspects of occupants. According to the proposed framework approach in Figure 5, three statements have been proposed;

Proposition 1: Environmental values, beliefs about sustainability aspects of building and awareness about sustainability aspects of building significantly predict pro-environmental behaviours in workplace.

Proposition 2: Environmental values mediates the relationship between each specific belief and awareness about sustainability aspect.

Proposition 3: Sustainable office building occupants have more awareness about their buildings' sustainability aspects and act more environmentally.

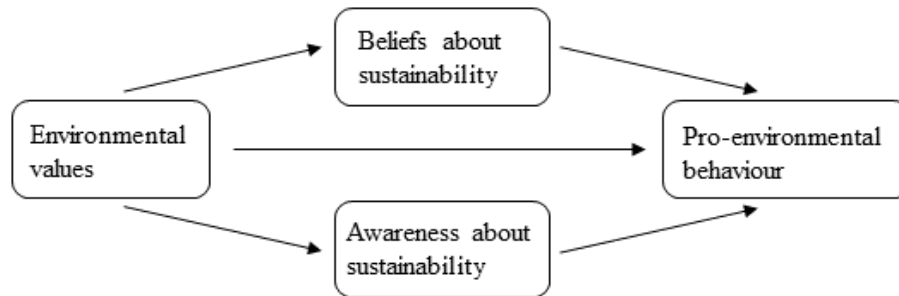


Figure 1: Proposed framework for pro-environmental behaviours

4.1 Survey Development and Pilot Survey

In order to determine reasons for not behaving pro-environmentally and understand the influence of occupants' pro-environmental behaviours on sustainability aspects of certified buildings, a 54-questioned 5-itemed online questionnaire has been designed and shared with potential participants through Istanbul Technical University's online survey platform VETI.

The survey questionnaire contained five sections. In the first part of questionnaire, participants were asked to specify some demographical information, such as; gender, age, education, profession, role in company and experience level in work-life. The second section aimed to measure environmental identity of participants and had 10-questions. The third part was prepared to understand the respondents' beliefs about sustainable buildings and had 9 questions. The fourth part of questionnaire, 10 questions were asked to specify awareness levels of participants about their office buildings' sustainability aspects. Finally, 14-question scale was applied to understand each participant's pro-environmental behaviours in workplace. In the second, third, fourth and fifth sections of questionnaire, participants were required to specify their opinion about given statements through 5-point Likert scale (from 1-strongly disagree to 5-strongly agree). In addition to those questions, participants were provided to specify additional opinion through open-ended questions.

Before inviting targeted groups to study, a pilot survey was conducted to test the appropriateness of the questions wording, the reliability and validity of the criteria used in each area and to include further criteria that might have been excluded during the literature review. In this stage, the respondents' sample was composed of key informants in sustainability assessment of buildings. After discussing about questions in the survey and completed required correction according to control group's suggestions, final version of questionnaire has been shared with volunteers from both traditional and sustainable office buildings.

4.2 Sample and Data Collection

Current study has been conducted with two groups of occupants from both certified and traditional office buildings in Turkey. Prepared questionnaire has been shared with a group of people from both sustainable and traditional office occupants. Eliminating the invalid and

deficient return of questionnaire, 55 participants from certified office buildings and 48 participants from traditional office buildings, totally 103 people working on various disciplines (managers, architects/engineers, law and accounting professionals, academic staff and technical staff) constitute the sample of this study.

According to the given answers to the questions in the first section of the survey, obtained demographic information about the sample is shown in Table 1. 53 of 103 participants were signified themselves as female and 48 as male, while 1 participant who chose “not mention” and 1 participant who did not answer the gender question (See Table 1). Considering the age range of participants; 1 person from the age below 20, 35 people from the age among 20-30, 46 people from the age among 31-40, 17 people from the age among 41-50, 3 people from the age among 51-60 and a person from the age above 60 have answered the questions. Finally, it is observed among the participants that; more than half have 4-years degree and 32% of the participants have even higher educational background.

Table 1: Sample characteristics

| | Gender | | Age | | | | | | Education | | | | |
|------------------------------|-----------|-----------|----------|-----------|-----------|-----------|----------|----------|-------------|------------------|-------------------|-----------|----------|
| | Female | Male | <20 | 20-30 | 31-40 | 41-50 | 51-60 | >60 | High school | Two years degree | Four years degree | Master | Ph.D. |
| Certified office occupants | 29 | 24 | - | 20 | 22 | 11 | 1 | 1 | 3 | 1 | 31 | 15 | 5 |
| Traditional office occupants | 25 | 23 | 1 | 15 | 24 | 6 | 2 | - | 1 | 6 | 28 | 12 | 1 |
| Total | 53 | 48 | 1 | 35 | 46 | 17 | 3 | 1 | 4 | 7 | 59 | 27 | 6 |

5. DATA ANALYSIS

The information obtained from the questionnaire consisted of primarily nominal and ordinal data. As far as ordinal data is concerned, it comprised five preference-ordered categories from strongly disagree (1) to strongly agree (5). Likert-type replies are thus the major components of the results, which do not allow for parametric statistics. Conversely, nonparametric tests such as the Mann-Whitney test can handle ordinal data gained from the survey results.

The analysis of the replies from the respondents included reliability assessment through Cronbach’s alpha, correlation analysis, Mann-Whitney u-test and path analysis.

5.1 Reliability Assessment

Cronbach’s alpha coefficient was used for the reliability of each scale in the questionnaire. Except the Environmental Value scale’s moderate reliability score (.673), all other scales in the questionnaire have high reliability results as Environmental Belief scale (.895), Environmental Awareness scale (.958) and Pro-Environmental Behaviour scale (.841), since they scored greater than .700 case. Thus, results obtained from the analysis of data gathered via these scales are accepted as persuasive results.

5.2 Correlation Analysis

To test the Proposition 2 which focuses on each scales relationship with pro-environmental behaviours, Spearman correlation analysis has been applied and gathered results are shown in text and in Table 2 and Table 3.

In Table 2, it is observed that, ecocentric value of individual (idea about protection of nature as its importance) significantly effects individual's beliefs about all four sustainability aspects (CO₂, electric consumption, water consumption and waste and recycling) investigated in the study, while anthropocentric value (idea about protection of nature for human benefit) does not. Furthermore, ecocentric value also motivates individuals to act more responsible on electric consumption, water consumption and waste minimization and recycling issues (see Table 3). However, it only effects CO₂ emission and waste and recycling related awareness of individuals. On the other hand, anthropocentric value of individual only has effect on water consumption behaviour.

Secondly, considering the relationship between beliefs and pro-environmental behaviours, it is seen in Table 2 that, CO₂ related belief does not have significant effect on any of the investigated behaviours. However, there exist high positive correlation between electric related beliefs and electric related behaviour, water related behaviour and waste and recycling related behaviour of occupants. For example, if an occupant believes energy consumption is an important parameter for sustainability, that occupant acts more responsible not only on electric consuming, but also water consuming and waste minimizing issues. Also, individual's water related belief significantly predicts that individual's electric and water consumption behaviours. Interestingly, waste related belief has no significant effect on waste-related behaviour, but on water-related behaviour.

Table 2: Spearman correlation coefficients of value, belief and behavior scales

| | Environmental Value | | Beliefs about sustainability | | | | Pro-environmental behaviours | | | |
|------------------------------|---------------------|-------|------------------------------|--------|--------|--------|------------------------------|--------|--------|------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| (1)Ecocentric value | 1.00 | | | | | | | | | |
| (2)Anthropocentric value | - | 1.00 | | | | | | | | |
| (3)Belief-CO ₂ | .350** | - | 1.00 | | | | | | | |
| (4)Belief-Electric | .460** | - | .567** | 1.00 | | | | | | |
| (5)Belief-Water | .486** | - | .613** | .684** | 1.00 | | | | | |
| (6)Belief-Waste | .334** | - | .536** | .649** | .485** | 1.00 | | | | |
| (7)Behaviour-CO ₂ | - | - | - | - | - | .197* | 1.00 | | | |
| (8)Behaviour-Electric | .324** | - | - | .357** | .270** | - | .468** | 1.00 | | |
| (9)Behaviour-Water | .317** | .224* | - | .337** | .233* | .274** | .241* | .655** | 1.00 | |
| (10)Behaviour-Waste | .365** | - | - | .289** | - | - | - | .540** | .816** | 1.00 |

* $p < .05$, ** $p < .01$

Thirdly, considering the relationship between awareness and pro-environmental behaviours, almost all of targeted behaviours show significant correlations with occupants' awareness about environmental features of their buildings. According to results in Table 3, awareness about CO₂, electric and waste and recycling can significantly predict individuals' CO₂ emission, electric consumption, water consumption and waste and recycling related behaviours. In other words, if an occupant has high awareness of CO₂ emission, electric consumption and recycling issues, that occupant develop more careful actions in use of energy (such as, turning PC off while going for lunch) and water (such as, reporting a broken faucet), less greenhouse gas emission and less waste disposal (such as, use of wrong printed papers to take notes). Moreover, individuals' CO₂ and electric consumption behaviours show significant correlation with awareness of water and sustainability certificate of buildings.

Lastly, pro-environmental behaviours show significant correlations with each other, that means, correlated behaviours predict each other. As it is seen in Table 3, electric and water consumption behaviours have significant positive relationship with CO₂ emission behaviour. Such that, an individual's responsible electric and water consumption behaviours indicate that individual's responsible CO₂ emission behaviour, such as; public transportation use, etc. similarly, an individual's environmentally responsible behaviours like waste minimization or proper disposal of recyclable waste indicate that individual's less energy and water consumption motivated behaviours.

Table 3: Spearman correlation coefficients of value, awareness and behavior scales

| | Environmental Value | | Awareness about sustainability | | | | Pro-environmental behaviours | | | | |
|------------------------------|---------------------|-------|--------------------------------|--------|--------|--------|------------------------------|--------|--------|--------|------|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| (1)Ecocentric value | 1.00 | | | | | | | | | | |
| (2)Anthropoc. value | - | 1.00 | | | | | | | | | |
| (3)Awareness-CO ₂ | .228* | | 1.00 | | | | | | | | |
| (4)Awareness-Electr. | - | - | .737** | 1.00 | | | | | | | |
| (5)Awareness-Water | - | - | .748** | .752** | 1.00 | | | | | | |
| (6)Awareness-Waste | .292** | - | .683** | .663** | .668** | 1.00 | | | | | |
| (7)Awareness-Certific | - | - | .796** | .736** | .742** | .611** | 1.00 | | | | |
| (8)Behaviour-CO ₂ | - | - | .213* | .211* | .226* | .252* | .256* | 1.00 | | | |
| (9)Behaviour-Electric | .324** | - | .359** | .351** | .301** | .423** | .250* | .468** | 1.00 | | |
| (10)Behaviour-Water | .317** | .224* | .337** | .264** | .236* | .303** | - | .241* | .655** | 1.00 | |
| (11)Behaviour-Waste | .365** | - | .249* | .213* | - | .292** | - | - | .540** | .816** | 1.00 |

* $p < .05$, ** $p < .01$

5.3 Mann-Whitney U-Test

Mann-Whitney U-test is the non-parametric alternative test to the independent sample t-test. It is a non-parametric test that used to compare two sample means that come from the same population and used to test whether two sample means are equal or not.

The results from Mann-Whitney U-test to investigate Proposition 3 are shown in Table 4. According to table, significant differences between awareness about buildings' water consumption minimization oriented aspect of certified office occupants are exist. Also, people who work in certified buildings have significantly higher awareness about their buildings' certificates.

Table 4: Mann-Whitney U-test

| Variable | | n | Mean Rank | Sum of Ranks | p |
|-----------------------|--------------------|----|-----------|--------------|------|
| Awareness-Water | Certified office | 55 | 56.06 | 3083.50 | .042 |
| | Traditional office | 46 | 44.95 | 2067.50 | |
| Awareness-Certificate | Certified office | 55 | 60.33 | 3318.00 | .000 |
| | Traditional office | 45 | 49.05 | 1732.00 | |
| Behaviour-Electric | Certified office | 55 | 45.00 | 2475.00 | .016 |
| | Traditional office | 47 | 59.11 | 2778.00 | |
| Behaviour-Water | Certified office | 55 | 46.01 | 2530.50 | .038 |
| | Traditional office | 47 | 57.93 | 2722.50 | |
| Behaviour-Waste | Certified office | 55 | 43.94 | 2416.50 | .005 |
| | Traditional office | 47 | 60.35 | 2836.50 | |

Contrary to expectation, there exist electric consumption, water consumption and waste and recycling related behavior difference between two groups in reverse way; that is, occupants

of traditional office buildings act more carefully on electric and water consumption amounts and waste minimization and recycling issues in their offices than those in sustainable offices. Such an unexpected result may be related with certified office occupants' perceptions about their buildings; they may have the idea that, technology and materials used in the building are environmentally friendly and they do not need to consider consumption reduction anymore.

5.4 Path Analysis

Finally, to test the Proposition 1 which focuses on prediction of pro-environmental behaviours, a path analysis model has been applied using AMOS 24.0 software. Validity of the proposed model for PEBs has been calculated through model fit calculations. According to the calculated values as; chi-square=1357.860 and $\chi^2/df=1.640$, validity of the model is acceptable. Fit indices were (GFI=.606, NFI=.613, CFI=.797, RMSEA=.092) moderate fit. As it is shown in Figure 2, none of the estimated regression coefficients from environmental value to belief (.66, $p>.05$), to awareness (.05, $p>.05$) and to pro-environmental behaviour (.03, $p>.05$) were significant. On the other side, regression coefficients from belief (.65, $p<.05$) and awareness (.35, $p<.05$) to pro-environmental behaviour indicates significant correlations. According to correlations it can be concluded that, pro-environmental behaviours can be predicted through beliefs and awareness about sustainability; in other words, a person's beliefs about sustainability and awareness about the sustainable features of the building he/she works, regulate that person's behaviours in more environmentally responsible way.

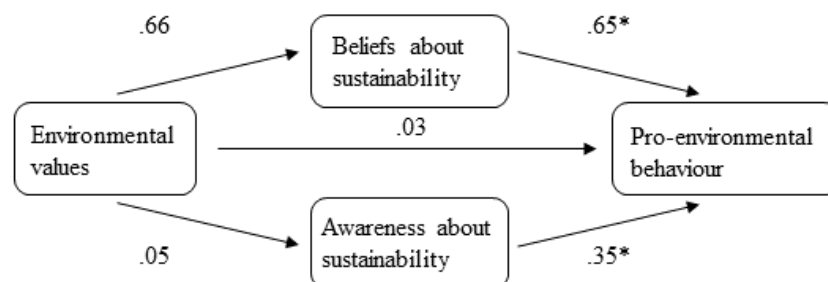


Figure 2: Path analysis of pro-environmental behavior with standardized regression coefficients

6. CONCLUSION

As sustainability is a global issue, “one size fits all” approach (Say and Wood, 2008) during the assessment of buildings' environmental characteristics sounds rational. However, in order to prevent possible defects during assessment due to national level or indigenous reasons, development of local building assessment systems is suggested (Say and Wood, 2008). Furthermore, despite various effort to improve sustainable characteristics of construction industry, desired results have not been achieved so far. One of the reasons of this fault may be derived from lack of understanding about the social dimension of sustainability while high concentration on economic and ecological features. Thus, distinctly from current application, more focus on operational phases of buildings while sustainability assessment is believed to be a significant factor for better success level in sustainability in construction sector.

Considering these reasons, this study targets to determine the predictors of pro-environmental behaviours and the interaction between building's sustainability aspects and PEBs. With this aim, two groups of occupants from both traditional and sustainable offices were asked to complete a self-report questionnaire. According to results from gathered data, high awareness of certified office occupants' about their buildings' environmental aspects and high correlation between awareness and pro-environmental behaviour were determined.

It may be concluded that, sustainable buildings create high awareness about sustainability subject on occupants and through this awareness, more environmentally responsible behaviours are exhibited, though some unexpected behavioural difference. In order to prevent misunderstanding of sustainability and sustainable building issues, more focus on informative training and regular control over sustainability scores of buildings may be supportive actions that construction professionals should consider. Additionally, while accounting sustainable buildings as teaching mediums for society about ecological subjects, individual effort based evaluation of building's environmentally-oriented performance may lead society to be more proactive against global environmental problems. Further focus on the integration of PEBs and sustainability assessment measures and local and territorial authority support on sustainability practices in construction industry are recommended.

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CLIMATE CHANGE RISK ON INFRASTRUCTURE AND POLICY IMPLICATIONS OF APPROPRIATE MITIGATION MEASURES IN THE NIGERIAN AGRICULTURAL SECTOR

S. Goyol, C. Pathirage and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: S.Goyol@edu.salford.ac.uk

Abstract: Agriculture a critical sector of the Nigerian economy contributes 26% to the country's GDP, and supports livelihoods by employing over 70% of the active population. The importance of the sector for food security, poverty reduction and economic development has been recognized. While population growth places increasing food demand and raw materials, the sector will have to double its productivity to meet demand and this is highly dependent on the availability of infrastructure. Infrastructure to support agricultural production and other economic purposes are found to be inadequate and the few available are in poor conditions due to inappropriate policy processes amongst others. The frequency and severity of climate related events occurring as rapid onset and slow onset events are on the rise posing threats to the few available infrastructures. This paper aims to analyse climate change risks on infrastructure in the Nigerian agricultural sector through a review of existing literature. Findings reveal that policy and institutional processes at levels of authority significantly influences the status of infrastructures at community levels which in turn contributes to increased risks and impacts of climate change. Suggestions for infrastructure appropriation for continuous capacity building can reduce risks from climate change, and improve resilience of infrastructures in agrarian communities.

Keywords: Climate change, Impacts, Infrastructure, Risk, Policy

1. INTRODUCTION

Climate change, a change in the average climate patterns is a challenge experienced globally with adverse impacts on almost all sectors of world economies. Climate change driven by both natural and anthropogenic activities contributes to global warming with consequences of rising temperatures, increased evaporation, heavy rains and storms, leading to extreme weather events such as floods on one end and droughts on the other end of an extreme. Climate change also increases the frequency and intensity of these extreme weather events with adverse impacts globally. These are expected to have more impacts on developing regions due to their limited capacity to adapt to adverse conditions (Sherman et al., 2016).

Nigeria, a tropical African country bounded by the Sahara desert to the north and the Atlantic Ocean to the south experiences contrasting adverse climate related events ranging from floods to droughts due to its location. Alongside, seasonal changes in weather patterns influences the climate related events experienced as floods are experienced mostly during rainy seasons and droughts in the dry season. These changes in weather and climate has resulted to more frequent and severe floods mostly along coastal/ riverine areas, droughts around the northern arid regions, prolonged dry spells, irregular precipitations, and water scarcity (Elusoji, 2016; Olayide, 2016). This has led not only to personal and large economic losses but huge impacts on critical infrastructure systems supporting everyday living thereby a threat to economic development (Ebele & Emodi, 2016).

Infrastructures, referring to core services in the form of hard physical facilities and organisational structures needed for the effective functioning of an economy, are at risk of adverse effects of climate change. However particular emphasis are placed on infrastructures in the agricultural sector; a critical sector which when affected will lead to high food insecurity, and poverty (Boko et al., 2007; Ebele & Emodi, 2016). Agrarian communities also known as rural communities that host agricultural activities are dependent on the availability of infrastructure systems such as roads, electricity, and water for optimal productivity. However these are grossly inadequate and the few available ones in poor conditions leading to economic underdevelopment and decay (Ayinde, Falola, Babarinde, & Ajewole, 2016). Infrastructures in rural communities are generally characterized by a state of low quality and/or long periods of usage without maintenance (Sam, 2014). Growing populations and the continuous use of the few available infrastructure systems reduces the resilience of such systems thereby exposing them to multiple risks such as climate change. Infrastructure risk is therefore the potential for losses due to the failure of infrastructure systems supporting agricultural production.

The increasing incidences of climate change driven events and the inadequacy in terms of quality and quantity of infrastructure systems to support agricultural production are major challenges that can lead to a failure in the agricultural sector with resultant impacts on the general economy. While little can be done to influence the changing weather and climate conditions, policies and processes can be tailored towards safeguarding infrastructures from loss/damage. Hence, infrastructure appropriation: the act of ensuring the adequacy of infrastructures in terms of quality and quantity is critical for climate change risk and impact reduction as well as improved resilience of infrastructures.

This paper aims to analyse climate change risk on infrastructure in the Nigerian agricultural sector in order to highlight the importance of resilient infrastructures for impact and risk reduction in agrarian communities. While extensive studies have been conducted on the importance of infrastructure to agricultural and economic development (Ikeji, 2013; T. Lawal, 2014), and limited research on the impacts of climate change on infrastructures such as roads, buildings and irrigation facilities (Adewole, Agbola, & Kasim, 2015; Ede & Oshiga, 2014) research on how the condition of infrastructure can exacerbate climate change risks and impacts are lacking. The main focus of this paper is on how institutional processes at levels of authority influences the status of infrastructures which in turn increases infrastructure risk to damage or loss by climate change so as to propose best practices for improved resilience of infrastructure systems. Following a critical review of existing literature, major climate related events experienced in Nigeria were identified and categorized into rapid and slow onset events according to DWF's (Development Workshop France) classification of disasters. We examined the current and future impacts of these events on infrastructure (transport systems, irrigation systems and agricultural services). We then considered how institutional processes influence the status of infrastructures thereby exposing them to further threats. The following sections of the paper are outlined thus. First is a general overview of climate change and its related events in Nigeria. The second section focusses on the impacts of climate change on critical infrastructure systems, particularly transportation systems, irrigation systems and agricultural services. Thirdly, is critical infrastructure status and factors influencing the status of infrastructure. Finally, the conclusion and recommendations.

2. CLIMATE CHANGE & RELATED EVENTS IN NIGERIA

Climate is the general weather conditions of a place over a period of time. Climate change is a shift in the average climate patterns as a result of increasing concentrations of greenhouse gasses (GHG) due to natural or human activities. GHGs such as carbon dioxide (CO₂), chlorofluorocarbon (CFCs), methane (CH₄), and Nitrous oxide (N₂O) contribute to global warming resulting in high temperatures, higher rates of evaporation, drying of water bodies, higher concentration/condensation of atmospheric pressure, consequently falling back as heavy rains. The concern about these alterations of weather patterns is that resultant climate-related events such as floods and droughts attribute to the frequency and intensity of natural disasters globally (Holling, 1973; Pelling, 2010). Not only is there an increase in the occurrence of these events but also its increasing impacts on the built environment and socioeconomic activities.

Generally, temperature and rainfall projection in Nigeria reveals hotter and drier conditions. Annual mean temperature increase of between 1-4°C is expected. Lower rainfalls are expected towards the north however due to high evaporation and ocean currents, higher rainfalls are expected towards the coast (B. J. Abiodun, Lawal, Salami, & Abatan, 2013). Rainfall in particular is a major determinant to the occurrence of either floods or droughts across the country (Fuwape, Ogunjo, Oluyamo, & Rabi, 2016). Climate-related events commonly recorded in Nigeria include drought, epidemic, extreme temperature, flooding, and storm (refer to Table 2).

Table 2: Climate Related Events in Nigeria 1900-2016 (EM-DAT IDD, 2017)

| Event type | Events count | Total deaths | Total affected |
|---------------------|---------------------|---------------------|-----------------------|
| Drought | 1 | 0 | 3,000,000 |
| Epidemic | 42 | 23,978 | 304,436 |
| Extreme temperature | 2 | 78 | 0 |
| Flood | 44 | 1493 | 10,478,919 |
| Storm | 6 | 254 | 17,012 |

Nigeria, a tropical African country, is particularly vulnerable to climate-related events ranging from droughts on one end and floods on the other end of the extreme driven by climate change. Floods record the highest frequency as well as the highest impact. Droughts on the other hand have the least frequency of occurrence yet a very high impact in terms of the number of people affected. Flooding is recorded almost annually in recent years due to the continuous rise in sea levels threatening coastal towns as well as infrastructures located in those regions (Davis, 2013). Droughts, formerly linked to only the north-eastern region of the country, are gradually experienced in other parts of the country as prolonged periods of precipitation deficiency lead to water shortages (Gwamzhi, Dongurum, Dabi, & Goyol, 2013). Warmer temperatures are increasingly experienced and new temperature records are set (Eludoyin, Adelekan, Webster, & Eludoyin, 2014). Changing rainfall patterns: late onset of rains, irregular and erratic rains often accompanied by storms are continuously recorded (Lawal et al., 2016).

Climate change and its related events can exhibit as rapid onset events or slow onset events (refer to Figure 27). Rapid onset events include floods, epidemics, and storms; while slow onset events include extreme temperatures, and droughts.

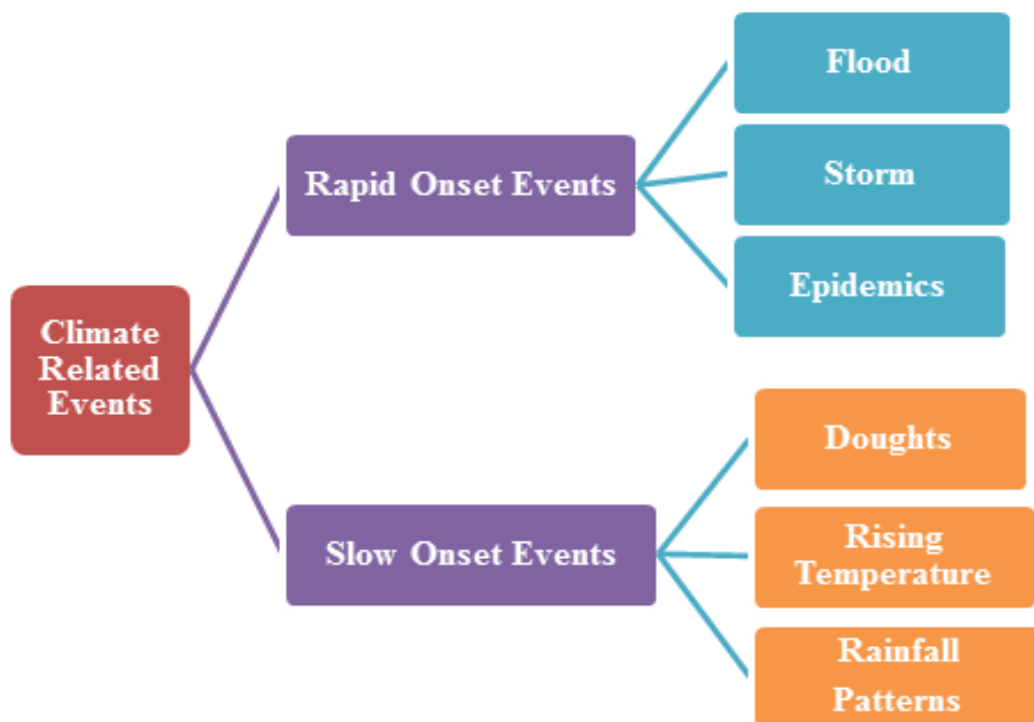


Figure 27: Classification of Climate Related Events

Whether rapid onset events such as floods or slow onset events such as droughts, both are on the increase and have impacts not only on individuals, communities and livelihoods, but also on infrastructures (Imo, 2014). As such, while studying the frequency and occurrence of climate related event is important, likewise the impacts of these events on critical infrastructures.

3. CLIMATE CHANGE IMPACTS ON CRITICAL INFRASTRUCTURE

Climate change and its associated events either occurring as rapid onset events such as floods or slow onset events such as droughts are on the increase and projections reveals that more will be experienced in the coming years. They have impacts on both human and socioeconomic activities thereby affecting the general economic development of a nation. These have negative implications for critical infrastructures such as roads, and bridges, irrigation systems, as well as agricultural services resulting in negative effects on water sources, disruption of services, the spread of epidemics from plant pests and diseases and lower rates of food production. This section focuses on the impacts of different climate related events namely: floods, drought, storms, extreme temperature and changing rainfall patterns on transportation systems, irrigation systems and agricultural services.

3.1 Impacts on Transportation Systems

Transportation systems to include but not restricted to roads, culverts, drainages and bridges are vulnerable to the impacts of climate change. Roads transportation occupies over 75% of total movements in Nigeria (FRSC, 2015). The development of new roads or an improvement of existing ones have a strong correlation on improved agricultural production (Laurance et al., 2014). Roads contributes to the increase in agricultural production by easing the movement of inputs and workers to farms and the transportation of produce from farms to markets (Binswanger-Mkhize & Savastano, 2017). The lack of good road network or a disruption in the system affects production rates and commuters wellbeing.

Rapid onset events such as floods of all kinds either coastal or flash floods have impacts on transportation systems. Coastal floods and storm surges can affect roads and bridges as salinity can speed up the rate of deterioration in road surfaces as well as concrete reinforcements. The 2012 floods in Nigeria brought to prominence the vulnerability of transportation system to impact of climate change. In parts of Plateau state, heavy rains resulting to flooding washed out the top soil, weakened drainages and culverts. Roads and bridges were destroyed cutting off communities and hindering recovery efforts to affected places (Umweni, 2014). This led to the loss of lives, properties and livelihoods as well as the disruption of services. Commuters were forcing to take longer routes at a higher cost or journey on canoes with uncertainty of getting to their destinations in safety (Plateau News update, 2012). This had huge impacts on agricultural production as low yields were recorded due to farmer's inability to access and move farm inputs such as fertilizers. The transportation of farm produce from farms to markets was also affected leading to large quantities of food waste. Though road transportation was crippled, new opportunities to a new source of income emerged for canoe operators (Times, 2012).

Droughts on the other end, either hydrological, meteorological or socioeconomic, can change the morphology of the land. Drought as a result of heat and rainfall changes can alter moisture balance consequently influencing the deterioration of road pavements. Cracks on road surfaces as a result of heat and subsequent water percolation into cracks causes potholes. The implication of droughts on road and bridges is that high heat and lack of moisture can leads to the gradual caving in of the land area thereby affecting designs and constructions under the initial land conditions. Extreme heat softens asphalts and expands bridge joints; heavy freight under these conditions damages road surfaces, and bridges respectively. Its nature reveals their vulnerability and makes them liable to destruction by adverse conditions.

3.2 Impacts on Irrigation Systems

Irrigation is an agricultural practice to augment for water supply for crop growth during periods of insufficient rainfall. Water for irrigation purposes are sourced from dams, tube wells, wash bores and boreholes: collectively referred to irrigation infrastructures. Sourcing water for agricultural purposes from these systems is increasingly difficult as both slow and rapid onset climate events affect their functioning (Binswanger-Mkhize & Savastano, 2017).

Heavy rains and floods accompanied by surface run-off deposits sand, silt and mud blocking irrigation systems. Wash bores drilled on shallow alluvial aquifers along river beds to source for underground water and wells can completely be blocked leaving farmers with no option but to recover by drilling new wash bores for the next planting season and re-dig the wells

(Umara, 2010). This affects the farmer's income levels. Small earth dams are commonly constructed by impoundment of river basins to collect water for agricultural purposes. The increasing demand for water resources has led to the construction of both concrete and earth dams which are used for either irrigation, water supply, hydropower generation or a combination.

Increase in temperature, evaporation and consequent droughts results in water shortages and lower water levels affecting the availability of water for irrigation. According to Olagunju (2015) droughts depletes not only surface and ground water but also affects land and environmental conditions. Rasul and Sharma (2016) opined that water shortages due to climate change among others, affects water levels of dams for irrigation and hydro-energy generation. The interdependencies between these two sectors is that the hydro-energy generated is in turn used to power irrigation facilities and run small scale food processing industries. For instance the six (6) dam sites used by Nigerian Electricity Supply Corporation (NESCO) for electricity generation in Plateau state is at risk of water shortages due to climate change (FMPS, 2006) . Communities where these dams are located also use these water sources for irrigation and other purposes. This will trigger competition for water resources between the energy sector and the agricultural sector. Other critical sectors interdepending on the water sector can also be affected by water shortages.

3.3 Impacts on Agricultural Services

Climate change has impacts not only on hard physical infrastructures such as transportation and irrigation systems but also on soft infrastructure services that support agricultural production. Here agricultural services includes but not limited to research and development (R&D) and extension services. Agricultural services provide support to meet the increasing demand from growing populations, through educational methodologies, technology transfer and advisory services. However climate change can challenge agricultural research and services.

Floods, excess rains and moisture supports the germination of fungi and bacteria as they thrive under damp conditions (Delcour, Spanoghe, & Uyttendaele, 2015). Rising temperature, high evaporation rates and changing rainfall patterns leading to warmer conditions causes genetic changes in pathogens making them develop resistance and contributing to the emergence of new or the spread of existing diseases (Delcour et al., 2015; Elad & Pertot, 2014; Sable & Rana, 2016).

Multiple and interconnected infrastructure systems ranging from telecommunications, transportation, and electricity can affect agricultural services in one way or the other. For instance, chemical agents such as pesticides, insecticides and herbicides acquired from input and extension services require optimal storage condition in order to get to the farmer in good quality. These conditions range from cool room temperature, dry environment and away from sunlight. The movement of these chemicals from the point of supply to the point of demand is critical in guaranteeing its quality. The storage conditions in most cases are not adhered to and the local farmer does not have the means to check the effectiveness of the agents before being administered. The poor quality of roads and vehicles are likely to make the journey longer and transportation will have an impact on the conditions of the chemical agents.

In another scenario, the administration of chemical agents is suitable non-rain days. The lack of early warning weather systems and weather information mechanisms greatly affects the functionality of chemical doses administered. Local farmers often rely on local knowledge to predict rainy and non-rain days (Kijazi, Chang'a, Liwenga, Kanemba, & Nindi, 2013). Uncertainties from climate change will challenge rainfall predictions from local knowledge (van Wilgen, Goodall, Holness, Chown, & McGeoch, 2016). Other times chemicals applied based on predictions from local knowledge are washed off leaving the farmer with no option than to re-administer the doses at a later date. Low-income farmers might not be able to afford another round of chemical agents. Farmers who have successfully curtailed the infestation on their farms are at risk of re-infestation from farms that have not been able to complete the treatment of such diseases.

Both rapid onset and slow onset events have impacts on transportation and irrigation infrastructures systems and disrupt agricultural services. The increasing frequency and resultant impacts of these events can reduce infrastructures life span. In assessing the impacts of climate change, though the frequency, intensity and severity of these events are a threat to infrastructures, the conditions or design of such infrastructures are important factors driving impacts. The next section focuses on the status of infrastructures and factors affecting the status of infrastructures at community levels.

4. CRITICAL INFRASTRUCTURE STATUS IN NIGERIA

Nigeria is increasingly becoming a society with multiple infrastructural challenges ranging from power blackouts due to power failure, transportation gridlock due to poor transportation network (Steven, O'Brien, & Jones, 2014; Yapicioglu, Mogbo, & Yitmen, 2017). These were ones seen as unfamiliar situations but in recent years are becoming common circumstances. Nigerian economy has experienced very little growth in the recent years due to poor productivity, this is however, strongly linked to the lack of infrastructural needs to support optimal productivity. The lack of or poor state of infrastructure for improved agricultural production increases the risk propensity of infrastructures to adverse climate change. Appropriate infrastructure particularly to the rural areas is critical for sustainable agricultural development and the economic advancement of a country. Infrastructures such as roads, bridges and irrigation systems play a vital role in the physical and socioeconomic development of not only individuals and but communities as a whole. (Ibem 2009) regards such infrastructures as essential assets that enable, sustain and enhance societal living conditions. As such they facilitate the production of goods and services, the distribution of finished products to markets, and the provision of basic social services.

The provision and maintenance of critical infrastructures which includes transportation and irrigation systems has solely been the responsibility of the three (3) tiers of government (federal, state, and local government) until in recent years when public private partnership has become common due to policy changes in national economy (Udoka, 2013). More than 80% of infrastructures are provided by the government through ministries, agencies, and government parastatals saddled with the responsibility of providing public services to the teeming population. However, the conditions of infrastructures such as roads are in deplorable states, characterized by large potholes, gullies, and reduced road width due to eroded road shoulders.

The limited design of infrastructures including roads, bridges and irrigation systems exposes of such infrastructures to impacts from extreme weather. For instance, Roads in agrarian communities are mostly unpaved feeder roads, characterized by laterite surfaces, heavy rains coupled with poor drainage, therefore the top soil is washed off. Water logging is experienced mostly at the peak of the rainy season though not necessarily as a result of heavy rains but consistent rains for days the soil becomes saturated with water thereby making roads un-motorable. Also traditional earth dams commonly constructed for agricultural purposes are more or less temporary structures which can easily be destroyed leading to dam breaks due to the material and nature of construction (Stephens, 2010). They are liable to dam leaks and water seepage which will lead to higher rates of water loss as compared to a properly constructed dam. Ebele and Emodi (2016) observed that weak infrastructure systems which are already at risk to adverse conditions are liable to damage or loss and disruption in services.

5. FACTORS INFLUENCING INFRASTRUCTURE STATUS IN NIGERIA

In recent year, government policies adjusted to involve private partnership in infrastructure provision in the country. Though PPP (public private partnership) provides about 15% of infrastructure provision which is yet to be fully been implemented (Adeyinka & Olugbamila, 2015), government still remains the main provider. Despite these efforts, the state of infrastructure has continuously been a thing of concern for sustainable development in Nigeria. Existing Literature such as Nchuchuwe and Adejuwon (2012), Agber, Iortima, and Imbur (2013), Agber et al. (2013), Abiodun, Akintoye, Liyanage, and Goulding (2013), Gbadebo and Olalusi (2015) have identified a number of factors that influence the status of infrastructures in Nigeria (refer to Figure 28).

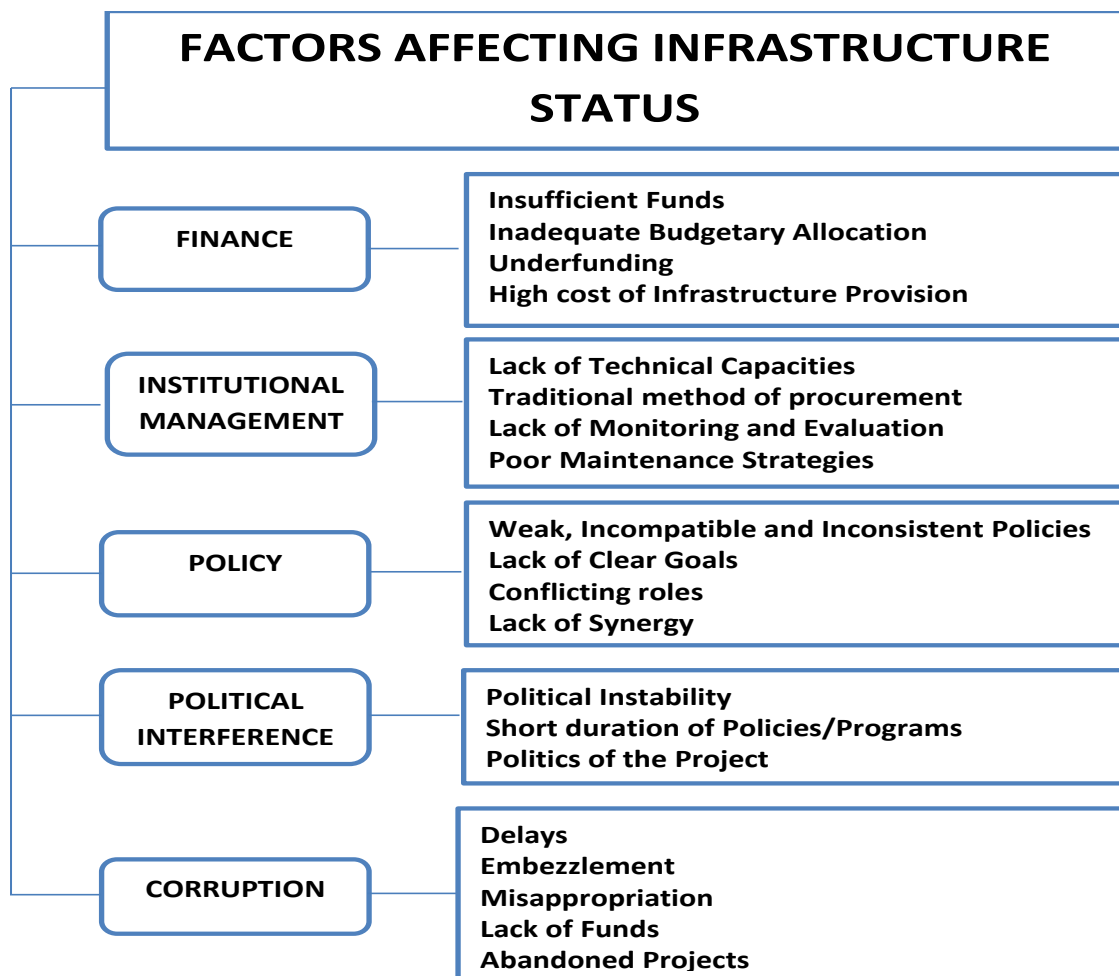


Figure 28: Factors Influencing Infrastructure Status

First, the poor state of infrastructure in Nigeria is as a result of financial constraints. Underfunding and inadequate budgetary allocation by the government as well as the high cost of infrastructure provisioning has led to inadequate number of infrastructures in Nigeria. Nchuchuwe and Adejuwon (2012) observed that government’ activities reveal that priority in policy formulation and resource allocation is accorded to urban areas at the expense of the rural agrarian areas. For instance, more than 70% of good paved roads are located in urban areas in Nigeria. As resources are meagre, the number of projects awarded will be less thereby affecting the available quantity of infrastructures most of which are not in favour of agrarian communities.

Secondly, weak institutional management as a result of lack of technical capacities, continuous employment of the traditional method of infrastructure procurement, lack of monitoring and evaluation alongside poor maintenance strategies.

Thirdly, weak, inconsistent and incompatible policies/programs influence the status of infrastructures at community levels. This leads to conflicting roles and a lack of synergy between different programs/projects of the 3 tiers of government. The relationship between existing institutions and the local community is important for the realization of the set roles for programs and projects.

Fourthly, is undue political interference. Political instability resulting to change in government has led to short duration of policies and programs as well as uncompleted

projects without full accountability. Political office holders award infrastructure contracts to friends and associates who are not trained to execute projects. This affects the final outcome such projects.

Finally, Corruption leads to delays, embezzlement, misappropriation and lack of funds to pursue specific policy/program to an expected end. Due to corruption, the quantified cost of a project at the point of execution is mostly not commiserating with the funds approved at the points of decision (Egharevba & Chiazor, 2013). This affects the designs of infrastructures as standards are not adhered to. Corruption is a major factor that foils almost all the factors influencing the state of infrastructure in Nigeria.

6. CONCLUSION AND RECOMMENDATION

Infrastructures (transport, irrigation and agricultural services) supporting agricultural production is in deficit and the few available ones are in poor condition. Climate change and its related events (droughts, floods, storms, extreme temperature, changing rainfall patterns and epidemics) will have future implications on the current state of infrastructures which will further weaken efforts towards improving agricultural production. Evidence reveals human influence through complicated institutional processes contributes to climate change risks and impacts as such the availability of appropriate infrastructures can reduce risk and impacts. Though infrastructures are located and function within communities, planning decisions for its provision are made by the government at levels of authority. It is recommended that infrastructure providers which are the 3 tiers of government (federal, state and local) as well private providers incorporate standards into the plan, design, operation and maintenance of infrastructures. Legal systems should be put in place to check corruption and undue political interference. Government budgetary allocation should accord priority to the infrastructure sector as well as rural agrarian communities. For improved resilience of infrastructures, periodic maintenance of roads and irrigation systems, reinforcement of bridges, renewal of stressed systems and redundant systems to ease stress on overused systems.

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TOWARDS A CONCEPTUAL INTEGRATED FRAMEWORK FOR SUSTAINABLE RURAL DEVELOPMENT PROJECTS IN NIGERIA

B. David and C. Udejaja

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: tundedavid27@yahoo.com

Abstract : Over the years, National Governments in Developing countries have invested heavily in implementing development projects in rural areas. This is in a bid to ensure that economic activities in these areas are promoted and the general livelihood of rural dwellers are improved in line with the Sustainable Development Goals (SDGs). Rural development projects have not stood the test of time because of poor planning, implementation and sustainability practices. The dearth of facilities in the rural areas is a major factor that has brought about unprecedented rural-urban migration which has resulted in the over-population of urban areas.

As the implementation of the Sustainable Development Goals commences globally, a key focus of the Goals is the development of robust monitoring & evaluation Systems that will promote accountability and sustainability of projects. The aim of this paper is to conceptualize an Integrative framework for the Planning and Implementation of sustainable rural development projects. This exploratory research studies seeks to conceptualize project themes related to the planning and implementation of sustainable rural development projects and to evaluate the methodologies involved in the Design, Implementation, Monitoring, Evaluation and Supervision of projects and programmes targeted at people living in rural and undeserved areas.

Keywords: Conceptual Integrative Framework, Nigeria Government, Rural Development Projects and Sustainable Development.

1. INTRODUCTION AND BACKGROUND

Rural development has for long been given the back seat in terms of funding, planning and implementation. A major void can be currently noticed in rural development as rural areas are being left behind in development. There is a dearth of sustainable rural projects which can be noticed in the variation of indices between rural and urban areas. A 2015 world Bank report highlights that only 23% of rural dwellers in Sub Saharan Africa(SSA) have access to improved sanitation facilities in contrast to 67.5% average of people with access to improved sanitation facilities worldwide. Also, only about 56% of the rural population in Sub Saharan Africa have access to improved water sources as against the global average of 96.5% of urban dwellers who have access (World Bank, 2016). With the above, rural development has become an imperative for SSA countries like Nigeria.

In some cases, projects are implemented in the rural areas but they have since failed for so many reasons. For example, a 2014 project mapping study carried out in Bayelsa State of Nigeria (a largely riverine state with over 80% made up of rural communities) showed that of the 1,527 projects identified and captured, 563 representing 37% of the implemented projects were found to be Non-functional. These projects include Education, Health, Water & Sanitation projects amongst others (OSSAP-MDGs, 2014).

Moving ahead, it is pertinent to have a grasp of the concept of development projects as the terminology could also be used in reference to Software development in the computer science field. For the purpose of this study, the term ‘development project’ is restricted to Human and Economic development. Hirschman defines development projects as units of public investments that bring about the direct involvement of political authorities and are seen as major components of the entire development process (Hirschman, 2014). Likewise, Gittinger also defines projects as ‘an investment activity in which financial resources are expended to create capital assets that produce benefits over an extended period of time’ and development project as the ‘smallest operational elements prepared and implemented as a separate entity in a national plan or programme’(Gittinger, 1982).

Rural development programmes and initiatives exist in different forms. Education, Entrepreneurship, physical infrastructure and social infrastructure are important components in rural community development (Rowley, 1996). Rural development programmes could also involve the provision of material and technical assistance to rural communities and villages to improve the quality of their lives, socially and economically (Akyurek, 1985).

Till date, several attempts have been made in formulating rural development frameworks by Governments, International development organizations, Non Governmental Organizations and Private Organizations; mostly as corporate social responsibility initiatives. In 2003, under the Food and Agriculture organization, a conceptual framework for National agricultural, rural development and food security strategies and policies was developed. Aimed at promoting food security through agricultural and rural development, the authors of the framework highlighted lack of will power, poor implementation and inability to effectively monitor the impact of the framework as drawbacks of the framework. (FAO, 2003). Likewise in South Africa, a comprehensive rural development framework was set up to be an effective response against poverty and food insecurity by maximizing the use and management of Natural resources to create vibrant, equitable and sustainable rural communities (MRDLR, 2009). A further review of this framework by Impact Economix in 2013 revealed various gaps in the framework such as; weak institutional arrangements and planning processes, absence of a collaborative procurement process, low level community mobilization, lack of an approach to targeting vulnerable groups, the need to improve value for money and sustainability amongst others (Impact Economix, 2013)

The aforementioned frameworks amongst many others provide evidence on the need to develop an integrative framework for sustainable rural development projects. This research work provides a premium opportunity to advance research and knowledge in rural development and it’s accompanying systems. Accordingly, this paper aims to explain the key concepts involved in the planning and implementation of sustainable rural development projects and propose a conceptual framework towards the implementation of sustainable rural development projects in Nigeria

2. RURAL DEVELOPMENT IN NIGERIA

This section seeks to explore various policies and institutions that have been established till date and also bring to the fore current practices in rural development. To address monumental development deficits in Nigeria, successive Governments have since independence created and implemented development plans. Till date four plans and a development strategy have been rolled out. Table 1 below shows the plans and their timeline.

Table 1: Nigeria's National Development Plans (Iheanacho, 2014).

| S/N | PLAN | TIMELINE |
|------------|--------------------------------------|-----------------|
| 1 | The First National Development Plan | 1962 |
| 2 | The Second National Development Plan | 1970-1974 |
| 3 | The Third National Development Plan | 1975-1980 |
| 4 | The Fourth National Development Plan | 1981-1985 |

The civilian Government of President Olusegun Obasanjo also introduced the National Economic Empowerment Development Strategy (NEEDS) in 2004. The NEEDS was designed as a home grown strategy geared towards sustainable poverty reduction, employment generation, wealth creation and value oriented economy (Obasanjo, 2004).

The major objective of the first National Development Plan was to maintain and if possible, surpass an average annual growth rate of 4% of GDP. This was majorly to be achieved by allocating over 70% of Federal Government capital expenditure towards economic development expenditure (Forrest, 1968). A major reason for the failure of this plan was the 'elitist' approach it took. This statement was further collaborated by (Okowa, 1982) who expressed that only 6% of planned investment of infrastructural facilities was allocated to the rural sector as compared to over 90% allocated to the urban sector. Furthermore, The second National Development plan was aimed at building a strong, united and self-reliant country. Although the objectives of the plan suggested a balance for the rural and urban sectors, those were mere political posturing as the plan focused on large scale industrial development thereby leaving out small scale industrial development (Ejumudo, 2013). The first and second development plans can be viewed from an urban theoretical point of view.

According to (Iheanacho, 2014), The third National development plan first presented the platform for priority to be given to projects and programmes that impacted positively and directly on the lives of rural dwellers. This was however conflicted by the very small allocations given to agriculture and social development schemes. The agriculture and Social Development schemes (Education, Housing, Health, Welfare etc.) only received 5% and 11% and these sectors were crucial to the improvement of the living conditions of the rural populace (Okigbo, 1989). This purportedly led to a negative growth of 2.1% of the agricultural sector while the 'urban sectors' such as the manufacturing sector recorded the fastest growth with an average of 18.1% per annum; building and construction grew at 13.9% (Egonmwan and Ibodje, 2001). The fourth National development plan took a similar posture to the third national development plan. The major differences were that increased fund allocations were made to the sub sectors and the objectives were enlarged and became more defined. Unfortunately, the implementation of the plan was marred by falling oil prices in the oil market (Ayo, 1988)

Several other reasons have been identified for the failure of these development plans which include but not limited to: Corruption, Lack of plan discipline, Lack of commitment, Absence or relevant data, over ambitious development plans, Lack of continuity of Government plans etc. (Iheanacho, 2014). These reasons have thus far shown to be the reason why no

comprehensive rural development plan or strategy has been developed for Nigeria, merely programmes and schemes. For example, between 1973 and 2000, the federal government of Nigerian launched five rural development programmes and over eight supportive schemes (Akpomuvie, 2010). A break down of some of these schemes and the year of their launch is shown in the table below.

Table 2: Rural Development Schemes in Nigeria (Paul et al, 2014).

| S/N | PROGRAMME | YEAR |
|------------|---|-------------|
| 1 | National Accelerated Food Production Programme and the Nigeria Agricultural and Cooperative Bank. | 1972 |
| 2 | Operation Feed the Nation: to teach the rural farmers how to use modern farming tools. | 1976 |
| 3 | Green Revolution Programme: to reduce food importation and increase local food production. | 1979 |
| 4 | Directorate of Food, Roads and Rural Infrastructure (DFFRI). | 1986 |
| 5 | National Directorate of Employment (NDE). | 1987 |
| 6 | Family Support Programme and the Family Economic Advancement Programme. | 1993 |
| 7 | National Poverty Eradication Programme (NAPEP) to replace the previously failed Poverty Alleviation Programme | 2001 |
| 8 | National Economic Empowerments and Development Strategy. (NEEDS). (Paul et al, 2014). | 2004 |

It is important to note that these schemes were majorly interventionist programmes with little or no plans to promote and ensure sustainable development of rural areas in Nigeria. The continuous re-christening of some of these schemes without the consideration of economic realities and their non-articulation have been identified as major reasons for the failure of these schemes (Jonathan, 2014). For example, Operation feed the Nation was re-christened to Green revolution. Other reasons attributed for the failure of these schemes include; weak industrial base, limited social amenities, dependence on small scale farming, deficiency of skilled technical, management and entrepreneurial labour force (Isigwe et al, 2014).

Presently, the Federal Ministry of Agriculture and rural development is charged with the mission of ensuring rural development in Nigeria. Notwithstanding, Ministries, Departments and Agencies implement projects relevant to rural areas in Nigeria. Some of these ministries are; The Federal Ministry of Education- Construction of classroom blocks and supply of learning and instructional materials to schools etc, Federal ministry of Water resources- Water and sanitation facilities in communities nationwide, Federal Ministry of Health- Construction of Primary Health care centres, supply of essential drugs and equipment etc.

3. CONCEPTUALIZING THE FRAMEWORK FOR SUSTAINABLE RURAL DEVELOPMENT PROJECTS

3.1 What is Sustainable Rural Development?

Sustainable rural development entails the continuous progression of the livelihoods and economic indices of rural dwellers. More succinctly, the Centre for Sustainable Development defines Sustainable rural development as “improving the quality of life for the rural poor by developing capacities that promote community participation, health and education, food security, environmental protection and sustainable economic growth, thereby enabling community members to leave the cycle of poverty and achieve their full potential”(CSD, 2017). This approach brings to the fore the fact that sustainable rural development is a continuum and not a stop gap measure. Furthermore, the need to achieve sustainable development in rural areas is intertwined in our understanding of the interrelations of the economy, society, environment and politics (Sachs, 2015).

3.2 Planning and Implementation of Rural Development Projects in Nigeria

As with most developing countries, Nigeria has witnessed little development in its rural areas over the last two decades. This can be attributed to the failure of past rural development programmes, the neglect of ‘rural’ sectors such as Agriculture and the ever increasing rural-urban Migration the country is witnessing. The Local Government Authorities are empowered by the 1976 local Government reform to ensure rural development as a major function. Nonetheless, the three tiers of Government implement rural development projects through various platforms. At the Federal Government level, Line Ministries, Departments and Agencies and regional ministries like the Ministry of Niger Delta implement projects using a budgetary method approach. This section will focus on Project Planning and implementation using the Nigeria Millennium Development Goals Office as a case study.

The Nigerian Millennium Development Goals(MDGs) Office (now known as the Sustainable Development goals office following the adoption and subsequent roll out of the Sustainable Development Goals) was charged with the fast tracking of the achievement of the MDGs in Nigeria. Utilizing a tripartite partnership arrangement called the Conditional Grants Scheme, states and Local Governments in Nigeria were invited to submit designed project proposals for specific development projects in their constituencies. The proposals were approved based on them possessing certain indicators like stakeholder inclusion, viability etc. On approval, Projects and programmes were implemented by local contractors in the mostly rural locations.

The MDGs Office project planning and implementation structure stood out from previous programmes due to the presence of a comprehensive independent Monitoring, Supervision and Data Collection(MSD) framework. This ensured that projects were implemented using a strict timeline and with the right quality/quantity of materials. As a major breakaway from the traditional OPEN M&E in Nigeria, the MSD helped improve project implementation rates drastically. Using the annual budgeting methods, the federal, state and local Governments implement rural development projects ranging from rural feeder roads to Primary health care centers to rural electrification, water supply systems etc. However, there is the urgent need to stop the failure of already implemented rural projects and design a framework to help promote sustainable rural development projects for future interventions.

3.3 Conceptualizing the Framework

Frameworks can generally be divided into conceptual, practical and theoretical types. A conceptual framework utilizes concepts to proffer a solution to a problem (Hicks, 1991). (Crossan, 2003) further explains a conceptual framework as one that can be represented using a graphic or narrative format. The conceptualized framework shows the main concepts to be studied, key factors and the supposed relationship between them. (Delueze et al, 1991) describe a concept as having components and being defined by them. (Jabreen, 2009) further defines a conceptual framework as: “a network, or “a plane,” of interlinked concepts that together provide a comprehensive understanding of a phenomenon or phenomena. The concepts that constitute a conceptual framework support one another, articulate their respective phenomena, and establish a framework-specific philosophy. (Jabareen, 2009) proposes a methodology for a conceptual framework analysis in seven phases; namely:

- i. Mapping the selected data sources,
- ii. Extensive reading and categorising of selected data
- iii. Identifying and naming concepts,
- iv. Deconstructing and categorising the concepts
- v. Integrating concepts
- vi. Synthesis, re-synthesis, and making it all make sense
- vii. Validating the conceptual framework.

This paper focuses on conceptualizing the different components involved in the planning and implementation of sustainable rural development projects. The review of multi- disciplinary literature shows the absence of an integrative/comprehensive framework for the planning and implementation of Sustainable rural development projects. To buttress this point, a 2009 report by the International fund for Agriculture development suggests that inefficient linkages between project components, lack of a unifying framework for analysis of impact and underinvestment in institutional strengthening amongst others are constraining factors to the likelihood of rural development project sustainability (IFAD, 2009)

The Project Management institute, the world’s leading organization for project management suggests Five stages in a Project Life cycle viz; Initiating Phase, Planning phase, executing phase, controlling phase and closing phase (PMI, 2000). The challenge with the aforementioned stages is that it is generic and does not reflect the peculiarities of rural development programming. Furthermore, Bennett suggests a six phase cycle that can be utilized for Development projects which are Construction related and could also be fairly applicable to other categories of projects. These phases are; The Pre-project phase, Planning and design, Contractor selection, project mobilization, project operations and project close out (Bennett, 2007).

Accordingly, Dennis Rondinelli also proposes a twelve-stage life-cycle of development projects. These stages include Project identification and design, project formulation, Project appraisal etc (Rondinelli, 1977), a preliminary review of this project life cycle shows the absence of some crucial components and they generally do not reflect the four tenets of sustainable development. Viz; Economic growth, Environmental Sustainability, Social Inclusion and Good governance (Sachs, 2015).

A 14- stage development project life cycle is proposed and shown below:

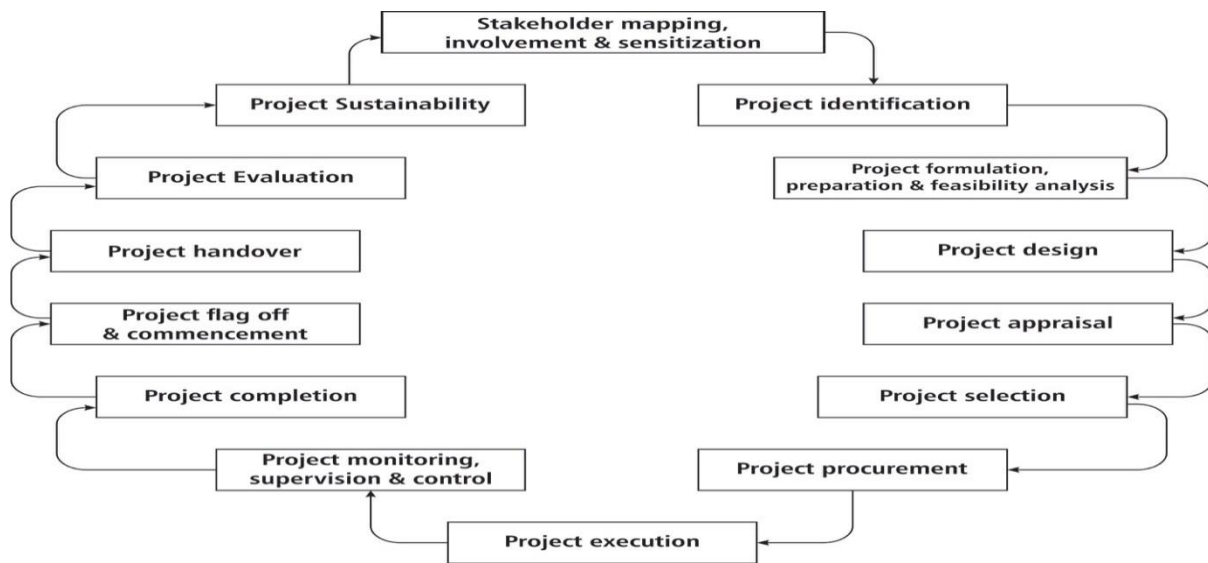


Figure 1: A proposed 14- stage model of the project life cycle

In conceptualizing the framework, the concepts have been sub divided into three broad phases. Namely: Phase one- Planning Phase, Phase two - Implementation phase and Phase three- evaluation phase. All the itemized concepts revolve around these three phases.

4. KEY PHASES IN SUSTAINABLE RURAL DEVELOPMENT PROJECT IMPLEMENTATION

4.1 Planning

The planning phase has been identified as a central element in modern day project management. Although, it does not guarantee project success, a lack of it will invariably ensure project failure this is because planning reduces the uncertainties in a project and thus improves project success possibilities (Dvir et al, 2003). The planning phase usually includes preparatory activities towards the actual implementation of the project.

Stakeholder Mapping, involvement and sensitization ensures that the relevant stakeholders in the project are discovered, entrenched into the project at all stages and efficiently sensitized on all activities during and after the life cycle of the project. Barker identifies stakeholders for a National project in Nigeria to be: National Government Agencies, Government Partners such as: USAID, DFID etc, State Government agencies, Local NGOs, Opinion leaders, Media and the academic sector (Barker, 2013). However, stakeholders are not limited to the aforementioned as they most times also include Community based organizations/groups, religious organizations, community leaders etc. A lucid process for stakeholder engagement as proposed by (IFC, 2007) is shown below:

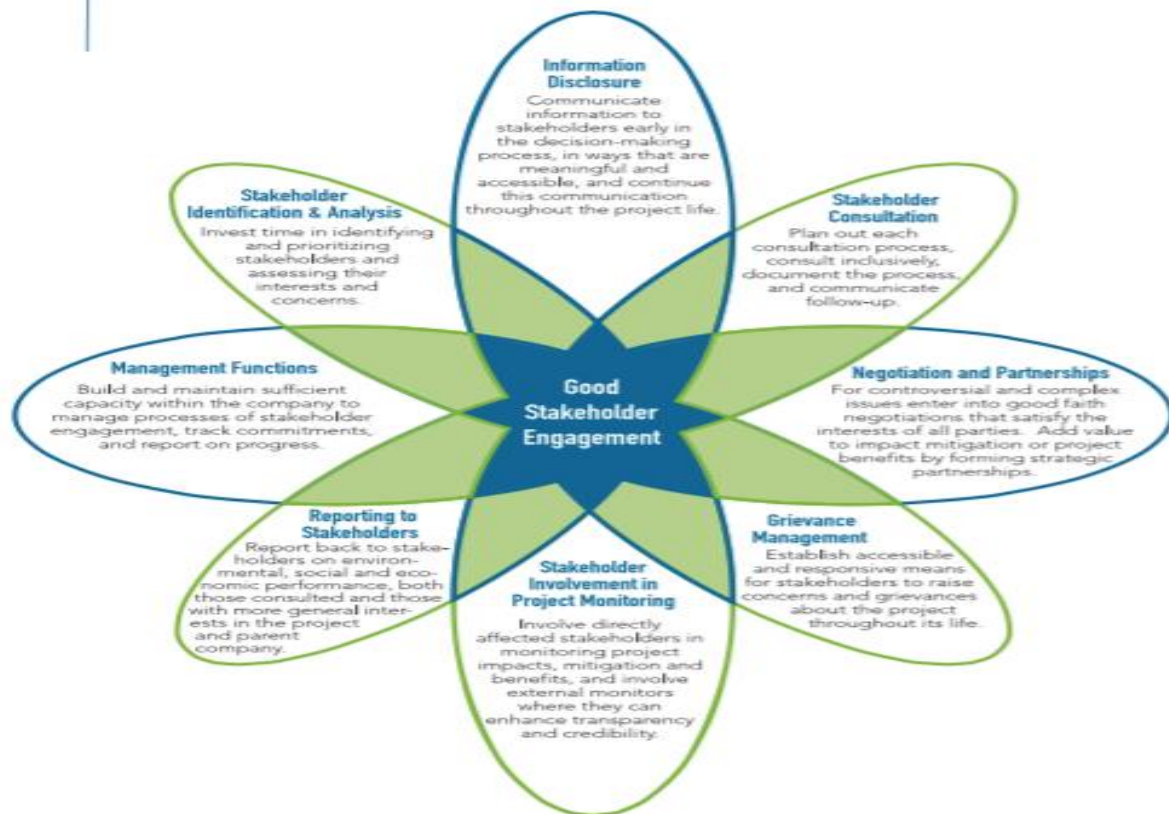


Figure 2: A lucid process for stakeholder engagement

Other components of the Planning phase include: Project identification, project formulation and feasibility analysis, project design; which puts into consideration the specific requirements of the intended beneficiaries, project approval and selection.

4.2 Implementation

The project implementation phase is the second phase in the proposed project life cycle and it includes the project procurement; which entails the gathering of goods and services which are key to the achievement of project objectives, Project Supervision and Control, Project Completion, flag off and handing over. Rwelamila also suggests that 'the incorrect choice and use of procurement systems has led to the neglect of the four pillars of sustainability and this has consequently contributed to poor project performance (Rwelamila, 2000). The four pillars of sustainability as proposed by (Hill and Bowen, 1996) are Social sustainability, Economic Sustainability, Biophysical sustainability and Technical sustainability.

In summary, a project can be said to be successfully implemented when it is completed on schedule, completed on budget, achieves the original goals set for it and is accepted and used by the intended beneficiaries. (Pinto and Slevin, 1987).

4.3 Evaluation

The last phase of the project cycle is the Evaluation phase. The evaluation phase addresses the following issues:

- a. Relevance: Is the project addressing the initial problems given. Is the project in line with national policies and is it meeting the needs of the beneficiaries?
- b. Effectiveness: The extent to which intended beneficiaries are being served by the project
- c. Coverage and targeting: The extent to which the right people are benefiting at the right time.
- d. Sustainability: How the project will be maintained and continued after Government/donor funding comes to an end; the overall process of ensuring that people's lives continue to be impacted (SPARC, 2013).

Results from the Evaluation process are vital to the planning for subsequent interventions as gaps that have been identified can be avoided in future projects. In all, effective Project Monitoring, Supervision and Control is crucial to the success of any project as it ensures that projects are completed on time and with the right quality. This should be undertaken throughout the life cycle of the project.

A proposed conceptual framework is represented in the figure below:

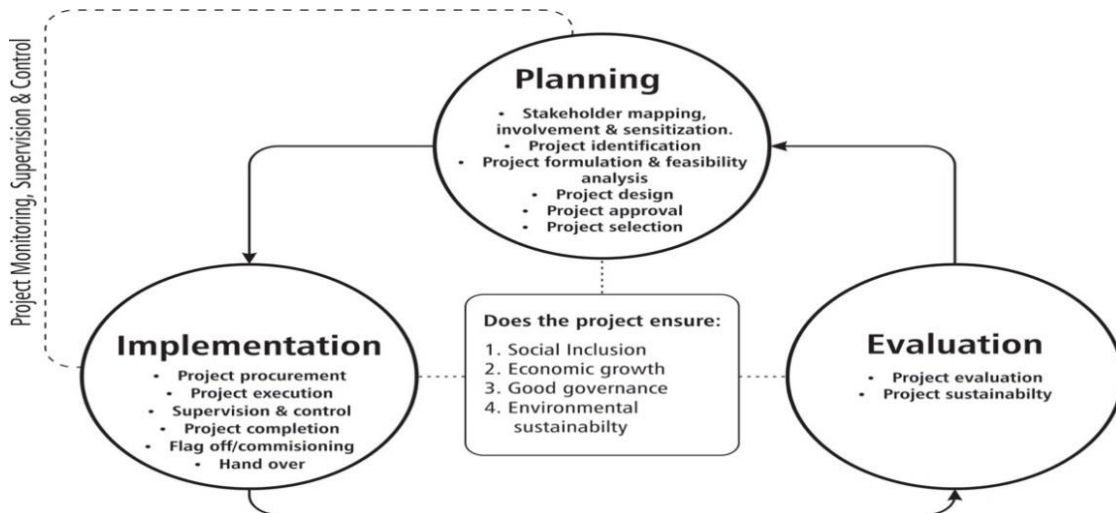


Figure 3: The proposed conceptual framework

The proposed conceptual framework above shows the integration of the three identified phases. viz; The planning stage, the implementation stage and the evaluation stage. From the above, the results from the planning stage feed into the implementation stage, the results from the implementation stage feed into the evaluation stage and the results from the evaluation stage feed into the Planning stage of subsequent project life cycles.

5. CONCLUSION

Towards filling the void in rural development projects in Nigeria, the need for an integrative framework for the implementation of sustainable rural development projects cannot be over-emphasized. The conceptual framework in this exploratory research has brought to the fore the different concepts that make up the successful planning, implementation and evaluation of rural development projects. Also described, is the interaction between the critical concepts and the cardinal factors involved in sustainability.

A potential pitfall of this research is the validity of the framework developed. In finalizing the research, there is a need to test the framework to determine its viability. In conclusion, the conceptualized framework still needs to be subjected to an expanded literature review and also employ a mixed methods survey research design. This will bring about the integrative framework; which is the end result of the conceptual framework.

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TECHNOLOGICAL INNOVATION AND FACILITIES MANAGEMENT PRACTICE: IMPLICATIONS FOR SOCIAL SUSTAINABILITY

U.J. Adama and K.A. Michell

¹ UCT–Nedbank Urban Real Estate Research Unit, Department of Construction Economics and Management, University of Cape Town, Private Bag X3, Rondebosch, 7701, South Africa

Email: ADMUNE001@myuct.ac.za

Abstract: This study evaluates social sustainability in facilities management (FM) organisations against the backdrop of advancement of technological innovations. Past studies have revealed that the practice of sustainability in FM is not holistic. A greater emphasis is placed on the economic and environmental pillars of sustainability to the exclusion of the social pillar. This exclusion is attributed to the inability to reach a consensus on what constitutes a social sustainability construct in light of the diverse elements of social sustainability. The study is explorative and relied on available literature on social sustainability integrated with FM literature. The author argues for the promotion of social sustainability in FM through the integration of three constructs of social sustainability, namely: social relationship, job satisfaction; knowledge development; and several other sub-indices. These constructs are seen as a starting point towards evaluating social sustainability practice in FM. The study proposed a social sustainability framework towards enhancing the understanding of social sustainability in FM practice. The framework suggests that an organisation's commitment to the promotion of social sustainability practice could result in optimal delivery of the core business objectives of the organisation. The framework provides useful direction for further studies in this research area.

Keywords: Facilities management, social sustainability, sustainable facilities management, sustainability, technological innovation.

1. INTRODUCTION

Technological advancement has brought a variety of possibilities to the built environment. Hence, FM is engaging in the adoption of new technologies to both transform and improve the overall triple bottom line of organisations. The common types of technological innovations that are adopted in FM practice include: Information Communication Technology (ICT), Radio Frequency Identification (RFID), cloud-based technology, drone technology, social media technology, robots and sensors. The adoption of these technological innovations has assisted in promoting the efficiency, profitability, flexibility, corporate image, connectivity and reduced the overall cost of doing business. However, previous studies argued that these technological innovations have changed the work patterns in organisations resulting in a negative impact on employees. For instance, employees' social well-being is affected by ICT-based technological innovations (Hing Lo *et al.*, 2014; Jiang, 2016; Hoeven *et al.*, 2016). The technologically induced work pattern causes employees to face social isolation, alienation, partial invisibility in the organisation, coupled with overwork and the intrusion of work into employees' home life (Grimshaw, 2007). Furthermore, employees face job losses due to the introduction of robots (West, 2015). The introduction of RFIDs in organisations results in a violation of employees' privacy and security, in addition to labour intensification (Fisher and Monahan, 2008; Azevedo and Carvalho, 2012). Fisher and Monahan (2008) further argued that both surveillance and labour intensification can

bring about additional stress and an overall decline in employees' morale. The challenges highlighted above have a social dimension and resultant implications for the social wellbeing and sustainability of the employees. There is a need for concrete action else, the quality of employees and social capital that will be available to organisations in the future will not be able to guarantee organisational success (Abbott, *et al.*, 2013). Moreover, Ware *et al.* (2017) argue the importance of evaluating how these social problems affect workforce productivity, innovation, and employment relationships on a sustainable basis.

International Facilities Management Association (IFMA) (2014) stated that sustainability is crucial to FM practice. However, there has been an increased demand for a holistic view of sustainability due to the imbalance in the application of the economic, social and environmental pillars of sustainability (Elmualim *et al.*, 2008; Jensen *et al.*, 2013). The social pillar which represents the people's concerns (Omann and Spangenberg, 2002) among the sustainability pillars has suffered continuous neglect despite the benefit that is derivable from exploring peoples' potential (Omann and Spangenberg, 2002; Sarpin, 2015). This is a gap in the practice of sustainable FM. Hence, this study explores the impact of technological innovations on FM practice and the influence on social sustainability by reviewing and integrating available literature on FM and social sustainability. The study adopted three constructs, namely: social relationship, job satisfaction and knowledge development to measure social sustainability against the backdrop of technological innovations in organisations. The strategy of the study is first, to carry out an overview of how technological innovation has influenced FM practice as evidenced in the literature. In addition, to investigate how the emerging FM practice influences social relationship, job satisfaction and knowledge development as measures of social sustainability.

2. INFLUENCE OF TECHNOLOGICAL INNOVATIONS IN FM PRACTICE

Technological innovations in this study includes cutting-edge technologies that are being adopted by FM professionals, for improved service delivery. These include: information communication technology (ICT), cloud-based technology, drone technology, robotics and the social media. These classes of technological innovations have provided opportunities for organisations to optimise employee capabilities, and respond efficiently to customer needs, gain valuable feedback, ideas and useful information (Lindkvist and Elmualim, 2009; Martin and Omrani, 2015; Kandampully *et al.*, 2016). From previous studies, the influence of technological innovations in FM practice includes: effective job performance, innovative work practices, operation of "Virtual Office" and the development of green buildings, increased commitment of employees, job flexibility, and greater task involvement (Huselid and Becker, 1996; Nutt, 2000; Grimshaw, 2005; Osterman, 2006; White and Bryson, 2013; Martin and Omrani, 2015). Furthermore, the adoption of technological innovation has transformed FM practice from being reactive to proactive, and with increased sophistication in technological innovations towards being predictive (Taival, 2017). More specifically, technological innovations like the Building Information System (BIM) has transformed operational FM. BIM is a tool used by architects to create a complete model of building before it is built. It enables the facilities manager to visualise the building in the pre-construction stage and make informed contributions at the design stage that will enhance the overall performance of the building throughout the building life cycle. BIM has also promoted enhanced communication by making data sharing flexible among the facilities maintenance managers in a building (Taival, 2017).

The drive towards “Smart building” is boosted by the integration and control of the different systems in a building facility like heating, lighting, ventilation, sanitation and security from one central point using technological innovations. From such point, smart sensors are used to detect and rectify inefficiencies like a leaky tap or a light that has been left on. This, has enhanced the practice of sustainable FM through the effective management of energy, water and waste. Furthermore, the internet and other wireless technologies have enabled FM productivity and efficiency on a sustainable basis. For instance, the virtual office is made possible by the internet. When applied to the transportation logistics, internet connectivity has helped FM professionals to determine and optimise the most fuel-efficient routes for transport services amongst others. The availability of different sensors has enabled effective remote monitoring and control using alarm monitoring and services in FM practice (Taival, 2017).

The use of automated devices and smart robots have also helped to transform FM practice in several ways. Robots are increasingly being deployed in FM sector for portering, security, waste management, building maintenance services, logistic deliveries, catering and customer services etc. These were services hitherto undertaken by human beings with all the associated overhead costs. Moreover, the increased use of robots in FM has reduced the energy cost and increased management efficiency. In the same manner, drones fitted with a camera can carry out efficient building survey assessment, do video and thermal imaging especially at a high level or high-risk areas thereby reducing the risk of falls associated with such tasks (Marginalia, 2016). Drones for FM services also known as "Aerial FM", can diagnose and record on video, the condition of roof defects, storm damages, and weathering issues in a quick and cost-efficient manner (Marginalia, 2016).

The adoption of technological innovations like computer-aided facilities management (CAFM) software has also increased the level of integration amongst employees and departments in FM organisations and promoted business operation on a sustainable basis. For instance, the integration of (CAFM) software removes ambiguity by ensuring that contractors and employees are using the same data set and methods over any contractual activity. Furthermore, smartphones, cloud computing and social media have increased the mobility of the FM services whereby facilities managers can conduct their operations from anywhere in the world. Cloud-based technology has promoted the unification of management in multiple geographically dispersed facilities, with immense capacity to store historic and current maintenance data about the facility (Lau *et al.*, 2013). The smartphones and social media technologies enable video conferencing, multimedia instant messaging, recording and photographing, which enables facilities managers to carry out their assignment from any remote location without necessarily visiting the site. Hence, technological innovation has influenced the practice of FM over the years. However, the impact of technological innovation in FM organisation is on the core business and the employees, but little is known about the impact on the employees as they are rarely discussed. This has made the discussion of technological innovation impact in FM not holistic. Since organisations are required to act sustainably, it therefore, has become important to assess the influence of technological innovation in the organisation holistically.

3. SUSTAINABLE FM PRACTICE

There is a growing interest in sustainable FM practice, especially with respect to evolving new strategies that will enhance the skills of facilities managers towards meeting sustainability criteria (Nielsen *et al.*, 2009; Sarpin, 2015). This is apparent as a result of the

critical role that the facilities managers play throughout the entire facility life-cycle (Elmualim *et al.*, 2008). Moreover, previous research efforts emphasised the possibility of deriving substantial benefits from sustainable FM practice (Hodges 2005; Lai and Yik 2006; Nielsen *et al.* 2009). This is because facilities managers have a growing influence over how profitability, productivity, energy management, waste management, employee wellbeing and public perception of an organisation are determined (Pitt, 2005; Shah, 2007). Brown and Pitt (2001) argued that the growth in the built environment practice and the consequential growth of the FM sector is expected to be significant and will impact on all aspects of sustainability. However, the practice of sustainable FM has not reflected a holistic approach because previous sustainable FM studies have been more favourable to the economic and environmental issue with little effort being directed towards the social issues. Sustainability comprises three pillars: economic, environmental and social that should be in equilibrium for sustainability to be holistic (Hodges 2005; Dillard and King, 2008; Teodorescu, 2015). In other words, the impact of one of the components is felt by the other two at any given time because of their interrelatedness. It further implies that there is an unbreakable relationship existing among the pillars of sustainability. However, Elmualim (2009), Vallance *et al.* (2011) and Jensen *et al.* (2013) all argued that the social pillar of sustainability has received the least attention. In a similar submission, the European Council (2001) affirmed that “at best social sustainability is mentioned separately including social objectives, but not fully integrated into the sustainability framework”.

Elmualim *et al.* (2009) argued that a balanced sustainability policy should integrate all the elements of the triple-bottom line (TBL). Elkington (1998) asserts that the essence of the TBL is to compel organisations to be more responsive by shifting their focus from wholesome economic pursuits toward some social and environmental concerns while conducting their business. An organisation (FM) is a social function (Ohmae, 1999; Gao and Zhang, 2006) that should not only be responsible for the well-being of its shareholders alone but ensures that its employees, customers, suppliers, local communities and the society enjoy security and a sustainable good life (Deegan, 2002; Gao and Zhang, 2006). Vanclay (2004) argued that although FM organisations are adopting the concept of TBL in their development and operations, a clear social dimension as a measure for the attainment of social sustainability is still unclear. Social sustainability is fundamental to sustainable FM practice because the performance of building designs and social infrastructure including access to services and recreation have a direct effect on the quality of life and wellbeing, and the cohesiveness of society (CIRIA, 2006). Therefore, the inability to fully integrate the economic, social and environmental issues in FM is a gap in FM knowledge (Sarpin 2015).

Vanclay (2004) suggested the integration of stakeholders' interest as a starting point for measuring social sustainability. Other studies like Wehling (1999) suggested combining both objective and subjective indicators of people as a measure of their social sustainability. This study combines the two positions, by adopting the employees in FM organisations as stakeholders that represents the society for testing social sustainability practice. This is because employment is a factor of social sustainability that mediates nature-society relationship. Therefore, when employees can meet their needs and other extended sets of human needs, the society's reproductive capabilities are sustained (Littig and Griebler, 2005). The study adopted three main constructs of social relationship, job satisfaction and knowledge development and several sub-indices as shown in Table 1 as social sustainability indicators. The inter-relationship of these constructs and sub-indices led to the formulation of social sustainability framework as shown in Figure 1. It is acknowledged that the subjective nature of social sustainability factors will negate having a set of constructs as absolute for its

study. Therefore, this study ensured that the sub-indices that constituted the three main constructs have direct bearing on employees' wellbeing and comfort. Furthermore, the study recognises that organisations contribution to their host community is a form of social sustainability practice that is well established in literature. However, it should be noted that the intention of the current study is to evaluate such contribution through the employees as representatives of the community. Hence, the premise of the study is that the employees' experiences whether positive or negative has an influence on the social wellbeing of the community and therefore on society as a whole.

4. THE CONCEPT OF SOCIAL SUSTAINABILITY

The sustainability concepts of the Brundtland report (WCED 1987) and the Rio documents (UN, 1992) required that the environmental, economic, social, factors be equally combined (Littig and Grießler, 2005). These different factors are referred to as "dimensions" or "pillars" of sustainability. In order for sustainability to be operationalised, the individual pillars/dimensions must be related to each other in more concrete terms. Kopfmüller *et al.* (2001) categorised the operationalisation of sustainability as either a one-pillar model or multi-pillar models. The one-pillar model prioritises the environmental dimension on the basis that, sustainability should essentially help to preserve the environmental systems and resources which are necessary for economic and social life as an important requirement for meeting the future needs of humanity (Littig and Grießler, 2005). However, the three-pillar model which is more recognised internationally emphasises an equal treatment of the environmental, economic, and social goals of sustainability. The proposition is that human needs are beyond merely providing an environmentally stable and healthy environment, but in addition social and cultural needs should be addressed (Littig and Grießler, 2005). In another argument, it was stressed that the environmental, economic, and social needs are three individually connected systems, which must remain stable so as not to endanger the successes of progressive development.

Sustainability in FM has traditionally been evaluated by in terms of the environmental pillar. Wackernagel (2001) argued that human well-being is essential for the well-being of a society. In a contrary view, Hodge and Hardi (1997) expressed the interdependence of people and their surrounding world by stating that the achievement of progress toward sustainability will require maintaining and improving, both human and environmental wellbeing, and not one at the expense of the other. Furthermore, Brandl (2002) argues that sustainability is the relationship between environmental and social elements which needs to be maintained in such a way that it doesn't destabilise the whole system: "From a system theoretical point of view, this approach aims to uphold both the functionality and the resilience of linked sub-systems, thus keeping the whole system stable" (Brandl 2002, p.13ff, transl. by Littig and Grießler, 2005). Evaluating the definition of sustainable development by the Brundlandt Commission as "development which meets the needs of the present without comprising the ability for future generations to meet their own needs" (WCED 1987, p.43), it can be argued that the use of the term "needs" in the Brundtland definition of sustainability, summaries the interplay of society and nature (Littig and Grießler, 2005). Within the context of nature, the needs of human beings are challenging to nature because of the emission of gases and generation of waste and alteration of the ecological systems associated with the exploitation of natural resources. However, if the meaning of "needs" is expanded within the context of paid employment, it includes the quest for education, recreation/leisure, social relationships, and self-fulfilment. The satisfaction of these needs will call for a much broader scope of

action and opportunities. In this study, we defer to the latter option, because by meeting these needs, employees will be able to take responsibility for shaping a decent life for themselves and the society.

Employment in the broadest sense plays an essential role in sustainability because the fulfilment of needs derived from employment requires some exchange between society and nature. Moreover, gainful employment is one of the foremost organisational and structural principles of society, which has continued to experience transformation over time (Fischer-Kowalski and Haberl, 1993). However, work in modern working societies, especially paid employment, has transformed beyond ensuring that people get a livelihood to satisfy their needs, towards becoming the means to stratify and structure society (Senghass-Knoblauch, 1998). Therefore, employment has become a factor of social sustainability that mediates the nature-society relationship, by reflecting the way that an extended set of human needs are met and the society's reproductive capabilities for a long period are promoted through social justice, human dignity and participation. Furthermore, it is expected that the concept of social sustainability in an organisation reflect elements of social welfare (Brandl and Hildebrandt, 2002) that not only secure employees' income but also promote integration and social cohesion (Senghass-Knoblauch, 1998). Based on these social sustainability concepts discussed above, this study adopted a set of three core indicators to assess the social sustainability in FM practice. The first construct is 'social relationship' which measures alienation, social network, work and home life balance, overwork and social isolation. The second social indicator deals with 'job satisfaction' which assesses job indices like remuneration, autonomy, job security, interaction, professional status, task requirement and organisational policy. The third social sustainability construct adopted in this study deals with 'knowledge development'. Knowledge development evaluates the level of workshops and seminars, professional development programs, retirement development plans and on-the-job training in organisations. Each of these will be discussed briefly below.

4.1 Social Relationship and Social Sustainability

Social relationship refers to any connection with at least one or more people that act harmoniously in a social situation. Alienation as a factor of social relationship involves estrangement from the larger social world. From the analysis of Marx's early writings, occupational alienation can be in the form of lack of control over ones' labour and the lack of control over ones' process of work are factors of occupational alienation. Therefore, the new order of work pattern due to technological innovation in organisations encourages occupational alienation because technology in most cases takes control over work processes (Bailey and Kurland, 2002; Kurland and Cooper, 2002; Grimshaw, 2007; Osin, 2009; Dempsey *et al.*, 2011; Rey, 2012; Nam, 2014; Mokyr *et al.*, 2015; Nørgaard *et al.*, 2015; Valtorta, 2016; Zhang, 2016). ICT promotes more virtual connectivity than physical connectivity which has affected social networks. Social networks are characterised by the joint activities of, and constant exchanges between, members in an organisation or a social system. This reflects the state of recurrent relationship that connects the actors in a social system (Bhatt 2001; Grimshaw, 2007; Bennett *et al.*, 2010; Dempsey *et al.*, 2011; Nam, 2014; Zavaleta, 2014; Valtorta, 2016). Also, the increased adoption of technological innovation because of globalisation has blurred the boundaries between work life and home life (Allen *et al.*, 2000; Frone, 2003; Galinsky *et al.*, 2004; Wallace, 2004; Wajcman, *et al.*, 2008; Grimshaw, 2007; Nicholas and Guzman, 2009; Beutell, 2010; Nam, 2014; Fapohunda, 2014; Mokyr *et al.*, 2015; Nørgaard *et al.*, 2015; Valtorta, 2016; Zhang, 2016)). A poorly managed balance between work and home life has been associated with stress, sub-optimal

productivity and high absenteeism. However, employees with better work and home life balance are reported to have a better sense of responsibility, ownership and control of their work life. Employees have demonstrated greater commitment and loyalty to organisations that help them balance their work and home-life (Thompson *et al.*, 1999; Allen, 2001; Clark, 2001; Behson, 2002, 2005).

Overwork as a sub-index of social relationship is one of the factors that is responsible for workplace stress (Eikhof *et al.*, 2007; Grimshaw, 2007; Nam, 2014; Valtorta, 2016). The resultant stress created by overwork negatively influence workers' health and well-being and in turn a negative impact on the productivity and profits of the organisation (Bickford, 2005). In a similar submission, The National Institute for Occupational Safety and Health (NIOSH) (1999) confirmed that the health of workers, and in turn, the health of organisations faces a threat from job stress due to the changing nature of work. It follows therefore, that, inefficient management of over work induced stress can result in sick and socially unsustainable society because workers will be spending their resources on health care challenges. Social isolation is the opposite of social inclusion. An organisation is presumed to pursue social inclusion when formal and informal social events at work are perceived as equally appropriate for employees (Beehr *et al.*, 2000; Cattani *et al.*, 2005; Marshall *et al.*, 2007; Casper, *et al.*, 2007; Dempsey *et al.*, 2011; Nam, 2014; Zavaleta *et al.*, 2014; Nørgaard *et al.*, 2015; Valtorta 2016). This is important in the promotion of social sustainability in light of previous studies on social identity theory which argues that people classify themselves into in-groups and out-groups using salient measures, while looking out to maintain a positive social identity in the process (Brewer, 1979; Tajfel and Turner, 1986). FM is a relationship management oriented profession with enormous responsibility to people, place and planet (Grimshaw, 2007; Ware *et al.*, 2017). Moreover, FM has to evolve new ways of operation that favours not only the shareholders of the organisation but also promoting positive community life (Kasim and Hudson, 2006).

4.2 Job Satisfaction and Social Sustainability

As earlier mentioned, employment is a factor of social sustainability that mediates the nature-society relationship, by reflecting the way that an extended set of human needs are satisfied. Therefore, job satisfaction for the employees becomes critical. Lance (1991) and Irvine and Evans (1995) in previous studies argued that a significant relationship exists between a low level of job satisfaction and the rate of employee turnover. Hence, job satisfaction is a buffer against conditions that encourage a high level of employee turnover. In a similar submission, van Saane *et al.* (2003) argued that job satisfaction also serves as a barrier to occupational stress, which is a factor that negatively affects social sustainability. Authors that have identified social sustainability factors that influence job satisfaction to include: remuneration, autonomy, job security, interpersonal relationship, professional status, task requirement and organisational policy (Beehr *et al.*, 2000; Bhatt, 2001; Grimshaw, 2007; Bennett *et al.*, 2010; Dempsey *et al.*, 2011; Nam, 2014; Mokyr *et al.*, 2015; Nørgaard *et al.*, 2015; Zhang, 2016).

4.3 Knowledge Development and Social Sustainability

Kandampully (2002) acknowledged that technological innovation has created a knowledge dimension to almost every manual job. Hence, organisations seek employees that are able and willing to update their knowledge on a continuous basis (Bhatt, 2001; Wiewiora *et al.*, 2010;

Ware, 2003; Dempsey *et al.*, 2011). Unlike the old practice, experience is of limited value because new knowledge is required to be productive with new technology (Kandampully, 2002; Pathirage *et al.*, 2008). Drucker (1993) and Nutt (1999) argued that the ability of the employees and organisations to be proactive in seeking current knowledge is the only means through which organisations can be sustainable. Nutt (2000) further affirmed that knowledge development is the foundation for synchronising organisation objectives with the facilities objective. In the context of sustainability, Bhatt (2001) maintained that the development of employees' knowledge should be regarded as significant in terms of the adoption of technological innovation in organisations. Sarpin (2015) further argued that the knowledge gap has remained a challenge to the practice of holistic sustainable FM. Hence, the upgrading of people's knowledge has a correlation with their wellbeing, which is fundamental factor in social sustainability.

5. TOWARDS THE PROPOSED SOCIAL SUSTAINABILITY FRAMEWORK FOR FM

As earlier stated, the study has evaluated social sustainability through the three concepts of social relationship, job satisfaction, and knowledge development. The systematic search of past literature on social sustainability between years 2000-2016 yielded sixteen factors with direct bearings on the employees' wellbeing, which are described as social sustainability indicators in the literature. These factors were grouped into the three main constructs for conciseness as shown in Table 1 below.

Table 1: Social sustainability constructs from the literature

| Construct | Social sustainability indicators | Author |
|-----------------------|----------------------------------|--|
| Social relationship | Alienation | Bailey and Kurland, (2002); Kurland and Cooper (2002); Grimshaw (2007); Osin (2009); Dempsey <i>et al.</i> (2011); Rey (2012); Nam (2014); Mokyr <i>et al.</i> (2015); Nørgaard <i>et al.</i> (2015); Valtorta (2016); Zhang (2016) |
| | Social network | Bhatt (2001); Grimshaw (2007); Bennett <i>et al.</i> (2010); Dempsey <i>et al.</i> (2011); Nam (2014); Zavaleta (2014); Valtorta (2016) |
| | Work/home life balance | Nicholas and Guzman (2009); Wajcman, Bittman and Brown (2008); Wallace (2004); Allen <i>et al.</i> (2000); Frone (2003); Grimshaw (2007); Beutell (2010); Nam (2014); Fapohunda (2014); Mokyr <i>et al.</i> (2015); Nørgaard <i>et al.</i> (2015); Valtorta (2016); Zhang (2016) |
| | Overwork | Eikhof <i>et al.</i> (2007); Grimshaw (2007); Nam (2014); Valtorta (2016) |
| | Social isolation | Beehr <i>et al.</i> (2000); Cattan <i>et al.</i> (2005); Marshall <i>et al.</i> (2007); Grimshaw (2007); Dempsey <i>et al.</i> (2011); Nam (2014); Zavaleta <i>et al.</i> (2014); Nørgaard <i>et al.</i> (2015); Valtorta (2016) |
| Job satisfaction | Remuneration | Nørgaard <i>et al.</i> (2015); Mokyr <i>et al.</i> (2015) |
| | Autonomy | Nørgaard <i>et al.</i> (2015) |
| | Job security | Grimshaw (2007); Dempsey <i>et al.</i> (2011); Mokyr <i>et al.</i> (2015); Nørgaard <i>et al.</i> (2015) |
| | Interpersonal relationship | Beehr <i>et al.</i> (2000); Bhatt (2001); Bennett <i>et al.</i> (2010); Nam (2014); Nørgaard <i>et al.</i> (2015); Zhang (2016) |
| | Professional status | Nørgaard <i>et al.</i> (2015) |
| | Task requirement | Nam (2014); Nørgaard <i>et al.</i> (2015) |
| | Organisational policy | Grimshaw (2007); Nørgaard <i>et al.</i> (2015) |
| Knowledge development | Workshop and seminars | Bhatt (2001); Dempsey <i>et al.</i> (2011) |
| | Professional development program | Ware (2003) |
| | Retirement | Wiewiora <i>et al.</i> (2010) |

| | | |
|--|---------------------|---|
| | development plan | |
| | On-the-job training | Bhatt (2001); Wiewiora <i>et al.</i> (2010); Dempsey <i>et al.</i> (2011) |

Based on the on the number of times that each of the constructs in Table 1 were cited in the literature, a tentative ranking, from a theoretical point of view, of the constructs was generated in Table 2 to show the frequency of each of the sub-indices under the main construct based on the emphasis placed on them in previous studies. The tentative ranking in Table 2 indicates that over the years under review (2000 – 2016), out of the 69 references made to social sustainability, 44 of those references were in relation to social relationship, 18 were related to job satisfaction and 7 were related to knowledge development. The authors perceive that this could be indicative of the relative importance of these factors that may require further empirical study to substantiate.

Table 2: Strength of each sub-constructs by frequency and ranking

| Construct | Social sustainability indicators | Frequency | Ranking | Overall Ranking |
|-----------------------|---|------------------|-----------------|------------------------|
| Social relationship | Work/home life balance | 13 | 1 st | 1 st |
| | Alienation | 11 | 2 nd | 2 nd |
| | Social isolation | 9 | 3 rd | 3 rd |
| | Social network | 7 | 4 th | 4 th |
| | Overwork | 4 | 5 th | 6 th |
| Job satisfaction | Interpersonal relationship | 6 | 1 st | 5 th |
| | Job security | 4 | 2 nd | 6 th |
| | Remuneration | 2 | 3 rd | 8 th |
| | Task requirement | 2 | 3 rd | 8 th |
| | Organisational policy | 2 | 3 rd | 8 th |
| | Autonomy | 1 | 4 th | 9 th |
| | Professional status | 1 | 4 th | 9 th |
| Knowledge development | On-the-job training | 3 | 1 st | 7 th |
| | Workshop and seminars | 2 | 2 nd | 8 th |
| | Professional development program | 1 | 3 rd | 9 th |
| | Retirement development plan | 1 | 3 rd | 9 th |
| | | 69 | | |

Subject to further empirical analysis, organisations that seek to promote social sustainability may need to pay more attention to the factors of ‘social relationship’ as, in terms of the literature, these seen as being more important to the employees than job satisfaction and knowledge development.

6. THE PROPOSED SOCIAL SUSTAINABILITY FRAMEWORK

This paper aims to provide a critical view of the changes that the introduction of technological innovation will cause to the employees in an FM organisation. Although the introduction of technological innovation in FM organisation will affect both the core business and the employees of the organisation as shown in Figure 1, as earlier stated, this study will concentrate on the employees as being indicative of the community and society. The conceptual framework in Figure 1 consists of five parts: firstly, the FM organisation; secondly, the technological innovation which is perceived as the external enabler that is adopted into the organisation. Thirdly, the core business to the left of the framework, and fourthly, the employee to the right of the framework. They are both impacted by the effect of any technological innovations that are adopted into the organisation. Lastly, social

sustainability which is the point of the interrelationship between the FM organisation and society.

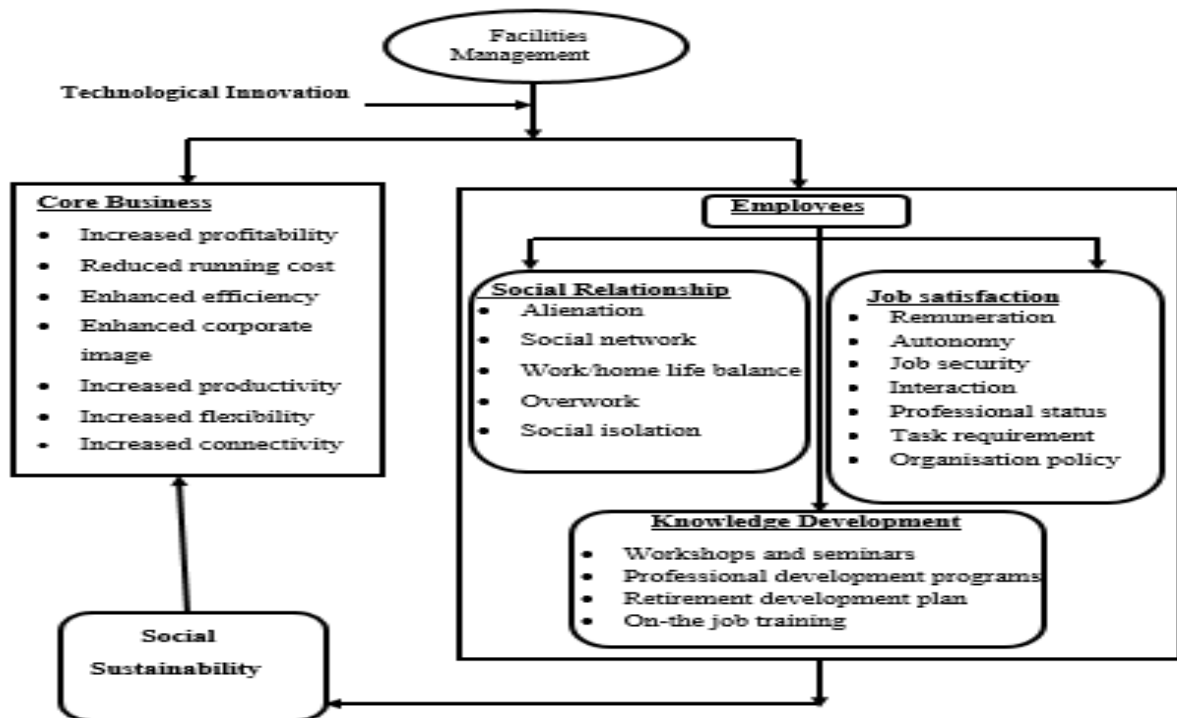


Figure 1: Proposed framework for social sustainability in FM

7. CONCLUSION

Technological innovations have influenced the practice of FM profoundly by helping to promote efficiency, profitability, flexibility, corporate image, connectivity and reduced the overall cost of doing business. It has also helped to improve safety and competitiveness. However, more benefits may be possible if the organisations explored the social sustainability of the employees. Organisations that will survive the global business competition in view of the technological advancements are those that will be more socially inclined to promoting employees' welfare. The study revealed from the analysis of literature searched, the most probable constructs for promoting social sustainability are the social relationship construct, the job satisfaction construct, and the knowledge development construct. It is further concluded that further empirical research is required in order to ascertain the relative importance of each of these constructs. Lastly, it may be concluded that facilities managers, in adopting technological innovations in their practice, should not only evaluate the advantages for the core business alone but also understand how the adoption thereof will impact on the social dimension of sustainability. This paper represents a preliminary stage of a comprehensive ongoing study in this regard.

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THE ROLE OF HUMAN ERROR IN ACCIDENTS WITHIN OIL AND GAS INDUSTRY IN BAHRAIN

M. AlKhldi, C. Pathirage and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: M.Alkhaldi1@edu.salford.ac.uk

Abstract: Through the last few decades, there is an increase in occupational accidents figures in different workplaces around the world. A number of causes contributes to these accidents but one of the main causes of these accidents is human error. Human error is an improper decision or behaviour of any worker in the workplace which leads to a negative impact on the workplace. In other words, it is an act which creates an emergency situation, causes loss of lives, damages property and environment, and hampers the economic activities of any workplace. In the case of Oil and Gas (O&G) industry, human error constitutes as the largest contributor of over 70% of all accidents. As O&G industry deals with a variety of risky chemicals and operations, the costs of these accidents are too high to the employees, workplace, economy and society. Few studies have paid attention to human error issue particularly within O&G industry. Therefore, considering human error related accidents within O&G industry is becoming an important global concern. Thus, the aim of this paper is to highlight the role of human error in accidents within O&G industry. This will be done through an extensive review of literature. Paper will provide a definition on human error in general and in O&G industry and discuss main causes that lead to human error related accidents. Study will consider Bahrain O&G industry as a case study and explore some recommendations that help in reducing the occurrence of human error related accidents.

Keywords: Accident, Human Error, Oil and Gas Industry, Safety.

1. INTRODUCTION

During the industrial history, there are several drastic industrial accidents that happened and resulted in loss in workers' life and workplaces. Piper Alpha disaster (1988), Bhopal Gas Plant disaster (1984), Chernobyl Nuclear Power Plant disaster (1986) and BP Deepwater Horizon Oil Spill disaster (2010) are examples of these accidents. As a result, safety revealed as a building block of any industrial policy to protect workers against sickness, disease and injury related to the working environment. Safety is reflected in numbers of beliefs or myths like 'safety first', 'safety comes first' and 'most accidents are caused by human error' (Besnard & Hollnagel, 2012). In simple expression, safety is the absence of an undesirable event that involves an unplanned and unacceptable loss; therefore, safety, risk, beliefs, perceptions of risk, causes of accidents and safety culture are fundamental prerequisites for effectively managing risks and designing preventive measures in workplaces (Edwards, Davey and Armstrong, 2013; Turtiainen and Vaananen, 2012; Nordlöf, Wiitavaara, Winblad, Wijk and Westerling, 2015). Thus, today more than ever, most types of industries have started to concern about ensuring safety, identifying, evaluating, and managing different risks and reducing accidents (Díaz-de-Mera-Sanchez, González-Gaya, Morales and Rosales, 2015; Zakaria, Mansor and Abdullah, 2012; Besnard & Hollnagel, 2012).

This concern is highly required in risky workplaces like O&G industry as the economic perspective of the accidents in this industry is an important issue (Bolu, 2011). Health and

Safety Executive (HSE) (1999) found that the costs of one accident in O&G industry like Piper Alpha disaster were over £2 billion including £76 million indirect insurance payments and 167 of people were killed while in comparison the cost of 7000 accidents occurring each year in motor vehicle repair industry was £250 million which equates to £5000 per garage. Moreover, the fatality rate of workers in the O&G industry was higher than the rate of other workplaces (Mason, Retzer, Hill & Lincoln, 2015). The accident rate of this industry in some countries is included in the accident rate of manufacturing sector as a whole. For example, in UK the accident rate for manufacturing sector that includes O&G industry was 23% in 2014 which was less than a quarter when United Kingdom was ranked as the 11th largest manufacturing nation around the world (Reporting of Injuries, Diseases and Dangerous Occurrences Regulations RIDDOR, 2014). However, in Malaysia, this rate was around 20% in 2015 and this rate declined in comparison to 35% in 2009 (Ministry of Human Resource MOHR, 2016). On the other hand, statistics of Ministry of Labor (MOL) in Bahrain showed that the number of occupational accidents in all industry types is high and human error plays a key role within these accidents (Alaradi, 2010). This rate in Bahrain is increasing in comparison to the declining trend in UK and Malaysia as it is shown in Table 1 (MOL, 2015).

Table 3 Accident Rate in Manufacturing Sector in Bahrain (Source: MOL, 2015)

| Year | Accident rate |
|-------------|----------------------|
| 2010 | 23.4% |
| 2011 | 24.2% |
| 2012 | 25% |
| 2013 | 23% |
| 2014 | 26.2% |

Based on these statistics and the consequences of these accidents in O&G industry in Bahrain, the aim of this paper is to highlight the role of human error in accidents within O&G industry. This aim will be achieved through the following sections. This paper has seven main sections which are introduction, accidents and occupational health and safety (OHS), O&G industry background, methodology, human error specific accidents in O&G industry, discussion and conclusion.

2. ACCIDENTS AND OCCUPATIONAL HEALTH AND SAFETY

Through the last few decades, there is an increase in occupational accidents figures worldwide. In general, an accident is an undesired and unplanned event that leads to death, personal injuries, damage or loss to property, plant, materials or the environment and/or loss of business opportunity (Zakaria et al., 2012). According to International Labour Organization (ILO) (2014), occupational accidents and work-related diseases result in more than 2.3 million fatalities globally every year, of which over 350,000 result from occupational accidents and around to 2 million result from work-related diseases. The current increasing trend in these accidents has seen as an alarming sound to deflect attention to OHS to gain considerable economic benefits regarding the availability of work, level of morale, human resources usage, labor and management relations, key skills, insurance costs, medical expenditures and faulty products (Díaz-de-Mera-Sanchez et al., 2015; WBG, 2011). OHS is promoting and maintaining the highest degree of physical, mental and social well-being of

workers in all occupations, preventing departures from workers' health caused by their working conditions, protecting workers from risks resulting from factors adverse to health and placing and maintaining the worker in an occupational environment adapted to his physiological and psychological capabilities (WBG, 2011).

Walters, Wadsworth and Quinlan (2013) argued that introducing and managing OHS in a workplace are based on how this workplace operates and what types of risks it has. Besides, identifying the causes of any accident is also a fundamental requirement. Based on literatures, many causes of accidents were identified as it is shown in Figure 1. Human error is one of critical causes, which will be explained in the next section.

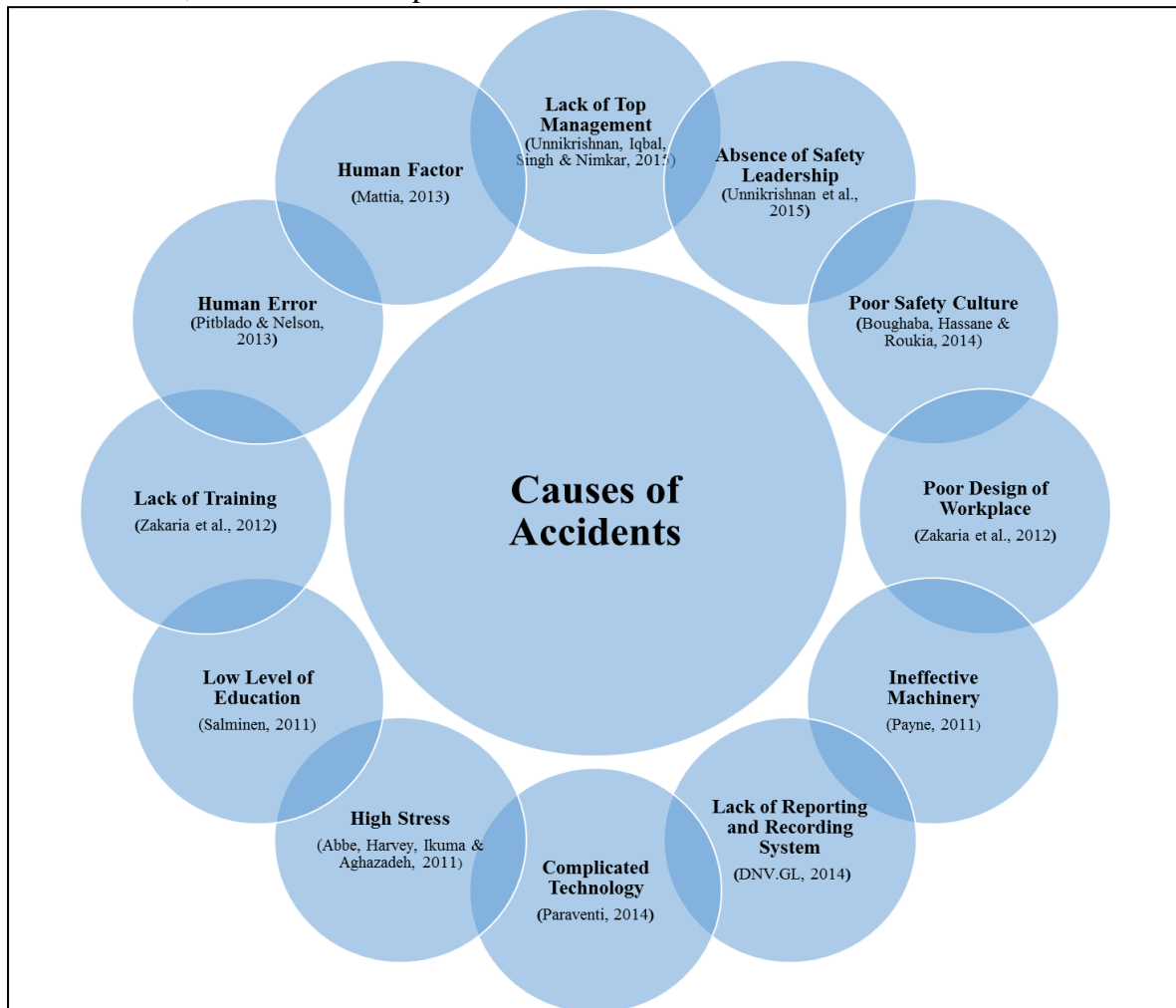


Figure 29: Causes of Accidents

2.1 Human Error

Human error constitutes as the largest cause of up to 80% of all workplace accidents and it was a root cause of all critical accidents in recent memory, including the Bhopal Gas Plant disaster, Hillsborough football stadium disaster, Paddington and Southall rail crashes, capsizing of the Herald of Free Enterprise, Chernobyl and Three-Mile Island incidents and the Challenger Shuttle disaster (Pitblado & Nelson, 2013; Manchi, Gowda & Hanspal, 2013; Zeng, Tam & Tam, 2008). Mattia (2013) and Patel, Sherratt and Farrell (2012) found that human error was and still is a concern of different researches and books since the Domino Theory of Heinrich. Heinrich is a leader of Industrial Safety Engineer (Mattia, 2013; Patel,

Sherratt and Farrell, 2012) and he described human error as a poor behaviour or an inadequate risk perception (Patel et al., 2012). In addition, Manchi et al. (2013) described it as a result of human nature. It is deemed as an improper decision or behavior of a worker which may have a negative impact on the effectiveness of safety performance system. However, Mattia (2013) interpreted human error as a natural consequence that is resulted from a break between human capacities (human) and the demands of processes and procedures (machine). He also found that human error is a result of lack of situation awareness, which is the perception of components in the process environment, the understanding of the meaning of these components and the projection of their situation in the future. However, earlier researches also had expressed human error. For example, Zhu and Xiao-ping (2009) found from the perspective of human mind that human error happens due to the artificial mistakes, whether intentional or unintentional. As well as, Zeng et al. (2008) claimed that human error that potentially causes an accident can be referred as an unsafe act that depart from hazard control or job procedures to which the person has been trained or informed and in turn this act leads to unnecessary exposure of a person to hazards.

Further, Reason (1990) and Kontogiannis and Embrey (1992) have introduced different classifications to illustrate this term as it is summarized in Table 2 and Table 3. According to Reason (1990), human failure is divided into two main categories which are human error and violation. Human error is by definition, an unintentional action or decision whereas violation is a deliberated intention to do the wrong thing or to depart from safe operating procedures, recommended practices, rules, standards or any noncompliant acts but not the bad consequences. Simply, human error is the failure of planned actions to reach the desired aim (Reason, 1990). Based on that, human error is divided into three main categories as slip, lapse and mistake. Slip and lapse are considered as failures in the execution time of routine and well-practiced tasks in a familiar environment. Within these two categories, the planned action does not go as planned or properly because something happened and prevented that. Slip occurs when actions were not carried out as intended or planned while lapse occurs when actions were missed. This scenario occurs due to confusing or poor labelling. On the other hand, mistakes occur in the planning phase. Mistakes are defined as actions that are executed entirely as planned, but the plan itself is inadequate to achieve the intended outcome. Mistakes occur due to a lack of knowledge or an inappropriate judgement. Reason (1990) also divided mistake into two categories based on the level of performance at which they occur as rule-based mistakes and knowledge-based mistakes. Indeed, rule based mistake describes a failure in the selection or application of problem solving rules. These problem solving rules are predefined rules that are known from experience and training. In contrast, knowledge-based mistake describes a failure of information processing capabilities of a worker while evaluating and solving a novel problem that does not have any pre-packaged rules. This form of mistake requires a solution from first principles.

Table 4: Reason's (1990) Classification of Human Error

| Classification of human error based on Reason (1990) |
|---|
| <ul style="list-style-type: none"> ● Slips: Actions were not carried out as intended or planned. ● Lapses: Actions were missed. ● Mistakes: A plan was inadequate to achieve the intended outcome. |

Apart from that, Kontogiannis and Embrey (1992) have formulated another classification structure of human error. They divided human errors into six types which are action, checking, retrieval, transmission, diagnostic and decision errors. First, action errors occur

when no action is taken or the wrong action is taken or the correct action is taken but on the wrong object. Second, checking errors occur when the checks are omitted, the wrong checks are made or the correct check is made on the wrong object. Third, retrieval errors occur when information that is required is not available, or the wrong information is received. Fourth, transmission errors occur when information has to be passed onto someone else, no information is sent, the wrong information is sent, or it is sent to the wrong place. Fifth, diagnostic errors occur when an abnormal event arises and the actual situation is misinterpreted. Last but not least, decision errors occur when the circumstances were considered but the wrong decision is made. In fact, action and checking errors are related to Reason's (1990) skill-based slips and lapses, retrieval and transmission errors are related to Reason's (1990) rule-based mistakes and diagnostic and 'decision' errors are related to Reason's (1990) knowledge-based mistakes.

Table 5: Kontogiannis and Embreys' (1992) Classification of Human Error

| Classification of human error based on Kontogiannis and Embrey (1992) |
|--|
| <ul style="list-style-type: none"> • Action errors: No action was taken/ wrong action was taken. • Checking errors: Checks were omitted/ wrong checks were made. • Retrieval errors: Required information was not available/ wrong information was received. • Transmission errors: No information was sent/ wrong information was sent/ information was sent to the wrong place. • Diagnostic errors: Misinterpretation of an abnormal event. • Decision errors: Wrong decision was made. |

As many definitions tried to define human error differently, human error is an unintended failure of achieving the planned outcomes in a form of action, checking, retrieval, transmission, diagnostic and decision errors. Thus, this definition has four main characteristics as:

1. there was no intention to commit an error,
2. the action was purposeful,
3. the action was action error, checking error, retrieval error, transmission error, diagnostic error or decision error,
4. the intended outcome was not achieved.

Having discussed accidents and human error in general, next section will discuss O&G industry and its current challenges from different angles.

3. O&G INDUSTRY BACKGROUND

O&G industry is an important part of the national economy and a backbone of the economy of most countries located in the Middle East like Bahrain and other regions worldwide (Mitchell et al., 2012). It is divided into three major units as upstream, midstream and downstream. The upstream unit embodies exploration, development, drilling and production of crude oil or natural gas. While the midstream unit focuses on processing and gathering the crude oil and gas and the downstream unit involves refining, storing, distributing and marketing petroleum products to domestic and industrial consumers. O&G industry has grown rapidly over the past 40 years and it is expected to grow more with a strong demand

(Mattia, 2013). Despite the fact that the recent rapid development projects in this industry have provided a wealth of new jobs and a burst of economic vitality for various countries, these benefits are at a cost (Paraventi, 2014).

The ageing O&G industry presents with numerous challenges that limit many developments. First of all, the price of oil is currently a great deal of uncertainty. As well as, O&G industry nowadays is confronting a sharpened focus on cost and an increased demands for uptime (Christ, 2015). Indeed, this industry is highly vulnerable to risks as many built-in health and safety risks may appear in most of the levels, operational conditions, production projects, facility operations, maintenance, construction, transport, storage, chemicals and end products which may spark serious health and safety problems and accidents (Awodele et al., 2014; Achaw & Boateng, 2012). Unfortunately, accidents are still relatively common in O&G industry (Christ, 2015; Pitblado and Nelson, 2013). Paraventi (2014) found that the rate of accidents in O&G industry is two and a half times higher than the construction industry and seven times higher than general industries.

3.1 O&G Industry in Bahrain

O&G industry is a pillar of Bahrain's economy. It covers the exploration, production, refining, marketing, and distribution of Bahraini oil for both domestic use and the international market such as Middle East, India, the Far East, South East Asia and Africa (Economic, 2013; EIA, 2011). O&G industry reserves more than 80% of total government revenues and more than 60% of total exports (EIA, 2011). Several new investments and competing projects are being planned or have recently been completed in O&G industry in Bahrain. For example, the current government policy in this industry is to consolidate the oil industry through further development in petroleum resources, improvement in seismographic surveys and enhancement in developmental drilling which all lead to explore new sources of O&G (WTO, 2014) and to double output from O&G fields (Economic, 2016). On the other hand, several challenges are facing O&G industry in Bahrain which will be illustrated in the next sub-sections.

Challenges as a Developing Country

Bahrain as a developing country that operates in today globalized market is enforced to operate among several regions and countries. As a result, a new challenge is initiated to propose more sophisticated accident prevention programs and OHS management systems taking into account cultural differences (Hassanzadeh, 2013). Furthermore, the complexity of the required instrumentation, regulatory regime, expertise and technology in O&G industry, the nature of the impact of the products, by-products and waste products on human health and the environment are main questions in this industry especially with the global trend for a safe and friend environment (Achaw & Boateng, 2012). Besides, Marcella et al. (2011) have indicated that this industry within these countries requires better OHS regulations, greater consistency, better safety standards and better enforcement due to lack of openness and sharing across management, robust safety assessment, agreement on competence measurement techniques and accurate training program. After explaining these challenges, the next section will explain challenges of petroleum countries.

Challenges as a Petroleum Country

Bahrain as a petroleum country is confronting also with several health and safety related problems regarding their economy and nature. For example, there are limited integrated researches on the region's long-term institutional and sectoral development and hence its long-term geoeconomic significance is missed (AlBanna, 2002; Matooq & Suliman, 2013). Further, ports and oil terminals in Bahrain are at high risk of major oil spills and accidents (Naser, 2011). Besides, details and statistics of occupational accidents in Bahrain are seldom recorded and this may be explained by likelihood of recording bias (Matooq & Suliman, 2013). Additionally, these statistics do not contain a lot of data about the root causes of the accidents (Matooq and Sulima, 2013; Bahrain News Agency BNA, 2013; AlBanna, 2002); thereby, Matooq and Suliman (2013) indicated that OHS framework in Bahrain is not suitable now to depend on. However, National Examination Board of Occupational Safety and Health (NEBOSH) in 2007 and Matooq and Suliman (2013) have confirmed that safety framework in Bahrain needs strongly more redesigning and development plans with more fairness and transparency in enforcement decisions. On top of that, there are no ongoing dedicated regulations for the processes in O&G industry. This poses a question to Bahrain, especially as it concerns on generating revenue instead of improving OHS standards while other industrialized countries are contemplating the importance of OHS laws within this industry (Neave, 2010).

4. METHODOLOGY

An extensive literature review of existing published relevant materials is carried out to explain human error, O&G industry and human error specific accidents in O&G industry in general and in Bahrain in specific. These relevant materials include textbooks, journals, conference papers, and Internet information that assist in capturing the background of accident and human error specific accidents in O&G industry in general and in Bahrain in specific. Some Bahrain's Governmental publications from the Ministry of Labor were also used to show some critical statistics related to the aim of this paper. The main purpose behind reviewing all these materials is to address human error related accidents in O&G industry in Bahrain by explaining the real setting of this issue and developing clear insights regarding it in order to provide some recommendations and solutions that help in reducing the occurrence of this type of accidents in this industry.

5. HUMAN ERROR SPECIFIC ACCIDENTS IN O&G INDUSTRY

Different causes were identified in literatures that focused on why an accident has occurred in O&G industry as they are shown in Table 4. The most common contributor with over 70% of all O&G industry accidents is human error (Bhavsar, Srinivasan and Srinivasan, 2015). Pitblado and Nelson (2013) and Mattia (2013) pointed out that the recent ongoing series of major accidents showed that current safety management programmes and improvement are not sufficiently effective in treating human element appropriately in O&G industry. However, Bhavsar et al. (2015) indicated that the cognitive challenges faced by operational workers during their interactions with the process and decision making in this industry were behind this high rate. To sum up, Lawyers and Settlements (2011) argued that accidents in O&G industry typically occur due to worker's carelessness or recklessness, workers postpone the

equipment's maintenance or repair and worker's misunderstanding. Next sub-section will explain human error in O&G industry in Bahrain.

Table 6: Causes of Accidents in O&G Industry

| Causes of accidents in O&G industry | Authors |
|--|--|
| <ul style="list-style-type: none"> • Human error | (Mattia, 2013) and (Bhavsar, Srinivasan and Srinivasan, 2015) |
| <ul style="list-style-type: none"> • Ineffective safety management programs | (Pitblado and Nelson, 2013) |
| <ul style="list-style-type: none"> • High numbers of active drillings • Inexperienced workers | (Christ, 2015), (Paraventi, 2014), (NIOSH, 2014) and (Lawyers and Settlements, 2011) |
| <ul style="list-style-type: none"> • Continuous increasing demand | (Christ, 2015), (Paraventi, 2014), (NIOSH, 2014) and (Lawyers and Settlements, 2011) |
| <ul style="list-style-type: none"> • Risk inherent to the production activity • Level of training of workers | (Díaz-de-Mera-Sanchez et al., 2015) |
| <ul style="list-style-type: none"> • High numbers of people employed • Nature of drilling process | (Lawyers and Settlements, 2011) |
| <ul style="list-style-type: none"> • Reoccurring disruptions during daily operations • Pre-warning signals | (Korvers & Sonnemans, 2008) |
| <ul style="list-style-type: none"> • Unique job requirements • Labor-intensive • Work overtime • Hard activities | (Roth, 2006) |
| <ul style="list-style-type: none"> • Inadequate training strategies • Poor maintenance priorities • Inadequate supervision • Failure of effective hazard identification • Inadequate auditing | (Anderson, 2005) |

5.1 Human Error issues in O&G Industry in Bahrain

As many projects have been undertaken recently in O&G industry in Bahrain and notable improvements have presented currently, these projects have appeared with several shortcomings. For instance, the evaluation of impacts of these projects on workers, workplace and environment is not sufficiently adequate as the cumulative and long-term impacts are neglected in addition to the fail in addressing the monitoring measures effectively in this industry (Naser, 2011). These shortcoming are putting Bahrain nowadays under a permanent threat from O&G industry especially as Bahraini ports and O&G terminals are at high risk. Further, from nineteen different researchers, like Madany, Jaffar and Al-Shirbini (1998), De Mora, Tolosa, Fowler, Villeneuve, Cassi and Cattini (2010), Naser (2011) and Freije (2013) have remarked that some mistakes during several operations and maintenance activities done by workers in O&G industry in the coastal areas of Bahrain were the primary causes of accidents in this area. In 2000, this industry in Bahrain had recorded six oil spills, including leakages in pipelines, over flooding of containers, weathered oil and tarballs, and incidents during loading of tankers in the terminals.

Though, these accidents led to oil spillages which have a strategic effects on people, workplace and environment. For instance, this kind of human error in this industry were behind the increase of hydrocarbon concentrations in this place (De Mora et al., 2010; Naser, 2011; Freije, 2013). Additionally, all these researches confirmed that the highest pollution concentrations in GCC countries were particularly in the places that have continuous human interventions to transport oil and clean oil tankers. This indicates that workers in these places did some errors while they are proceeding their job and this have created cumulatively in this highest pollution. Besides, Sheppard, Al-Husiani, Al-Jamali, Al-Yamani, Baldwin, Bishop, Benzoni, Dutrieux, Dulvy, Durvasula and Jones (2010) and Naser (2011) have noticed an escalating in human activities in the area of O&G industry in Bahrain which have several negative effect on human, workplace and environment in Bahrain. On top of that, Salminen (2011) expressed that the foreign employees were mostly behind the most of occupational accidents in Bahrain. Further, Alaradi (2010) found that workers' mistakes are behind the delay in daily procedures which indeed hinders several improvement in this industry. Therefore, Naser (2011) has indicated the importance of improving worker's understanding regarding the negative impacts of their mistakes.

6. DISCUSSION

As recent industrial statistics in O&G industry have revealed a high rate of occupational accidents that were caused by human error and have a great toll on workers, workplace and environments, attention should be diverted to investigate human error extensively even if some research have started to do so because still various perspectives remain question till yet. Serious attention should be paid currently because most of the expletory attentions to improve OHS performance were allocated to Nuclear and Aviation industry (Mattia, 2013) and to construction industry (Patel et al., 2012) but not O&G industry. On top of that, as currently this industry has a rapid pace of growth in demand along with an uncertain price of oil, this industry should shed lights on reducing costs and accidents by controlling risks across all different levels. Thus, O&G industry should give safety a top priority and continually build upon this record. In other words, this industry should press ahead to ensure that safety issues meet international standards and best practices that are needed to build and maintain safety with the lightest environmental footprint possible (API, 2016).

Nevertheless, as human error seems as a failure in the interactions between workers and other factors in the workplace, understanding the real setting of a human error specific accident is not just a seldom concept, rather, it is an integrated one that embeds factors like individuals, workplace components and environment. Hence, if there is a gap in one or more of these factors then errors will be common and accidents will be more probable. However, as the relationships among these factors and safety practices are complex, safety issues cannot be adequately addressed in any workplace using technical analysis solely instead a broader strategy that outlines the strategic direction of workplaces is required increasingly (Johnson, Whittington, Scholes, Angwin, & RegnŽr, 2013) especially to enable OHS at work widely. It is important to note here, as there is no best strategy and even if any strategy built a success it will not stand as a best without any alterations; therefore, radical changes in this strategy are required to remain effective and relevant.

Apart from that, driving a safety culture in the industry is a significant contributor. This can be achieved by creating a multidisciplinary team that directs this culture. This team indeed understands the needs of the industry and the gaps in skills clearly. Therefore, this team

should invest in the human capital of the industry and especially in the talented one to address the shortage in any required personnel capabilities and skills. This team also should be responsible for creating an open channel for new ideas and encouraging innovative ways of working. Nevertheless, adapting Information Communication Technologies (ICT) in this industry is a valuable point that should be added to the strategic agendas of the industry in order to take advantage from the current trend of digital transformation which is described by an extensive use of ICT and automation systems. Aligning with the benefits of these technologies, companies in this industry should develop collaborative partnerships and invest together through these technologies in order to generate, innovate, share, analyze, store data quickly. This point is an important enabler for this industry if the current concerns over data privacy and usage, security and interoperability are addressed and balanced.

On the other hand, O&G industry is thirsting for any extensive studies on a continuous basis to improve its performance and reduce accident rate as the mainstream of research tends to reflect the priorities of political and economic elites. Therefore, governments in petrochemical countries in specific should reform this stream to safety aspects and applications through shaping, for example, shared safety information systems, research donations and partnerships. In addition, these governments should increase the awareness of carrying out this nation widely in the nearest future in contrast with the status quo of silence. Moreover, governments should establish an authorized agency or authority that works as a coordinator or regulator. This coordinator tends to oversight and coordinate O&G industry and other essential industries to ensure that these industries survive within safe workplace conditions. Besides, this party is responsible of issuing annual risk assessment reports and evaluating all comments. It is important to mention that having this authority will not neglect the importance of having a safety committee in each industry also.

Finally, these recommendations need first to be sponsored from the top and then to set a clear vision, commit funding and resources and actively coordinate the associated management changes in order to ensure that these recommendations are fully integrated into the industry's core business. On top of that, O&G industry, governments and other related parties will not maximize the benefits of these recommendations to reduce human error accidents if they each act separately. Instead, addressing human error accidents with all these parties stands to reap potential gains that have never been greater.

7. CONCLUSION

From the overall review of the literature, O&G industry in general and in Bahrain in specific has a strategic importance in the national and local economy and safety is a core value in this industry. Unfortunately, accidents are common in this industry in general and the main cause of most of these accidents is referred to human error. In Bahrain, human error specific accidents in O&G industry are also high. This problem is increasing recently during the pressure of high demand. Many negative consequences and costs on workers, workplace and environment were recorded. As a result, this industry in general have started to adopt different safety-related programmes and systems to reduce this high rate of human error specific accidents. In conclusion, addressing human error effectively can be a challenging, but necessary, endeavour. Clearly, focusing on the real scheme of these accidents in this industry and committing to safety requirements in all operations may assist in overcoming this problem and identifying various solutions. Further empirical studies of this problem in Bahrain are needed as it has not been sufficiently researched to date. These studies should

place particular emphasis on not only OHS implementation and legislations in the overall industry in Bahrain but also on improving the employees in term of their safety awareness.

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CHANGE MANAGEMENT IN PUBLIC AGENCIES TO ATTAIN EFFICIENCIES

K. Ibbotson and P. Farrell

School of Engineering, University of Bolton, Deane Road, Bolton. BL3 5AB, UK

Email: km9bee@bolton.ac.uk

Abstract: There is great impetus to implement change in all areas of the UK economy. Key aims are to progress low carbon solutions, reduce costs and to increase efficiency. There are often difficulties in putting change into practice, evidenced by the perceived lack of progress on 1990s recommendations by Latham and Egan. Change can be most difficult in the public sector; whereby long established ways of working are culturally ingrained. The foundation for this research is a comprehensive literature review, followed by an electronic survey of practising professionals in a leading government agency that procures major Flood and Coastal Risk Management construction projects. The survey embraces the whole supply chain of the agency, since many authoritative sources call for integration, and for change to be implemented in partner organisations. The main analytical approach is quantitative. There is a focus upon the role of leadership in implementing change and judgements are made about whether the knowledge level of practitioners is sufficient to allow them to drive new initiatives. Conclusions and recommendations are made regarding training, knowledge management, organisational culture and low carbon prioritisation.

Keywords: Construction, Low carbon solutions, Organisational culture.

1. INTRODUCTION

In an everchanging economic climate and a fast-paced work environment, trying to put change into practice becomes a challenging task. The difficulties of implementing change however, are not specific to the here and now, with the UK construction industry having had many attempts to move into a more 'Lean' and innovative industry; recommendations by Latham (1994) and Egan (1998) highlighted the need for the industry as a whole to improve. These previous attempts have been limited, with Egan stating that 'Since 1998 we could have had a revolution and what we've achieved so far is a bit of improvement' (Wolstenholme, 2009). The question then is why have previous attempts at implementing change been received with enthusiasm, but the results have been limited in their effect? According to Wolstenholme 'the construction industry has been sheltered by a strong economy. This has enabled construction to prosper without having to strive for innovation'. The review by Farmer (2016) also highlights the fragmented leadership role within government and asserts the current ambitions highlighted within the Construction 2025 (HM Government, 2013) report regarding Carbon reduction 'look impossible to achieve'. It does however, note that some sectors are actively focusing 'on key industry issues that can deliver change and enable the construction supply chain to improve the efficiency and delivery of construction projects for the benefit of the UK economy' (Farmer, 2016).

Today's economic climate is different and offers an opportunity to think again, with both risks and opportunities (Wolstenholme, 2009; GLA Economics, 2008; Sundar, 2013; Farmer, 2016). To address the underlying issue of whether the construction industry and the public sector will be successful in implementing current Government initiatives for change, further

understanding of organisational culture and change is required. Employees in both public and private sectors, and in all areas of the value chain need to buy-in to change processes for this to be successful; the process for change needs to be linked to organisational culture. The challenge for public sector organisations and their supply chain is to ensure that Government priorities for a low carbon economy, are fully understood, embedded and prioritised on public sector construction schemes. This is in addition to the demand for construction schemes to be built on time, to the required engineering and environmental quality and cost, and meeting the needs of partnership funding bodies and stakeholders. All of these requirements do not always cohesively work together in an asset management environment, and can result in conflicting priorities and rely on a collaborative approach and common objectives. The collaborative and common objective approach to low carbon is supported by the Publicly Available Standard (PAS) 2080 report, which outlines the roles and responsibilities for all members of the value chain, who have the ability to influence carbon reduction (Construction Leadership Council, 2016).

The construction industry has been affected by many Government initiatives focused on improvement. The 'Never Waste a Good Crisis' (Wolstenholme, 2009) report suggests that changes to the industry have not been as wide ranging or self-evident due to lack of incentives, which has been masked by a buoyant economy and it is only since the recent recession within the UK that organisations are having to make cutbacks and demonstrate that they are not only adding value to the work they do, but leading the way with green technology and low carbon initiatives. Moving to a low carbon economy is the right thing to do; this view is supported by the Infrastructure Carbon Review (HM Treasury, 2013) and Construction 2050 (HM Government, 2013).

This paper presents research work and major findings from a pilot survey undertaken: to measure whether organisational culture influenced the prioritisation of low carbon in the UK Public Sector Flood Coastal Risk Management (FCRM) construction industry. A leading government agency and its supply chain was selected as the population, whereby carbon had historically been measured on public sector FCRM construction projects. The survey consisted of three sections and consisted of 33 questions: background; organisational culture and organisational leadership; and low carbon. Both qualitative and quantitative analysis methods were included within the survey. The paper makes a comprehensive review of the previous research on the prioritisation of low carbon government initiatives and the effect of organisational culture; it then discusses the data collection method; presents a selection of the raw data collected and, finally, analyses the results by mapping public and private sector returns against the review of low carbon and cost against specific project stages.

2. LITERATURE REVIEW

2.1 Low carbon within Public Sector Construction

For public sector organisations undertaking construction schemes it is not just the organisation itself but the supply chain that needs to be influenced. Implementing change in commercial construction organisations should focus on the need to stand out from their competitors making them more commercially attractive. Economic competitiveness is defined as the ability to maintain or expand market position based on cost structure; the loss or gain of competitiveness can be caused by a relative increase or decrease in cost (Sathre, 2007). However, due to the current culture of the construction industry after initial and basic requirements are met, the cheapest construction materials are utilised. This highlights 'the

importance of the public sector driving and providing incentives for the use of low carbon dioxide materials in the construction industry' (Ng, 2012). There could be a feeling that cheaper unsustainable materials are often used in favour of more expensive and more sustainable alternatives, given that capital cost may often be prioritised over life-cycle issues.

Similarly the requirement to include carbon emissions in risk assessments has not been emphasised (Bogle, 2010), and climate change has been specifically excluded from the UK National Risk Register (HM Government, 2010) on the grounds that it would not affect the safety and security of the UK within a five-year time scale (Thornley-Walker, 2010).

The use of a Carbon Calculator within public sector construction schemes enables project teams to demonstrate that they have achieved a saving on the carbon output, from appraisal through to detailed design and at construction end. This information is monitored within the public sector and contributes to the carbon target for each leading government agency. Although monitored to ensure that set targets are not exceeded, it falls short in both recording the full carbon figure, as operational carbon is not consistently taken into account; it also fails to actively motivate project teams to prioritise low carbon within their projects. With no clear project level targets set or the ability to accurately and routinely challenge the cost of low carbon solutions, construction professionals frequently do not reduce greenhouse gas (GHG) emissions, for example by specifying granular material instead of concrete in many locations. Under the correct incentives or pressures, effort in design and procurement processes could affect changes each week, that most members of society would hardly achieve in years (Thornley-Walker, 2010). However, the likely outcome is that cheaper cost solutions are prioritised over low carbon materials, ensuring that low carbon targets are not exceeded but efficiency targets are achieved as an alternative.

The Infrastructure Carbon Review (HM Treasury, 2013) clearly highlights the benefits of low carbon and through its promotion the resultant cost saving; this saving has largely been focused within the infrastructure sector with clear evidence from Anglian Water for example, of the quantum of carbon reduced and costs saved. In refining the scope of this research, to obtain originality and maximise current network opportunities available, the sector focused on became UK Public Sector FCRM construction schemes. Wolstenholme (2009) in *Never Waste a Good Crisis*, highlighted that the construction industry as a whole had not progressed as envisaged and there is a lack in overall motivation and culture change to embrace and embed new initiatives. Further research noted that in-order to embed new ways of working, a change of both organisational culture and organisational leadership (Construction Leadership Council, 2016, HM Treasury, 2013) is required to successfully achieve a positive change.

2.2 Organisational Culture

Culture is viewed as the foundation that establishes the trust that impacts on the degree to which employees buy-in to change and highlights the commitment to drive and sustain change; in addition to this, it focuses on employee willingness to share information and collaborate, which ultimately determines the ability of organisations to survive disruptions, effecting and its capacity to advance (Alavi, et al., 2005; Barney, 1986; Janz et al., 2003; Taylor, 2013). According to Gaplin (1996) there is no single component to describe organisational culture as each element is individual to the organisation and relies on how each element interacts on a day-to-day basis. Understanding and diagnosing organisational culture can assist in implementing the type of change needed and establishing organisational

readiness for change (Johnson, et al., 2008; Clerke 1994 cited in Burnes, 1996; and Sundar, 2013). This view is also supported by Galpin (1996) who states that ‘the primary motive for managing culture during change is to implement and sustain changes. Too often, executives and managers struggle when implementing change because they don't understand how to make it important to employees’.

Bascal (2009) emphasises that the success of organisational change ‘require the understanding of how individuals change, associating this understanding with the specific phases such as Preparation, Acceptance and Commitment whereby an individual gains more of an understanding of the changes and therefore automatically has a positive acceptance of these stages’. In contrast Kubler-Ross and Fisher (Kubler, 2009) focus on the psychological changes associated with individual positive and negative feelings and reactions. As individuals and their reactions are different, this poses a risk that can develop into negative attitudes towards work. This will in turn make people risk adverse and afraid to innovate (Scott, 1989).

The ability for individuals to cope with change varies, since for some not enough pressure leads to boredom and low self-esteem. The correct amount of pressure can be a challenge, and improves performance and innovation; for others too much pressure can lead to feelings of being out of control, poor quality work, then leading to stress and a loss of confidence in ability (Willis, 2008). Kotter and Schlesinger’s (May, 2014) six change approach method for overcoming opposition are mirrored with Galpin’s (1986), organisational culture components; Galpin however takes a step further into how methods for change can be sustained through knowledge management. Hogg, (1996) believes for a public body, employee commitment is the way forward, utilising a marketing strategy of ‘trust, empowerment and effective communication’. However, trust relies on having the confidence that people will do what they say they are going to do or are competent to do the things they say they are going to do (Mink, et al., 1993).

3. METHODOLOGY

The survey was sent out to 1000 individuals listed on the Government Knowledge Management registration list. All users who had access has an involvement within Public sector FCRM Construction projects. People were randomly selected, and of the 1000 emails sent out a total of 255 out of office replies were received indicating individuals were no longer within the organisation or were on long term absence. Of the possible 745 survey returns a total of 35 were received. To understand the current position of a leading government agency and its supply chain, the survey focussed on several Government initiatives: low carbon, BIM and efficiency savings. Results presented are related to low carbon and cost.

This paper focusses on the findings from three specific questions from the survey these can be found in Table 1. Firstly, participants were asked if they work in the public or private sectors. Secondly they were asked ‘At what stage is LOW CARBON actively discussed (i.e. action plans put in place and/or monitored) on your projects?’ Nine possible stages were offered in tick boxes, ranging from ‘the start of projects’ to ‘the end of projects’. A ‘never’ option was given also. Participants were able to select more than one possible answer. Thirdly, participants were asked ‘At what stage are COSTS actively discussed on your projects?’ The same nine answer options and a ‘never’ were again offered. For these latter

two questions, the basis of the multiple-choice answers was derived from the stages within the 5 Case Business Model (HM Treasury, 2003) and for evidence within the Infrastructure carbon review (HM Treasury, 2013) that tackling carbon early can result in the greatest opportunities to reduce carbon on projects

4. RESULTS AND ANALYSIS

Of the 35 surveys returned, 60% were from the Private sector and 40% from the public sector. All returned surveys were fully completed with no missing or ambiguous data. Tables 1, 2 and 3 outline the results from the two main questions. Overall there was a greater response to cost (72%) being reviewed at each stage compared to low carbon (41%). ‘Never’ was selected once in each question this was not by the same return; both of these were from the public sector. The stage that scored the highest return for both low carbon and cost was the ‘At the start of the project’ with 73%; this was followed by ‘At construction stage’ with 69%.

Table 1: Summary of results; frequency scores for each question

| Question | Multiple choice answer | Frequency scores |
|--|--------------------------------------|-------------------------|
| At what stage is LOW CARBON actively discussed (i.e. action plans put in place and/or monitored) on your projects? | At the start of a project | 22 |
| | At every progress meeting | 8 |
| | At the start of a contract | 11 |
| | At the procurement of material stage | 17 |
| | At options appraisal stage | 17 |
| | At detailed design stage | 18 |
| | At construction stage | 20 |
| | At the end of each stage | 4 |
| | At the end of a project | 12 |
| Never | 1 | |
| At what stage are COSTS actively discussed on your projects? | At the start of a project | 29 |
| | At every progress meeting | 26 |
| | At the start of a contract | 25 |
| | At the procurement of material stage | 22 |
| | At options appraisal stage | 26 |
| | At detailed design stage | 24 |
| | At construction stage | 28 |
| | At the end of each stage | 21 |
| | At the end of a project | 24 |
| Never | 1 | |

On reviewing the results further stages where low carbon was actively discussed showed similar results for 5 out of the 9 stages (Table23), but showed significant differences for stages: At the start of every progress meeting; At the start of the contract; At construction stage; and most significantly, At the end of construction. The Public sector was more consistent throughout the project lifecycle and its stages in actively discussing low carbon. The key reporting stages for carbon have historically been at options appraisal, detailed

design and end of construction for public sector reporting to Government. Both the public and private sector score similar results for options appraisal and detailed design. The end of the project stage shows a significant difference; this is attributed to the public sector having to report end of project carbon results to Government.

Table 2: At what stage is LOW CARBON actively discussed (i.e. action plans put in place and/or monitored) on your projects? Percentage scores for public and private sectors.

| Nine possible multiple-choice answers and 'never' | Public % | Private % |
|--|-----------------|------------------|
| At the start of a project | 64 | 62 |
| At every progress meeting | 14 | 29 |
| At the start of a contract | 43 | 24 |
| At the procurement of material stage | 50 | 48 |
| At options appraisal stage | 50 | 48 |
| At detailed design stage | 50 | 52 |
| At construction stage | 64 | 52 |
| At the end of each stage | 14 | 10 |
| At the end of a project | 57 | 19 |
| Never | 7 | 0 |

Where cost is actively discussed the public sector scored higher at every stage apart from options appraisal (excluding never) Table 4 shows significant differences for each stage. This is consistent with the need for public sector to provide key cost information on a monthly basis. Again, both the public and private sector score similar results for options appraisal and detailed design. The end of the project stage shows a significant difference; this is attributed to the public sector having to report end of project cost results to Government.

Table 3: At what stage is COST actively discussed (i.e. action plans put in place and/or monitored) on your projects? Percentage scores for public and private sectors.

| Multiple choice answer | Public % | Private % |
|--------------------------------------|-----------------|------------------|
| At the start of a project | 93 | 76 |
| At every progress meeting | 86 | 67 |
| At the start of a contract | 79 | 67 |
| At the procurement of material stage | 64 | 62 |
| At options appraisal stage | 71 | 76 |
| At detailed design stage | 71 | 67 |
| At construction stage | 86 | 76 |
| At the end of each stage | 79 | 48 |
| At the end of a project | 86 | 57 |
| Never | 7 | 0 |

When comparing cost and carbon responses for the public and private sector separately, it is evident that cost is a more important consideration than carbon. Many participants have different project priorities and therefore overall, there is not a cohesive and common objective for all project members in regards to low carbon. The problem is aggravated by a

lack of consistency between the public and private sector, in discussing low carbon throughout project stages. Figures 1 and 2 outline the key differences for each sector in regards to cost and low carbon being actively discussed. What is evident from both results is that low carbon is not being discussed adequately at each progress meeting, at the start of a contract, nor at the end of each stage. The latter two of these stages can have a significant impact on how low carbon is viewed and prioritised on projects. If low carbon is not discussed and adequately written into contracts as a requirement for suppliers, then there is little incentive to ensure that it is discussed on a regular basis. This is evident from the survey returns whereby private sector participants do not actively discuss low carbon at the end of projects. Not actively discussing low carbon at the end of each stage, highlights that key learning and decision-making opportunities are not being raised and shared with project teams, and specifically those involved in the next stage of work.

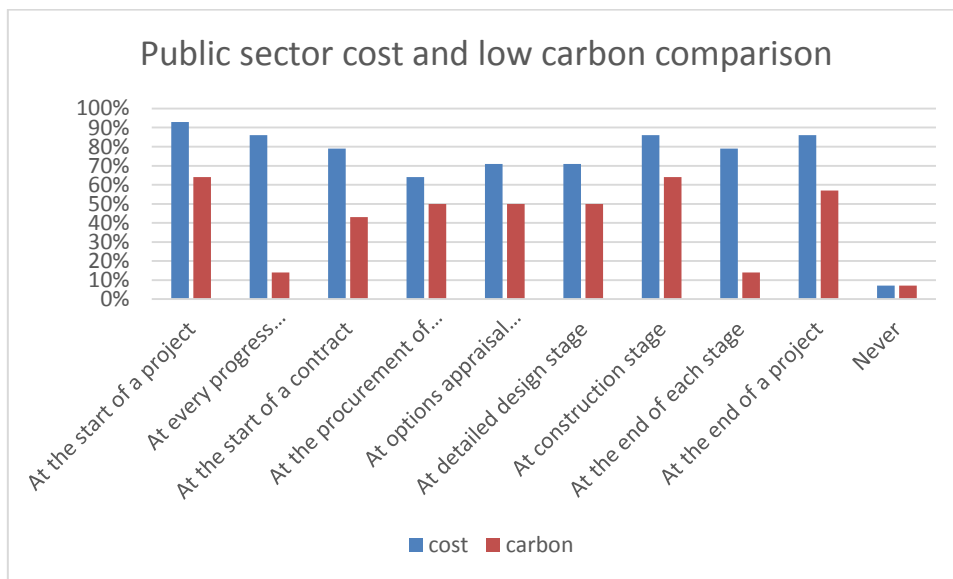


Figure 1: Public sector cost and low carbon comparison

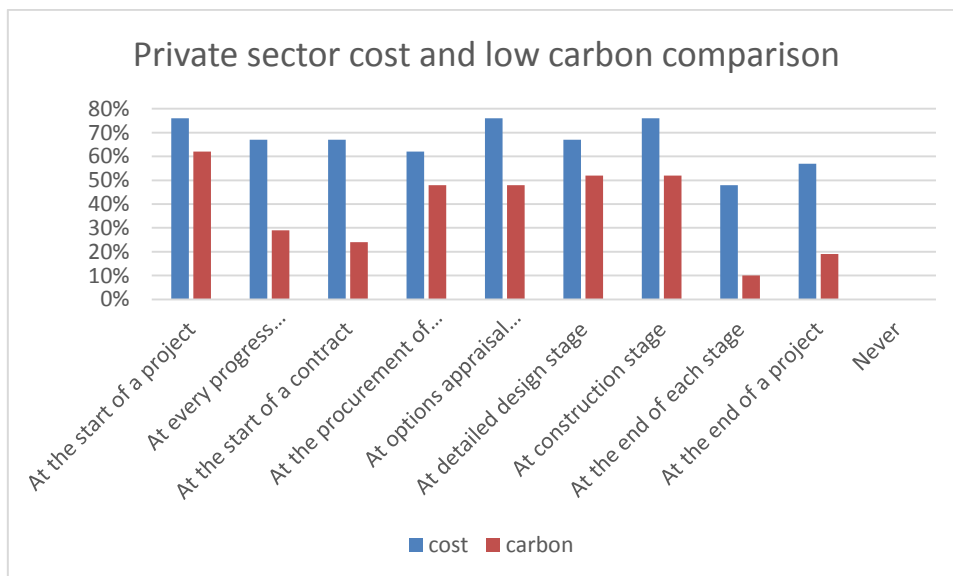


Figure 2: Private sector cost and low carbon comparison

5. CONCLUSION

Although carbon is one of the key reporting criteria to government for UK public sector Flood and Coast Risk Management construction schemes, it is as yet, not at the same level of importance as cost. In the absence of a mechanism that is particularly designed to assess carbon and cost alongside each other, truly embedding low carbon solutions and materials within the FCRM asset management industry will always be a challenge. This paper reports on a pilot survey of 35 public and private sector practitioners who actively work on FCRM schemes to gain their opinions on how low carbon and cost is actively discussed at project level. The survey participants represent a broad spectrum of construction stakeholders, including the public-sector client, consultant, and contractor organisations.

The results of the survey indicate that cost is considered a higher priority for both public and private sector organisations with low carbon, although included in discussions, not featured as prominently throughout each project stage. However, cost and carbon are discussed by both public and private sector participants at options appraisal and detailed design. At present, the opportunity to discuss and capture key learning for cost and carbon at the end of projects is diminished, with the public-sector valuing discussion at this stage more important than the private sector.

The problem is aggravated by a lack of consistency between the public and private sector, in discussing low carbon throughout project stages. One view is that project participants have different project priorities and therefore overall there is not a cohesive and common objective for all project members in regards to low carbon. Utilisation of current publicly available standards such as the PAS 2080 (Construction Leadership Council, 2016), will provide the opportunity for initiatives such as low carbon to be consistently and actively discussed at key project stages; with members of value chains having clear objectives and understanding of their roles in regards to low carbon at each stage.

Ensuring that low carbon is adequately included at the procurement stage and explicitly included as a requirement under contracts, is essential to ensuring the delivery of the objective on projects, with clear reporting stages identified; this would reduce the impact of low carbon information, and shared learning being lost at the end of each stage and the end of projects. Resources and effort are required to develop and maintain a clearer link between carbon and cost to enable a more consistent approach to low carbon on projects, this alongside better communications across all organisations within the value chain will assist in change within industry required.

Future research, therefore, needs to be aimed at finding solutions to the following problems identified in this research:

- (a) establishing a mechanism for low carbon to be included and reported upon at key stages within project lifecycles;
- (b) establishing a key link between carbon and cost;
- (c) better understanding of the impact of cost, on low carbon solution/material implementation;
- (d) collection and maintenance of a suitable carbon database for knowledge share and target setting.

In addition, further work is needed to clarify how PAS 2080 (Construction Leadership Council, 2016) and its general principles can be embedded within UK public sector FCRM industry, to attain clear organisational and cultural change in the prioritisation and promotion of low carbon projects. Finally, it is felt that the UK public sector FCRM construction community would benefit considerably from client led initiatives that collaboratively includes and benefits all members of the value chain in regards to the implementation low carbon projects.

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HOUSING AND URBAN REGENERATION: HONING AN EXISTING ASSESSMENT METHOD THROUGH THE DESIGN SCIENCE METHODOLOGY

K. Dean, C. Trillo and E. Bichard

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: kevin.dean@forviva.co.uk

Abstract: The Design Science (DS) methodology has emerged from the information technology field as a robust framework that allows researchers to create something not yet existing (the artefact) and subsequently validating it against more conventional evaluation methods. In this paper, the Design Science methodology is applied for honing and validating an existing assessment method – Sustainable Return on investment or SuROI - which places a value on social and environmental change in the built environment. The housing sector is currently lacking a specific evidence-based assessment methodology that quantifies the impacts of both the social and environmental effects of regeneration. Failure to quantify the economic implications of sustainable change could lead both to favouring the wrong priorities, and can contribute to a lack of engagement of key stakeholders. This paper aims at solving this practical problem by showing how housing associations can use a tailored methodology that both contributes to a better understanding of hidden social and environmental benefits, and creates meaningful partnerships with people capable of influencing the outcome of the regeneration project. The paper builds on the Sustainable Return on Investment methodology by using DS to produce a decision-making tool (the artefact) for place-making bodies promoting social housing. This is intended to support better decision making in the housing sector, but could be applied in a wider context to tackle the current financial constraints that hinder sustainable regeneration processes.

Keywords: Sustainable Return on Investment, Housing led urban regeneration, Assessment methodology, Design Science

1. SETTING THE CONTEXT: THE DESIGN SCIENCE RESEARCH

Research carried out under the paradigm of the traditional sciences, such as the natural and social sciences, focus on explaining, describing, exploring or predicting phenomena and their relationships with each other (van Aken, 2004; March and Smith, 1995). This translates into the assessment of things that exist. However the traditional sciences have limitations when the goal of research is to study the design, construction or creation of a new *artefact* i.e. something that currently does not exist (Simon, 1996), or to conduct research based on problem solving. March and Smith (1995) emphasised the importance of a science that is able to support the construction and evaluation of new artefacts. It is in these circumstances when the usage of Design Science Research (DSR) is recommended as a new epistemological paradigm for conducting research (van Aken, 2004; March and Smith, 1995, Simon, 1996).

This paper is driven by a problem solving approach and aims at creating something new, suitable to fill an existing gap in the current methods of assessment of interventions on social housing. For this reason, the DSR has been considered the most appropriate framework to create and validate a novel *artefact*, which is, in this paper, a new method. DSR is an example of constructive research approach, which focuses on producing innovative

constructions to solve real world problems, to implement the developed construction and test its practical applicability and to make a contribution to the theory of the discipline within which it is applied (Lukka, 2003) brought from the pragmatist philosophical stance (Vaishnivi and Kuechler, 2007; Lukka, 2003).

DSR is the scientific study and creation of artefacts as they are developed and used by people with the goal of solving practical problems of general interest (Johannesson and Perjons, 2012) which subsequently make a contribution to the theory of the discipline in which it is applied (Lukka, 2003). It is a systemic but flexible methodology aimed at improving practices through iterative analysis, design, development and implementation in real-world settings (Wang, Vogel and Ran, 2011). Whilst empirical research seeks to “describe, explain and predict the world” and sees the world “as it exists, regardless of human interests and biases”, DSR does not only describe, explain and predict, but wants to “change the world and create new worlds” (Johannesson and Perjons, 2012:1). Along the same lines, Iivari and Venable (2009) define DSR as “a research activity that invents or builds new, innovative artefacts for solving problems or achieving improvements”. Academic research in applied disciplines such as the built environment have the dual role of generating theoretical conceptual knowledge and simultaneously contributing to the solution of practical problems (Azhar et al., 2010). DSR is a research procedure which incorporates this ‘research for practice’ stance (Chynoweth, 2013) and seeks a solution to a real world problem of interest to practice. It stems from a problem solving paradigm and seeks to create innovations (Hevner et al., 2004), which, through the artefact being developed, is the goal of this study.

The main goal of this paper is, by applying DSR, to deal with a real life organisation where the problem and potential solution is practice based and practice related. DSR is therefore an appropriate choice of methodology. As Archer (1995) writes “there are circumstances where the best or only way to shed light on a proposition, a principle, a material, a process or a function is to construct something, or to enact something, calculated to explore, embody or test it”. This is exactly what DSR does. It “attempts to create things that serve human purposes” and devises artefacts to obtain goals (March and Smith, 1995).

This paper will apply the DSR to create an *artefact* in a disciplinary field still new to this approach, i.e. evaluation methods, by: (1) exploring the problem to be solved and the *artefact* needed; (2) demonstrating how DSR can be employed to support the creation and validation of a new method, building on and putting forward an existing method (SuROI) already tested; (3) showing the outcomes of such an innovative method through a case study allowing to test the process in an extant housing initiative (validation of the *artefact*).

2. THE PROBLEM TO BE SOLVED AND THE ARTEFACT NEEDED: HALLENGES TO HOUSING ASSOCIATIONS

Housing associations are currently operating under severe financial constraints, which make the decision making process extremely demanding, since every choice needs to be thoroughly assessed in terms of benefits. This situation has become particularly harsh in recent times, while in the past, less scarcity of resources allowed more flexibility in choices. Before the economic crash of 2008, housing associations could rely on significant bank financing to fund their development. Banks and other lenders historically provided housing associations with loans in favourable terms. Until the advent of the credit crunch, banks priced loans to housing associations at 20 to 30 basis points above the London inter bank lending rate (House

of Commons, Communities and Local Government Committee, 2009). However, once the credit crunch came about, not only did banks charge more for new loans, but they also sought to rewrite the already existing housing association loans they had outstanding. Housing associations seeking additional financing found that banks demanded rates as high as 300 basis points above LIBOR, often more than 10 times higher than their previous rates. A number of lenders refused altogether to lend to housing associations (Hilditch, 2009; House of Commons, Communities and Local Government Committee, 2009). Banks sharply increased the cost of credit for housing associations, whilst demand for for-sale homes and shared-ownership housing plummeted, reducing revenue for housing associations (Dowler, 2009). More recently as part of the housing white paper, the UK Government has announced that the recent 1% rent decrease is to remain in place until 2020 and that there remains a focus on Right to Buy (UK Government, 2017).

Because the economic climate is now more demanding, it is important that the evaluation of housing led urban regeneration schemes is of a high standard, and that the conclusions coming about from a particular evaluation, are accurate. To this end, it is additionally important that all benefits arising from a particular scheme are taken into consideration, and that as much information as possible on scheme impacts is available for strategic decision makers. However, authors have noted an absence of frameworks used to assess impacts in terms of sustainable development in the built environment (Thomson et al., 2009) or certainly a limited number of such frameworks (DETR, 1998; OECD, 2000) and the absence of appropriate frameworks has often been considered as playing a part in the inability to deliver the desired objectives of urban regeneration schemes (Kazmierczak et al., 2009) which can have negative repercussions, especially in the current economic climate when money is not always readily available and mistakes are costly. Along these lines, Tyler et al. (2013:171) pose the question as to why, despite the resources that many countries commit to urban regeneration, there has been “so little evidence available on the aggregate value of regeneration benefits?”

A systematic review of existing methods for evaluating housing schemes has been provided by Dean and Trillo in previous work (2017), including the EGRUP Guidance, the Evaluation of City Challenge, the Evaluation of the Single Regeneration Budget and of the New Deal for Communities programme, of Urban Development Corporations and Enterprise Zones, the Hemphill framework, the Sustainable Urban Renewal Project Assessment Model, the INDicator-based Impact-assessment and the Regeneration Balance Sheet. However, these methods do not appear to take into consideration the previously hidden or intangible social and environmental benefits of a scheme. In addition, until now no tool has been used to quantitatively measure such hidden benefits.

However, the literature provides evaluators with alternatives. The Sustainable Return on Investment (SuROI) approach (Bichard, 2015) is a structured approach to calculating the social and environmental value of change in the built environment, which can be used for this purpose. SuROI incorporates such valuation method frameworks as Social Return on Investment (SROI), Ecosystem Services Analysis (ESA), Wellbeing Valuation or Life Cycle Assessment which allows the appraiser to make a quantitative valuation of both social and environmental benefits following the implementation of a regeneration scheme. In this study, SuROI has been selected in order to: (1) deliver a quantitative assessment of tangible and intangible benefits deriving from urban regeneration schemes including those within social housing; (2) adding a further component to the current SuROI, thus creating a new

methodology suitable to support decision making in social housing and to map stakeholders potentially interested in collaborating to the delivery of the social housing project.

According to Nicholls et al. (2012:8), “things which get bought and sold take on greater significance”. Sustainable Return on Investment takes this mantra on board (Bichard, 2015) and places a numerical value on the social and environmental components of the triple bottom line; aspects which are normally difficult to compare against more easily measured economic impacts (Conejos, Langston and Smith, 2013). Authors have previously cited that there is typically a difficulty in measuring the social ‘pillar’ within the realm of sustainability, due to its abstract nature and that they consider that it could be overshadowed by economic and environmental domains (Lehtonen, 2004; Davidson, 2009; Littig and Griessler, 2005). Xing et al. (2009:210) cite that one of the main challenges can be a difficulty in the measurement of what they term “apples and pears”, which is to compare the measurement of costs and values which are expressed in different units. The SuROI method potentially solves this issue. In addition, recent guidance from the Royal Institute of Chartered Surveyors (2014) recognises the need to include a wider range of factors that can influence the value of built environment projects and asserts that sustainability considerations are now considered as being important when undertaking valuations (Bichard, 2015). The Social Value Act (2012) additionally requires that economic, environmental and social benefits are taken into consideration as part of any procurement processes, showing that the focus on sustainability is perhaps starting to change and become more important at national level also.

SuROI aims to allow the environmental and social value of a project, programme or policy in the built environment to be made explicit through evidence, and be added to capital costs to give an overall sustainable value (Bichard, 2015). SROI compares the prospective social benefits of a particular scheme against its costs and ESA takes the costs and benefits of the environment into consideration. ESA covers both the natural and built environment, including architectural aspects within its definition (DEFRA, 2013).

The SuROI approach assesses the degree to which change has occurred, both in terms of the significance of the change and the number of people experiencing that change. Both social and environmental outcomes are then monetised by identifying an appropriate indicator for the change and then by applying a suitable monetary value or proxy to each indicator. Indicators and proxies are typically taken from wellbeing sources, or socio-economic statistics compiled by a range of agencies. The values are multiplied by the numbers affected and the amount of time the change is expected to last for (Bichard, 2016). SuROI combines stakeholder accounts and statistical trends as part of its calculations, to ensure “a robust and defensible result” (Ibid, 2016). Because all value is monetised, this has the advantage of measuring and presenting information according to the same metric. The social monetary changes are added to the environmental monetary changes to give a gross value used to calculate SuROI. The net value is then subsequently derived once adjustments are made, including deadweight (amount of outcome that would have occurred anyway), displacement (amount of activity that has been displaced), attribution (amount of outcome caused by other interventions) and drop off (the deterioration of an outcome over time).

Data used within the impact map can be that of primary data, secondary data or both. Methods of primary data include interviews, focus groups, surveys or questionnaires, whilst secondary data includes data sets such as social/ economic statistic sets, indicators, proxies and databases. Stakeholder data collected in the field can be used to evaluate social and

environmental change caused by previously completed projects, and also to predict future change from planned projects.

3. FURTHERING THE SUROI METHOD THROUGH THE DESIGN SCIENCE METHOD

As anticipated in the previous section, this paper suggests that SuROI can be further improved by being used to map out costs and benefits of potential future stakeholders, potentially involved in the housing led urban regeneration scheme or process. The assessment methodology can be easily adaptable by being refocused in terms of stakeholders' engagement. By repackaging the financial calculation allocating costs and benefits across different stakeholders involved, it would be possible to attract potential new investors, willing to increase the benefits that the method has unveiled. This resulting form of SuROI means that it is packaged as a hybrid, including both the exposure of hidden costs and benefits, but additionally with a transfer of the methodology to attract potential new investors.

If previously invisible and intangible benefits resulting from a housing led urban regeneration scheme are being made visible and tangible by using the SuROI method, then by analysing which potential stakeholders are receiving benefit from the said scheme, we can highlight to those stakeholders not yet involved in the scheme, the cost benefit that is attributable and which is actively helping that stakeholder organisation, as a result of the said scheme.

By actively seeking out and discussing the financial benefits that are coming the way of the not yet involved stakeholder, we can prevent schemes being affected by current economic cuts, by offsetting budgetary cuts through striking agreements with those stakeholders who benefit.

As an example, let us say that due to a regeneration scheme, local housing association tenants are benefitting health wise from works that have been carried out, but the NHS is not currently an active stakeholder in the scheme in question. Through using the SuROI methodology, we can highlight to the NHS how much we feel they are receiving in terms of previously intangible benefits being costed out, according to the methodology.

We can highlight to the NHS that although they do not have to participate in any way in the urban regeneration scheme in question, by donating an amount of money to the ongoing works involved in the said scheme, they could be saving an outlay of money in the future. It could be the case that by not investing, they accrue higher costs if the sustainability of the scheme is compromised by lack of funds, which then ends the productivity of the scheme and ends the benefits that were previously created; those benefits previously saving the NHS money.

It was the results of the previously conducted interviews with key members of staff at City West Housing Trust which led to the hybrid idea. Interviewees stated that there had previously been many regeneration schemes where lots of investment had been put in, only for the social return to be minimal. Interviewees additionally stated that in the current economic climate, the housing trust doesn't want to be outlaying massive investment, only to be having to do exactly the same in 30 years' time. Employees interviewed wanted to see more sustainability, less wasting of money and most importantly, ways to plug the gap

created by the recently experienced economic shortfall which is impacting on housing associations, tenants and communities alike.

Since this resulting hybrid is different from the original method, it can be considered an “artefact” within the DSM. The application of the DSR method in order to produce a new methodology will be clarified by referring to an extant case study, the City West Housing Trust, based in West Salford. It will be showed how the DRS model can be successfully employed as robust framework to create and verify the new method, following a rigorous and cross-reliable process. There are many models within DSR literature including Peffers et al. (2007), Hevner et al. (2004) and March and Smith (1995), however the most comprehensive one is that of Johannesson and Perjons (2012).

The following sub-sections will systematically show the application of this DSR model to the design and verification of the new method, by going through each individual stage through the selected case study perspective. The City West Housing Trust housing association has been chosen for easy access to data, since an author of this paper works for it as an employee. The implementation of the DSR to the case study has been performed through a qualitative methodology, based on a constructivist approach, by administering a set of semi structured interviews modelled both on the SuROI method and allowing the development of further concepts, thus deriving a further component of the method, suitable to put it forwards in a different perspective (stakeholders mapping and quantification of the respective benefits/costs). It is anticipated that the evaluation of the artefact still needs to be performed and will be done through a qualitative method through the implementation of the hybrid method to two examples. For validation purposes, interviews with experts from different housing associations, other than the City West Housing Trust will also be administered.

Stage 1: Explicate problem

The problem experienced within housing led urban regeneration is that there is no tool which can evaluate schemes holistically and sustainably, by quantitatively measuring social and environmental impacts and no tool which takes into account potential budgetary cost savings to ensure future financial sustainability.

A Process For Explicate Problem

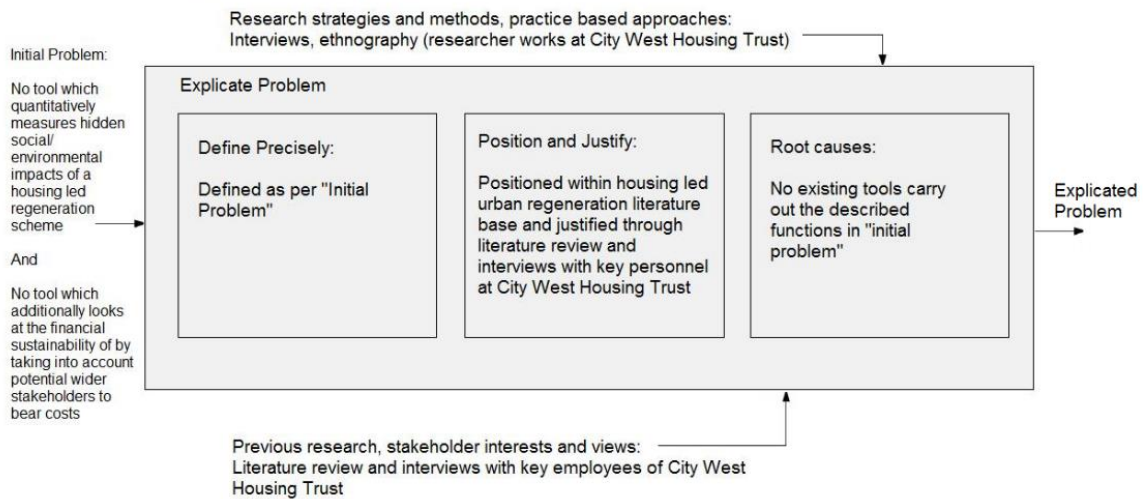


Figure 1: Stage 1 of DSR broken down according to the case study (authors' elaboration)

Stage 2: Outline artefact and define requirements

Further to the explication of the problem above, a tool is needed that evaluates housing led urban regeneration schemes, by using SuROI to uncover the hidden social and environmental benefits of a given scheme and by analysing company budgetary costs and, which goes further, by identifying potential further stakeholders capable of turning a cost into a profit to satisfy the concept of economic sustainability.

A Process for Define Requirements

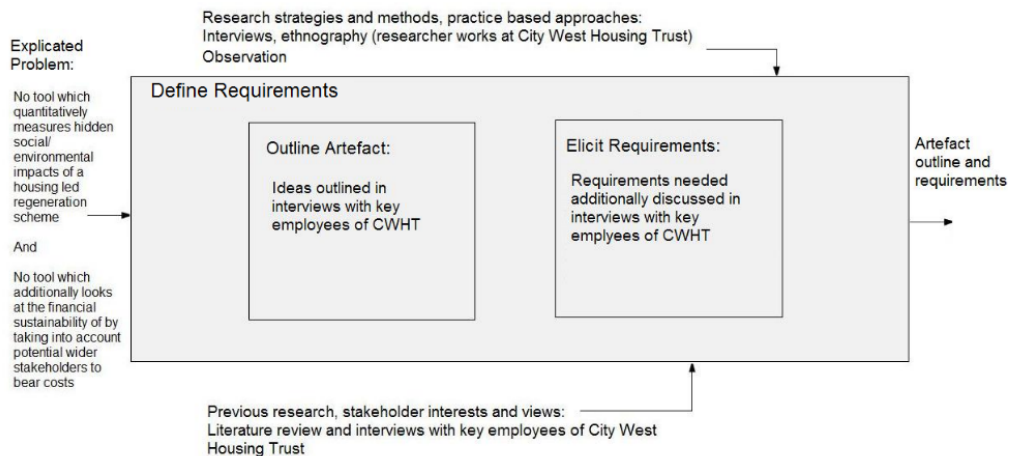


Figure 2: Stage 2 of DSR broken down according to the case study (authors' elaboration)

Stage 3: Design and develop artefact (i.e.: the "hybrid" method)

The design and develop artefact stage can be viewed as a "search process through a solution space" (Simon, 1996). The designed and developed artefact created after the outline artefact and define requirements DSR stages takes previous research on SuROI into account (Bichard, 2015), stakeholder interests and views, the existing literature and interviews with key

employees of the author’s housing association into consideration. This stage of the DSR process, although being an innovative stage, is related and compared to already existing solutions (Johannesson and Perjons, 2012). However, the existing literature base is not enough to create the new artefact, as we are looking to further the knowledge found within the already existing literature. This stage of the DSR process involved the generation of innovative and useful designs (Johannesson and Perjons, 2012). The hybrid component was devised through action research, ethnography and naturalistic observation carried out within the City West Housing Trust. Additionally, divergent thinking (the generation of new alternative solutions and choosing amongst them) and the brainstorming of ideas, through discussion and structured interviews, was carried out with employees of the City West Housing Trust. The interviewees typically focussed on the current financial difficulties found by not only City West Housing Trust, but with the entire social housing sector as an area which needs addressing and needs quite urgent improvement. It was felt that a more pragmatic and practical artefact would include an aspect relating to this and that anything which could identify potential cost savings or efficiencies would be very useful and would subsequently create a positive impact on this current real world problem.

A Process for Design and Develop Artefact

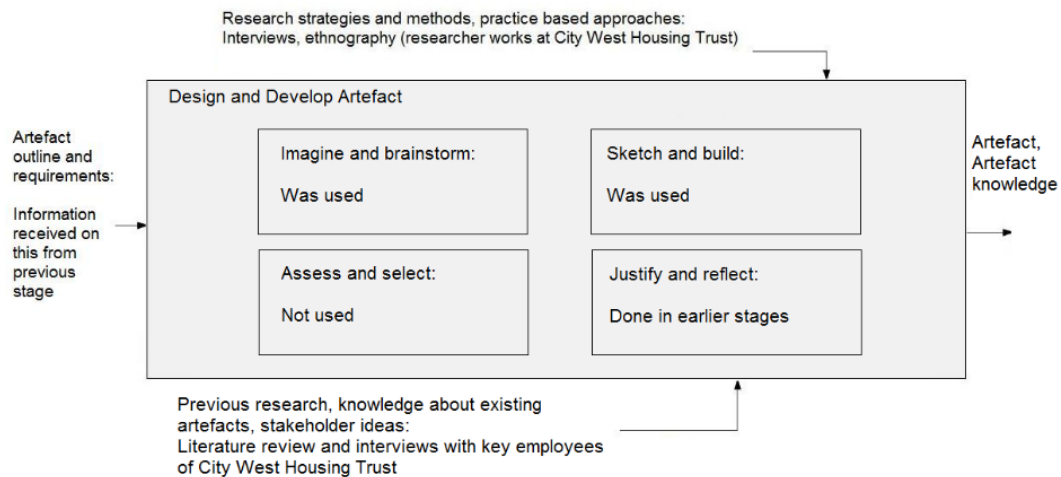


Figure 3: Stage 3 of DSR broken down according to the case study (authors’ elaboration)

The above stage leads to the creation of the artefact itself, as shown in pictorial form later in the paper (Figure 6). The built artefact shows the progression/ improvement of the SuROI method, by utilising the techniques in terms of potential future stakeholder mapping.

Stage 4: Demonstrate artefact

The process for the “demonstrate artefact” stage of the DSR can again be explained with reference to the guidance found in Johannesson and Perjons (2012) below, and includes the application of the artefact through different methods:

- 1) Artefact applied on a City West Housing Trust scheme with liaison with key employees of the housing association. This would be contextually relevant and appropriate due to their knowledge of the organisation and the housing field and their day to day, practical knowledge. Feedback on any potential failings of the artefact would then subsequently be gained and gauged.

- 2) Artefact discussed within a focus group context with key employees of City West Housing Trust. Gain and gauge feedback on potential artefact failings.
- 3) Artefact discussed with contacts and colleagues of the author, pertaining to other, different organisations within the housing sector, to attempt to get a further, more rounded and fuller feedback on the artefact, from real world professionals working within the field on a day to day basis, but from other organisations than City West Housing Trust. Gain and gauge feedback on potential artefact failings.

Any required changes gathered as a result of feedback and/or any practical failings are carried out, in accordance with the feedback received, and changes made continually until all stakeholders are happy with the artefact. This process continues until all are in agreement that the artefact has been developed to such a stage where all are happy with it. On the receiving of feedback which is thought to either highlight failings, or be of added value to the artefact, the DSR process goes back to “design and develop artefact” and then moves on again to “demonstrate artefact”.

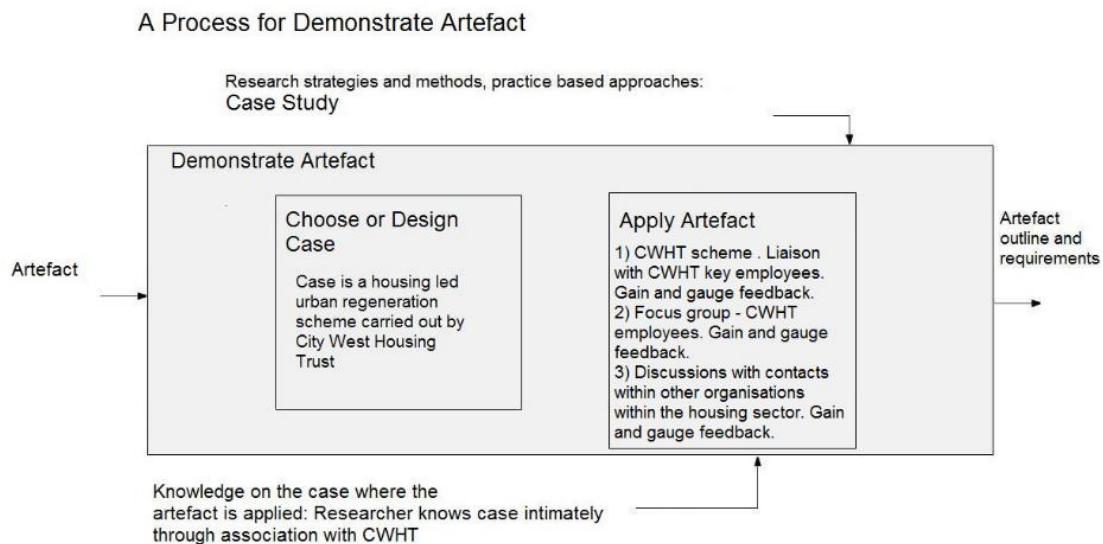


Figure 4: Stage 4 of DSR broken down according to the case study (authors' elaboration)

Stage 5: Evaluate artefact

The detailed process for the final stage, the “evaluate artefact” stage of the DSR process, is visualised below, following Johannesson and Perjons (2012).

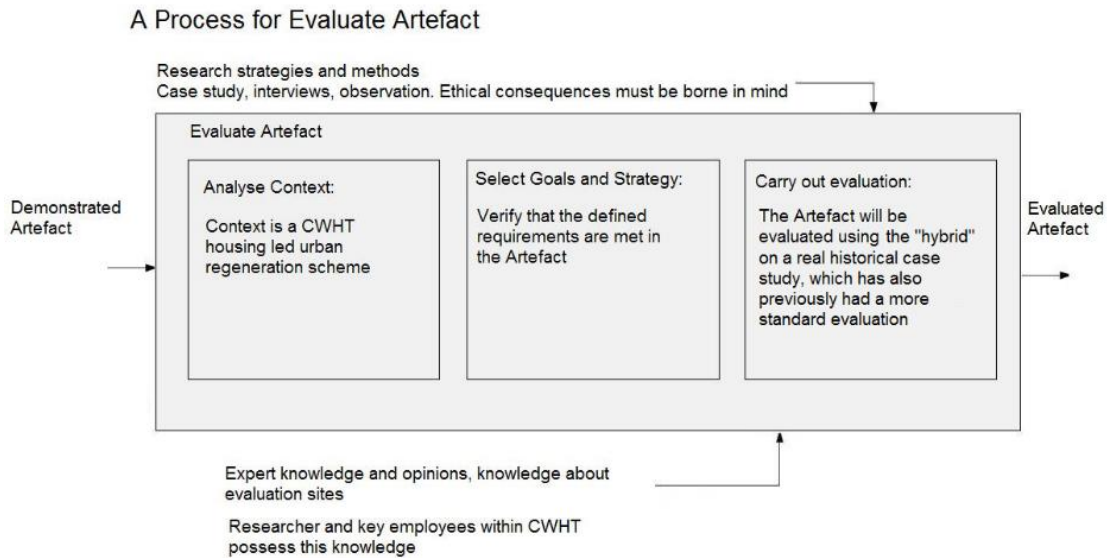


Figure 5: Stage 5 of DSR broken down according to the case study (authors' elaboration)

Upon verifying that all defined requirements are met in the artefact, from the demonstration stage, the artefact/ tool can then be validated by being applied to a housing led regeneration scheme which has already had a more traditional form of evaluation carried out on it in the past. An evaluation will then be carried out of the same scheme, but this time through the "hybrid" artefact. Results will then be compared, contrasted, discussed and analysed. Furthermore, a second round of interviews for validation purposes will be administered with a sample of experts from housing associations different from the City West Housing Trust case study.

Because the SuROI methodology incorporates in its very essence, the usage of stakeholder involvement, we can look into the area of stakeholder analysis to uncover some gaps within the stakeholder analysis and SuROI literature base, to better clarify the "SuROI Hybrid" that this paper subsequently focuses on.

4. STAKEHOLDERS ANALYSIS: LIMITATIONS AND POTENTIAL FOR HONING THE SUROI METHODOLOGY

A stakeholder analysis can be used to inform the planning, implementation or evaluation of a project (ODA, 1995; MacArthur, 1997) by typically identifying key persons involved in a project, and subsequently assessing their knowledge, interests, positions, alliances, and importance related to the policy in question. This enables more interaction, success and the prevention of potential problems (Schmeer, 1999). A stakeholder approach reflects the realisation that the interests and influence of individuals or groups, both within and outside a prospective organisation, need to be taken into consideration (Brugha and Varvasovsky, 2000).

Stakeholder analysis was derived from business management (Reed et al., 2009), with the original concept behind stakeholder analysis being to identify any stakeholder groups wishing to threaten corporate organisations. This changed full swing over time, to give a voice to marginalised stakeholders in order that decision making by the powerful could be influenced. Various methods and techniques outlining how to carry out a stakeholder analysis have been outlined previously within the literature.

These typically follow a set amount of “steps” to follow. Such methods include Schmeer’s “eight steps” (Schmeer, 1999), the five steps of Grimble and Chan (1995), the four steps of 1) stakeholder identification 2) mapping of stakeholder interests 3) evaluation of stakeholder importance and influence and 4) development of stakeholder strategy plan (Rietbergen-McCracken and Narayan, 1998), Shirey (2012)’s four steps, the three steps of Reed et al., (2009) or Jepson and Eskerod (2008), or the two steps of Jones (2003).

5. TOWARDS A HYBRID ASSESSMENT METHOD

As anticipated, the aim of this paper is that of offering preliminary insights on a novel methodology, created by furthering an existing assessment method, that of SuROI. This will be achieved by creating a “hybrid” method, aimed at drawing from the stakeholder analysis to sharpen the understanding of measurable benefits and costs for each stakeholder. The benefit from merging two different approaches will consist of filling each other’s gaps, which are due to the intrinsic nature of either qualitative or quantitative methods.

From one side, the stakeholder analysis presents some weaknesses: (1) Subjectivity. It has been noted that subjectivity can weaken the effectiveness of a stakeholder analysis (Shirey, 2012). The quantitative approach outlined within SuROI could be utilised to reduce the subjectivity of the stakeholder analysis. (2) Lack of outcomes. Bryson, (2004) has argued that at present there is no overwhelming body of evidence indicating that stakeholder analyses help produce desirable outcomes. Therefore, an addition is needed to the stakeholder analysis process showing a potential quantified outcomes, thus proving that such an analysis can produce a desirable outcome. (3) Consider levels of interest/ influence. Reed et al. (2009) proposed the use of ‘extendable matrices’ that consider levels of interest and influence of stakeholders. This paper suggests that not only should the interest and influence of stakeholders be quantified, but how much a particular stakeholder would stand to gain, or lose, quantifiably, from a given project.

On the other hand, SuROI still presents room for improvement: (1) Understanding of the “extent of stakeholders”. As stated in Bichard et al. (2017), Watson and Whitley (2016) suggest that with SROI, and so consequently SuROI, being very stakeholder orientated, without an understanding of the extent of the “web of interconnected stakeholders”, it cannot be clear at the outset if the analysis can capture the full nature of the project’s eventual impact. This “understanding” can potentially be improved by reinforcing the stakeholder analysis component of the SuROI methodology. (2) Understanding who the winners and losers are. SuROI doesn’t take into account who the winners and losers of a given project are, and how much they gain or lose from a project individually: it normally only allows the quantification of the overall benefits from a given intervention.

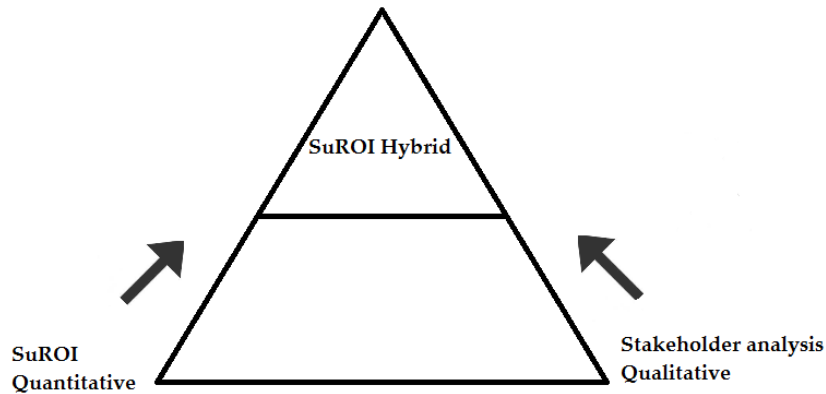


Figure 6: The SuROI Hybrid

The proposed “SuROI Hybrid” (Figure 6) is transdisciplinary in nature, in that it combines the quantitative approach of SuROI (which stems from cost benefit analysis), with the qualitative approach of stakeholder analysis (which in essence is a management/policy making tool). The creation of a “hybrid” method allows the production of a new “artefact”, useful in supporting decision makers not only in making the right decision, but also in negotiating with potential further interested parties. Being a management/ policy making tool, current stakeholder analyses fall into the same category as previous methods of evaluating housing led urban regeneration projects, which is that it is typically qualitative in nature. As has been seen earlier in this paper, qualitative methods have disadvantages, which can be solved by introducing quantities into the analysis. To counteract the qualitative essence of stakeholder analysis, we can use the SuROI methodology to change the analysis into a quantifiable one. By doing this, it would be possible to quantifiably measure how much each given stakeholder of a project gains or loses from a given project. At the same time, by readdressing the SuROI traditional methodology towards a stakeholder oriented perspective, it is possible to emphasise the potential benefits for different stakeholders influenced by the intervention, thus orienting its usability from a decision making tool to a management tool. This is particularly relevant in the era of “New Public Management” within public administration which involves such aspects as explicit standards and measures of performance, a greater emphasis on output controls, a shift to the disaggregating of units in the public sector, a shift to greater competition in the public sector and a stress on greater discipline in resource use (Hood, 1991). Rather than thinking in terms of overall “public” benefit, it is important to rely on quantifiable methods showing benefits and costs for different public actors.

The SuROI hybrid would be used to gauge the quantifiable amount of impact for each stakeholder involved in a housing led urban regeneration scheme and would show in monetary units whether or not each stakeholder gains or loses from a given project, and additionally, by the cash flow amount involved.

Future research will exploit the potential of the SuROI as a quantitative methodology for the assessment of the interventions. In particular, the concept of time can be brought into SuROI. It is possible to pinpoint the time of the break even point for a project, by using the resulting quantifiable impact from the SuROI methodology to make explicit the point at which total cost and total revenue are equal.

In addition, the time of the break even point, where the quantifiable impact meets the figure of the inputted cost of the project, can be calculated by using the SuROI methodology and

would typically result in a graphical format as shown below. The break even point can be calculated for both the entirety of the scheme and, alternatively, for each individual stakeholder, as can be seen in Figure 7 below:

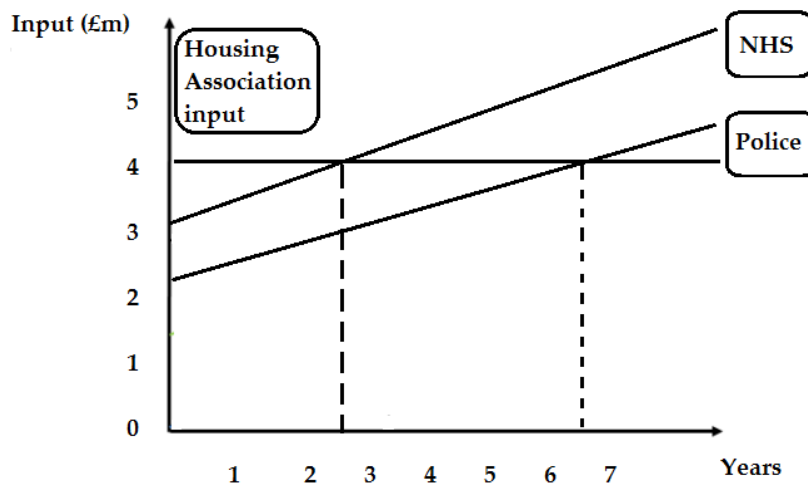


Figure 7: Break even point by using calculations from the SuROI methodology

A validation of the “SuROI Hybrid” will be carried out as part of future research, to gauge how effective it is, by following and adhering to the previously described DSR methodology. Liaison will be carried out with colleagues within housing associations and organisations specialising in the field of housing led urban regeneration that the author knows from his extensive work and longevity of employment in the field.

6. CONCLUSIONS

This paper aims at addressing an existing gap in the current assessment methods, which can cause a lack of knowledge on the real values of housing led regeneration schemes, by assuming that within the midst of a difficult economic climate for housing associations to operate in, current assessment methods tend to underestimate intangible benefits and costs associated with urban regeneration interventions. Sustainable Return on Investment (SuROI) can overcome these limits by providing a better understanding of hidden social and environmental benefits. Not only this, but the existing SuROI approach can also be progressed and improved, leading to a mapping of potential stakeholders capable of contributing to covering the budgetary costs of a housing association. This is highly applicable in the current times of economic hardship.

The paper explored the potential of the Design Science Methodology (DSM) in order to adapt the current SuROI method to the housing sector with a stakeholder led approach. The built artefact incorporated the novel SuROI method outlined. The artefact will be subsequently validated by comparing and contrasting with a more traditional form of evaluation carried out in the past. By having adopted a DSM framework, the developed artefact can be considered a more general solution applicable to the wider scale. Possible applications of the new method are suitable to support decision makers on housing regeneration schemes in the larger international context, since the method can be replicated in different areas by quantifying hidden costs and benefits and associating them to a different map of potential stakeholders to be engaged in the production of housing. For this reason, the impact of the method can be extremely relevant to the housing sector internationally. The SuROI Hybrid was explained,

which was formed from the gaps in the literature base from the quantitative SuROI methodology and the qualitative stakeholder analysis. This new contribution to knowledge can gauge the quantifiable amount of impact, in terms of cash flow, for each stakeholder involved in a housing led urban regeneration scheme and can additionally introduce the concept of time into the methodology, by being able to use the quantified outputs and outcomes to gauge when the break even point occurs; either for a scheme itself, or for each separate stakeholder involved in a scheme. This quantified information provided can be extremely useful to housing associations in today's difficult financial environment.

Further research can explore the application of the method to different sectors, such as health care or sport facilities, by exploring a variety of different stakeholders and respective benefits and burdens and testing their willingness to be subsequently engaged in the production of public goods.

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IMPORTANCE OF COMMUNITY PARTICIPATION IN DISASTER RECOVERY

T. Van Krieken, U. Kulatunga and C. Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: vankrieken.tony@gmail.com

Abstract: The aim of this paper is to investigate the views about community on their participation during disaster recovery and how they can be empowered. The community participation from the beginning to end of the project, and future maintenance of the community is essential for a successful recovery in an efficient and effective manner. Little, or token, participation by the community has proved to be fatal through schedule delays in recovery or public uprising. This article will outline a global literature review of community participation complemented with some interview preliminary data from San Francisco and Christ Church, New Zealand. The outcome is a framework of community participation and empowerment. As "owners", the community will ensure a well- maintained community for many years ahead.

Keywords: Community, Disaster, Empowerment, Survivors, Project Management.

1. BACKGROUND

1.1 Need of empowering the disaster effected community

Communities are the first responders during the aftermath of a disaster. Numerous studies about single countries (Ainuddin, 2012; Bornstein, 2013; Chandrasekhar, 2012; Crawford, 2013; Magnin, 2007; Olofsson, 2007; Twigg, 2009; World Bank, 2005, 2008) provide incredible insightful information on why the community is very important even when their power and influence are low and why it is important to empower to disaster affected community (San Francisco, 2013; Rowlands, 2013; Slotterback, 2013).

Currently, Federal Emergency Management Association (FEMA) encourages the community to take care of itself during the first 72 hours after a disaster as shown during the recovery from Hurricane Sandy (San Francisco, 2013). Following a disaster, if the government does not deliver on recovery, or on time, then citizens protest. According to a San Francisco interviewee, to offset the potential dissatisfaction from the affected community, the community needs to be encouraged to be part of the recovery. However, the community tends to ignore disaster recovery plan after the disaster event and their demands could be not possible to fulfil after the disaster. In essence, they become stakeholders with unreasonable expectations and a single person within the community can stop the recovery project. Therefore, agreement with the community from the beginning of the disaster recovery process must be established.

Rowlands (2013) indicates that empowering the community and maximizing the community's participation at the local level will give the community control of the process and enable it to take charge of its rebuilding. This means tapping into the community's resourcefulness; tapping local providers to supply materials and services (such as psychology and social work); and tapping workers to rebuild the community is required to ensure

meaningful disaster recovery projects within the social and cultural sectors of natural disasters.

The community's ideas and wisdom helps to shape the community through empowered decision making with the government and other agencies. Would the government go this far? That is part of empowerment: community involvement in the process. Not everyone from the community sits at the planning table. The chain of command of the recovery project does not allow ownership but allows participation in decision making. There are rules to govern on how this happens through civic engagement of the community to the government. Community is not asked to meddle nor implement in the recovery process. Accordingly, this paper investigates the about community on their participation during disaster recovery and how they can be empowered

2. LITERATURE REVIEW

2.1 Community Empowerment

Davidson's study (2006) proved that there existed variation in community participation among different countries as stakeholders in the projects. Some of the communities were informed, consulted but were not empowered; in essence have no power to affect the deliverables of the project. The International Association of Public Participation (2007) developed the following guidelines on how the community can participate and powered and be empowered.

IAP2 Spectrum of Public Participation

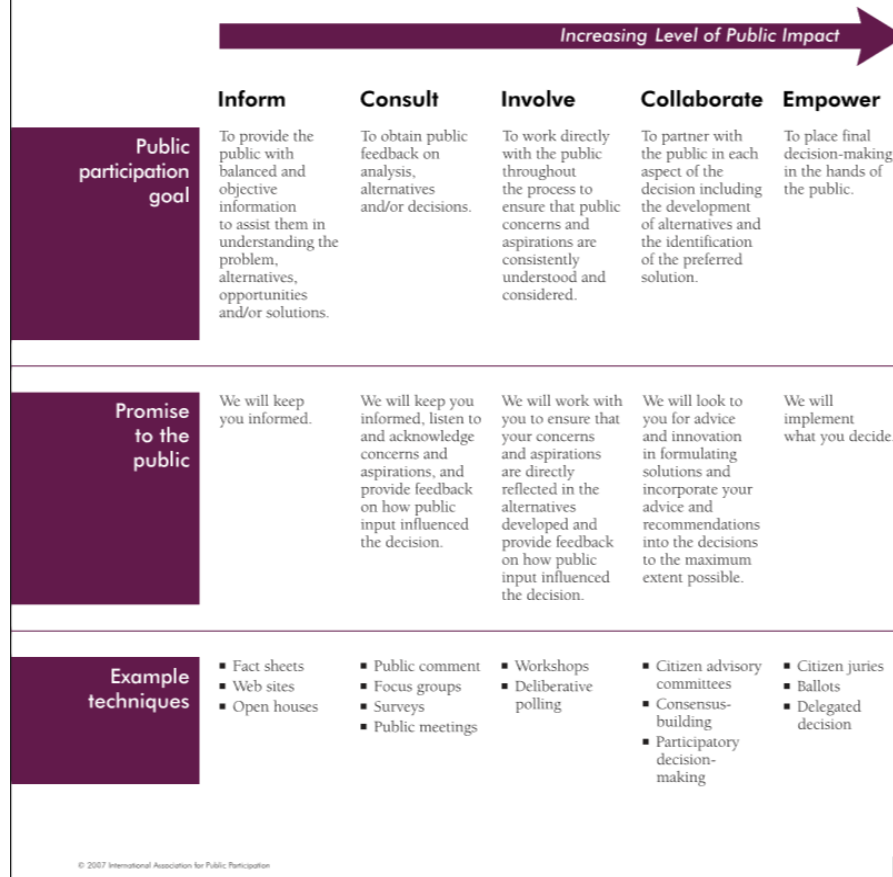


Figure 1: Spectrum of Public Participation

As noted in Figure #1, empower enables final decision-making in the community. Regional Australian Institute (2013) indicates the empowered community share responsibility in decision making and accountability. Legislative and policy frameworks within the state/country establish the level of power communities can decide: some were limited and some wide ranging within a defined time period. In the case of collaboration, there is delegated decision-making, but the government retains the overall decision-making power.

The different types of participation is effective in different contexts; empower may not be suitable for all situations. Slotterback (2013) noted that effective management of power differences between stakeholders and community can help the community trust the process; some powerful stakeholders might be reluctant in the process if they feel their power is diminished. We need to make the Government and Project Manager aware and utilize community empowerment within their projects. Community empowerment within disaster recovery has much to offer as shown in the next section.

2.2 Community Empowerment in Disaster Recovery

The premise of Figure #1 above is those affected by a disaster must be involved in the decision-making process (IAP, 2007). Work in San Francisco, based on the “Whole Community Approach” from the Federal Emergency Management Agency (2011), has taken the above premise to enable community members to be trained in leadership and in project management for the communities to adapt to stressors, such as residential fires, heat waves, earthquakes and power outages (San Francisco, 2016). The community will act immediately in an effective and efficient manner when trained and recognized (ADAP, 2004). Their performance goes beyond traditional disaster management practices of preparedness and response to mitigation and recovery (San Francisco, 2016) when masterly dealing with stressors (disasters). Community empowerment has great benefits for Emergency Management, government agencies, private and non-profit sector organizations when their budgets are impacted by economic constraints (FEMA, 2011).

2.3 How to empower the community?

Collective Resilience

The news presents disasters as mass panic: rioting, looting and killing. Once the masses have descended to a primitive psychological state, it is thought to be pointless trying to reason with them about their civic obligations — let alone attempting to involve them as active partners in disaster response. Instead, greater legal powers for government, and even coercive force, should be used to restore social order. ‘Sensitive’ information is restricted to the establishment elite, government and their functionaries, who not only ‘know best’, but are somehow immune to the “mass panic” (Drury, 2012). The conclusion is that the victims are too traumatized to take care of themselves.

“Collective resilience” forms in which the attitude of mutual helping and unity in the middle of danger (Drury, 2012). In the initial absence of the emergency services, people within the crowd act as ‘first responders’: applying make-shift bandages and tourniquets, sharing water, talking to keep each other’s spirits up, physically supporting each other, and thus contributing to each other’s survival and recovery as far as they were physically able. Majority of the people, who are strangers to one another, see themselves as fellow mates helping one another. Survivors need the provision of resources (food, shelter, communications and technologies), know their family’s whereabouts, and find contact and location details of agencies and professional services to restore their lives.

Survivor Assets

Survivor assets are the human, economic, physical and social capital. Human capital refers to *skills, education and job experience*. Economic capital refers to *funds to rebuild housing, agricultural, retail and manufacturing*. Physical capital refers to *material, housing, infrastructure and land to rebuild the community*. The least acknowledged is the *social capital – people and their networks*. Are the networks loose or dense? The residents of New Orleans’ Village de L’Est were a close-knit community before Hurricane Katrina hit; through their parish priest they maintained their sense of community when temporarily relocated to Houston. Within two years, there was a 90% population return and 90% rate of business re-opening (Aldrich, 2008).

Survivors' resourcefulness

The next step for empowerment is to understand community resources. During the Japan's March 2011 earthquake, elderly and infirm were saved by the social capital, such as, networks of neighbors, friends, and family and the resources (Aldrich, 2015). Social capital provides financial (such as, loans and gifts for property repair) and nonfinancial resources (such as, child care during recovery, emotional support, sheltering, and information). Isolated individuals with few social ties are less likely to be rescued, seek medical help, take preventative action in evacuation, and receive assistance from others, such as shelter (Dynes, 2005, 2006). Linking social capital connects community members with those in power.

After the Aceh Tsunami, Aldrich (2011) noted that Indian villages with high levels of bonding and linking capital received greater amounts of aid and assistance more quickly than communities which possessed only bonding capital. The villages who overcame collective action problems and efficiently extracted resources from donors and government officials also left out tsunami-affected villagers on the social margins of society.

Vulnerable Survivors

Vulnerable groups must be engaged not just protected and in need of care. The elderly, children, and women, must be made priorities during effective post disaster response (Ranghieri, 2014). Older people are more often thought of as a vulnerable group in need of care rather than as a resource to support younger generations. When marginalized, elders lose opportunities for interaction and the ability to contribute to society, and young people lose the wisdom and talents that elders can offer. After the Great East Japan Earthquake of 2011, Ibasho, an NGO, heard many stories about elders who saved the younger generation by telling them where to escape or by teaching them how to survive with extremely limited resources.

Marcillia (2012) recommended that flexibility and open ended design in reconstructing homes be very advantageous in the critical transition of the community to their new homes such as the location and size of kitchen or parlour.

Social and Cultural Coping

Another way is how to utilize those resources through social and cultural coping. Cretney (2016) outline coping, response and adaptive capacities to rebuild. Wlodarczyk (2016) confirmed that coping strategies and participation occurred at an individual and communal level in different cultural contexts. Communal coping strategy was found to be higher in collectivism countries as Colombia and Chile rather than in individualistic culture of Spain. Spiritual coping was found to be high in Colombia and Chile but growth was found in Spain. Social support was high in Colombia and Chile, but had a mediating role in Spain.

The importance of coping as an avenue to build relationships between community organizations and higher level governance institutions allow for communities to take some level of ownership and control. This reinforces the importance of moving away from the command and control approach that has focused on an intensive role of State and governance actors, relegating individuals and communities to passive roles in response and recovery (Singh-Peterson et al., 2015; Prior and Eriksen, 2013).

A paradigm shift from perceiving the community as victims to survivors is necessary to utilize the inner strengths and resources of the community to rebuild the community after a disaster into a resilient and sustainable community.

3. RESEARCH METHODOLOGY

To investigate the views about community on their participation during disaster recovery and how they can be empowered, a case study research strategy has been used. Accordingly, the below section includes the findings of the initial case study carried out in San Francisco. The unit of analysis of the case study is Project Manager and Community Leader. Semi-structured interviews were used as the data collection method within the case study. Data obtained through the semi-structured interviews were analysed by using NVivo software. This section aims to present and analyze the data obtained from fourteen semi-structured interviews in the San Francisco area.

The analyzing of data through Nvivo started by classifying the data into nodes related to Community empowerment methods (49%) and Project Management methods (51%). Community node was further broken down into community strategies, community response and community factors. The result is highlights of learned experience in community participation and empowerment. The highlights gave an understanding of which dynamics to note, such as social capital and organizational change management, for the efficient and effective rebuilding a community.

4. FINDINGS

The analysis is to establish the importance of empowering disaster affected communities in the post-disaster phase. Accordingly, the below node on Community Empowerment in NVivo was established.

| | | |
|----------------------------|----|----|
| CE - Community Empowerment | 13 | 43 |
| Social Capital | 11 | 14 |
| Relationships | 4 | 4 |
| Connections | 2 | 2 |
| Community | 5 | 9 |
| Participation Power | 4 | 4 |
| empower | 5 | 5 |
| empower | 1 | 1 |

Figure 2: Nvivo screenshot of the Community Empowerment themes nodes

The references discussed in the interviews were subdivided into three groups: Social Capital, Community and Empowerment. Social capital is defined by interviewee IP13 as *"created by individuals who work in an area of concern for necessity or interest. The work they do often volunteer bring benefits to larger group of people. Bottom up approach in social capital. Brought to the community skills that they can utilize to the benefits of the community"*.

Interviewee IP4 stressed: *"Need to focus on what is tangible to the community. ... Community let the professionals to do the work. Citizens and professionals must establish a balance on what can be done by each other. Once ask citizens to do work of professionals then the*

citizens will push back". This indicates that what we need to have during the post-disaster recovery is a collaborative working relationships between the community and professionals. Interviewee IP6 commented that consultation with the community does not exist: "Consult does not exist: City agencies working with themselves. Do not listen (active listen). They have their own agenda. This agnostic approach is not getting anywhere. Belief in collaboration rather than conformational to form better relationships. A lot of infighting within city and community result...Community has kernels of knowledge. Meet with the community in group and one to one. Get to know them. Project manager cannot do this because they have a lot of money to spend. Get their buy in". The community expresses this frustration of being ignored, priority is on the funders (government and banks) for expediency of the project. Priority is to spend the money expediently; consulting with many people is onerous and bothersome with many conflicting views. Interviewee IP9 stress that "Community ideas and wisdom helps to shape the community. Empower to shape decision making. The challenge for poor communities is what they want their community to look like".

Interviewee IP9 stress that you "*Cannot separate all the components of public participation. Community needs to be informed to start decision making. Community is allowed to decide after the decision was made to move them. Community participate in final phase of the project not the first phase*". The result is tokenism takes place to ensure government and other organizations have public participation. A token to shareholders but a blow to the community. From a stakeholder perspective, interviewee IP4 commented:

"Government is not a stakeholder. It is a hired help: a layer bureaucracy. Government players do not have vested interests in the project. Their vested interests is only as a job. They lose their job rather than house, family and friends that community experience. If government employees live in the area; they are stakeholders as citizens but they are employees; therefore their jobs becomes priority".

Importance of community member's participation is emphasized where interviewee IP1 indicated the community: "*it is where the community lives and works. They sense what happened in the past. They may not want to restore in the same way as the past; parks and roads are different design dependent on changing values.*" Community input is stressed.

Interviewee IP4 stressed the community is the owner of the project; hence major stakeholder of the project through the following quote: "*community owns the project. Owns is the ultimate responsibility for the benefits or deficiencies of the project. Own is an extension of the idea the citizen are responsible to their representatives (elected officials and professionals). They are the major stakeholder; they are the owners. The community tend to ignore to plan after the event. Their demands are not possible to fulfill. They become stakeholders with unreasonable expectations*".

5. DISCUSSIONS AND CONCLUSION

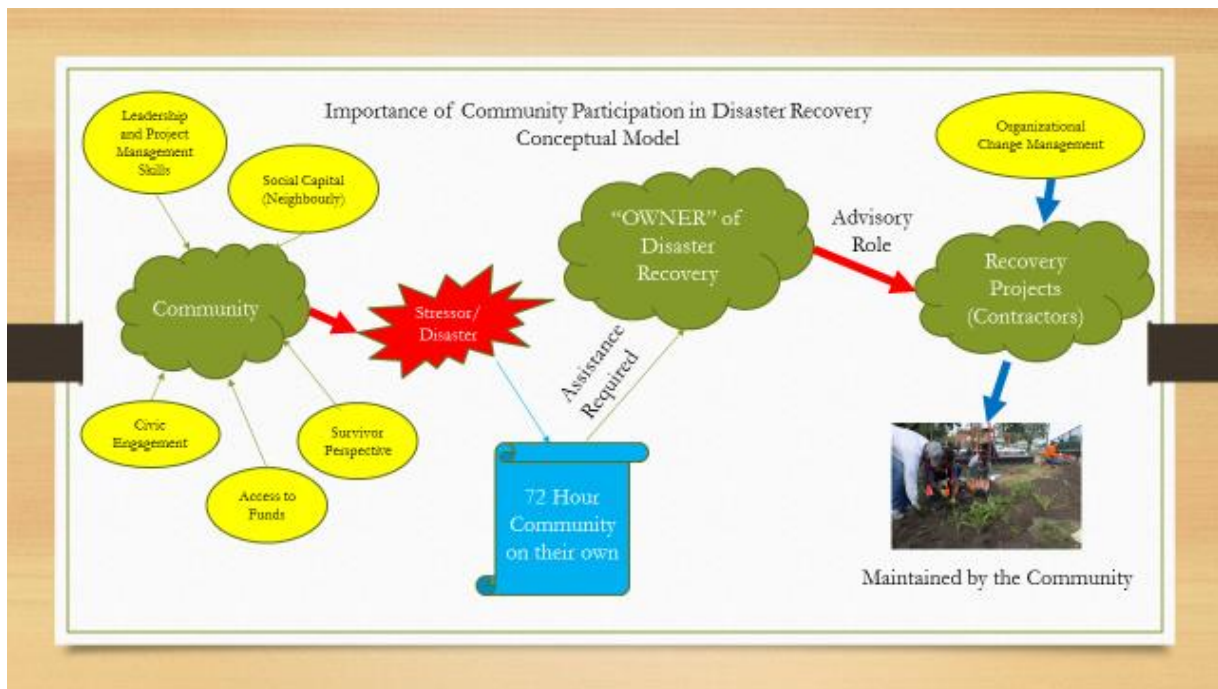


Figure 3: Importance of Community Participation in Disaster Recovery

5.1 Discussion - Empowerment

The above conceptual model summarizes the interview comments as highlighted in this paper. As shown above, the community is the "owner" of the project. The community has vested interest because they raise their children in the community; work in the area; have intimate knowledge of the geography, social and cultural environment; and have close friends they grew up in the area. In addition there are people with leadership and project management skills within the community to assist in the recovery. These skills were taught through the community and assistance from local universities. The community members have to learn to work with the various levels of government which takes time and guidance – civic engagement. Time to build expertise in civic engagement and be recognized by various levels of government in return. The most important advice given is the community has an intimate knowledge of itself. That knowledge and expertise is available in a collaborative and empowerment manner. The community asks to be walked through the process in an advisory role as the "owner" of the project. The principles of organizational change management on close involvement and frequent communication of stakeholders is greatly stressed.

The community is a major stakeholder since the community "owns" the project. They are the "owners" of the project as the persons ultimately responsible for the benefits or deficiencies of the project. Extending the idea that the citizen are responsible to their representatives (elected officials and professionals). Ownership part of the project is formed by the attitude of citizens. Citizens feel that government should do their job. Government is going to fix if government has the capacity. These ideas formed the basis for Figure #3 (Importance of Community Participation in Disaster Recovery). The community is shaped by social capital; funds available for recovery through various mechanisms; well-being indicators on health, social and economics; civic engagement (working relationships within the community and

government); and leadership skills of community leaders to work within the community and stakeholders (government, NGOs, and INGOs). The first 72 hours the community is on their own after disaster; therefore community participation is extremely important in disaster recovery.

5.2 Conclusion

To investigate the views about community on their participation during disaster recovery and how they can be empowered, a case study research strategy has been used. Accordingly, findings of the initial case study carried out in San Francisco. The unit of analysis of the case study is Project Manager and Community Leader. The findings were based on 14 semi-interviews. The result is highlights of learned experience in community participation and empowerment. The highlights gave an understanding of which dynamics to note, such as social capital and organizational change management, for the efficient and effective rebuilding a community. Further analysis is required for the statistical relationships of the various components. A note of caution: similar cookie approach in recovery cannot be applied in disaster recovery since the community and its environment differ from one another. Principles of participation and empowerment must be understood and worked with.

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SUSTAINABLE BUILDING CONSTRUCTION PRACTICES IN LAGOS STATE, NIGERIA

O. Faremi, I.B. John and C. Nwokediuko

Department of Building, Faculty of Environmental Sciences, University of Lagos, Nigeria

Email: juliusfaremi@gmail.com

Abstract: It is a globally acknowledged discourse that the construction industry significantly consumes enormous energy and emits greenhouse gases (GHG). This is due to its effort in bridging the current housing deficit which is a resultant of increased population both in developed and developing countries. Extant studies have revealed the barriers and challenges in adopting sustainable construction practices. Hence, this study assesses the extent to which sustainable building construction practices are incorporated in the construction of buildings in Lagos State, Nigeria. A survey of one hundred (100) construction professionals was conducted on frequently implemented sustainable practices on buildings projects and the perceived satisfaction of users of buildings on sustainability features. A total of eighty (80) questionnaires were successfully retrieved and processed for analysis using frequency tables and relative implementation index (RII) as tools for the descriptive statistics while spearman rank correlation was used as the inferential statistical tool for this study. The results of analysed data shows that there is a significant positive relationship between sustainable practices and the satisfaction of building users. This study recommends enlightenment of both construction project designers and clients on the need to implement sustainable features in the construction of buildings within the study area.

Keywords: Construction industry, Buildings, Sustainability, Stakeholders, Sustainable construction.

1. INTRODUCTION

The importance of the construction industry in any developing country, such as Nigeria cannot be overemphasized. Nwokoro and Onukwube (2011) opine that the construction industry is a complex one due to the involvement of its numerous stakeholders and their divergent interest. Notwithstanding its complexity, the construction industry plays a critical role in the economic, social and environmental sector of the nation, hence the need for resource optimization and implementation of global best practices in the industry. The process by which such resource optimization and environmental preservation while the set goal is achieved is termed sustainability (Kuhlman & Farrington, 2010). Sustainable construction entails the effective application of the principles of sustainable development to the comprehensive construction cycle of a building. This ensures optimum comfort and viable use of a building through its lifetime (Rahim, Yusoff, Zainon, Wang, & Lumpur, 2014).

There are criteria by which a building or construction project is evaluated for sustainability compliance. These criteria are recognised as the metrics of sustainability (Loman, 2014). The US Green Building Council (2009) posits that sustainable building development entails the construction of buildings in a manner that it effectively meet the metrics of resource efficiency, water efficiency, innovation in design, energy efficiency, improved indoor and environment air quality as well as reduction in the emission of greenhouse gases. Although

Elmualim and Alp (2016) opine that the construction industry should be the main sector in which the requirements of sustainability are met, far from that expectation is the present reality especially in developing countries. In Nigeria for example, buildings are often times constructed using the traditional construction practice in which the goal is to complete construction activities as quickly as possible while little or no attention is paid to the consequential impact of the activities on the environment.

The practice of sustainable construction is further seen to be at infancy in Nigeria with the low level of awareness of construction professionals on the key concepts of sustainable building development (Nduka & Ogunsanmi, 2015). It appears that construction professionals are generally reluctant to embracing the totality of the practices of sustainability on construction projects. This study therefore investigates frequently implemented sustainable practices in the design and construction of building projects in Lagos State as well as the extent to which building occupants are satisfied with the level of sustainability features in their buildings.

1.1 Research hypothesis

Ho There is no significant relationship between sustainable construction practices and the satisfaction of building occupants in Lagos state.

2. LITERATURE REVIEW

Literature has established that there are three dimensions of sustainability namely; social, economic and environmental dimensions (Kuhlman & Farrington, 2010; Pancovska, 2017). The process of achieving sustainable construction involves the optimisation of design, tendering, site planning, organisation, material selection, recycling and waste minimisation. Globally, the incorporation of sustainable practices across different fields have become an increasing trend that is aimed at scaling down the negative impact of man's activity on the environment. In the construction industry, a project is considered sustainable only when all the basic principles of sustainability are compatible with each other (Mateus & Bragança, 2011). It is in this regard that Ilesanmi (2015) describes the concept of sustainability as the attempt towards simultaneously achieving the goals of a better economy, improved environment and a more participating society. In addition, Du Plessis et al. (2001) posit that the construction of sustainable building is a concept aimed at creating harmony between the natural and built environment. This involves all processes initiated during construction that satisfies economic, environmental and social issues throughout the service life of a building (Basiago, 1999).

The practices of sustainability are a fast rising trend amongst countries especially the developed ones as it has become the pivot around which all other activities depend (Miranda & Marulanda, 2002). This is because the earth's resources are under severe pressure due to the increase in population and economic expansion (Ametepey, Aigbavboa, & Ansah, 2015). Sustainable development of any building or construction projects is characterised with the major goal of creating a healthy built environment based on efficient use of resources and smart ecological design (Shofoluwe, 2013). The elements and key feature of sustainability comprises of energy efficiency, resource or material efficiency, healthy indoor environmental quality, utilizing clean and renewable energies, environmental degradation followed by

greenhouse gas emission, sustainability in designs and contracts and water conservation (Taheriattar & Farzanehrafat, 2014).

Schwarz, Beloff and Beaver (2002) explain that there are five basic indicators of sustainability metrics for construction projects. These indicators include material utilisation, energy utilisation, water utilisation, toxic emissions and pollutant emissions. Furthermore, Robert, Parris and Leiserowitz (2005) add that the entire exercise of sustainability compliance aim at achieving leadership role in greenhouse gas emissions reduction, energy efficiency, renewables, and waste treatment and handling. One of the known agents promoting sustainability in the construction industry is the Leadership in Energy and Environmental Design (LEED). LEED is a third-party certification program and an internationally accepted benchmark for the design, construction and operation of high performance sustainable buildings (Canada Green Building Council, 2017). LEED provides sustainability metrics for benchmarking the design and construction of buildings across five areas comprising sustainable site development, water efficiency, energy efficiency, material selection and indoor environmental quality. This study adopts all the metrics of sustainability highlighted in the literature that were reviewed in the investigation of sustainable practices in the construction of buildings in Lagos state.

Furthermore, the implementation of sustainable practices on a project largely depends on the knowledge, perception and involvement all stakeholders on the project. It is also of importance that these stakeholders have an appreciable understanding of the consequences of their individual actions (Plessis & Africa, 2012). However, Abidin (2010) reveals that the overall awareness and knowledge of construction stakeholders on sustainability concepts in developing countries are below satisfactory taking the case of Malaysia as an example. The case in Nigeria is not so far from that of Malaysia as the practice of sustainability in the Nigerian construction industry is yet to be pronounced.

Previous studies (Mensah & Castro, 2004; Abolore, 2012; Loman, 2014; Abisuga & Oyekanmi, 2014) have highlighted the potential benefits of sustainable construction practices to the built environment and eco-system through protection of natural resources and efficient energy utilization. The studies posit that sustainable practices significantly increase financial profit, delivers long term competitiveness, maximum utilisation of land, optimised energy input and decrease in the possible impacts of risks for the global and local environment. Furthermore, Nwokoro and Onukwube (2011) opine that the practice of sustainability in buildings also impact on the satisfaction and safety of occupants through the attainment of visual and thermal comfort, and satisfactory indoor air quality. This study adopts the criteria of visual comfort, thermal comfort and indoor air quality as variables for assessing the satisfaction of the respondents on sustainable practices within the study area.

3. METHODOLOGY

This study was delimited to Lagos state located in the south-western region of Nigeria. The choice of Lagos State was because Lagos state is the economic nerve centre of Nigeria with the largest concentration of industries, financial institutions and major sea port. The human population of the state is in excess of 9 million people (National Population Commission, 2009). This rank the state among the fastest growing cities in Nigeria with a significant level of construction activities which enhanced the collection of data for this study.

A structured questionnaire was developed and administered as the principal instrument for collecting data for this study. Using simple random sampling technique, a total of one hundred (100) questionnaires were administered to professionals engaged in the construction of buildings within the study area. A total of eighty (80) questionnaires were retrieved. Retrieved questionnaires were scrutinized for errors, omissions, completeness and consistencies and were found to be adequately completed and suitable for analysis. The returns represent 80% response rate. The data were processed and analysed with the aid of Statistical Package for Social Sciences (SPSS) version 20.0. Frequency tables and relative implementation index were used for the descriptive statistic while correlation analysis was utilized to test the hypothetical statement formulated for this study.

4. RESULTS AND DISCUSSION

Table 1 below shows the characteristics of respondents for this study. The table shows that about 23 percent of the respondents were Architects, 35 percent were Builders, 25 percent were Civil Engineers and 20 percent belong to other profession. The other profession category comprises of other professionals that were involved in the management of building construction projects within the study area.

Table 1: Demographic data of respondents

| Demographic Data | Frequency | Percentage |
|---------------------------------|------------------|-------------------|
| Years of experience | | |
| Below 5 years | 38 | 47.5 |
| 6 – 10 years | 32 | 40 |
| 11 – 15 years | 6 | 7.5 |
| 16 – 20years | 2 | 2.5 |
| Above 20 years | 2 | 2.5 |
| Total | 80 | 100.0 |
| Profession of respondent | | |
| Architect | 18 | 22.5 |
| Builder | 28 | 35 |
| Civil engineer | 18 | 22.5 |
| Others | 16 | 20 |
| Total | 80 | 100.0 |
| Academic qualification | | |
| OND | 4 | 5 |
| HND | 14 | 17.5 |
| B.Sc. | 40 | 50 |
| M.Sc | 22 | 27.5 |
| Total | 80 | 100 |
| Nature of organization | | |
| Building contracting | 12 | 15 |

| Demographic Data | Frequency | Percentage |
|--------------------------------|------------------|-------------------|
| Building and Civil contracting | 36 | 45 |
| Building and Civil consulting | 20 | 25 |
| Others | 12 | 15 |
| Total | 80 | 100 |

Furthermore, Table 1 reveals that 15 percent of the respondents work in building contracting firms, 45 percent work in building and civil contracting firms, 25 percent work in building and civil consulting firms and 10 percent work in other type of firms. Also the years of experience of respondents show that 47.5 percent of the respondents had working experiences below 5 years, 40 percent had work experiences ranging between 6 to 10 years, about 8 percent of the respondents had work experiences ranging between 11 to 15 years, about 3 percent of the respondents had work experiences of between 16 to 20 years and about 3 percent had work experiences above 20 years. The general outlook of the length of working experiences of the respondents implies that the respondents are conversant with construction processes and have ample experiences on construction activities. This suggest that majority of the respondents have the requisite experience to answer questions on the practices of sustainable construction and were able to provide valuable responses in line with the objective of this study.

This study assessed sustainable practices that were frequently implemented in the design and construction of buildings in Lagos state. In evaluating sustainable practices that were often incorporated into the design of buildings, a list of sustainable practices that should be incorporated into the design of buildings were extracted from literature into the questionnaire and presented to the respondents. The respondents were asked to rate their responses on a 5 point Likert scale ranging from 1= never to 5= always. This was intended to elicit information on how often each of the sustainable practices were incorporated into the design of buildings in Lagos state. The data collected were analysed using relative implementation index (RII) formula. The RII is expressed as:

$$RII = \sum W / (A * N) \dots\dots\dots \text{equation 1}$$

Where:

W= weight given to each sustainability practices by the respondents

A = is the highest weight

N = is the total number of respondents

The calculated RII values were interpreted using the scale $RII \geq 0.76$ means most often implemented , $0.67 \leq RII \leq 0.75$ means often implemented, $0.45 \leq RII \leq 0.66$ means rarely implemented and $RII \leq 0.44$ means not implemented (Waziri & Vanduhe, 2013; Magutu & Kamweru, 2015). The resulting analysis is presented in Table 2.

Table 2: Frequency of implementing sustainable practices in building design

| Sustainable practices | N | RII | Rank | Remark |
|---|----------|------------|-------------|---------------|
| Ease of access in and out of site | 80 | 0.97 | 1 | MOI |
| Health, welfare and satisfaction of occupants | 80 | 0.92 | 2 | MOI |

| Sustainable practices | N | RII | Rank | Remark |
|--|----------|------------|-------------|---------------|
| Effective prevention of water pollution. | 80 | 0.89 | 3 | MOI |
| Improved indoor air quality using daylighting system and passive ventilation | 80 | 0.88 | 4 | MOI |
| Minimization of waste | 80 | 0.84 | 5 | MOI |
| Efficient use of water in building during and after construction | 80 | 0.83 | 6 | MOI |
| Optimization of energy during and after construction. | 80 | 0.82 | 7 | MOI |
| Comfortable thermal environment | 80 | 0.81 | 8 | MOI |
| Cost efficiency | 80 | 0.78 | 9 | MOI |
| Reduction in the whole life cost of the building | 80 | 0.77 | 10 | MOI |
| The use of passive and efficient ventilation system for improve indoor air quality | 80 | 0.73 | 11 | OI |
| Visual comfortability | 80 | 0.71 | 12 | OI |
| Proximity of site and effective land utilization | 80 | 0.69 | 13 | OI |
| Control of pollution and abatement of noise | 80 | 0.69 | 14 | OI |
| Use of recyclable and renewable materials to effect cost efficiency | 80 | 0.57 | 15 | RI |
| Reduction of environmental impact through sustainable site allocation | 80 | 0.44 | 16 | NI |
| Conservation of existing natural areas and promoting biodiversity | 80 | 0.44 | 17 | NI |
| Efficient utilization/consumption of energy within building overtime | 80 | 0.43 | 18 | NI |
| Conserving energy through renewable and recyclable materials | 80 | 0.42 | 19 | NI |

Note: MOI = Most often incorporated, OI = Often incorporated, NI=Not incorporated

Table 2 shows that the sustainability practices that were often incorporated into the design of buildings in Lagos state include; efficient use of water in building during and after construction, optimization of energy during and after construction, comfortable thermal environment, cost efficiency and reduction in the whole life cost of the building. However, reduction of environmental impact through sustainable site allocation, conservation of existing natural areas and promoting biodiversity, efficient utilisation or consumption of energy within building overtime and conserving energy through renewable and recyclable materials were sustainable practices that were not incorporated in the design of buildings within the study area. The results suggest that building designers and construction professionals within the study area incorporate sustainable practices that impact on the project overall cost than those that impact on the environment in which the buildings were constructed.

The implication of this result is that not all the possible sustainability practices are incorporated in the design of buildings in Lagos state. Building construction activities in the state therefore have potential negative consequences on the environment. This implication buttress the concern of Baloi (2003) that the lack of recognition in the design process for the extensive use of natural resources, various sources of energy, and water demand of a building

would often result in severe consequences on the environment. Furthermore, Ofori, Gyadu-Asiedu, and Assah-Kissiedu (2015) explain the importance of conceiving sustainability right from the design of building projects. The authors posit that the future of sustainable construction has its roots in past and present actions and the future depends on the awareness of the consequences of construction stakeholders' acts and deeds.

This study also assessed the sustainable practices that are implemented during the construction of buildings in Lagos state. In assessing this, a 5 point Likert scale ranging from 1= never to 5= always was presented to the respondents. The data collected was analysed using the relative implementation index (RII) formula. The calculated RII values were interpreted using the scale $RII \geq 0.76$ means most often implemented, $0.67 \leq RII \leq 0.75$ means often implemented, $0.45 \leq RII \leq 0.66$ means rarely implemented and $RII \leq 0.44$ means not implemented (Waziri & Vanduhe, 2013; Magutu & Kamweru, 2015). Table 3 shows the result of the analysis.

Table 3: Frequently implemented sustainable practices during building construction

| Sustainable practices | N | RII | Rank | Remark |
|--|----------|------------|-------------|---------------|
| Downsizing the dominant use of incandescent bulbs and replacing them with energy saving bulbs (i.e. CFLs & LEDs) | 80 | 0.89 | 1 | MOI |
| Innovative waste water technologies to reduce waste water generation | 80 | 0.83 | 2 | MOI |
| Use of efficient insulating wall materials to enhance indoor air quality | 80 | 0.83 | 3 | MOI |
| Innovative water management to increase water efficiency | 80 | 0.82 | 4 | MOI |
| Application of daylighting to increase visual comfort | 80 | 0.82 | 4 | MOI |
| Use of low energy cooling system to enhance Indoor Air Quality (IAQ) | 80 | 0.80 | 6 | MOI |
| Use of effective acoustics materials | 80 | 0.78 | 7 | MOI |
| On site application of renewable technology | 80 | 0.67 | 8 | OI |

Note: MOI = Most often implemented, OI = Often implemented, NI=Not implemented

The results in table 3 shows that the downsizing of the dominant use of incandescent bulbs and replacing them with energy saving bulbs (i.e. CFLs & LEDs) to achieve energy optimization is the most often implemented sustainable practice (RII= 0.89) during the construction of buildings. Innovative waste water technologies to reduce waste water generation and the use of efficient insulating wall materials to enhance indoor air quality jointly ranked as the second most implemented sustainable practices (RII= 0.83) during the construction of buildings. These were closely followed by innovative water management to increase water efficiency and the application of day lighting to increase visual comfort (RII= 0.82). Use of low energy cooling system to enhance IAQ (RII= 0.80) and the use of effective acoustics materials (RII= 0.78) ranked as the second to the last and last most often implemented sustainable practices respectively. This results aligns with the findings of (Degefa, 2010; Natural Resources Defense Council, 2012; Apanavičiene, Daugeliene, Baltramonaitis, & Maliene, 2015) that significant cost savings can be achieved in the cost of energy through the use of energy saving bulbs.

This study assess the level of satisfaction of building occupants on the features of sustainability in their buildings. This was done by asking the respondents of this survey to rate the feedback of occupants on the parameters of sustainability in their buildings. A 5 point Likert scale ranging from 1=very dissatisfied to 5= very satisfied was provided to the respondents for the assessment. Table 4 shows the result of the analysis.

Table 4: Occupants satisfaction on the level of sustainability features in buildings

| Sustainability features | N | Mean |
|-----------------------------|----|------|
| Indoor air quality | 80 | 4.08 |
| Visual comfort and lighting | 80 | 4.05 |
| Thermal comfort | 80 | 4.03 |
| Acoustic comfort | 80 | 3.68 |

Table 4 shows that the building occupants were satisfied with all the four sustainability features in their buildings. The level of satisfaction was in the order; indoor ventilation and air quality (4.08), lighting and visual comfort (4.05), thermal comfort (4.03) and acoustic comfort (3.68) respectively.

4.1 Test of research hypothesis

- H₀- There is no significant relationship between sustainable practices and the level of occupants' satisfaction with sustainable features
H₁- There is significant relationship between sustainable practices and the level of occupants' satisfaction with sustainable features

The postulated hypothesis was analysed using the spearman rank correlation. The result of the analysis is shown in table 5 below:

Table 5: Correlation between sustainability practices and building users' satisfaction

| | | EIW | WWT | ART | ADL | EAD | LEC | WRT | ESB | ADS | VCS | LDS | IAQ | TCS |
|-----|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----|-----|-----|
| EIW | <i>r</i> | 1 | | | | | | | | | | | | |
| | <i>p</i> | | | | | | | | | | | | | |
| WWT | <i>r</i> | .897** | 1 | | | | | | | | | | | |
| | <i>p</i> | .000 | | | | | | | | | | | | |
| ART | <i>r</i> | .886** | .886** | 1 | | | | | | | | | | |
| | <i>p</i> | .000 | .000 | | | | | | | | | | | |
| ADL | <i>r</i> | .859** | .794** | .890** | 1 | | | | | | | | | |
| | <i>p</i> | .000 | .000 | .000 | | | | | | | | | | |
| EAD | <i>r</i> | .935** | .877** | .904** | .919** | 1 | | | | | | | | |
| | <i>p</i> | .000 | .000 | .000 | .000 | | | | | | | | | |
| LEC | <i>r</i> | .876** | .825** | .903** | .943** | .943** | 1 | | | | | | | |
| | <i>p</i> | .000 | .000 | .000 | .000 | .000 | | | | | | | | |
| WRT | <i>r</i> | .917** | .927** | .883** | .854** | .927** | .880** | 1 | | | | | | |
| | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | | | | | | | |
| ESB | <i>r</i> | .871** | .760** | .824** | .894** | .889** | .874** | .806** | 1 | | | | | |
| | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | .000 | | | | | | |
| ADS | <i>r</i> | .937** | .947** | .865** | .799** | .876** | .826** | .930** | .790** | 1 | | | | |
| | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | | | | | |
| VCS | <i>r</i> | .842** | .837** | .894** | .915** | .875** | .875** | .869** | .824** | .851** | 1 | | | |
| | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | | | | |
| LDS | <i>r</i> | .999** | .899** | .887** | .862** | .935** | .877** | .918** | .872** | .937** | .844** | 1 | | |

| | | EIW | WWT | ART | ADL | EAD | LEC | WRT | ESB | ADS | VCS | LDS | IAQ | TCS |
|-----|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----|
| IAQ | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | | |
| | <i>r</i> | .823** | .821** | .913** | .898** | .859** | .867** | .833** | .818** | .812** | .952** | .824** | 1 | |
| TCS | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | | |
| | <i>r</i> | .844** | .836** | .895** | .919** | .876** | .880** | .873** | .826** | .855** | .997** | .845** | .956** | 1 |
| | <i>p</i> | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | .000 | |

Note: **. Correlation is significant at the 0.01 level (2-tailed), EIW= efficient insulating walls, WWT= waste water technologies, ART= application of renewable technology, ADL= application of daylighting, EAD= effective acoustics design, LEC= low energy cooling system, WRT= water reduction technology, ESB= energy saving bulbs, ADS= acoustic design satisfaction, VCS= visual comfort satisfaction, LDS= lighting design satisfaction, IAQ= indoor air quality satisfaction, TCS= thermal comfort satisfaction.

Table 5 shows the relationship between the variables. The result shows that the correlation coefficient values (*r*) was greater than 0.3 and the corresponding significant *p*-values are less than 0.01 for all the cases. The results shows statistically significant positive relationship between sustainable practices and building users' satisfaction with sustainable features in their buildings. This results suggest a rejection of the null hypothesis (**H₀**) and an acceptance of the alternative hypothesis (**H₁**).

4.2 Discussion of Findings

This study explored the level of sustainable construction practices in the construction industry in Lagos state. The result of the survey shows that sustainability practices that are often incorporated into building designs include the ease of access in and out of site, health, welfare and satisfaction of occupants, effective use of water during and after building construction, control of pollution and cost efficiency. The result correlate with the study of Khalfan, Noor, Maqsood, Alshambri and Sagoo (2015) and Ofori et al (2015) that construction professionals should incorporate sustainability practices in the design of buildings which would assists in making the right construction solutions in terms of materials selection, building orientation, costs and lighting system.

Furthermore, the practice of sustainability in construction is not limited on the building designers' desk. It however transcends the designing, planning and construction stage of a building and dovetails into the occupancy, operation and maintenance of the building. Therefore, the result of this survey shows that the top three sustainability practices often implemented during the construction of buildings within the study area include a reduction in the use of incandescent bulbs, innovative waste water management and the use of efficient insulating wall materials. This result aligns with results of previous studies (Blok et al., 2007; Degefa, 2010; Heberling, 2013) on the need to increase the use lighting bulbs that are energy efficient and to embrace technological solutions for effective waste water management in buildings to promote sustainable environment. In addition, the positive correlation between sustainable practices and the satisfaction of building occupants agrees with the findings of Asmar, Chokor, & Srour (2014) that the satisfaction of building occupants was influenced by good space layout, good indoor air quality and high lighting level.

5. CONCLUSIONS AND RECOMMENDATIONS

The implementation of sustainability practices in the construction industry is a global challenge as stakeholders in the industry need to achieve a balance between environmental and economic performance of building construction projects. Although in Nigeria, the

construction professionals appear to be making effort at the application of sustainable practices during construction, those at the design end of building projects appears not to be doing enough in incorporating sustainable practices in the design of buildings. This study therefore recommends that building designers should be enlightened on the benefits of incorporating sustainable concepts in building designs. Furthermore, the campaign for sustainability practices on construction projects should not be targeted at construction professionals alone but should be extended to clients of building construction projects. This approach would improve the awareness of clients of building construction projects on the potential benefits of sustainable buildings. Consequently, clients of building construction projects could express their project requirements within the provisions of sustainability.

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MOBILITY AND ACCESS TO TRANSPORTATION FOR THE RURAL POOR: EXAMINING THE ROLE OF INTERMEDIATE MEANS OF TRANSPORT (IMTS) IN GHANA

C. Asafo-Adjei, U. Iyer-Raniga and G. Aranda-Mena

School of Property, Construction and Project Management, RMIT University, GPO Box 2476, Melbourne VIC 3001, Australia

Email: s3449103@student.rmit.edu.au

Abstract: In the absence of conventional vehicles, there is the need to consider other alternatives and one such alternatives is the use of intermediate means of transport. The research examined the role of Intermediate Means of Transport (IMT) in addressing the transportation needs of the rural poor in Ghana. The study was undertaken from a qualitative perspective because of the need to ask more probing questions than just limiting the participants to a set of responses. The data was collected through in-depth interviews and focus group discussions. The questions for the in-depth interviews and focus group discussions were generated from a critical review of literature on intermediate means of transport as well as rural transport in general. The responses highlight the fact that in the absence of the conventional vehicle, IMTs can be used as the main vehicle on rural roads as they have the potential to address some of the transportation challenges particularly associated with the rural poor in Ghana. The research concludes that IMTs positively impact on the transportation of small and medium loads which are difficult for human beings to carry and, at the same time, expensive to carry by other means of transport.

Keywords: Accessibility, Mobility, Rural transport, Intermediate means of transport, Feeder Roads in Ghana

1. INTRODUCTION

It is recognised that a good transport system does not only rely on road infrastructure but also the availability of suitable vehicles. These vehicles must be at the right place and the right time, so as to serve the needs of the people or the purpose for which the road was constructed (Dawson & Barwell, 1993; Ellis & Hine, 1998; Porter et al, 2012; 2013). In the absence of conventional vehicles, there is the need to consider other alternatives. One such alternative is the use of Intermediate Means of Transport (IMT). This is defined as any form of transport ranging from human walking to large-scale transport. IMT seeks to address some of the transportation challenges particularly associated with the rural poor (Starkey, 2001). They are seen as intermediate because they are between human walking and motorised transport and can positively impact on the transportation small and medium loads which are difficult for human beings to carry and, at the same time, expensive to carry by other means of transport. The call for the use of IMTs in Sub-Saharan Africa came up strongly in the 1980's even though not much research has been conducted in this arena (Starkey, 2001; Porter, 2014).

A number of studies have identified different types of small-scale road transport carriers which are suitable for Sub-Saharan Africa. These include wheelbarrows, hand-drawn carts, animal-drawn carts, motorised three-wheelers, tricycles, motorcycles and others (Starkey et al., 2002; Starkey, 2001). These same studies have indicated that despite the suitability of the IMTs identified above, the use of IMTs have been very low in most parts of Africa. Countries

such as Ghana, Angola, Nigeria, Kenya and Zambia have attempted to adopt IMTs but are faced with numerous problems. The reasons for this low patronage include, but are not limited to, low economic activity, lack of expertise in design, high seasonality of cashflows and transport demands, inadequate supply of components among others (Starkey, 2001; Okoth, 2005; Gauthier & Hook, 2005). Most people in rural areas do not have the means to own a car and, therefore, mobility is synonymous with walking or intermediate means of transport (IMT) or, better still, public transport. Transport services in most rural settings along feeder roads are delivered by way of animal-drawn carts, bicycles, motorcycles, tricycles or taxis. These are the main transport for the rural population in most countries. An interesting observation is that IMT as a means of transport is often ignored even though it plays a critical role in the mobility of rural people. While providing access to markets, healthcare facilities and educational facilities, IMTs also provide employment to the operators of these IMTs (Porter, 2002a; Iga, 2002; Okoth, 2005).

Despite the contribution or the relevance of IMTs as a means of transport, African governments have not given it the needed attention. Currently tricycles and motor cycles imported from China and India seem to be making headway as far as rural transport is concerned. The assumption underlying the construction of roads in developing countries is that if roads are constructed, automatically the private sector will take advantage by developing transport services along the road. This continues to be a failure as in most cases the roads have been built but only a few number of people are actually utilizing the roads as there are no conventional transportation systems. It is important for governments' in developing countries to look for innovative ways of address the transport challenges facing the rural people through proper and effective planning which was hitherto not the case. Therefore, the study examines the issues of mobility and access transportation in rural Ghana by critically analysing the role that IMTs can play.

2. LITERATURE REVIEW

2.1 Government and Transport Infrastructure

A country with a sound infrastructure base is able to attract investment growth and expansion of its economy as it becomes very attractive for further investment (OECD, 2006; World Bank, 2008). Transport infrastructure has been in demand for many developing countries; there is the need for new construction and the maintenance of the existing roads. Lack of road access deprives many people access to educational, health care and other economic activities. Poor transport infrastructure are the causes of many deaths, for this reason, transport needs have become major discussion for consideration under the United Nations post 2015 agenda (Doczi, Dorr, Mason, & Scott, 2013). Sound investment in the transport infrastructure and services contributes to economic growth; because transport infrastructure is a key to tourism development. There is enough evidence that countries with high level of investment in transport infrastructure have comparative high volume of trade. Generally, high investment in transport infrastructure also leads to lower transport cost (Canning & Pedroni, 1999). Infrastructure availability influences decision made by individuals, households and entrepreneurs. The cost of transport, for instance, serve as incentives for firms and individuals to locate or relocate activities to a given place. Transport is a necessary input for wealth-creation and transformation of economies from lower income levels to higher ones.

Across Africa, banks, clinics, hospitals, secondary schools, extension agents, produce markets and the likes tend to be located in larger rural service centres, usually served by

paved roads. For women, the financial, time and, in some cases, cultural constraints on mobility (and thus on access to these facilities), can be particularly restrictive. A review of three aspects of access to medical care, markets and credit facilities illustrates the difficulties, frustrations and costs of off-road residence. Villagers emphasize the need for access to health care in emergencies, but health facilities of any kind are rare in off-road locations. In Morocco, places with better rural roads reportedly have twice the use of health care facilities (World Bank, 2000:78). Ironically, off-road inhabitants are often the most in need of medical assistance, since water supplies are frequently poor, and poverty levels are above regional averages. Research in Ghana and Uganda on Participatory Poverty Assessment (World Bank, 2000) suggests that vaccination programs sometimes miss off-road settlements, exposing these residents to further risk. In a nutshell, ill-health is most often worse in rural regions and very poor during wet seasons precisely at a time where travelling conditions even for pedestrian are worse off due to poor roads. This problem constantly persist in Ghana and among many other countries in Africa, although in less densely populated areas the distances to hospital are often much greater and it may be impossible to make the journey at all.

According to Porter (1995; 1997) due to poor and inaccessible roads traders are often reluctant to move into remote areas to do business unless suppliers from accessible areas are insufficient. Moreover, when urban-based traders visit areas where access is difficult, the competition from other traders is likely to be limited and prices achieved by local farmers will thus be poor, especially for perishable produce (Lyon, 2000). Indeed, market decline and closure in off-road locations appears frequently to be one of the unforeseen effects of road construction programmes. In some parts of sub-Saharan Africa, there are cultural constraints which restrict women's movements. In addition to physical and economic constraints, off-road market closures following road construction have had a particularly severe impact on women living off-road. When vehicles are available, off-road journeys to market by motor vehicle tend to be more expensive, because of the increased costs of maintenance. In coastal Ghana, journeys off paved roads are roughly double those along paved routes.

2.2 The role of IMTs in addressing transportation issues

IMTs provide solutions to the numerous transportation challenges faced by people to reduce labour cost associated with transport (Starkey, 2001). They are seen as intermediate because they are between human walking and large-scale transport. IMTs can improve transport of both small and medium loads which may be a bit difficult for human beings to carry. The recognition of the potentials of IMTs in Sub-Saharan Africa was discovered in the 1980's even though it is only in recent times that research and development have been enormous (Starkey, 2001; White et al., 2000). The dominant IMTs identified in the late 1980's include bicycles, tricycles, ox-carts and water carriers. IMTs have been adopted extensively in Asia. It is yet to make similar impact in Africa due to differences in population density, income levels, industrial base, taxation and cultural factors (Ellis, 1997).. As earlier indicated, most people in rural areas do not have the means to own a car and therefore mobility is synonymous with walking or IMTs or, better still, public transport. Transport services in most rural settings along feeder roads are delivered by way of animal-drawn carts, bicycles, motorcycles, tricycles or taxi (Fasakin, 2001; Porter, 2002a; Iga, 2002; Okoth, 2005, Lopes, 2005).

2.3 Benefits of IMTs

IMTs provide solutions to the numerous transportation challenges faced by people to reduce labour cost associated with transport (Starkey, 2001). IMTs can improve transport of both small and medium loads which may be a bit difficult for human beings to carry. The recognition of the potential of IMTs in Sub-Saharan Africa was discovered in the 1980's, even though it is only in recent times that research and development have been enormous (Starkey, 2001; White et al., 2000). Most people in rural areas do not have the means to own a car and therefore mobility is synonymous with walking or IMTs or, better still, public transport. An interesting observation is that IMT as a means of transport is often ignored even though it plays a critical role in the mobility of rural people. IMTs present numerous benefits to the rural people which studies have confirmed (White et al., 2000; Gauthier & Hook, 2005; Starkey, 2007). For example, these studies have found that IMTs represent a reliable means of transport both for goods and human beings. While providing access to markets, health care and educational facilities, IMTs also provide employment for the operators (Guyer, 1997; Yunusa, 1999; Fasakin, 2001; Porter, 2002a; Iga, 2002; Okoth, 2005, Lopes, 2005).

2.4 Challenges affecting the adoption of IMTs

IMTs are not new in Africa as several countries such as Angola, Ghana, Kenya, Nigeria, Uganda, Zambia and others have attempted to adopt them, even though they have been confronted with numerous challenges. A number of challenges hamper the adoption of IMTs, particularly in Africa. Literature reveals that economic activity, lack of expertise in design, high seasonality of cashflows and transport demands, inadequate supply of components constitute some of the challenges affecting the adoption of IMTs in most developing countries (Starkey, 2001; Okoth, 2005; Gauthier & Hook, 2005). The influence of gender in the adoption of IMTs seems to be posing a challenge to its adoption in some countries such as Ghana (Porter, Blaufuss & Acheampong, 2012). It is also believed that the adoption of IMTs is challenged by such issues as culture, gender, cost, poor road network and others (Porter & Lyon, 2006; Starkey et al., 2007; Porter et al., 2012). In addition to the above, most government officials in Africa look down on IMTs as means of addressing the transportation problems facing rural people (Starkey, 2001). For example, the provision of poor or low quality equipment has been a very significant challenge for most of these countries, especially Ghana. Most of the equipment provided for the implementation of the Village Infrastructure Projects were all inappropriate (Porter, 2002; Porter and Lyon, 2006). It is important for governments in developing countries to look for innovative ways of addressing the transport challenges facing the rural people through proper and effective planning which has hitherto not been the case.

3. METHODOLOGY OF THE STUDY

For the purposes of achieving the study objectives, a qualitative approach was adopted. The study was undertaken from a qualitative perspective because of the need to ask more probing questions than just limiting the participants to a set of responses. The qualitative approach was adopted because there was the need to get a detailed account of the key issues affecting rural transportation and intermediate means of transport. This approach enabled the participants to freely discuss these issues without any fear or limitation. The interviews and the focus-group discussions focused on the what, why and how questions. The study sought

to explore the issues surrounding access and mobility of the rural poor, hence the need to adopt an approach which could drive this agenda. As indicated by Teddlie & Tashakkori (2003), qualitative studies are very relevant when a study seeks to explore or gather in-depth understanding of a particular issue such as this.

The study relied on data from both primary and secondary sources. With respect to the primary data, the study collected information through in-depth interviews and focus group discussions whereas the secondary information was gathered from Annual Reports, policy documents, and research reports on rural transport and intermediate means of transport. In all, thirty (30) respondents participated in the study and they were made up of the community people such as community leaders, chiefs, opinion leaders and other members of the community and selected engineers. The study specifically interviewed ten (10) Road Engineers in the Head Office of Department of Feeder Roads while the focus-group discussions featured twenty (20) participants who were mainly farmers and indigents who live around the selected roads. The Engineers were selected from Department of Feeder Roads whereas the focus group participants were selected from Abekoase, Obuasi, and Subriso. These are communities along some feeder roads in the Eastern Region of Ghana. The engineers were purposively selected due to the role in rural transportation whereas the focus group participants comprising of community elders, and opinion leaders were conveniently selected from the communities above. The respondents participated willingly when they were informed of the purpose of the study. The Engineers were selected purposively because they exhibited the characteristics expected to answer the research. It made it possible for the researcher to reach the target sample within a very short time. Purposive sampling is normally used to select information-rich cases in qualitative studies (Patton, 2002). Scholars such as Creswell & Klassen, Plano Clark & Smith (2011) have shown that purposive sampling involves the selection of individuals or groups who have experienced an issue of interest. Quite apart from the above, it was also important to consider the willingness and ability of respondents to participate to get the right answers.

The questions for the in-depth interviews and focus group discussions were generated from a critical review of literature on Intermediate Means of Transport as well as Rural Transport in general. The data gathered from the interviews and the focus-group discussions were analysed qualitatively by inspecting the data for recurrence. For the sake of clarity, the contents of the interviews and focus-group data were grouped according to the study themes. As indicated by Wilkinson (2004), content analysis presents a comprehensive overview or summary of the data collected making it possible for researchers to have a broad view of the data collected. The content analysis was undertaken for the purposes of coming out with the key themes as they occur in the data collected. These themes were grouped together in view of coding which made it easier for further conclusions to be drawn. Based on the above the findings were then compared to the literature.

4. ANALYSIS AND DISCUSSION OF FINDINGS

IMTs have emerged as popular interventions to address the challenges associated with mobility and accessibility particularly in developing countries. The findings gathered from the interviews and the focus group discussions are presented in this section, which contains information on the role and use of IMTs, benefits of IMTs and the challenges associated with the use of IMTs.

4.1 The role and Use of Intermediate means of transport

IMTs are generally seen as anything between walking or motorized transport and therefore this section analyses the views of respondents in respect of the role and use of IMTs in Ghana.

On the role and use of IMTs, an engineer indicated that:

“IMTs are for short distance. They are most appropriate to use because you don’t need to get a certain number of people. In terms of short distances, IMTs are needed. Eventually, IMTs are used for commercial purposes, therefore I see IMTs as good transport system on rural roads to carry goods”.

Adding to that, a female respondent revealed that *“IMTs are not that common and few ones are used by men whereas we the women and children walk either to farm or school”* (AAF).

Another respondent who happens to be an engineer also said: *“IMTs can serve several purposes as it can even be used in times of emergency. Some communities I have visited use IMTs for emergency services. From my experience, I feel it will be useful for the rural community. They can be used to carry goods, children, and other passengers”*

An interviewee (BOM) stated that *“IMTs are very important and, if managed properly, they will serve as one of the best solutions for rural transport services, because people will move from head loading practices which can greatly affect their health”.*

On the issue of IMT suitability, some respondents indicated that IMTs are suitable in communities where conventional transport systems are ineffective or absent. To these respondents the suitability depends on the availability of other forms of transport as well as the nature of the road network. A respondent reiterated that: *“In communities where they have no commercial means such as buses and taxis, IMTs can be used as a means of transport for both human beings and goods. They can serve emergency purposes. I’m saying this because it is used to convey pregnant women in the rural areas”* (CSM).

According to the responses IMTs have been adopted in several African countries which implies that Ghana can also adopt these, provided the right framework or policy is developed. Respondents see the adoption of IMTs on rural road as a good as it is largely cheap, economical, affordable and user-friendly. Thus, in the absence of the conventional vehicle, (like buses, taxis, etc.) IMTs can be used as the main vehicle on rural roads. All these can be achieved if road planning considers transport as well. Roads are meant for vehicles so there is the need to investigate the type of vehicle that will be using the road.

4.2 Benefits of IMTs

Adding his voice to the above, an engineer illustrated how IMTs can be beneficial in the fight against poverty in rural areas. He shared this: *“to the rural folks, whether it is bicycles, camel or donkeys, the most important thing is that it relieves the hardship from the rural folks. So instead of carrying it on the head, these non-motorised means will help. It saves them a lot of time”.*

Some respondents noted that IMTs, such as bicycles, are very helpful for school children and farmers especially those who travel distances every day before they get to school or farm. A respondent opined *“Oh, bicycles are very good for school children and farmers, as it is a good way of keeping fit on daily basis”*.

Respondents also added that IMTs provide alternative means of transport for the rural who cannot afford to use motorised transport. A respondent shared his thoughts *“it is very good for those of us who are poor because... we cannot afford to use motorised transport”* (BOM).

As an alternative means, some respondents revealed that IMTs are very beneficial in times of emergency. A respondent who shared his experience had this to say *“in my community we use IMTs a lot for emergency services. Over here bicycles are sometimes used to carry pregnant women who are about to deliver to nearest hospital because of the absence of conventional vehicles. Had it not been this, am sure a lot of people would have lost their lives”* (CSM).

In addition, a respondent indicated that *“IMTs are very useful to those of us far from the main road because the roads that link our community to the main feeder road are very bad and therefore IMTs do a great job for us”* (BOF).

Though the responses point to the fact that only a limited number of people use IMT, the respondents were quick to add that it presents significant benefits to the users as evident in the responses presented above. What is more interesting is the fact that IMTs can be very beneficial in times of emergency which is an indication that they can be promoted to make it more useful than it is now.

4.3 Challenges with the use of IMTs

Asked why IMTs are not making the necessary impact in Ghana, respondents indicated a number of challenges confronting their promotion and subsequent adoption. A respondent shared that: *“even though the cost of acquisition is not high, as compared to motorized transport, there is the need for subsidies to be provided because a lot of them cannot afford to buy on their own. Loan schemes can contribute in this arena”* (BOM).

In addition to the above, a respondent noted that: *“The reason why we don’t use IMT is the fact that we are poor and we are unable to finance the purchases. Unlike vehicles or motorized transport that have several financing mechanisms, IMTs are not like that and so if you don’t have the money, you need to wait until you get it”* (AAM).

An engineer who had an issue with that quality of equipment in the market and poor nature of some of the roads are also affecting the adoption of IMTs. He indicated that *“most of the supporting equipments are of inferior quality and therefore it doesn’t last. Again, most of the rural paths or roads are in bad shape such that donkeys or other animals will struggle to ply”*.

An engineer who complained about the nature of the road had this to share: *“Apart from Subriso, all the communities mentioned earlier are not in a good shape. We are even affected by it as well especially during the raining season”*. Adding to the above, a respondent revealed that *“we find it difficult to use IMTs because of the nature of the roads in our*

community. For me when the road is good I will use IMTs but in this deplorable state I won't risk my life" (BOF).

Some of the respondents indicated that IMTs are not making the necessary impact because of cultural differences. Some of the respondents believe that the use of IMTs, particularly animal driven carts and the likes, are very alien to them and therefore it will be very difficult for them to adopt, irrespective of government's intervention. A respondent had this to say *"Oh as for our community, people will laugh at you when you decide to use animal-driven carts. In fact, they will give you all sorts of names because it is alien to our culture. Our culture is different from that of the Northerners so that is why it is not common here"* (AAM).

In addition to the above, a respondent stated that though IMTs can be used by all people, women and children are often discouraged about their use, because it is perceived that men are the ones who are supposed to use them. He had this to share: *"we don't encourage women and children all because it is not good for them IMTs. In our culture women don't use these things"* (CSM). Again a respondent noted that *"because of our household chores we do not get enough time to learn how to ride a bicycle and other IMTs and also one of the challenges we, as women, face. This significantly affects the adoption of IMTs"* (CSF).

The responses show that IMTs can be very useful in addressing the challenges faced by the rural poor in Ghana, though certain issues are affecting the adoption and need to be effectively addressed.

4.4 Discussion of Findings

The responses above point to the fact that IMTs are very relevant for rural transport and can be used for both short and long distances, depending on the area and activity. Respondents believe IMTs are appropriate because they can be used anytime and for commercial purposes in some cases. It is pretty clear that IMTs provide significant benefits to the rural folks, from transportation of goods to improving health care. The responses on the adoption of IMTs are not surprising as previous studies have hinted the extent to which countries in the Sub-Saharan Africa have adopted IMTs as a reliable means of transport, both for goods and human beings. This has been supported by numerous studies (Ellis, 1997; White et al., 2000; Gauthier & Hook, 2005; Starkey, 2007).

The challenges, as revealed, differ from what previous studies have found. Whereas some literature have found low economic activity, lack of expertise in design, high seasonality of cashflows and transport demands, inadequate supply of components (Starkey, 2001; Okoth, 2005; Gauthier & Hook, 2005), as key challenges affecting the adoption of IMTs in Ghana and some other countries, this study revealed poor nature of some of the roads, acquisition costs, cultural differences, lack of time, location and others. This shows that though the challenges identified in literature may have existed in the past, recent dynamics may have shifted the attention from them. For example, respondents believe that culture is playing a key role in the adoption and promotion of IMTs in Ghana. The adoption rate in the Northern part of Ghana is higher than the Southern part, primarily because the Northerners have been using IMTs, whereas the reverse is the case in Southern Ghana. Again, the responses show that the limitations in the use of IMTs in the selected communities can be attributed to the perception that IMTs are men's prerogatives and therefore women are not expected to use them.

IMTs generally offer a complementary transport mode for the rural people, particularly for personal travel and carrying loads. Though mostly used by men, because women and children are normally discouraged from using them, a situation which does not prevail in the southern part of Ghana. This to some extent confirms the views of some scholars on the influence of gender on IMT adoption (Porter, Blaufuss & Acheampong, 2012). The findings, as presented above, show that IMTs continue to play key roles in many areas particularly in the hinterlands despite the costs involved. Notwithstanding preference for motorized transport by the respondents, the contribution of IMTs cannot be discounted. Scholars such as Starkey et al. (2007) have indicated that the adoption of IMTs vary according to the regions, due to reasons such as culture, gender, costs, poor road network and others (Porter & Lyon, 2006; Starkey et al., 2007; Porter et al., 2012). Unlike motorised vehicles which are financed by several institutions, IMTs are normally supported by NGOs which largely affects its adoption.

5. CONCLUSIONS

IMTs are assuming significant roles in developing countries such as Ghana. The study has shown that IMTs can be very significant to the rural poor in Ghana though there are a number of issues facing their adoption. These include, but are not limited, to low income and cultural barriers in most of rural communities. It is clear from the above that the adoption rate varies depending on the location of the country. For example, the adoption rate in the Northern part of Ghana is higher than the southern part, primarily because the northerners are used to them. On the other hand, IMTs are not common in the southern part because the people prefer motorized transport to IMTs, primarily as a result of their cultural orientation. Most people prefer motorised transport because it is fast and it carries a lot of goods and requires little human efforts as compared to IMTs. Some of the respondents also noted that they prefer motorised transport to IMTs because IMTs are kept for individual use. An interesting observation was the fact that the closer a village or community is to the main road, the lesser the use of IMTs. This implies that IMTs are very relevant and supportive to communities in the hinterlands, as compared to those closer to main roads. In the absence of conventional vehicles, emergency situations, such as carrying patients in critical condition, most rural poor communities resort to innovative approaches by using bicycles, pedicabs and other IMTs to provide these essential services.

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ADAPTING SUSTAINABILITY IN PALESTINE; BARRIERS AND MOTIVATORS IN THE IMPLEMENTATION OF GREEN ARCHITECTURE

H.Sabboubeh and P.Farrell

University Of Bolton, Deane Road, Bolton, BL3 5AB, UK

Email: hebasabboubeh@gmail.com

Abstract: As a developing country under occupation, Palestine has limited resources but huge development needs. Whilst construction is a main driver for the economy, it is also the main source of pollution and the largest consumer of its natural resources. Palestine has no fossil fuel, and has to import petroleum products and electrical energy from Israel. This study aims to create better understanding and classification of barriers and motivators in the development of sustainable construction in Palestine, and links these to a need to implement green architecture.

The main data collection instrument is questionnaire survey, that received 43 replies from construction professionals in Palestine. The questionnaire design was founded on issues in the literature; data reliability was supported by interviewing five Palestinian experts in sustainable construction. Participants agreed that barriers listed in literature were applicable in the context of Palestine. Accordingly, financial, educational, cultural, political and technical constraints were ranked. It is recommended that efforts at all levels: environmental, educational, political and governmental should be combined. Industry stakeholders supported by authorities should formulate legislation, standards and codes to enhance sustainable construction practices, together with training courses, campaigns and workshops on green buildings. Authorities should introduce financial incentives for green buildings.

Keywords: Green architecture, Palestinian construction sector, sustainable construction.

1. INTRODUCTION

Green architecture is defined as "... a current design attitude which requires the consideration of resource reduction and waste emissions for the period of the building's whole life cycle" (Wang et al., 2005).

Energy is considered to be influential in every life aspect, and plays a key role to support the development of economies and the prosperity of the communities on one hand; on the other hand it adversely affects the environment, especially in the case of increased usage of energy where the environment cannot disencumber itself of the negative effects of unrenowable energy consumption. Therefore, reducing the energy consumption is a public responsibility of society and institutions (Brundtland, 1987).

Palestine has a tenuous environment due to: high levels of land degradation and loss of land to Israeli settlements; high price of energy; shortage of fresh water, and; rapid urbanization arising from population increase with its associated problems of air pollution and high pressure on the existing infrastructure such as waste management systems (Enshassi and Mayer, 2005). The Palestinian National Authority (PNA) have made some initiatives to put in place some key stones to promote sustainable development. However, these initiatives are not

enough to promote a strong sustainable construction sector. The success of sustainable construction is highly dependent on the desire of construction industry stakeholders to be committed to change and work towards conformed objectives and goals (Ofori et al., 2015).

1.1 Natural resources in Palestine

There are no fossil fuel resources, and the PNA has to import 100% of petroleum products from the Israeli market and around 92% of electrical energy from the Israeli Electric Corporation; that costs more than 385 million Euros per year (Yaseen, 2008). Israel controls the import of energy and prevents open trade of electricity and petroleum products between Palestine and any other country (Yamin, 2015). The cost of electricity is a huge debt burden and a major concern of the public and private sectors, especially with the political risks that electricity supplies may be cut off or Palestinian energy distributing companies confiscated (Aljazeera, 2014).

According to the International Middle East Media Center (IMEMC), since year 1967, there has been many Israeli resolutions that have confiscated natural resources, including underground water. Palestine has been unable to secure permits to dig new wells. This is an old practice which means once a well is dry, there is no more water; inside Israeli settlements the drilling is free-flowing as it notable from greenery (IMEMC, 2007). Political conflicts have led to the destruction of large parts of the water utilities in the West Bank, such as wells, irrigation systems, reservoirs and water pipelines. This results in a major deficit in underground reservoirs, and an increasing difficulty for the Palestinian population to have access to drinking water on a daily basis (Issac et al., 2004).

2. THE LITERATURE

As populations grow and seek higher standards of living, there is increased consumption of energy. Construction is one of the most important drivers of job creation in Palestine; it is also the largest sector in the Palestinian economy. Construction has grown at an annual rate of 20.5% and made the largest sectorial contribution to overall gross domestic product (GDP) growth since year 2006 (Trust, 2013; Enshassi and Mayer, 2005). Construction has the potential to nearly double its annual contribution to GDP to reach \$2.8bn per year and create up to 64,000 new jobs through to 2030 (Trust, 2013). However, construction is a high contributor to environmental pollution, due to its dependency on conventional machines, material and transportation, in addition to the large quantity of waste produced during the life cycle of buildings and a lack of suitable areas to dump or recycle (Salameh, 2012). Demolition that arises from political disputes places extra pressure on natural resources and energy consumption.

2.1 Motivators in implementing green architecture:

The sustainable construction movement is reshaping the construction industry and its market share is rising internationally (Ahn and Pearce, 2007). Hydes and Creech (2010) stated that the schemes and concepts for sustainable construction are already there, the trick is to control the safety of businesses and dare to innovate. There are many benefits and motivators to encourage societies to go green. Motivators for green architecture are classified thus:

Economic (Financial) and market motivators

Green buildings are more popular and sellable, and there is often customer demand and a willingness to pay for it. Cruickshanks (2012) pointed out that green architecture improves property value. The purpose of all businesses is to ensure they can persistently generate more value; while the main concern of green architecture is environment, developers will always insist it proves its financial viability (Robichaud and Anantatmula, 2011). A study carried out by Fuerst and McAllister (2010) investigated the selling price of buildings with environmental certification on commercial real assets, and found that there is price raise of 10% and 31%. The same fact was confirmed in a later study by Chegut et al (2013), who pointed out that buildings with green characteristics have a positive impact on rental and sales prices, with an increase per square meter between 21 and 26%.

Yudelson (2009), Häkkinen and Bellon (2011) and Langdon (2007) agreed that it is predicted that sustainable construction will have higher initial cost than the conventional construction because of the increase of the unfamiliarity of the design, which increases consultant's fees, and the cost of construction assessment tool documentation. However, the cost is returnable over the project life cycle during maintenance and operation phase (Häkkinen and Bellon, 2011; Pearce, 2008).

Social motivators

Green lifestyles have turned out to be fashionable and socially attractive these days which has formed belief about sustainable demand and has influenced community behavioural intentions and motivations (Kaiser and Scheuthle, 2003).

Studies in behavioural sciences according to Berit (2010) and Heerwagen and Orians (1993) suggest that green buildings sustain: the relationship with nature; sense of community; behavioural control and choice; opportunity for habitual exercise; sensory variability and privacy when needed. McGraw Hill Construction (2013) agreed with Kibert (2007) that social sustainability enhances some social facets such as well-being feelings, aesthetics, health and comfort, safety, security and occupants' satisfaction, suitable living environment and social integration. Behavioural theories support arguments that the features and attributes of buildings are strongly linked to wellbeing of occupants such as ensuring natural ventilation, suitable temperature, and the ability of buildings to adapt to environments to suit personal needs and preferences of users (Heerwagen and Orians, 1993).

Environmental motivators

Construction affects the environment due to the extraction and the use of materials during lifecycle of buildings. Construction activities start with the utilization and processing of raw materials, extending to the supply of inputs such as: energy, water and equipment, and terminate with demolition phase and waste disposal (Gundogan, 2012). Hence, sustainable construction reduces the negative impact of buildings and that is a motivator for the green buildings.

According to a study carried out by United Nations Environment Programme (UNEP, 2009), around 30% of greenhouse gas emissions are produced by buildings. Intelligent design of

green buildings, can lead to a saving of about 12% in water. Studies have shown around 40% of the solid waste produced, arises from population activities when using buildings (Karzam, 2016).

Organisational motivators

Promoting sustainable practice in organisations leads to change in organisational culture. Green buildings may enhance productivity, product quality, increase innovation and time saving (Heerwagen, 2000). Organisations can integrate sustainable strategies into their strategic plans. Zhang et al. (2010) argued that the meaning of green strategy is that organisations can gain sustainable advantage by contributing to environment savings as a part of their social responsibility. This can have an impact on financial performance, because it leads to better employee well-being and satisfaction, with improved morale and productivity.

2.2 The barriers to green buildings

Barriers to green architecture could be categorized as following:

Economic barriers

Higher initial cost is cited as one of the top challenges. Green architecture solutions may be abandoned because clients are concerned about higher financial risks (Nelms et al., 2005). It is important to realise that design fees are largely paid before implementation phases start, and that is before clients decide with certainty whether projects will be developed or not (Chegut et al, 2013). Hence, design fees are very high risk investments.

Educational/ awareness barriers

A survey was carried out in Kuwait by Al Sanad et al. (2011), to measure the level of awareness of industry leaders and their understanding and use of sustainable construction strategies. The results showed that whilst there seems to be a good level of awareness, that is not currently well reflected in design and construction practices. On the other hand, engineer Hani Al Hassan (2011) stated in an interview, that the current scattered buildings in Palestine reflect the ignorance and lack of concern and awareness regarding the environment; these buildings do not interact with the surroundings and designs neglect the orientation of buildings in four directions.

Market barriers

Currently in Palestine, the availability of delivered green buildings is very limited. This makes the sustainable buildings market very weak, and there is a lack of exemplar or flagship projects that can be held up as best practice. Furthermore, there is poor availability of sustainable construction materials, technology and skills, and therefore procurement options are very much restricted.

Organisational and legal barriers

The Palestinian National Authority (PNA) and municipalities have basic rules and regulations in regard of green architecture and its development in the country, calling for the inclusion of the environmental conditions in building permits and placing emphasis on it (Hasan, 2011). However, most Palestinian construction companies have weak management systems and processes, so at early stages of development a decision is often made not to go green.

3. METHODOLOGY

A detailed literature review was carried out, to investigate barriers and motivators for implementing sustainable construction in general. A questionnaire was used as the main data collection instrument. A preliminary draft was evaluated by experts and academics in Palestine, to ensure that the questions were valid, clear and precise; subsequently, the questionnaire was modified. Methodological procedures and ethics were adapted from the work of Farrell et al (2016). The questionnaire assumed seven categories which are based on the literature review as follows: people impact, cost impact, time impact, technology impact, market impact, legal impact, political impact. The selected sample were professional people that are working in the construction industry in Palestine (engineers, architects, contractors, academics, developers and construction materials suppliers). Each category was measured using multiple questions; 61 questions across the seven categories. 70 questionnaires were distributed in all districts in Palestine, and 43 replies received representing a response rate of 61%. Interviews were carried out with five key persons in sustainable construction in Palestine. Interviewees were selected according to the recommendation of the Engineers Association of Palestine and from the lead author's experience in the construction field. The aim of these interviews was to collect supplementary data and to cross check the findings of the survey.

3.1 Scoring method

Participants were asked the extent to which they agree or disagree that given barriers and motivators apply in Palestine. A quantitative score of 0 (zero) was allocated to strongly disagree, 1 = disagree, 2 = neutral, 3 = agree and 4 = strongly agree. To analyse the responses, the arithmetic mean was calculated using the following standard:

- ❖ High level of agreement: if the arithmetic mean is more than 2.0.
- ❖ Medium level of agreement: if the arithmetic mean is equal to 2.0.
- ❖ Low level of agreement: if the arithmetic mean is less than 2.0.

Arithmetic means were converted to a percentage score to aid ease of understanding by multiplying by a factor of 25, such that for example a mean score of 3 out of 4 became 75%. An overall mean percentage for the study was determined, and each of the seven categories ranked from most severe to least severe.

4. RESULTS, FINDINGS AND DISCUSSION

For brevity in this paper, results and discussion are limited to barriers; it is hoped to disseminate results about motivators in future work. Table 1 illustrates results for the seven perceived categories of barriers to sustainable construction development in Palestine; the table shows in rank order the arithmetic mean for each category.

Table 1: Barriers overall results, arithmetic mean and ranking

| Category | Number of questions/category | Arithmetic mean | Percent | Ranking |
|-----------------------------|------------------------------|-----------------|------------------------|---------|
| Political situation | 6 | 3.21 | 80% | 1 |
| Legal aspects (legislation) | 7 | 3.08 | 77% | 2 |
| Market | 6 | 2.93 | 73% | 3 |
| People | 12 | 2.89 | 72% | 4 |
| Time | 11 | 2.77 | 69% | 5 |
| Technology | 5 | 2.75 | 69% | 6 |
| Cost | 14 | 2.69 | 68% | 7 |
| Summary | 61 total questions | | 72% overall mean score | |

The overall mean score is 72% which equivalent to a score of 3, therefore in average people ‘agree’ the suggested barriers are present. That would seem to suggest that there is a lot of work to be done in Palestine to break down these barriers.

4.1 Discussion

The study findings show that participants believe that the main obstacle to sustainable construction implementation is the political situation, which scored 80%. Although the Palestinian National Authority (PNA) was established more than twenty years ago, Israeli occupation impedes development. Palestine has limited sovereignty on its land, borders and resources. It is recognised that this barrier is not easily overcome. Investors, developers and construction leaders are often cautious and afraid to bring new ideas to the table, and this confirms the view of Halas (2016), that future development depends on the ability of the PNA to control its own resources, without dependence on foreign aid. There is consensus from participants that occupation inflicts damage upon urban landmarks, especially in the Gaza strip (Wattan, 2009). Furthermore, the construction industry and its supporting technologies are restricted, since the PNA do not control policy on the trade movements across borders (Yaseen, 2008). Moreover, 88.3% of the sample think that access difficulties cause extra cost, since there are several check points within Palestinian territories, and closure may occur anytime, thus requiring that alternative longer routes have to be taken for materials, plants, and labour.

The second barrier was legislation. Palestine is a newly developing country with limited capacities, managerial skills, financial resources, and experiences; in addition legal and administrative systems are limited in their support of development, and codifying and

formulating strong regulations (Enshassi and Mayer, 2005). Williams and Dair (2007) identified lack of sustainability measures by stakeholders as the most commonly recorded barrier. The attainment of sustainable development needs to activate the cooperation of the international community in both capital and expertise, and needs the application and development of systems for economic and environmental strategies (Enshassi and Mayer, 2005).

There are clearly, multiple stakeholders and local bodies in charge of the environment, which creates complexity in relations between different programmes. The Palestinian construction industry has not yet succeeded in application mechanisms; big efforts are there but they are not interconnected with each other and there is weak coordination between different parts of the country to provide the possibility of building green materials becoming available locally. Moreover, questionnaire participants agreed that a lack of strategic planning hinders the start of a sustainable construction movement in Palestine, and there are inadequate institutional structures at a local level.

The country should have mandatory controls on the use of new buildings licences. New construction rules should be set for projects at early stages of development and the licensing phase. According to Karzam (2011) as sustainable construction is not compulsory in Palestine, authorities should provide economic incentives that include tax reduction on green building related goods, and encourage easy availability of finance; the private-sector should provide incentives such as discounts on green buildings' insurance fees, and give preference to green buildings housing loans. High interest rates are a lead obstacle in promoting sustainable development, and banks may restrict loan facilities for such projects, especially when any predicted gains may not come to fruition (Yaseen, 2008). Enshassi and Mayer (2005) agreed with Karzam (2011) and confirmed that sustainable construction should be a natural result of legislation and sustainable development. A lot could be achieved by integrating the sustainable concept into management systems including planning and design, and action must include long-term structural change in policy frameworks, market incentives, technologies and legislation. Authorities should form new codes to protect the industry. 88.5 % of the questionnaire participants think that there are no clear regulations to protect national products and thus enhance a sustainable materials industry.

An interesting finding of the study is that the third barrier for implementing sustainable construction is markets, which conforms with Williams and Dair's (2007) work that identified the lack of demand by clients as a commonly recognised barrier for implementing sustainable construction. People in Palestine are not familiar with green architecture, and not aware of its benefits. The importance of "doing the right thing" as a motivator for green building is not common, as sustainable behavioural patterns are a long way from being achieved. "Doing the right thing" may explain why the green building market has matured internationally, and has become more visible and standard in some countries; market-driven factors may have supplanted the early-adopter vision as a trigger for choosing sustainable construction (Benjamin, 2016).

A further problem related to market, is the availability of sustainable materials. Locally manufactured green building materials are very limited, and successful projects usually need products to be imported from elsewhere (Osaily, 2010). There is industry dependence on using natural unrennewable resources such as natural stone, and quarries and stone crushers are scattered all over Palestine. These pose environmental threats in many ways: the uprooting of vegetation which leads to a sharp decline in pastoral and agricultural area, and

impeded biodiversity including in surrounding areas, as has happened in Seir, which contains more than 30 species of rare plants threatened with extinction as a result of quarries. Quarrying is also changing the topographic features of land by making huge cavities, with depths varying from 10 to 40 meters, causing a distortion of the landscape of the earth. There can be weak compliance with occupational health and safety matters in these quarries (Wafa, 2011), and consequently there is a threat of collapse to surrounding houses. The survey also showed that 86% of the sample think that there is too little interest or demand for sustainable construction by both clients and designers. There is belief that green labelled products are used for marketing reasons more than for environmental conditions. Also, most developers think that there is absence of distributors and importers for the sustainable materials, in addition to restrictions and obstacles imposed on importing materials, including high import taxes. 83.7% of participants expressed the view that Palestine local raw materials are not able to support the construction of green buildings. Environmental alternatives are often unavailable or substantially more expensive than in other countries. There are no strong regulations to protect local products.

That leads directly to the fourth barrier (people impact), as there is a lack of awareness of sustainable construction, which accords with the findings of Häkkinen and Belloni (2011). There are no live examples for green houses or “demonstration projects”, and people are still not familiar with the idea of green buildings and sustainability. Every new idea is challenging in the beginning, but as communities realise benefits they may become established. Karzam (2012) argued that unfortunately, the Palestinian community are not aware of the necessity and importance of developing green architecture, which has the potential to make a significant contribution to economic growth. 76.7% of participants believe there is an absence of sustainability culture and there is resistance to change. Palestinian society is very cautious and there is a clear reluctance by all parties to try new ideas, and thus avoid risks. There is too little evidential data about capital and running costs associated with environmental improvements, and hence clients, developers and other organisations can be reluctant to invest.

Time barrier was the fifth in the study list, and scored 69%. Time barriers were: weak time planning skills; time for training workforce; time risk in providing sustainable materials as they are not readily available, and; a lack of exemplar buildings in Palestine, that facilitate templates to prepare accurate plans. It can be argued that time constraints can be overcome if there is careful planning.

The effect of technical barriers is ranked as the sixth barrier. There is a lack of technology implementation, and a lack of trust in technology which perhaps derives from too little experience. Rydin et al (2006) asserted that designers and developers in the construction industry are not confident in their own knowledge about sustainable construction. Whilst the availability of technical information on sustainable construction is substantial for designers, contractors responsible for implementing designs, have problems gaining access to such information at an affordable rate (Osaily, 2010). Construction industry leaders are not open to admit that there is shortage of experiences and skills related to technologies in sustainable construction in Palestine. Inadequate professional training among engineers on new applications and schemes in sustainable construction and green architecture is also an obstacle. The results suggest that technological capability in both human, institutional and other resource terms is relatively weak.

Surprisingly, cost turned out to be the last barrier, which contradicts literature sources that suggest high influence of financial barriers e.g. Häkkinen and Belloni, 2011; Nelms et al, 2005; and Hydes and Creech, 2000. The survey identified fear of higher investment costs, ignorance of lifecycle costs, lack of financial resources and dependence on external funds, absenteeism of local currency, risks in exchange rates as more than one currency is used, and finally the financial investment in building up capacities to provide sustainable materials. The additional financial cost of sustainability of construction has been cited by many researchers as being a major barrier to the realisation of sustainable construction (Ofori et al, 2015), though it is documented that the long-term benefits are worth initial increases in investment (Safadi, 2016). Since there are limited initial budgets available to clients, sustainability implementation may lead to an increase in construction costs in the short term. 80% of participants believe that financial barriers are an important obstacle halting sustainable construction development. It is also relevant that there is an important socio-economic barrier, which is the low income of the families in Palestine, which makes them unable to cover the initial cost of green homes. In addition, most large construction projects depend on international funding with many constraints imposed on budgets, so designers often need to focus on achieving the function of buildings with available limited means. There is also a reluctance from funders to adopt innovative technologies, due to high risks in politically unstable conditions. The need to import sustainable materials makes cost predictability uncertain, and there is an issue in procurement systems over which parties to contracts accept price volatility movements as work progresses on sites. If contractors are asked to accept risks, this may lead to very high tender bids. Palestine does not have its own currency, and uses alternatively the Jordanian Dinar, Israeli Shekel and US Dollar. Contractors deal with different currencies under the same contract, and may get paid in one currency and have expenditure in another. There can be rapid fluctuation in exchange rates, which is in addition to delays in payments by funders, can impose risks that money loses its value over time.

5. CONCLUSIONS

Incentives to enhance green buildings in Palestine are inadequate. Regulations do not insist on higher standards of building design and construction, which leads developers to produce buildings at the lowest price and in the shortest time possible. It is noticeable in the survey and interviews responses that apparently, the education and raising awareness of the necessity of green architecture would achieve improvement in the building culture in Palestine; authorities should start working on an environment education movement by funding educational initiatives in this sector. Another important role for authorities is to set clear mandatory regulations and update building laws in Palestine, and introduce energy-efficiency regulations and code changes so that market demand can be created.

To support successful implementation of sustainable construction, authorities with the help of construction industry stakeholders, should formulate training courses, discussions, seminars, campaigns and workshops. Developers should include sustainability credentials in their design briefs and authorities need to consider introducing financial incentives. The environment for constructing green buildings should be enabled, to successfully start sustainable construction and promote construction sustainability for the benefit of the society at large.

There may be a perception amongst some officials that sustainable development is only for rich people, and is not an aspiration that most Palestinian people can aim for; that needs to

change, since sustainability is key to a prosperous future for all. There is desperate need to find solutions to the energy crisis and enhance green architecture, but given that Palestine continues to face many political challenges, it can be difficult for administrators to implement medium and long term initiatives, when there are always short term political issues that take priority. Never-the-less, it is important to pursue research in this area, in order that small windows of opportunity are grasped when sustainability choices do become available.

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RATING THE COMPONENTS OF INDOOR ENVIRONMENTAL QUALITY IN STUDENTS CLASSROOMS IN WARM HUMID CLIMATE OF ULI, NIGERIA

C. Munonye and Y. Ji

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: C.C.Munonye@edu.salford.ac.uk

Abstract: The indoor environment of classrooms needs to be comfortable for the occupants to perform their class work effectively. To achieve this objective, architects and engineers need to be proactive at the early design stage by giving adequate consideration to the very component of Indoor Environmental Quality (IEQ) occupants of buildings consider most as the hindrance to comfortable living. This paper presents the findings of a post-occupancy evaluation of students' subjective responses to the various environmental qualities; lighting, odour, noise and temperature/thermal comfort in warm, humid university classrooms. The aim was to rank the IEQ on the scale of students' consideration of a comfortable indoor classroom work. This was done using questionnaires to get subjective responses from the respondents. The work was conducted in January 2017 in two university classrooms while the students were engaged in various class activities. Sixty-five students participated in the study. The result suggested that a majority of occupants rated thermal comfort number one as the component of the IEQ that usually gives them the most concern. This result is consistent with earlier studies on IEQ attributes conducted in other climatic zones in Nigeria and will be helpful to designers, engineers, facility maintenance managers when taking decisions on construction of classroom blocks. The findings inform future work whereby a comprehensive subjective and objective evaluation of thermal comfort will be conducted in the warm humid, climate using the primary school setting as a case study.

Keywords: Classrooms, Indoor environmental quality, Rating, Students, Thermal comfort.

1. INTRODUCTION

Studying in a classroom that has an acceptable Indoor Environmental Quality (IEQ) enhances the well-being, productivity, learning ability and reduces stress, fatigue of the occupants. These benefits of a good IEQ are confirmed by studies such as Wargochi & Wyong (2007); Ayeni & Adelabu (2012). On the other end of the spectrum, studying in an unacceptable indoor environment has its negative consequences. A growing body of research recognizes that poor IEQ in schools may result in illness, leading to student absenteeism as well as adverse health symptoms and decreases academic performance (Mendel & Heath, 2005; Wargocki, & Wyon, 2006; Simeons et al, 2010; Haverinen-Shaughnessy et al, 2012). Also, research on IEQ conducted by numerous researchers has proved its significant influence on occupants' health and productivity regarding air quality, lighting, acoustics, and thermal comfort (Fisk, 2002; & Moon, 2016).

However, providing an acceptable indoor environment is possible if IEQ parameters are given adequate consideration at the early design stage of buildings. Al horr et al (2016) agrees that design of buildings needs to consider occupants well-being parameters with IEQ right at the beginning. Bogenstätter (2000) had noted that 20% of any decision made in the early phase of design has 80% consequences on the overall design cost. Apart from cost

implication, the Pareto 80-20 rule also applies to other general design success or failures whereby 20% poor design input could lead to 80% building failure. This could be attributed to an issue such as not seeking the opinion of users when designing a building. As such, early design decisions are of great importance to design outcomes. Allu et al (2013) added that assessing the IEQ should be the first step to designing a low-energy building and ensuring the comfort of the occupants.

Despite the importance of knowing the IEQ of an indoor space, there is still very limited research work involving building occupants that ask them to identify the component of IEQ that gives them most concern, especially in a school setting. Huizenga et al (2006) argues that there is far less data that assesses occupants' satisfaction across a large number of buildings using occupant opinion as a measure. Sundstrum (1987) reported some findings of increased satisfaction with environments designed through user involvement. Peretti & Schiavon (2011) added that building occupants are a very rich source of information about indoor environmental quality and its effect on comfort and productivity. The post-occupancy (PO) survey has identified that occupants are more "forgiven of", and work effectively in buildings they like (Nicol, 2012). According to Jiboye (2012), PO involves systematic opinions about buildings from the perspective of the people who use them. It aims at identifying what the occupant considers possible mistakes in the occupied building that hinder comfortable living so that lessons are learned to guide future designs. However, PO evaluation is achieved through mutual interaction between the buildings and the users with an ultimate goal of providing this improvement.

Chukwuemeka Odumegwu Ojukwu University, Uli (COOU) is to embark on the construction of phase two of the Department of Architecture (Fig 1). Students have been using Phase one (Fig2) for classroom/studio work for years. Literature reviews have reported various cases of unacceptable thermal conditions of indoor spaces, especially in institutions of higher learning in Nigeria. For example, Olanipekun (2014) evaluated the thermal perception of the occupants of naturally ventilated hostel blocks and observed that occupants frequently complained of inadequate comfort in their indoor environment of their buildings because of high temperature, especially in the afternoon periods. Amasuomo & Amasuomo (2016) investigated the relationship between students' perceived thermal discomfort and stress behaviours in lecture theatres in the humid tropics in Nigeria with findings that the students experienced a considerable level of thermal discomfort. Uzuegbunam (2011) investigated comfort conditions in hostel buildings in Enugu, Nigeria and reported poor indoor thermal conditions because of the replication of the western style of architecture which conserves heat and limits infiltration of outside air to the interior. The best way to know how people actually feel in a particular situation is to go and ask them by the method of fieldwork (Nicol et al, 2012). As a result, there is a need for PO evaluation of phase one in the form of feedbacks from the users (students) to know the very component of IEQ that gives them most concern to comfortable classroom work. This feedback will guide in the final design of phase two of the school building.

This paper, therefore, presents the findings of a field study of Post-Occupancy (PO) evaluation of students' subjective responses to the various environmental qualities namely: lighting, odour, noise, and temperature/thermal comfort in warm, humid university classrooms in Uli, Nigeria. The aim was to rank the IEQ on the scale of students' consideration for a comfortable indoor classroom work.



Fig 1: Phase 2 view from courtyard



Fig 2: Phase 1 view from courtyard

2. LITERATURE REVIEW

2.1 Previous Studies on IEQ

Indoor Environmental Quality (IEQ) of educational buildings has been vigorously studied in primary, secondary and university classrooms. However, the various research specifically concerned with the learning effect of the learning environment of students tends to be carried out in western Europe and particularly in the USA (Higgins et al, 2005), while Peretti & Schiavon (2011) mentioned North America, Europe, and Australia as the focus of Centre for the Built Environment (CEBE) surveys with limited data available from Asia, Africa, and South America.

Frontczak (2011) summarized previous studies on IEQ undertaken between 1977-2009 with findings that thermal, acoustical, visual environment and air quality all influence evaluations of the overall indoor environment, noting that thermal comfort was ranked by the majority of cases to be of slightly greater importance for overall comfort than acoustics and visual comfort and satisfaction with air quality. Kim et al (2013) investigated gender differences in occupants' perception on various aspects of the indoor environmental quality with samples from North and South America, Asia, Middle East, Europe, and Oceania. Among the four main dimensions of IEQ notably Indoor Air Quality (IAQ), thermal comfort, lighting, and acoustics; the literature was dominated by IAQ and thermal comfort. However, findings from these regions may not be generalized to other parts of the world, especially in the tropical Africa, because climate, culture, adaptation and other variables may have effects on the perception and ranking on the IEQ components.

Gado et al (2005), did a subjective investigation of the environmental performance of government schools in Egypt and came out with findings that 78% of the occupants were thermally uncomfortable. Hayatu et al (2015) assessed the environment of school theatres in Nigeria and reported thermal discomfort as a major problem to the occupants of the theatres. Uzuegbunam (2011) investigated the comfort conditions of the hostel buildings in Enugu and observed that thermal comfort tops the list of human needs in a hot humid tropical environment in South East Nigeria. Olanipekun (2014) studied the perception of the occupants to the environmental conditions of naturally ventilated hostel blocks in Nigeria and observed that occupants frequently complained of inadequate comfort in the indoor environment of their buildings because of high temperature, especially in the afternoon periods.

Researchers have adopted various methods to rate the IEQ of a building. Some employed both objective and subjective methods while some others such as Carlopio (1996) & Leaman,

(2010) used subjective approach. However, Holiday & Turner-Henson (1989); Borgers et al, (2000) advised the adoption of well-structured and brief questionnaires since long questionnaires could result to low motivation and difficulties in keeping up concentration and may result in poorer data quality.

2.2 IEQ Rating Tools

Literature from IEQ researchers remains unclear on common or standardized POE tools to measure occupant ratings of the built environment (Veitch et al, 2007 & Kim et al, 2013). However, building sustainability rating tools assess the indoor environmental quality of buildings using two broad strategies: occupant questionnaires called POP, and instrument measurements of physical conditions inside buildings (de Dear et al, 2016). Kim et al (2013) adopted the Centre for the Built Environment (CEBE) survey questionnaire while investigating the gender differences of occupants on various aspects of IEQ. This is actually the most widely used POE tool to date. For example, it is recommended by ASHRAE (American Society of Heating, Refrigerating and Air-conditioning Engineers) as a basic evaluation process of building performance measurement (ASHRAE, 2013a).

Various types of scales have been adopted by researchers in the Post Occupancy (PO) evaluation of the IEQ in buildings. Rohles et al (1989) while rating the components of IEQ used a six-point scale of acceptability ranging from 1 (very unacceptable) to 6 (very acceptable). Zhang et al (2007) adopted a 7-point semantic differential scale with end points “very dissatisfied” to “very satisfied” to conduct occupant satisfaction with respect to nine environmental categories in office buildings. De Giuli et al (2012) while evaluating the IEQ of pupils of primary schools in Italy used a four-point rating scale. De Giuli’s argument was that “it forces pupils to give an answer that is clearly positive or negative”. Neutral option were removed, arguing that choosing neutral option results in loss of information.

2.3 INDOOR ENVIRONMENTAL QUALITY COMPONENTS

Literature reviews have narrowed IEQ attributes to four basic components namely; Lighting, noise, thermal Environment and Indoor air quality.

(i) Lighting

There are various debates among researchers on which form of lighting, daylight or artificial light, is the most suitable for the classroom. In relation to student achievement, it is argued that day lighting offers the most positive effect. Liberman (1991) argues that the majority of humans prefer a daylight environment because sunlight consists of a balanced spectrum of colour, with the benefits of reduced utility costs for school districts, improved student attendance and academic performance, and a less stressful environment for students. Furthermore, other benefits are increased student and teacher attendance, increased achievement rates, reduced fatigue factors, improved student health, and enhancement of general development.

(ii) Acoustics/Noise

Acoustic problems in buildings could come from airborne sounds, outdoor noise, noise from adjacent spaces, noise from office equipment, noise from nearby facilities or noise from students themselves in school. A more reliable finding is that chronic noise exposure impairs

cognitive functioning and a number of other noise-related problems (Suter, 1989; Goines, & Hagler, 2007). As a result, reviews of the consequences of aspects of the physical environment tend to conclude that acoustics and noise are important factors in a school environment (Earthman, 2004).

(iii) Thermal Environment

A good learning environment that is thermally comfortable cannot be overemphasized, especially in this era of global action on climate change mitigation. Thermal comfort is defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) as “that condition of mind that expresses satisfaction with the thermal environment (ASHRAE, 2013a) and sets an 80% satisfaction quota as target for human comfort. Fanger (1970) suggested that the six most important factors or variables that determine the thermal condition of a given space are: air temperature, humidity, air velocity, mean radiant temperature, clothing and activity/metabolic rate.

Air temperature is considered an important determinant to thermal comfort evaluation of a given indoor space. Relative humidity (RH) is a measure of the moisture in the air, compared to the potential saturation level. High humidity accompanied by high ambient temperature causes a lot of discomfort (Eliah, 2014). Earlier, de Dear et al (1991) came out with results, after investigating the preferred temperature of two subjects with different clothing values that there are no significant differences when the RH was set at 70 and 55%. Mallick (1996) added that there are instances where people have reported to be comfortable in a humidity above 95%. In naturally ventilated buildings, especially in the tropics, air movement is believed to have some positive effect on the thermal comfort conditions of the occupants. Study by Candido et al (2011) suggests that more people view air movement as positive in offices and in classrooms. Researchers, such as Cena & de Dear (2001); Wong et al (2002); Zhang et al (2007), who conducted various surveys around the world in different climates suggest the idea that the width of the comfort zone could be increased with higher air movement. Mishran and Ramgopal (2015) further argued that with the setting of a fan to raise air movement up to 0.3m/s, there could be a rise in the lower and upper limits of temperature by 2.4 and 2.2°C respectively.

Adaptation is another factor that plays an important part in thermal comfort especially as it applies to naturally ventilated buildings. The adaptive thermal comfort is based on the premise that humans will generally change their behaviour and act in ways that will make them thermally comfortable which, according to (Nicol et al, 2012), has proven to be more suitable for free running buildings. This premise suggests that there is a relationship between preferred indoor temperature and outdoor temperatures (Nicol, 1999; Du, et al, 2014). Comfort temperature was, therefore, defined as “a band rather than a single threshold” for free-running buildings (Ji et al, 2016). Adaptive actions could include taking off clothing, reducing activity levels, opening a window, moving to a different place in the building, and by drinking hot or cold water (Nicol, 1999; & Wong et al, 2002). However, unlike in residential buildings, these actions are reported to be restricted in places such as in offices and in schools.

(iv) Indoor Air Quality

Natural ventilation using air infiltration mechanism is considered an appropriate zero carbon emission strategy that could help vary the indoor pollution. On the other hand, natural ventilation can be harmful in buildings where air pollution is high. However, design considerations such as building location, orientation, overall design such as space allocations

and ventilation, climate control, materials selections, and specifications, ought to be considered at the earliest building design stage to avoid locating these buildings in polluted environments. Al horr et al (2016) added that based on research on sick building syndrome (SBS), it is important that buildings be designed in such ways as to reduce the exposure to indoor chemicals.

3. METHODOLOGY

3.1 The Study Area

COOU, Uli is situated in Anambra State South East of Nigeria, has geographical coordinates: latitude $5^{\circ} 47^1\text{N}$ and longitude $6^{\circ} 52^1\text{E}$. Hot & Dry, Warm & Humid and Composite between the two (Batagarawa ,2012) constitute the three basic types of climate in Nigeria. The study area under discussion falls within the warm, humid. With an average temperature of 28.5°C , March is the warmest month while July has the lowest average temperature of the year which is 25.2°C . The dry season runs from November to March, while rainy season runs from April to October. The annual relative humidity is 75% reaching 85% in the rainy season. COOU has two campuses; Igbariam and Uli campus. The Department of Architecture is located in Uli campus.

3.2 Data Collection

This study adopted the subjective approach to rate the different components of the IEQ in the classrooms. Questionnaires, observations and the physical measurement of the classroom spaces were used to collect data from the participants. Evaluation was conducted in the early January, 2017. The administrative protocol to have access to the participants was brief because the researcher is a staff of the institution. Participants (students) had no prior information about the nature of the study as they were waiting for their lecturer to arrive for class work. The survey did not disrupt their class schedule as they had their lecture immediately after the questionnaires were collected (Fig 3). However, before the commencement of the survey, the students were informed that participation was voluntary and the confidentiality of any information they provide would be respected. Two naturally ventilated classroom spaces, with ceiling fans which were never used, were randomly selected for this study; studio 300 level and MSc 1 studio (fig 4) measuring 81m^2 and 143m^2 respectively. The building was chosen because the second phase is at the stage of design completion, so the need for the users (participants) to rate the indoor conditions of phase one became imperative.



Fig 3: Students after the survey

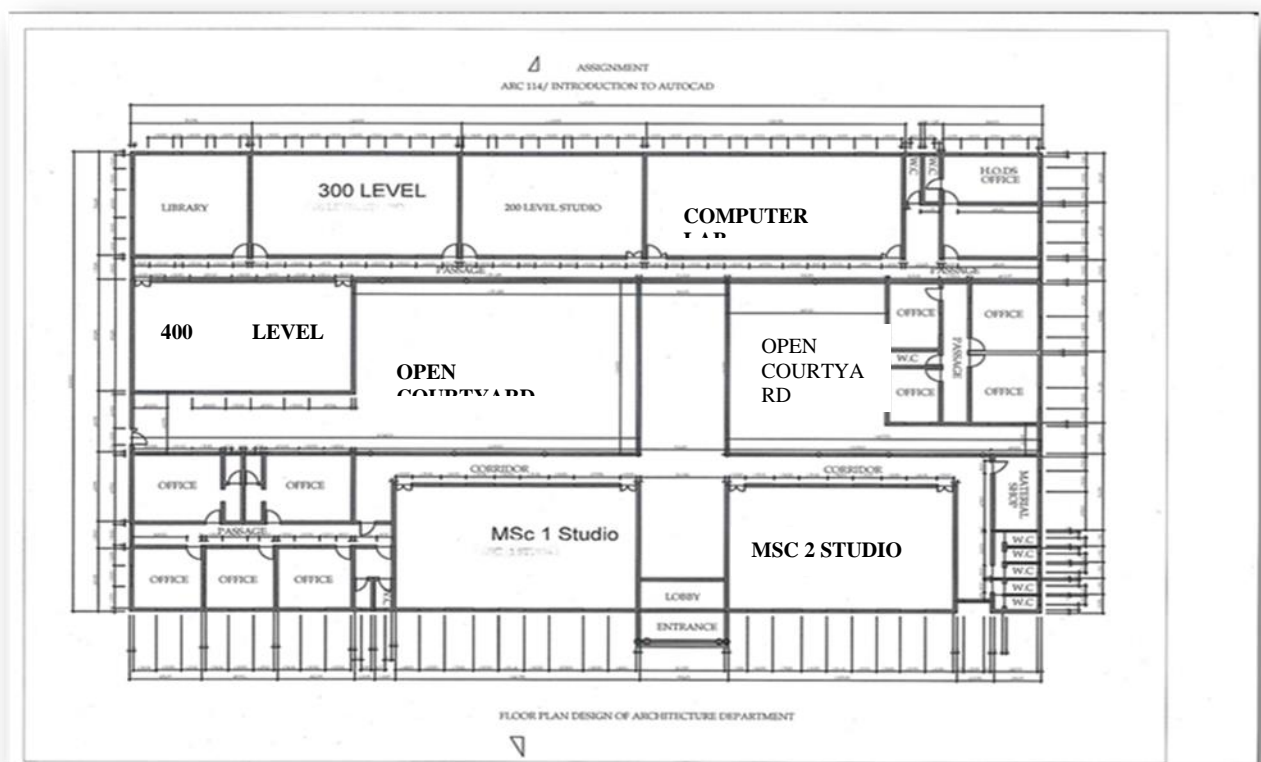


Fig 4; Floor Plan of the existing school Building

3.3 Participants

A total of seventy-five participants from a sample population of about three hundred and eighty (380) students of the Department of Architecture Uli was distributed questionnaires. Sixty-five participants completed the questionnaires representing 87%, while ten opted out. 100% of these questionnaires were correctly completed. Out of this sixty-five participants, 77 % and 23% were male and female respectively. However, a survey based on gender differences was not one of the objectives of this study. The majority of the students' (78%) ages ranged from 18-24 years. The survey was conducted at 1400 hrs with an average completion time of four minutes for the questionnaires. However, the researcher spent an

additional two hours to observe and note the behaviours of the respondents as they adapted to the indoor conditions.

This study employed ‘‘Yes’’ or ‘‘No’’ methods to rate the general comfort conditions of the classrooms. Prior to this question, participants were asked to vote where they usually prefer to sit in the classroom (‘‘beside the window, at the rear of the classroom or at the centre’’). A follow-up question asking them to rank the reason they would prefer to sit in that position (‘‘to avoid noise, better lighting, better thermal comfort/temperature, to avoid odour’’) using a four- point scale ranging from 1 (not important) to 4 (most important). The last question, using the same four-point scale, asked them to rank the components of the IEQ that they consider would make them comfortable while in the classroom (‘‘Less noise, better lighting, less temperature and less odour’’). The last two questions seemed related, but the reason was to see how the rating they gave to both questions correlates.

4. RESULTS AND DISCUSSION

The findings of the PO evaluation of the students’ subjective responses to the various IEQ are summarized below.

(i) Subjects’ response to the question ‘‘ where do you prefer to sit in the classroom?’’

The subjects’ response, as shown in fig 5, indicate that 71% of the respondents prefer to sit beside the windows, while 23% would prefer the centre of the classroom. Only 6% of the respondents would prefer to sit at the rear of the classrooms. 79% of this number which prefers to sit beside the window rated thermal comfort their number one reason. Hence, there is a strong linear relationship between thermal comfort and window openings which agree with the previous studies that window opening, which allows air flow, is the number one adaptive opportunity used by occupants of buildings to restore comfort. The fans, though in good condition, were not put to use by the students during the survey even when electricity was available. However, only 10% of the number that prefers to sit beside the window rated odour last on their scale of the reason for preferring to sit near the window. Hence, there is a very weak correlation between preferring to sit near the window and odour. This might be attributed to the location of the campus in a non-industrial zone.

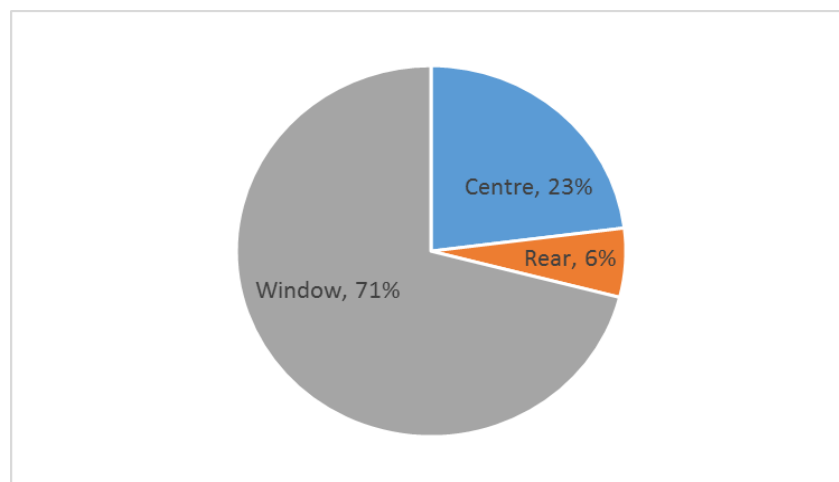


Fig 5: Pie Chart showing percentage of responses to sitting preferences in the class/studio [n (respondents) for centre=15, n for window=46, n for rear=4]

(ii) Subjects' response to the question 'rank the reason why you prefer to sit in that position'?

The subjects' response indicates that 65% of the respondents rated better thermal comfort as the most important reason why they prefer to sit in a particular position, better lighting, avoid noise and avoid odour were rated 20%, 7.5% and 7.5% respectively. The responses are consistent with those in result (i). Furthermore, 89% of the respondents rated thermal comfort by voting "most important (4) and important (3)" as their reason for preferring to sit near the window.

(iii) Subjects' response to the question 'rank the component of the IEQ you consider that will make you comfortable while in the classroom'?

Subjects' response, as shown in fig 6, indicate that the respondents ranked "Less temperature/ better thermal comfort" 62%, "less noise/acoustic and better lighting" each ranked 15% while "less odour" was ranked only 8%. Questions (ii) and (iii) appear similar but the intention was to check how consistent the participants were in answering questions and whether the answers could correlate. Generally, both questions show consistency having followed the same trend in the rating. Majority of the respondents rated thermal comfort very high while odour was rated low in both questions (ii) and (iii).

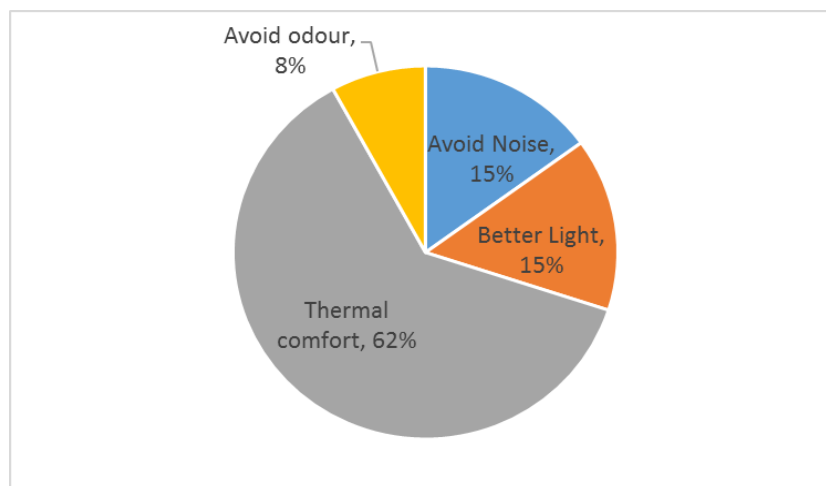


Fig 6: Pie Chart showing percentage ranking of IEQ components by the respondents {n(respondents) for noise=10, n for light=10, n for thermal=40, n for noise=5}

(iv) Subjects' / acceptability answer to the question "is the classroom presently comfortable"? Subjects' response as shown in fig 7 Indicates that the classrooms' general comfort was acceptable to 54% of the respondents while 46% rated it unacceptable.

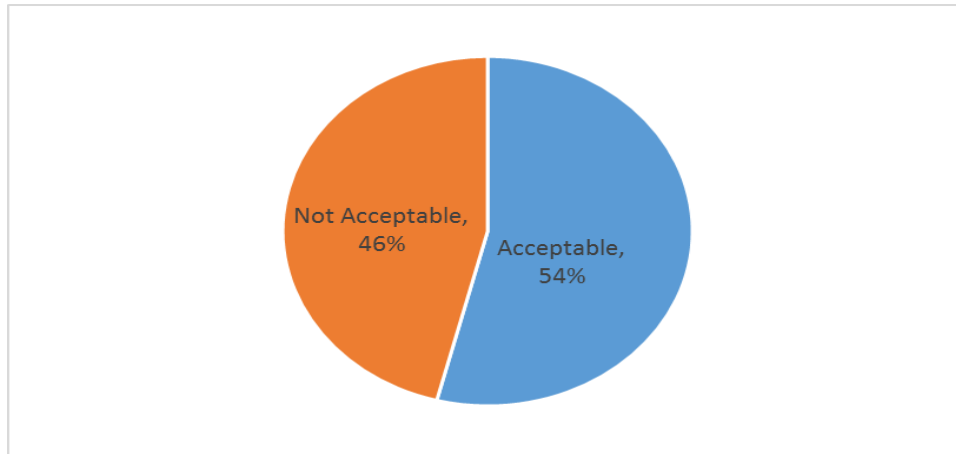


Fig 7: Pie Chart showing percentage of acceptability to IEQ {n(respondents) for acceptable=35, n for non-acceptable=30}

The high-level of acceptability could be because of the large window openings and their placements in opposite directions in the classrooms which allowed high infiltration of air and cross ventilation. This confirms earlier literature review that highlighted the importance of air movement to the indoor thermal conditions. Even with the high humidity of 71 %, which the weather channel showed on the survey day, the majority of the participants still accepted the indoor condition. This also confirms the argument by various researchers that humidity has little or no effect on thermal comfort even when, according to Mallick (1996), it is reported at 95%. Though the majority (54%) accepted the indoor thermal conditions, the acceptability could have been higher if the adaptive opportunities available were effectively used, and the high occupancy in the classroom was resolved.

5. CONCLUSIONS

Field subjective survey of 65 respondents, (using PO survey), in the university classroom of COOU, Uli campus was conducted. The conclusions are as follows:

- i) Majority of the respondents ranked thermal comfort as the component of IEQ that gives them most concern for comfortable indoor classroom work. This is consistent with other previous work in Nigeria.
- ii) The majority of the respondents prefers to sit beside the window. This confirms previous studies that find a strong relationship between thermal comfort and the opening of windows.
- iii) The majority of the respondents accepted the general indoor condition of the classrooms though the acceptability was short of the 80% acceptability criterion set by ASHRAE (ASHRAE 55:2013a).

In addition to the above findings, the researcher observed the inability of the students to put on the ceiling fans which were in good condition even when the lights were on. The researcher reasoned that it might be because the majority of the students who accepted the general thermal condition of the classrooms may not like the ceiling fans to be put on or that they were not free to do so because of the presence of their lecturer. The indoor comfort of the occupants of the classrooms that voted ‘No’ to thermal acceptability could probably have been enhanced if they made use of the ceiling fans that were available. Humphreys and Nicol (2002) argued that subjects can be comfortable at temperatures up to or even exceeding 30°C, in hot climates, especially if fans are used to increase indoor air movement. Mishran

and Ramgopal (2015) further argued that with the setting of a fan to raise air movement up to 0.3m/s, there could be a rise in the lower and upper limits of temperature by 2.4 and 2.2°C respectively. Results from the various field studies led to the extension of the boundaries of the comfort zones with respect to three different air speeds – still air (up to 0.2m/s), natural air flow (0.2m/s – 0.5m/s) and forced air flow with ceiling fan assist (0.5m/s – 1.5m/s) (ASHRAE, 2013).

Generally, the results of this study show the rating of the different components of IEQ in a university building and highlight the importance of post-occupancy evaluation. The findings, will guide in the final design of phase two of the department of architecture, COOU and will also be useful to other designers, engineers, facility maintenance managers and stakeholders in educational institutions when taking decisions on construction of classroom blocks in order to increase the comfort of the occupants. This PO information also motivates the need for future work that will adopt both objective and subjective methods to evaluate the thermal comfort perception of children, this time, in a primary school setting.

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THE DEVELOPMENT OF PERFORMANCE SPECIFICATIONS TO PREDEFINE THE NEEDS OF REFUGEE DWELLINGS IN HOT DRY CLIMATES

A. Aburamadan, B. Trillo and P. Coates

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: R.F.Aburamadan@edu.salford.ac.uk

Abstract: Accommodating refugees is becoming an increasingly relevant issue in many countries. Climate change related natural and human hazard will increase this trend. Despite of the magnitude of the problem and its widespread diffusion across the globe, humanitarian agencies and institutional bodies still approach it with one-size fits all solutions, including the provision of standardized shelters. This is particularly true in hot climate contexts. However, to appropriately accommodate refugees it is necessary to provide accommodation that aligns with their needs.

This paper offers a different perspective, by providing the readers with a list of performance specifications, capable to address the shelters design in hot dry climates according to the end users' perspective of the case of Al Za'atari camp in north-western Jordan, which has accommodated Syrian refugees since 2012. A robust research methodology allows drawing conclusions from a wide variety of sources. Lessons learned is there is a need to overcome an approach based on standardizations of users' needs, there is needs to recognize the actual time frame of the duration of the camps and to prioritize stakeholders' needs.

Keywords: accommodating refugees, Al Za'atari camp, hot dry climate, lessons learned, specifications

1. INTRODUCTION

The world is currently facing significant difficulties in accommodating refugees because of the unstable situation that many countries are experiencing. As the United Nations High Commissioner for Refugees [UNHCR] reported in 2013a, many areas around the world are suffering from security situations and political unrest that has led to major challenges. Recently, Syria, Libya, Yemen and other countries have experienced conflict situations leading to large outflows of refugees. The UNHCR (2014-2015) describes the main stakeholders in conflict areas as refugees, governments, non-government organizations (NGOs), and neighboring areas. The Middle East and North Africa (MENA) region are the most region that suffer from dwelling refugees and it showed 60 refugee camps are distributed in MENA region. They were categorized by the UNHCR as protected refugees, returned refugees, protected Internally Displaced Persons (IDPs), returned IDPs, Asylum-seekers, people under UNHCR's stateless mandate and 'various' others. By the end of 2012, Sub-Saharan Africa and Asia accounted for 63% and 29% of refugee camps, respectively. Maak (2015) indicated in Sub Saharan Africa 72 percent of the population live in slums, the demand from this increasing population is a critical concern around the world and the United Nation (UN) reports indicate that by 2050 the increasing refugee population will reach 1.5 billion people and additional needs of dwellings and services must be completed to meet the demand.

The aim is to develop specifications as framework for refugees' shelters. The research focuses on developing specifications list and populate to stakeholders as frame work to dwelling refugees, it is a process as roadmap for refugees' studies and shelter establishment by following criteria specifications list. Specifically the research will assess refugees' physical and social needs and put forward specifications for shelters that are modified based on these needs, related to the particular circumstances of being located in the hot-dry climate of Jordan.

The paper considers refugee camps in hot-dry climate conditions that are located in different places around the world. The Al Za'atari camp in Jordan is located in such hot-dry climate conditions and represents the second largest camp in the world as reported by the UNHCR (2013b). For this reason, this camp will be used as the location for primary data collection in this study.

2. REVIEW LITERTURE- USERS' NEEDS

Increasing refugees and concerning of accommodating are an issue that needs to review several requirements which present in users' needs, who are concern of stakeholders and their requirements, environment challenges and specifically hot dry climate which is area of the paper, and practices of shelter performance of previous studies.

A review of the literature showed a lack of attention to human needs regarding what refugees exactly needs and their differences and situations. Eastmond (2015, p.105) defines refugees regarding UNHCR "is an individual who has crossed a national boundary, and has a well-founded fear of persecution in the county of origin on the basis of race, religious or political affiliation, ethic or social group". In common with others, refugees had their own lives before becoming refugees. Due to the harsh situation that refugees have faced, it is normal that they refuse adaptation to a new community, they lost everything; their homes, indigenous location, their daily activities, so it is difficult to be part of a new community (Lambo, 2012). It is important that refugees continue their lives as normal after the threat of war has disappeared. When they first arrive in a host community, it may be enough to provide them with their basic needs but over time, stress and psychological suffering lead to a more complex framework in providing for their needs. Zavei and Jusan (2012) mentioned the consequences of absence of the social factor from humanitarian organization reports as this can cause instability and impact on human psychological health that might lead to community violence. Also, findings of primary data in this study showed refugees' stories of frightening and terrifying times besides what they faced before and after settlement and how this impacts on health and social stability. Refugees overlap between needs levels as shows in Figure (1) in order to obtain their needs. When people cannot obtain their needs at the lower level of the pyramid needs, they go to another level of needs and it is possible for them to go back and forth between these levels. Duncan (2011) argues Alderfer's theory (1969) that presents that people may intensify their focus on the lower level of needs if they are frustrated in locating the higher level of needs. In history, refugees' needs and satisfactions have shown an overlapping pattern in terms of obtaining needs. In this regards, the requirements of modern life have an influence on people, despite refugees' need for protection and security. Also they need to interface with modernity, for instance using modern devices such as phones, washing machines that explain another level of self-actualization needs. Kesebir, Graham and Oishi (2010) mentioned how social and cultural aspects play a vital role in driving peoples' needs

and show variability even in physical needs that cross culture features such as people's sleep or eating patterns which impact on satisfaction of living conditions.

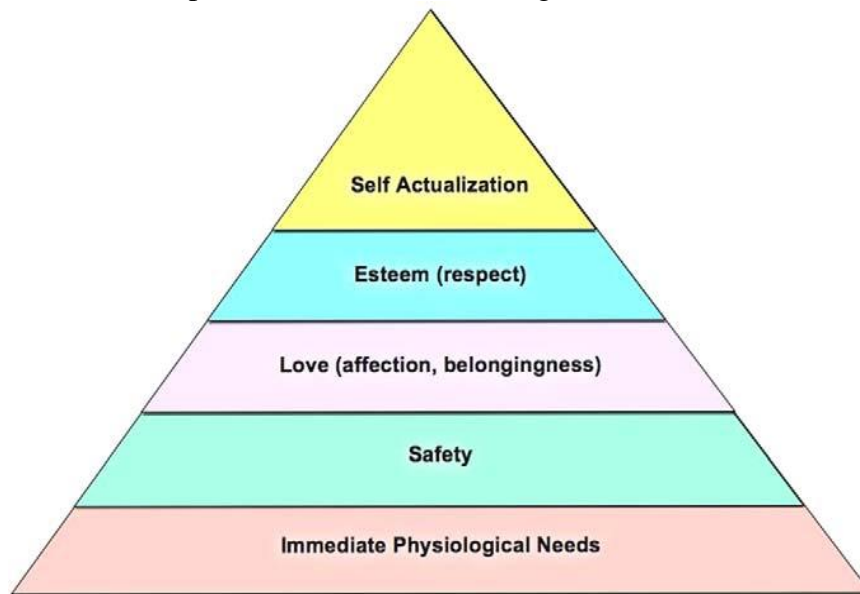


Figure 1: Maslow's classic hierarchy of needs (Source: Kenrick *et al.*, 2010)

Additionally, one of the essential basic needs is shelter, various factors determine the characteristics of a shelter, such as comfort, control, stability, environmental resistance and privacy. Shelter provides protection from the elements, climate conditions and other physical dangers such as animals and strangers. The provision of refugees' shelters is influenced by several requirements and the lack of establishing basic human needs and desire in existing shelters is apparent in most shelter solutions (Heywood, 2004). Zavei *et al.*, (2012) shows the importance of finding the connection between peoples' motivations and the architectural elements that could lead to a suitable result of shelter satisfaction, it will be more appropriate to establish a framework of peoples' needs, environment aspects and the context then suggest a proposed design of a shelter by defining shelter performance.

3. HOT DRY CLIMATE DIFFICULTIES AND AFFECTING DESIGN FACTORS

Hot dry climate have hot summer and cold winter and the more concentrated sun in summer means high summer aridity. This climate has an average temperature of between 0°C in winter and above 38°C in summer, and a large variance in temperature between day and night in the same season (Fuchs, Stark, Zeumer & Hegger, 2012).

This climate has a number of elements that formulate its conditions. These are: direct sun, low humidity, very low average precipitation with the possibility of sudden heavy precipitation, severe winds that cause dust storms, temperature fluctuations, clear skies and low cloud density and high levels of dust in the atmosphere (Fuchs *et al.*, 2012). There are fundamental building requirements that are obligatory in achieving internal comfort in buildings in a hot-dry climate. These building incorporate protection from high heat absorption due to high temperatures and building materials that offset direct heat and minimize temperature fluctuations.

Accordingly, the nature of such a climate must be clarified by orientation, formation, vegetation, materials and construction. Designers should limit the amount of dust entering a

dwelling during sandstorms and prevent dust from blowing around inside. Also, the cold should be considered in terms of the nights being surprisingly chilly, especially in arid areas (Corsellis & Vitale, 2005).

In short, the point of interest is to enhance the quality of refugee shelters by establishing a framework of performance specifications suitable to steer the design process. First, criteria are formulated on the basis of theories of human needs, refugee studies and involved organization reports. Then, performance specifications are; related to the following criteria: safety and security, social context, comfort, stability, flexibility and modularity, being demountable, durability and having constant energy which are formulated by reviewing literature.

4. INVOLVING STAKEHOLDERS

The significance of the paper is about creating a framework of establishing refugees shelter with taken onto consideration stakeholders' opinions and views about the problems and reality of dwelling refugees in camps which is absence on previous practices in this field, moreover, the researcher had to understand the context carefully by determining who stakeholders are involving in dwelling refugees which presents in local governments, humanitarian organizations, refugees, manufacturing companies, professionals and experts which the paper chooses stakeholders based on reviewing literature and primary data, while other researchers could add other stakeholders who are involving on the context of refugees' dwelling, both socially and environmentally. The potential point is formulated by the researcher to determine who has a direct and indirect connection with the whole process of developing performance specifications and it is limitless to determine due to the differences of camps situation in terms of environment challenges and social aspects.

Concerning the justification of choosing stakeholders stands on literature, and explicating the problem of dwelling refugees. It was appropriate in order to achieve the paper aim to find the right explanations. In this regard, the researcher conducted the data analysis through involving those stakeholders to develop performance specifications as framework for who are in charge to dwelling refugees in hot dry climates area.

4.1 Stakeholders' Requirements

The paper explores stakeholders' needs and requirements by secondary data as well as primary data that conducted in the Al Za'atari camp in Jordan. Stakeholders' requirements formulate their prioritizations where the priorities are different between stakeholders in terms of the research criteria. An analysis of the results presents the differences in stakeholders' priorities, the different priorities helped in considering further requirements when demonstrating performance specifications. The paper draws stakeholders prioritizations by exploring primary data from the field with taken into consideration the criteria of adequate living conditions from reviewing literature which presents in the paper criteria.

As collected data from the fieldwork that indicated in the refugees' sections, protection is the first priority while other priorities fluctuate between other requirements in relation to social and environment context, as for local government priorities. The establishment of security inside camps is a vital part of the political issue in host countries, whereas local manufacturing companies' priorities are mainly concentrated on financial income. The

priorities of humanitarian organizations located in Jordan are primarily the protection of refugees as well as minimizing service difficulties (discontinuous electricity and water). These priorities are followed by social and cultural differences, climate difficulties and shelter performance.

Experts and professionals noted that their priority is construction and the structural requirements of shelters which are referring to durability under shelter performance. They stated their priorities as the following; at first construction and structural elements must be obtained from a local market for adapting the environment context and decreasing the high cost of transferring, the second considering environment context (climate and land conditions) which is referring to comfort, dignity and identity consideration is the third priority which relate to social context, other priorities varied between stability, safety and security, and independent constant energy. Responsible institutions noted that the first priority was management control (cost and time) which relates to settlement implementation which is outside the research criteria, considering background diversity is the second priority which refers to social context, the third priority is environment context (climate and land conditions) under comfort, then stability, safety and security, shelter performance and independent constant energy are the next other priorities that fluctuated depending on the context situation.

In summary, the refugees' requirements pay more attention to social and cultural difficulties and shelter performance than other stakeholders' requirements. Some interesting points to humanitarian organizations are the same as the priorities of refugees' requirements; humanitarian organizations have direct contact with refugees and are involved in their stories due to their position in the field. The quality of production, the absence of standardized supervision, local market forces and obtaining financial benefits for local manufacturing companies. Regarding considering the social network, local manufacturers have a subjective understanding that refugees must go back home and units are adequate for a short period of time.

5. PREVIOUS STUDIES

Humanitarian organizations and other involved institutions are concerned with delivering shelters for large numbers of people. Crawford, Manfield and McRobie (2005) point out that the main concern is to provide shelters for large numbers of refugees within a limited time even though recent examples show that shelters are slow to develop and often inadequate for occupation.

Davis (1978 cited in Hadafi & Fallahi, 2010) that refugees need to be accommodated immediately in an emergency or temporary shelter as a quick response to their situation at relatively short notice. Emergency shelters are often provided in the form of tents which can last for up to two years, if facing changing weather conditions (Jabr, 1989). After this time, refugees should be moved to semi-permanent or permanent prefab shelters. A variety of strategies have been employed in pre-disaster and post-disaster programmes, including industry based on standardisation, repetition and a single technology, while the informal sector leads to variety, multiplicity and a combination of structural technologies (Lizarralde & Root, 2007).

At the beginning, refugees need shelters as the immediate environment of family life and daily activities. It provides protection and security, personal safety, and access to services such as clean water and sanitation (Hadafi *et al.*, 2010). Shelter is referred to in many different ways but all have the same meaning; emergency shelter, temporary shelter, temporary housing or dwellings, recovery and reconstruction housing. All these refer to protecting people who have faced unpredictable situations. Temporary shelters provide places for a limited stay for refugees until they move to permanent accommodation. Problems arise when people stay beyond the life of the temporary shelter which cannot function under the climate difficulties and structural limitations. A United Nation [UN] (2006) points out that as well as providing immediate shelter, a shelter must consider the importance of adaptation within a host community. Verderber (2001) discusses four levels of providing shelters, each of which has programming implications for design and urban organizations. The first level is the provision of shelters in up to seven days; the second level is provision between 30 to 60 days and the third level is a transitional shelter that may be established on a destroyed site or near to the host community and which exists up to one year. The fourth level is a permanent shelter which is not acceptable to the local community in most cases.

The recent approach to providing shelters was as a transitional shelter, as developed by the Shelter Center. The approach to the transitional shelter as described by Corsellis is to improve a temporary shelter from plastic sheet to sustainable local materials until the reconstruction of destroyed houses is complete. Life of between two to five years means it is more durable than tents which last no more than 12 months (Corsellis *et al.*, 2005). With regards to the transitional shelter, Corsellis and Johan, who created an IKEA T-shelter, stated during an interview that there was a difference between the prototype and the product. There were 45 developed shelters in the UNHCR alone and the challenge was to develop the prototype through establishing a process, involving a non-stop design process. However, the examples established to accommodate affected people were presented as a prototype for certain circumstances rather than global concerns.

Thus, several examples are developed for accommodating affected people each year, which are discussed, yet there are many others that are not discussed, however, most of these examples provide solutions for certain circumstances considering cost and time factors, but there is a limitation in terms of offering adequate accommodation. Additionally, although agencies present guides and standards in reports for providing shelters, inappropriate shelters are often the result due to the lack of their understanding of users' needs.

Data has been compiled from the results analysis for stakeholders throughout the methodology phases. It shows different concerns for each group (local governments, refugees, humanitarian organizations, local manufacturing companies, responsible institutions and experts). Such differences depend on the interest and points of view regarding the problem of dwelling refugees in hot dry climates.

6. METHODOLOGY

Anticipated, the paper adopts a Design Science (DS) method to describe and develop a new opportunity of understanding the world that can help people to obtain their needs. Design science is a new area in the Information system (IS) which aims to create novel ideas, methods, models or other opportunities to solve practical problem of broad interest and support its knowledge under (IS).

Saunders, Lewis, and Thornhill (2009) mentioned that design science aim is to develop an *artefact* by valid knowledge to support solving the problem in the context. Design science method tries to create something that in purpose of human needs, in this regard it is a solution oriented in considering human activities, and design science is key feature applied to link between theoretical aspects and a solution in the field. Also, the paper presents design science with considering clarification the application of design science activities on the research besides the reasoning behind using design science rather than other behavioral science in terms of methodology to achieve the research aim.

Many empirical research methods describe, explain and predict the world, whereas Design Science goes further by seeking change, improvement and the creation of new worlds. Design Science can produce a solution to practical problems of general interest while maintaining the rigour of an empirical study. The following section will discuss design science method besides justifying design science method comparing with other research methods where the research considers the reliability and validity of such method regarding collecting data and iteration process.

6.1. The Design Science Activities

The paper follows the techniques of design science method. Techniques differ between design science phases and that depends on the purpose of each phase and the goal that the paper would be achieved by the researcher. Johannsson and Perjons (2012) points out the researcher needs to determine which technique and tools are appropriate to produce knowledge needed for global practice and get the result discussed and evaluated, for this reason researchers use design science to determine appropriate tools and techniques applicable for each activity of design science to get sufficient knowledge and results. Design science method includes five phases which are; explicate problem, outline requirements and define artefact, develop artefact, demonstrate artefact and evaluate artefact. In this regards, the performance specifications is the means of artefact that is formulated by research criteria from phase one, then outline stakeholders' requirements from the field in the phase two. Developing and demonstrating performance specifications are followed in phase three and four respectively and finally evaluating phase by involving local architects to illustrate design proposals of refugees shelters based on understanding the list of performance specifications and validate feasibility of using performance specifications in dwelling refugees.

The research techniques included interviews and questionnaires regarding the design science phases as follows:

- Phase one aims to explicate the problem and it conducts a literature review of previous studies to define and clarify the problem.
- Phase two is to define the requirements of the problem, in this activity, the researcher conducted informal interviews, in-depth interviews. The informal interview was with local government in the Al Za'atari camp to explain the context of refugees besides allowing her to formulate and design questions for the next step in phase two. In-depth interviews and structured interviews were conducted, where the former was with 29 refugees in their context to focus on their needs and requirements in the context where the result of interviews was continuous with the latter technique with 147 refugees for explaining the connection between refugees' needs and settlement

challenges variables. In the same phase the researcher lead in-depth interviews with local humanitarian organizations in Al Za'atari camp, also the researcher conducted in depth interviews with local prefabricated manufacturing companies to explain the ability of shelter performance, challenges and barriers faced this field regarding the refugees' situation. All steps in this phase led to formulating and defining the list of requirements of stakeholders to develop the list of performance specifications to provide adequate refugee shelters in a hot dry climate.

- Phase three was developing the list of performance specifications for refugee requirements and considering the output of literature review and other stakeholders.
- Phase four aimed to demonstrate the requirements; in-depth interviews were conducted with 31 participants, including experts, professionals, architects, engineers, and researchers. This provided the benefit to reformulate the specifications list regarding the iteration process of design science.
- Phase five was the evaluating phase where the researcher presented the specifications list to 7 architects that are not involved in dwelling refugees and allowed for illustration of the performance specifications list to validate the defined requirements.

The contributors were selected by the researcher based on three conditions; the first was that they had to possess a wide knowledge of refugee situations concerning their needs and challenges regarding the environmental impact (in a hot dry climate), social need and shelter implementation. The second condition that the phase requires to choose certain participants to obtain the aims of the phase, the last condition was all of the participants are part of accommodating refugees in camps whether they are the main stakeholders such as refugees or because of their experiences in this field, to improve and implement refugee shelters, such as researchers, architects and NGOs.

7. JUSTIFICATION OF USING DESIGN SCIENCE

Many factors are involved in the production of a solution for the settlement of refugees in a new community, and this is a crucial challenge for humanitarian organizations, local institutions and local governments. Previous studies have shown that most shelter practices suggested several solutions in terms of prototypes that could implement design performance or urban planning strategy, however, there is an absence of solution that combines stakeholder requirements and as a result it produces a number of prototypes without considering a process. Turner (2011) discussed developing an *artefact* (which is the performance specifications list) occurs throughout the design science method that provides the process and connections between many factors in one process where the other research methods do not offer the opportunity of iteration in the development process (Johannesson *et al.*, 2012).

The paper conducts the design science approach and follows the process to achieve the proposed solution of formulating performance specifications for refugees' shelters in a hot dry climate. The design science method was selected for the following reasons;

- Most academic research on refugees' studies currently point to an understanding of the refugees' situation with less attention to innovate a proposed solution that might present challenges. Unclear evidence is presented in the literature about the use of

design science as a method to producing an original solution to the problem (Dresch, Lacerda, & Antunes 2014).

- Unlike behavioral science research, design science is solution oriented, so the result comes from a scientific understanding of the theory and practical problems in the relevant field and involving people in the solution which is driven through an iterative design cycle of data collection and analysis (Wieringa, 2013).
- Many research strategies have been conducted to achieve the research aims, objectives and results, although there are similarities between design science and other strategies including the case study and action research approaches. However, the difference appears in term of the whole process of design cycle as a main variance, clearly interpretivists' perspective show hermeneutic as cycle of design and documentation text of the researcher in certain point of the field (Bryman, 2012).

In summary, design science investigates the reality of the problem and offers a practical understanding of the gaps between theoretical academic research discipline and the practical field. Puroo (2002) discussed that natural science research stands on existing and emerging phenomena without effect on phenomenon and the barriers to delivering an original solution for general interest which is appropriate to refugees' situation as general interest around the world.

8. LESSONS LEARNED

The lessons learned are from the paper supported by literature and field work which included interviewed refugees, humanitarian organization members and experts. The broad findings of the paper showed gaps of understanding users' needs from one side and standardization of such needs in different cases by humanitarian organizations on the other side. Humanitarian organizations have formulated reports or annual reviews with lessons learned that are rigid to add new knowledge and updating the lessons. Drawing from all the evidence gathered through the research, it can be concluded that:

1. It is difficult to find a balance between financial viability that leads to standardized solutions, and community needs, that require a customized and tailored response, however a good balance is paramount in order to avoid situations of discomfort in living conditions.
2. Overcoming the rigidity of the current shelter performance is essential to fill the gap of the variances between shelter elements, users' requirements and camp layout.
3. Donors' awareness on the actual refugees' specific needs should be elicited by humanitarian organizations.
4. Lack of integration between social and physical well-being in shelter negatively influences users' daily activities and leads to social instability.
5. Shifting from the shelter to the camp is often a merely quantitative issue, while more attention should be paid to the social dimension of the camp.
6. It is still possible to design an architectural prototype that meets both the requirements of the producers and the needs of the users.

Different prioritizations between stakeholders meant it was difficult to confirm one standard list, besides the difficulties to confirm a social framework. The interpretation of local policy and rigid annual reviews of humanitarian organizations leads to a top down strategy which mitigates providing users' the right of self-settlement, to contribute to a bottom-up strategy throughout the duration of stay allows users to be involved in the process of choosing a way of life and allocating shelters within a plot inside a camp. This thesis can address lessons learned by contributing to knowledge that impacts on housing refugees with better circumstances.

9. CONCLUSION

The paper highlights challenges in providing refugees with shelters in a hot dry climate. It serves through perception gaps between the literature review and primary data that support stakeholders to face challenges. In this regard, the paper links between theoretical stance and practical solutions filled through the design science method. The connection between two approaches (theoretical and practical) gives a foundation to improve performance specifications that might be a solution for the settlement of refugees globally. The broad principles and guides of establishing refugee shelters which were shown in reviewing the literature led the paper to comprehensive understanding, it is impossible supporting technical or engineering issues through following such general perspectives already used by organizations, so the theoretical knowledge is constructed by an absence of the concept of performance specifications, while connecting between physical, technical approaches and social and cultural meanings, in this regard the research developed performance specifications with take into consideration different social directions in the context. Thus, such flexibility of presentation is what people need in the same list of specifications depending on the local context and environment conditions as another identification of theoretical contribution.

Adoption of the design science method allows the field work providing unique insights into connecting the theoretical and the practical parts in the process of producing refugee shelters in terms of building, testing and demonstrating prototypes kept a balance between all needs of stakeholders and specifically users' needs. This led to highlighting the gap of awareness about stakeholders' prioritizations which is another key issue of considering appropriate solutions for refugee shelters not just producing a prototype. The paper contains a general approach by developing the performance specifications list and to maximize the impact of the research findings, the conclusions are complemented by a set of lessons learned targeted to decision makers involved in the process of providing refugees with shelters in hot dry climates.

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ENHANCING DISASTER RISK TRANSFER AND SHARING IN THE BUILT ENVIRONMENT THROUGH CONSTRUCTION CONTRACTS

V. Nguyen, D. Greenwood and K. Ginige

Faculty of Engineering and Environment, Northumbria University, 2 Ellison Pl, NE1 8ST, UK

Email: vinhnguyen.1990@gmail.com

Abstract: Reducing the financial impact of natural disasters and extreme weather events (NDEWE) on governments and societies through the mechanisms for disaster risk transfer and sharing for both public and private investment has been emphasized as a vital and critical element by Sendai Framework for Disaster Risk Reduction 2015 – 2030. The entire built environment, which contributes around 50% of Gross Domestic Capital Formation across most developed countries and facilitates the functions of the society, is one that is directly exposed and most susceptible to NDEWE. The increasing pattern of NDEWE witnessed over the recent times prompts the importance of achieving the optimum response to the impact of NDEWE-related risks on construction projects. The normal vehicle for doing this is the construction contract: the commonly-used standard forms contain provisions for handling the impact of NDEWE-related risks. However, not only do different standard forms of contract deal with weather-related risks in different ways, there is a gap between these principles and their application, which often involves subjectivity; hence uncertainty. A review of the literature reveals that the principles of NDEWE-related risk allocation within construction contracts appears, at first sight, to be reasonable and straightforward. However, its implementation remains problematic. The provisions of standard forms of contract are far from easy to apply. Different standard forms of contract have presented numerous problems, including the use of vague language to define adverse weather conditions, and exclusion of important factors necessary for precise weather analysis. What is proposed is a guidance protocol as a means by which contracting parties can limit the need for subjectivity; hence reduce uncertainty, and thereby avoid unnecessary efforts, disputes and their associated costs. Such a protocol would integrate disaster risk reduction into the construction projects in a more efficient and effective manner. This paper is compiled based on the desk study of the initial stage of a PhD research that aims to develop a framework to integrate disaster risk reduction more effectively into the built environment.

Keywords: Built Environment; Construction Contract; Extreme Weather Event; Disaster Risk Management; Natural disaster.

1. INTRODUCTION

Climate change has become one of the major challenges faced by countries worldwide. Recent years have witnessed a noticeable increase in both frequency and intensity of the phenomena of climate change. An example is the occurrence of natural disasters and extreme weather events (NDEWE). Therefore, reducing the financial impact of NDEWE on governments and societies through the mechanism for risk transfer and sharing for both public and private investment has been emphasised as a vital and critical element by Sendai Framework for Disaster Risk Reduction 2015 – 2030 (UNISDR, 2015).

The built environment sector (i.e. the industries that create the built environment) typically contributes about 50% of Gross Fixed Capital Formation in most developed countries; a figure which increases in less-developed economies. It is also one that is directly exposed to, and most susceptible to NDEWEs. In construction projects, NDEWEs can result in work

delays, cost overruns, disruption and also conflicts and legal disputes between project parties (Baldwin, 1971; Laufer and Cohenca, 1990; El-Razek, 2008; Nguyen, 2010). In response, a variety of risk management tools and strategies are normally adopted. These include buying insurance and sharing or transferring risk to other parties via appropriate contract terms and conditions.

Contracts are considered to be one of the most effective method for dealing with risk and uncertainty, and for reducing claims and disputes since they outline and define roles, relationships, rights and obligations between parties (Shapiro, 2013). To this extent, construction contracts potentially offer an important means by which impacts of NDEWEs can be minimised and mitigated via rational negotiation of risk transfer and risk sharing terms and conditions. However, different forms of contracts deal with NDEWE-related risks in different ways and the risk allocation within construction projects in practice is intrinsically problematic.

This study proposes a new approach to dealing with NDEWE-related risks through contracts. The paper begins with a review of the related literature to explore current NDEWE-related risk allocation in construction contracts, its efficacy and residual problems of NDEWE-related risk transfer and sharing among contracting parties. It then proposes an outline solution that addresses what are perceived to be the shortcomings of current practice. Finally, a protocol is proposed, that would overcome the problems that exist between the interpreting and understanding the broad principles of risk allocation of NDEWE-related risks, as they exist in most standard forms of construction contract, and their application to specific instances as they occur in actual construction projects. The aim of such an approach would be to minimise subjectivity, uncertainty and ambiguity, thus creating more efficiency in the forming of contractual agreements.

2. PRINCIPLES OF TRANSFERING AND SHARING OF NDEWE-RELATED RISKS

2.1 NDEWE-related risk allocation: theory versus reality

No construction project is risk free. Risks can be specific to the project, its location and the availability of information, especially when the risk comes down to the question of weather systems (storm, typhoon, hurricane, flood, for example), and geological phenomena such as volcanic eruptions and earthquakes (Ling and Hoi, 2006). The fundamental principles of risk allocation and issues regarding to the transfer and sharing of risk are widely discussed. However, when it comes to applying these principles, for example, in the case of NDEWE-related risks in construction, there has been less published work. It is commonly accepted that risks should sit with the party that has the best capability to control and manage them (Cooper, 2005; Xu, 2010). Risks that are beyond the control of contracting parties, such as NDEWE, should best be shared (Groton and Smith, 2010). Some risks are unavoidable and can hardly be ever eliminated (Loosemore and McCarthy, 2008). Instead, they can only be transferred to another party or shared, based on relevant contractual terms and conditions (Andi, 2006). Such transfer and sharing of risk should be done in an effective manner as this has a crucial impact upon construction costs (Yates and Sashegyi, 2001). Nonetheless, risk is often indiscriminately allocated to parties that do not hold the best control capabilities (Waldron, 2011; Sharkey, 2014). Contractors are parties that perform the most tasks in delivery of projects, meanwhile they are also in charge of the majority of risks, including those pertaining to NDEWE (Akintoye, 2003). A contract can be perceived as a trade-off

between the contractor's bid price for executing the work and their willingness to carry all manageable and unmanageable risks that have been assigned to them (Flanagan and Norman, 1993). The allocation of risk is therefore one of the most significant decision-making processes in support of successful delivery of construction projects.

In reality, a contract is normally compiled or established by the 'employer' or 'owner', which is the party initiating a project (Yates and Sashegyi, 2011). Consequently, the employer leans towards allocating more risks to the contractor by intentional adjustments to standard forms of contract with the expectation that the contractors are competent to manage the risk (Groton and Smith, 2010; Waldron, 2011). Such perception correspondingly forces the contractors to enter the tendering process in a reactive mode and input higher amounts of contingency to their bid price for the purpose of minimising their risk liability (Andi, 2006).

2.2 Risk allocation models and their implementation in practice

The goal of risk management in construction is not only to diminish the total cost of risks to a project, but also to minimise the costs to each party separately following a contractual agreement (CII, 1993). The toughest task is determining how risks, including those related to NDEWE, can be efficiently allocated to achieve such goal upon the completion of the project. Over 20 years ago, Thompson and Perry (1992) observed that, despite the availability of various models as well as standard packages of general conditions of contract, the principles used to establish the risk allocations in these contract documents were not been explicitly stated. It is arguably the case that little has changed. Furthermore, the nature and extent of risks have a considerable element of subjectivity to them, varying from project to project and circumstance to circumstance. This makes standard form of contracts tend to be inappropriate in the high-risk scenarios of modern construction and multi-disciplined complex projects due to increased complexity and shorter delivery times. In the other words, the utilisation of tailor-made contract strategies is believed to be more suitable and desirable (Rahman and Kumaraswamy, 2002).

Hitherto, there has been a variety of risk allocation principles developed by a number of researchers, which the transfer and sharing of NDEWE-related risks can follow. These include work by Casey (1979), Kuesel (1979), Barnes (1979), Abrahamson (1984), and Thompson and Perry (1992). These principles are said to be an essential platform for allocating risks, which is useful to avoid bias in making decision and correspondingly beneficial to both employers and contractors (Grove, 1998). However, in common with a majority of management doctrines, all of these risk allocation principles are normally expressed in natural language, which makes their actual application become ambiguous. This leads to final decisions that rely substantially on the qualitative judgement and experience of construction professionals. In fact, the attitude of the project parties together with bias existing in personal perception and judgment may produce substantial variations on the decision outcomes (Barnes, 1979; Lam, 2007).

In contrast to the qualitative approach, Lam (2007) suggests an alternative principle for allocating risks in a more efficient manner by the use of a prototypic quantitative model. Lam's proposed model demonstrates its ability to extract and transform vague linguistic principles and experiential expert knowledge into a more viable quantitative analysis. In context of NDEWE, this provides a number of advantages, in that an explicit and systematic framework to support distribute NDEWE-related risks is utilised rather than a prejudiced and

undetectable approach built upon individual's expert judgement. In addition, the allocation of risks is examined in a more fundamental way based on accepted principles rather than simply adopting standard clauses of construction contract without considering the rationale behind them. Importantly, recommendation from the model has shown the consistency with the contracting practice as NDEWE are conventionally treated as a shared risk in most contractual arrangements.

Besides Lam's research, a number of other previous publications have also suggested quantitative models of risk allocation (Jin and Doloi, 2008; Jin, 2009; Xu, 2010; Jin and Zhang, 2011). In follow, Khazaeni (2012) developed a fuzzy ('TOPSIS') decision model which accommodates a reasoned decision-support tool in order to achieve optimal allocation of risks. Interestingly, unlike Lam's original model, this improved version is able to consider different parties simultaneously and can be applied flexibly to be appropriate with different project contexts and contractual arrangements. Due to the inclusion of the objectives of all the project parties, the ultimate outcome is argued to be more realistic and satisfactory to them.

Despite the fact that there has been a broad industry experience with the principles of realistic and equitable risk allocation, construction project employers have shown lack of progress in adopting and applying recognised risk allocation framework, even as implementation methodologies have been continuously upgraded. According to Groton and Smith (2010), the main barrier that limits the implementation of better risk allocation practices being more widespread is the difficulty in educating employers to the reality of risks in construction, as well as the benefits that can be earned from the application of realistic risk allocation. In fact, many employers are the least experienced stakeholders in construction projects, particularly those that are occasional or even one-time participants. It is indisputable that the questions of transferring and sharing NDEWE-related risks cannot escape from the aforementioned problems in implementing proper risk allocation principles.

3. PROVISIONS FOR TRANSFER AND SHARING OF NDEWE-RELATED RISKS IN STANDARD FORMS OF CONTRACT

According to the majority of standard forms of construction contract used in the UK, delays caused by NDEWE are considered as being permissible but not compensable (Cobb, 2015), which means the contractor is entitled to additional time and released from the imposition of ascertained and liquidated damages, but not able to recover any direct loss and expense arisen from the delay. Besides, there are some other forms of contract even exclude any extension of time (EOT), which is GCWorks form for example, leading the contractor to bear the effects of a potential natural hazard in its entirety.

Nevertheless, even EOT that relates to NDEWE is innately a problematic area. The most dominant challenge lies with the definition of adverse weather, where the description for distinguishing "normally" from "abnormally severe weather conditions" has remained unclear (Nguyen, 2010). Additionally, Nguyen (2010) through his research on analysis of adverse weather for excusable delays also reveals other fundamental points that typical construction contracts may overlook, including weather thresholds, type of work, lingering days and criteria for lost days.

The following sections present an overview of standard contract forms that are prevalently used in the UK construction industry, including Joint Contract Tribunal (JCT), New Engineering Contract 3 (NEC3) and International Federation of Consulting Engineers (FIDIC) with regards to provisions of NDEWE-related risk allocation.

3.1 JCT Standard Building Contract and Sub-Contract Models

Under JCT suite of contracts, NDEWE can be found under the term “exceptionally adverse weather conditions”. These are classified as ‘Relevant Events’ (i.e. under clause 2.29.10 in JCT Standard Building Contract with Quantities 2011) which entitles the contractor to an EOT for completion. However, as these events are not listed as one of the ‘Relevant Matters’, the contractor is unable to claim payment for loss and expense originated from impact of NDEWE disregarding to the extent of their severity.

However, exceptionally adverse weather conditions are not clearly defined by the JCT and also there exists no universally accepted definition of what this important term really means (Frame, 2010): whether the application for EOT under JCT contracts is successful depends on the way that the denotation of exceptionally adverse weather conditions is ultimately decided, subject to the discretion of the contract administrator (Wakefield, 2012).

In addition, ‘Relevant Events’ through the JCT forms of contract also includes loss and damages originated from any events that are listed under force majeure. Yet, it would be a real challenge for a contractor who sought an EOT under JCT contract by citing force majeure. Despite the existence of the term ‘Force Majeure’, its meaning is effectively restricted since events otherwise qualified to be within the force majeure definition are specifically dealt with under separate headings (Williamson, 2012).

3.2 NEC3 Standard Building Contract and Sub-Contract Models

NDEWE, according to NEC3 contract family, can be considered as a ‘Compensation Event’ under clause 60, and specifically a force majeure event under clause 60.1 (19), which provides the contractors with entitlement for additional time for the delay of construction works, and payment to cover associated loss and damages (Danby, 2014).

The employer, at the tender stage, decides what types of measurements will be recorded, where the weather measurements will be taken, who will be authorized to supply them and against which local weather data in the history the measurements will be confronted. In the UK construction industry, the default measurements of weather comprise cumulative rainfall, the number of days with over-5mm rainfall, the number of days with less-than-0-degree-Celsius minimum ambient temperature, and the number of days with snow covering the ground. In comparison to JCT, the NEC3, with its inclusion of such analysis, is seen as a much more objective and prescriptive route (Tatham, 2011). However, these also reflect that NEC3 contracts only deals with cold, snow and rain and excludes other types of weather extremes, such as intensive wind, which have been proved to cause many collapsing crane incidents across the UK (Eggleston, 2006).

In fact, NDEWE will only entitle the contractor to a compensation event if its related weather measurement, which is recorded within a calendar month, shows that such phenomenon has occurred less frequently than once in ten years. According to NEC3 contracts, only

exceptional adverse weather (with reference to weather measurement data) will be considered (Evans, 2013). Consequently, this means that the contractor will suffer the risk of any bad weather that cannot be proved to lie within the list of strict criteria constituting a compensation event. In addition, an adverse weather condition under NEC3 contracts is only measured based on calendar months. If the event lasts from a particular month to the following one, the weather measurements accounted within each individual month may not reach the level of adversity that qualifies a compensation event (Wakefield, 2012).

3.3 FIDIC Standard Building Contract and Sub-Contract Models

In FIDIC standard forms of contract, there are several clauses that provide platforms to deal with NDEWE. In FIDIC Red Book, clause 8.4 states that risks pertaining to climatic conditions are shared between the employer and the contractor, in that the employer will allow an EOT if exceptionally adverse climatic conditions obstruct construction activities and productivity of the contractor. However, like the JCT suite of contracts, this means that the contractor will have to be responsible for relevant costs incurred due to such risks.

Nevertheless, in accordance with clause 17.3 and 17.4 in FIDIC Red Book, the contractor possesses the entitlement to an EOT and also payment as cost compensation if any event concerning unforeseeable natural forces occurs. These forces may consist of some climatic conditions, especially when they turn out to be natural catastrophes, such as hurricane, typhoon, etc. under clause 19.1 and 19.4 which deal with force majeure. In terms of other natural catastrophes including earthquake and volcanic-related events, the risks are mainly allocated to the employer under clause 19.1 and 19.2 (Zhang, 2006).

In short, it can be seen that the NDEWE-related risks are basically shared between the employer and the contractor under FIDIC standard forms of contract. However, the problem with regards to vague language remains the same as with JCT, with exclusion of guidance to prescriptively define the term “exceptionally adverse climatic conditions”. In addition, a contractor may find it confusing when differentiating “exceptional” from “unforeseeable”.

4 TRANSFERRING NDEWE-RELATED RISKS TO INSURANCE

No discussion of risk transfer and sharing is complete without considerations of the role of insurance. NDEWE-related risks can be shared with, or partially transferred to an insurance company through appropriate terms and conditions. An insurance policy is perceived as a contract whereby the insurance company promises to assume financial responsibility for a specific loss and expense, or liability on behalf of another, who is commonly known as the insured (Clough, 2015). However, insurance is regarded as the subject that has the least attention during pre-contract negotiations due to the fact that the project parties at that stage do not want to envision what might go wrong, and that they are questions which tend to be passed to the professionals (Bellhouse and Walton, 2012). In practice, project insurance procured should be tailored to meet the specific risk inherent to the work and the project’s location (Boswall, 2005). It is beyond the scope of this paper to give an in-depth discussion of insurance, but there are a few points that need to be mentioned.

Firstly, all risks are not covered. Coverage against storms, hurricanes and other types of NDEWE such as earthquakes, varies with insurance provider and product: some policies do

not accommodate coverage for such losses at all, while others offer some level of protection (SDV, 2015). Secondly, contractors' risk policies that specifically cover hurricane or named-storm perils characteristically contain restriction on the available limits for associated losses of such events by imposing another figure that is below the general coverage, or including a greater amount of deductible (Roth and Kunreuther, 1998). Moreover, availability as well as limitation for coverage of those NDEWE-related perils can also be influenced by geographic region. For instance, areas with a significant number of insured events witnessed in the over years, like Christchurch, New Zealand (in the case of earthquakes) the number of add-ons that were formerly provided by insurance companies at low or no additional premium had declined dramatically, and in several cases insurance is even unavailable (Bellhouse and Walton, 2012). Lastly, provisions that contain a so-called 'anti concurrent cause clause' (i.e. a policy provision that modifies cover when two or more causes occur concurrently) can have an impact upon coverage of NDEWE-related damages and losses. For example, with regard to a hurricane, the contractor according to such provisions, is not insured against losses in occasions where an excluded peril such as water is associated with covered peril like wind to result in a loss (SDV, 2015). In the other words, the anti-concurrent cause language is used for the purpose of precluding coverage even if the excluded peril is not a proximate or predominant cause.

Thus, despite the fact that insurance can bring about some reliefs for the insured in case of occurrence of NDEWE, it should not be used and compromised as an opportunity to put aside a forthright discussion about NDEWE-related risks, or abandon the procedures in the contract for tackling with responsibility allocation and claims with regards to NDEWE, simply because such risks are covered.

5. DISCUSSION, CONCLUSIONS AND FUTURE WORK

NDEWEs involve forces beyond the control of project parties and this makes them particularly demanding of careful consideration. Project stakeholders usually employ various strategies that include the transfer and sharing of NDEWE-related risks via contractual provisions. According to standard forms of construction contract, including JCT, and FIDIC, a majority of NDEWE-related risk is shared, in that the contractor is entitled to an EOT but is not able to gain any additional payments to cover associated loss and damages, and the employer recovers no liquidated damages. To this extent, the contractual practice expressly reflects its similarity to a various realistic risk allocation principles developed by a number of researchers.

The principle is straightforward but the provisions in standard forms of contract are also far from easy to apply. Different standard forms of contract present numerous problems that include the use of vague language to define adverse weather condition, and exclusion of important factors needed for precise weather analysis. Furthermore, construction project employers have shown reluctance in adopting risk allocation frameworks, and their tendency is to pass risks to contractors wherever possible.

The ultimate aim of the study described within this paper is to supplement the standard contractual approach to NDEWE-related risks through developing a protocol that would overcome the problems of interpreting the broad principles of the standard contracts and their application to specific instances in actual construction projects. The protocol should contain the following elements:

- NDEWEs must be explicitly defined. They must be linked with contractual provisions through the inclusion of appropriate means of distinguishing the 'exceptional' from the 'normal' to systematically classify a particular event based on its intensity and potential impact.
- A preferred method of evaluating loss and damage resulting from NDEWEs should be included. This should take into account all possible elements of the project, including construction plans, machines, tools and equipment logs, materials and labour force records, work schedules, etc.
- Assessment and evaluation of NDEWE-related loss must be done in an objective manner, possibly through the involvement of a third-party inspection.
- The share of responsibility assigned to each side has to be explicitly determined for each element of the project.
- NDEWE-related delay analysis must be systematically approached and executed in order to obtain reasonable EOT. This can be done by the inclusion of weather thresholds, types of work, lingering days and criteria for lost days. It may also necessary to involve a third-party to ensure proper judgement.

The aim of such an approach would be to minimise subjectivity, uncertainty and ambiguity, thus creating more efficiency in the forming of contractual agreements.

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NATURAL HAZARDS AND BUILDING SKIN: SYSTEMATIC LITERATURE REVIEW

M. Bigolin¹, L.C. PINTO Da Silva Filho¹ and H. Elkadi²

¹ UFRGS, Brazil

² School of the Built Environment, University of Salford, Salford M5 4WT, UK

Email: morgane.b@gmail.com

Abstract: This paper investigates the extent of research of the inter-relationship between building skin and natural hazard. The paper explores the trends and identifies the research gaps in this increasing field of concern. A total of 162 peer-reviewed papers published between 1984 to 2016 were systematically analysed and classified in the following research areas: assessment of damages caused by natural events (field observations, field measurements, laboratory measurements, innovative methodologies for measurements, analytical and numerical modelling and cross studies) and new building skin technologies developed to mitigate the impacts of those events. Additionally, the articles were organised chronologically, their geographic location, and the building skin typologies. Results showed that the number of building skin research related to the natural hazards has grown during the period of study; with over 60% of all papers published since 2010. Earthquakes and storm were the most researched themes followed by fire. Additionally, this review enabled concluded that, although there is a great interest about buildings skin research in events of disaster, some important key gaps in the knowledge still remains, especially about flood research. Based on the analysis, some suggestions for further investigation to fulfil those gaps are provided.

Keywords: systematic review, disasters, building skin, climate change, natural hazard

1. INTRODUCTION

Natural events, such as flooding, earthquakes, tornados etc., causing damage and disruption in urban environment, have increased environmental stress (Iyer & Mastorakis 2006). According to the United Nations Office for Risk Reduction (2015), just in 2015, 346 disasters connected with natural events were reported around the world. These frequent events caused, at least, 23.000 fatalities affecting about 100 million people. Apart from the loss of lives and physical damages, these disasters resulted in approximately USD 70 million in damage during 2015 (CRED & OFDA, 2016).

Furthermore, these disasters occurred in high density built environment and thus increase the number of victims and financial losses. In order to mitigate these problems and reduce loss of lives and damages in buildings, a number of studies were developed several of them are related to building skin. These studies have different approaches. A number of research papers aim to investigate, measure and assess the resistance and damages caused for specific disasters (Grayson et al. 2013; Spence et al. 2004; Rocha et al. 2011) while others aim to introduce new materials, technologies or techniques to improve the performance to specific or multiple disaster (Shetty et al. 2014; Pantelides & Truman 1996; Feng et al. 2012).

A building skin is crucial to performance in natural hazard (Pita et al. 2015). At the same time, it is one of the most vulnerable parts of the building (Pantelides & Truman 1996). There are various definition of a building skin; for instance: “A transition between inside and

outside – between the building and the urban space” (Schittich, 2010) or “A group of roof and walls with partially or none structural purpose (Del Grosso & Basso 2010). In this paper, a building skin is the area where different internal and external forces are interplay to maintain a constant internal comfortable environmental conditions. Thus, the building skin could be viewed as an important building system to be studied in an event of disasters.

Building skin have different functions: energy saving, natural ventilation insulation and sun protection. Although, nowadays, they are more frequently associated to energy efficiency besides the traditional function of lighting, glare, noise and fire protection (Del Grosso & Basso 2010). Therefore, the design of a building skin requires multi criteria objectives and trade-offs about the impacts on environment and the technologies assessed, economic and aesthetic reason.

Several authors have reviewed the performance of building skin to different impacts. For example, Minor (2005) reviewed damage documentation, insurance records and computer simulation of building skin failure in windstorms. Sadineni et al. (2011) made a technical review about the components of building skin and the improvements from an insulation perspective. Blocken et al. (2013) presented an important state of the art about rainwater on building facades. More recently, Mavrigiannaki & Ampatzi (2016) have presented a systematic review of heat storage in buildings elements to cold climates. However, despite practical experiences and methodological advances, there is no comprehensive literature review that explores a holistic perspective about the impacts caused by natural hazard in building skin.

It is believed that there is a need for a systematic survey to consolidate and synthesize research conducted in this area. Therefore, this paper aims to provide a literature review about papers regarding measurements and assessments of damages in building skin caused by different natural hazard, seeking to assess emerging trends and identify issues for future investigation. In addition, it attempts to provide a better understanding of the current status of new technologies developed to mitigate the damages. With this review, it attempts to answer the following questions:

1. which natural hazard are most often assigned to building skin in literature?
2. where was the research undertaken?
3. are these studies correlated with the occurrence historical natural hazard in this locales?
4. which skin typologies are the most frequently studied?
5. which are the gaps of knowledge and which methodology is undertaken on the studies related to each natural hazard?

It is important to highlight that this study do not intend to drawn any conclusion, but start a discussion around the theme and find possible gaps. The remainder of this paper is structured as follows. In Section 2, the selection of natural hazard adopted in this review are briefly described. Section 3 outlines the search strategy and the methodology used to classify the literature. Section 4 covers the discussion of the outcomes and provides answers to the research questions. Finally, Section 5 presents concluding remarks, limitations and assumptions that were taken into account at the beginning of the study, as well as recommendations for further research.

2. NATURAL HAZARD

Hazard and Disaster do not have the same definition. The IPCC definition mentioned that a hazard is “the potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources”. A disaster in other hand, takes place when a hazard (natural or man-made) interacts with the human environment, especially in a vulnerable scenario (CEPED/RS-UFRGS 2016).

There are many definitions of disaster as many authors writing about it. A definition widely accepted is presented by The United Nations Office for Risk Reduction that defines disaster as “a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources” (UNISDR, 2009).

There is no common agreement regarding the classification of disasters and the subdivision typologies. Some researchers classify disasters in 5 categories: natural, unnatural or man-made, purely social, technological and hybrid (Shaluf, 2007a). The Centre for Research on Epidemiology of Disasters (CRED) classifies disasters in two groups: natural and technological. In (Shaluf, 2007b) opinion on natural disasters, those events are resulting from natural forces, where man has no control. However, the terminology of “natural disaster” is continually used by some authors and by the media, it is not widely accepted. O’Keefe et al. (1976) stated that the term ‘natural disaster’ was a misconception, and argue that disaster are more consequence of socio-economic vulnerability and lack of preparedness than natural factors. Therefore, it is more appropriate to use the term ‘natural hazard’ when talking about earthquakes, droughts, floods, or storms, or ‘disasters’ when discussing a serious disruption of the functioning of a community or a society as a result of an exposure to a hazard. A better classification of disaster based on its root cause: geological, hydrological, meteorological, climatologically and biological (CENAD, 2013), besides technological and human induced threats. In this paper, this classification will be used to group the natural hazard, and the chosen keywords are the events related in which group. It is important to highlight that the events select are those who is believed affect in some instance the building skin.

3. FRAMEWORK FOR SYSTEMATIC LITERATURE REVIEW

3.1 Search strategy

A comprehensive literature review was undertaken, aiming to identify peer-reviewed papers relating natural hazard to building skin. With this scope, the systematic quantitative approach outlined in Pickering & Byrne (2014) was used, since this method is explicit, reproducible and offers more insights than traditional narrative reviews. To ensure that potentially relevant papers were not missed, five mayor library databases were systematically searched, including Scopus, ProQuest, Science Direct, Emerald Insight, and Web of Science. Publications such as doctoral dissertations, book chapters, reports, and conference proceedings were not taken into account. Furthermore, only papers written in English were included. To find eligible papers in the mentioned databases, Boolean functions were applied to combine the following keywords, as show in Table 2:

Table 2: Keywords and Boolean functions

| | GROUP | KEYWORDS | | KEYWORDS |
|------------------|---------------------|---|-----|--|
| Geological | Earthquake | Earthquake* Tsunami* | AND | Envelope* Façade* Skin* |
| | Volcanic activity | Volcan* | | |
| | Mass Movement | Landslide* OR Mudslide*Subsidence* OR Avalanche* | | |
| Hydrological | Flood | Flood* | | |
| Meteorological | Storm | Storm* OR Hailstorm* OR Blizzard* | | |
| | | Hurricane* OR Tornado* OR Typhon* | | |
| | | Lightning* | | |
| | Extreme Temperature | Cold OR Snow | | |
| | | Heat* OR heatwave* | | |
| Climatologically | Wildfire | Fire* OR explosion* | | |

Distinct combinations of these terms were used, taking into consideration the requirements of each search engine. For example, some databases allowed search in “title, keywords and abstract”, whereas others did not. Thus, different functions were applied for each database. When possible, only the abstract, title, and keywords were searched. These criteria narrowed the search and allowed excluding papers that mentions the keywords only in the references.

These queries elicited over 1900 potentially eligible references published between 1984 and June 2016. At first, the title, abstract and keywords were screened manually to exclude irrelevant references. After this pre-selection, the full-text of 242 select papers was revised in detail. The paper was excluded if it was not specifically focused on building skin, or when the disaster and the effect were not clear. At the end, 162 papers met all inclusion criteria and were considered in the analysis.

The review covers articles published in 81 different journals, in several knowledge areas. Journals with most papers were *Engineering Structures*, followed by *Journal of Wind Engineering and Industrial Aerodynamics*, with 12 and 8 articles respectively. The remaining journals account only for one or two published papers each.

3.2 Classification scheme

Following the selection, all included papers were classified according to some domains: natural hazard, publication year, country of application, building typology, skin typology and research aims, that include new technologies developed, and impact assessments (classified in field observation, field measurements, laboratory measurements, and analytical and numerical modelling). Regarding to natural hazard seven types were identified, as follows:

1. Earthquake: comprises the selection of studies that aim to investigate the effects of earthquakes in building skin, as fissures and other damages, or new technologies developed

to support the seismic events. Among the keywords has also been included tsunami since had been noted that the studies connected both subjects.

2. Volcanic activity: the papers in this class are mainly concerned with the damages linked to the high temperatures of the ashes.
3. Mass Movement: mainly consists of papers about the assessment of potential damages caused by soil subsidence and avalanches landslide or mudslide in building skin and comprises the articles that investigate the structural problems.
4. Flood: refers to articles that assess the problems related to mechanical failure and water infiltration besides mould and moisture issues
5. Storm: this group comprises all the articles related to hailstorms, blizzard, hurricanes, tornados, typhoons and lightning. The concern was related to tightness problems and structural failure.
6. Extreme temperature: refers to articles that assess the lack performance in thermal comfort, when the building skin was under extreme cold or extreme hot temperatures.
7. Wildfire: the papers in this class are concerned with the behaviour of building skin related to fire and explosion, as fire resistance and reaction and smoke characteristics.

4. ANALYSIS OF FINDINGS

This section presents a systematic analysis of 162 papers published between 1980 and June 2016, since this was the period of time that papers were found in the database consulted. The papers have been analysed from a quantitative point of view at five different levels: distribution by natural hazard, year of publication, geographic distribution, building skin typology and research methodology. The aim of this analysis is to better understand the maturity of the research topic from different points of view. The results are summarized in various charts and tables that allow a visual comparison of the results.

4.1 Trends by natural hazard

The findings regarding the different natural hazards reveal that the most common event related to building skin was earthquake with 33.3% of the articles selected. These studies mainly focus in the damages that earthquakes can cause to building skin. A reason for this type of hazard to be the most studied among the group may be a reflection of the maturity of this field study on buildings. Also because, even moderate earthquakes, can cause important disruptions in the function and security of building skin (Pantelides & Truman 1996).

The second most common disaster type was storm (32.7%) followed by fire with 18.4%. Regarding the hazard type extreme temperature, just 8 papers were selected despite the large number of papers selected during the first step of the research (1219 articles). This is because the subjects about heat and cold associated to building skin have wide interest regarding to thermal comfort and energy efficiency. However, when the articles related just about extreme temperature and how this could be dangerous for users or damage to building skin were selected, the number of papers were considerably reduced. Flood, volcano, and mass movement presented a reduced number of papers, indicating gaps of research that could be better explored of the building environment fields. Especially regarding to floods since this

kind of hazard is a challenge to all the river cities and are expected to increase due to climate change (Liao 2012). In order to have a complete vision of works published through the group types of natural hazard **Error! Reference source not found.** present the results of the two teps of the research.

Table 3: Distribution of papers by natural hazard topic

| Natural Hazard | N• | % |
|---------------------|------------|------------|
| Earthquake | 56 | 33.33 |
| Storm | 55 | 32.74 |
| Fire | 31 | 18.45 |
| Extreme temperature | 8 | 4.76 |
| Flood | 7 | 4.17 |
| Volcano | 3 | 1.79 |
| Mass movement | 2 | 1.19 |
| Total | 162 | 100 |

4.2 Trends by year of publication

In an attempt to model the evolution of the concern about buildings skin research related to natural hazard in time, the data gathered was organized by year of publication (**Error! eference source not found.**). This figure shows how there was a continued growth of the number of every hazard types analysed, mainly in the last five years. In fact, over 60% of the compiled papers have been published since 2010. A reason for the increasing number of publications could be a reflection of a growing interest by the academia about how natural hazard affect the built environment. Secondly, other factor is the increase of the information and data analysed about the hazards. As an example the first papers about flood started after 2000, as presented in **Error! Reference source not found.**.

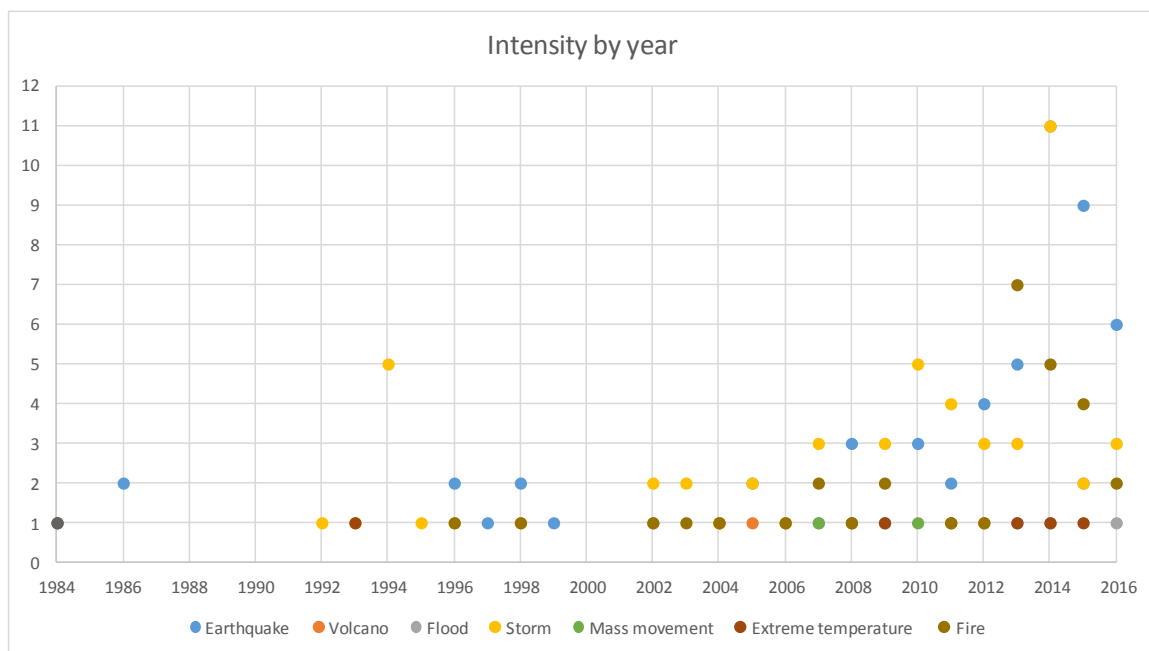


Figure 1: Number of papers published over the period 1982-2016.

The result analysis about the number of papers related with Storm and Earthquakes compared with the number of disaster in time do not present a direct correlation, since the studies about specific events can be taken even years after. However, had been noted that several of the studies are indeed related to some specific event. As example, the consequences about the hurricane Andrew of 1992, were reflected in the articles published in 1996 (Behr & Kremer1996). Other example, is the 2009 L`Aquila earthquake that was focus of seven different papers. The earliest of them was published 4 years after the disaster occurred (Lucibello, Brandonisio et al. 2013, Bisegna, Ambrosini et al. 2014, Boscato, Pizzolato et al. 2014, Ferreira, Vicente et al. 2014, Gattulli, Lampis et al. 2014, Arcidiacono, Cimellaro et al. 2015, Mauro, de Felice et al. 2015).

4.3 Mapping geographic distribution

Totally, 30 countries have contributed to this survey (Figure 2: Distribution of papers by country

), showing that the concern about natural hazard in the built environment is a global issue. United States accounts for 26,19% of the overall publications. It is not surprising, especially regarding to the studies about storms, in which this country present 58% of the papers selected for this research. This is also explained because, in United States, storm events are the most numerous kind of natural disasters reported (CRED & OFDA, 2016). Similar approaches were also found regarding to volcanic activities. All the papers selected for this hazard type were presented by Italy. This country has also a high participation in papers about earthquakes, followed by United States and Australia.

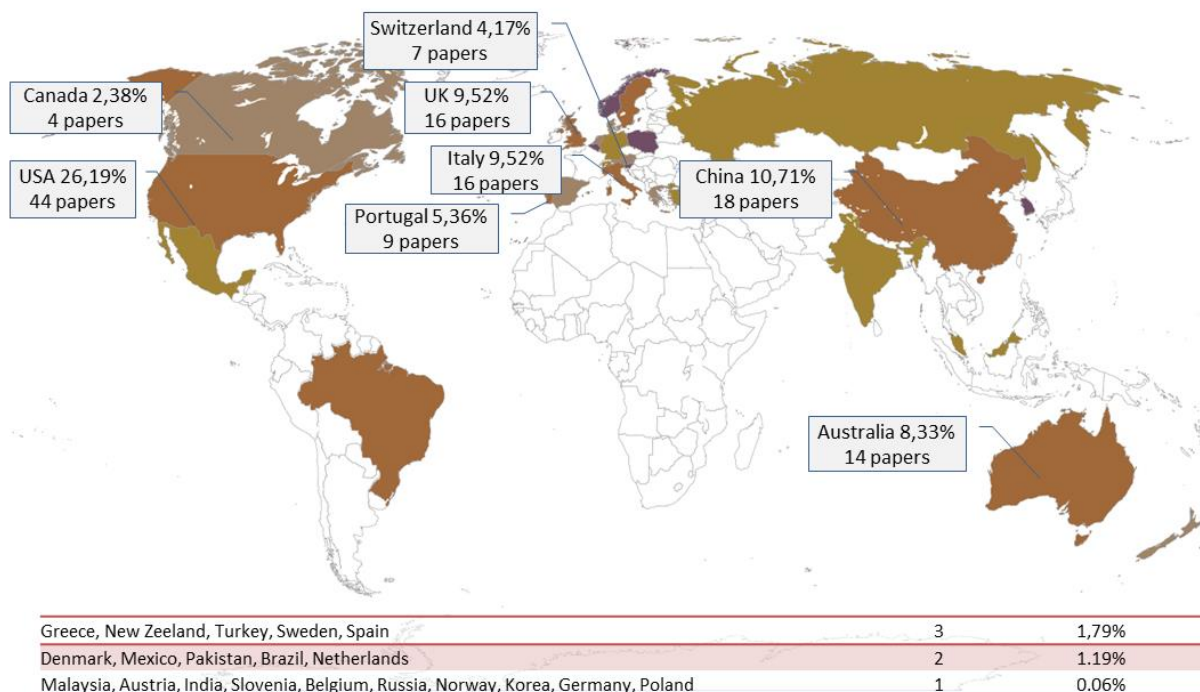


Figure 2: Distribution of papers by country

However, it is understood that since this systematic review just take into account papers written in English, this figure does not represent the full picture of research related to natural

hazard associated with building skin, but it is possible analysing the papers put some light on this theme. As instance, South American countries, such as Brazil, Colombia and Venezuela, which are severely affected by floods, were not represented among the selected papers in this theme. About flood, the UK is the country which accounts for the highest participation. UK and China were found to be prolific in studies about fire. Portugal had showed a important concern about earthquakes. The results about this topic are summarized in the Figure 2: Distribution of papers by country

4.4 Trends by building and skin typology

Building skin is an important subject in architecture and engineering research. Traditional and new technologies have been constantly studying which concerns to performance and durability. The papers selected in this review were classify according to building typology (residential, commercial, educational, religious, etc.) and skin types analysed for each hazard group. Several papers do not define any specific building or skin typology. Due to this fact, some considerations could be made.

In the earthquake review, 28 papers (48,27%) discuss about masonry wall. Related to storm the concern turn to roofs and glazing systems. Among the articles selected for Fire disaster, several articles have been highlighted about double skin façade, and some about windows themes, as geometry and glass resistance. Flood, extreme temperature and volcano types, do not present any building skin type, also because the number of papers is reduced. In general, the papers just analyse the damages caused by these disasters in different types of building skin.

Regarding to building typology most of the papers analysed (69%) do not present a specific building typology studied. From the remaining articles, 9 are about religious buildings related to earthquakes and 18 papers are specific to residential building under storm.

4.5 Trends by methodology

Natural hazards are a concern for multiple research fields and the research about building skin is a main area of interest in architecture and engineering. Research on building skin associated with natural hazard could be performed by multiples assessment methods. In this review, the papers report field observation, field measurements, laboratory measurements analytical and numerical modelling, some cross studies (laboratory measurements and analytical numerical modelling) and innovative methodologies for damages measurements and innovative technologies to withstand disasters. The papers selected were classified into these categories (**Error! Reference source not found.**), in order to provide a understanding f the gaps and which sort of methodology is undertaken on building skin research related to natural hazard. The analysis and methodologies undertaken was indicated for this review was defined following the categories summarized and reported in **Error! Reference source not found.** These categories define field observation, field measurements, until innovations that was considerate the level when the problems related to the disaster are already well know and is possible to develop new technologies to cope with this possible events.

The survey shows that more than 40% of the research into earthquakes and storm develop analytical and numerical modelling. Surprisingly, the number of papers doing some type of field analyses was not as high as expected. This in part may be explain, for the difficulties in disaster research are where field works can be restricted to some point events, and not for measures that you can take on a regular basis. Similar situation was found with flood and extreme temperature types, that besides they have a reduced number of papers, they presented analytical and numerical modelling papers.

| NATURAL HAZARD | 1 | | 2 | | 3 | | 4 | |
|----------------|--------------------|--------------------|-------------------------|--|------------------------------------|---|--------------------------------------|-----------------|
| | Field observations | Field measurements | Laboratory measurements | Inovative methodologies for measurements | Analytical and numerical modelling | Cross studies: laboratory and analytical/ numeral | Inovative building skin technologies | Critical review |
| Earthquake | 8 | 3 | 12 | 0 | 25 | 5 | 3 | 0 |
| Storm | 7 | 4 | 13 | 0 | 23 | 1 | 4 | 3 |
| Fire | 3 | 2 | 12 | 1 | 9 | 1 | 3 | 0 |
| Extreme temp. | 0 | 1 | 2 | 0 | 5 | 0 | 0 | 0 |
| Flood | 2 | 0 | 1 | 1 | 3 | 0 | 0 | 0 |
| Volcano | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mass Movement | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 23 | 12 | 40 | 2 | 65 | 7 | 10 | 3 |

Figure 3: Distribution of papers by application

This table enabled identify, although earthquakes and storms have a greater number of papers, they have few papers about innovative technologies to cope with hazard. Therefore, with the existent knowledge about earthquakes and storm risks related to building skin, there is still have research opportunities to develop new technologies to withstand these hazards.

5. CONCLUSIONS

5.1 Summary and limitations

This study presented a systematic literature review of 162 papers about building skin research related with natural hazard, aiming to provide an overall picture of the gaps of knowledge to develop strength and resilient building skin. This concern has motivated researchers and practitioners of 28 different countries over the past 32 years. The findings suggest an increasing interest about all different hazard analysed in the last 10 years. A wide range of analysis was identified, with most of the papers focusing on earthquake, storm and fire, followed by extreme temperature, flood, volcano and mass movement. Surprisingly, the number of papers related to flood was lower than expected, since this events are worldwide a concern mostly in the built environment. Nearly 55% of the studies were conducted in four countries: United States, China, Italy and United Kington. Most of the papers do not present a specific building typology or present a specific building skin type as a focus of study. However, several papers in earthquake group discuss about masonry problems and related to fire and storm, the concern are focused in glass systems. Most of the papers about earthquakes, storm and fire, performed analytical and numerical modelling, followed by laboratory measurements. Overall, have been not finding a high number of field work studies, what may can be explained by the eventuality characteristic of this research area. Nevertheless, is important to highlight that this study aimed to identify just the papers in English related to building skin; other building systems (structural, foundations, hydraulic etc.) have not been included, also no other languages what could potentially change the present results.

5.2 Recommendations for future research

This review enabled identifies key gaps in the knowledge about buildings skin research related with natural hazard. First, there were, surprisingly, few studies that effectively considered the impacts of natural hazard in building skin. Although earthquakes, storm and fire events, have more papers, it could be assessed that these studies do not cover all areas of the different existing building skin technologies. Besides that, there were just a few papers discussing about innovative technologies to cope with hazard. Future research could focus in developing new technologies based on the modelling and results already identified in the literature.

Secondly, there were identified just a few papers about extreme temperature, although it is a consolidated research field regarding to thermal comfort and energy efficiency. The papers analysed discuss about the performance of the building skin regarding to insulation and ventilation in cold and hot weather. But most of them do not consider future climate projections. Even those studies about thermal comfort and energy efficiency that have included some considerations, do not consider extreme temperatures. Innovative approaches could focus in the analysis of better understanding the performance of the building skin to extreme high temperatures, developing possible solutions for this scenario.

The third challenge, and perhaps the most relevant gap, refers to the studies regarding floods since flood hazard is already a growing concern in many cities and it is the cause of many damages, especially in densely built environments. Future research could be directed to assess and measure the impacts of floods in the building skin, and additionally to develop solutions for new materials and designs to mitigate or avoid the flood impacts in the building interior and the building skin itself.

Although just a few papers were identified related to mass movement, flood and volcano, even for the other natural hazard types, the number of papers identified do not represent consolidated research fields. Besides to be a challenge, a change in this scenario is also fundamental. Research regarding building skin related with natural h are important in a world where the human population is increasing and more building will be necessary. Moreover, the future climate predicts more stress and disasters, and the buildings need to withstand and be resilient. This has been tackled in a recent study by Champagne & Aktas (2016) that set some resilience requirements and indicate the importance of the building skin to develop buildings that can withstand stress and be resilient.

6. ACKNOWLEDGEMENTS.

This work was supported by the Brazilian Coordination for the Improvement of Higher Education Personnel (CAPES) through the grant 002-16-0.

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MAPS-LED

TOWARDS A NOVEL FRAMEWORK OF KEY PERFORMANCE INDICATOR FOR MEASURING THE IMPACTS OF SMART CITIES IN EMERGING ECONOMIES

M. Aghbali, C. Trillo and T. Ferrnando

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: m.agbali@edu.salford.ac.uk

Abstract: Smart Cities take advantage of innovative technologies to improve city-administration, increase the level of interactivity and improve the quality of life of citizens in a community. An important question is whether cities are truly measured in their policies and practices relative to any proposed model. Based on focus-group interview supplemented by an aspect of Q-methodology, this paper investigates how stakeholders prioritize the factors/indicators of cities smartness in the context of Abuja city. The paper addresses the challenges of quantifying the Key Performance Indicators (KPIs) needed to monitor the impacts of smartness in emerging economies. To propose a novel framework model, the study analyse the existing models and frameworks for measuring the impacts of Smart Cities with a view to identifying the core indicators that will be unique for cities in emerging economies. The analysis shows that the existing models focused on the identification of indicators of economy, people, governance, environment, mobility, and living. However, the study found that core indicators on infrastructure are omitted. The paper therefore propose collapsing the well-known indicators into three core components of smart cities, namely Smart infrastructure, smart institution and the smart people to have a more holistic assessment of smart cities impacts.

Keywords: Smart Cities, KPIs, Emerging Economies, Smart Infrastructure, Smart Institutions, Smart People.

1. INTRODUCTION

Many cities are transitioning from traditional cities into Smart Cities and a main motivation for this trend is because of their perceived ability to improve the standard of living of the people residing in such cities. However, in order to justify this assertion it is necessary to identify some relevant Key Performance Indicators (KPIs) through which we can analyze their impact. A number of research efforts have focused on the development of such indicators and many of their derived KPIs are already in use today.

A systematic literature review of such prior research shows that many of the KPIs were developed with the assumption that they would be implemented in developed countries, which already have the relevant amenities and infrastructure. However, this assumption does not hold for developing economies, where many amenities and basic infrastructure are lacking. The examples cited in the analysis are illustrations of potential aspirational and practical solutions that are already realized in advanced economies such as USA.

This research aims to bridge this knowledge gap by proposing a list of KPIs that can be readily used in emerging cities in a developing country context. In particular, the study have derived KPIs that take the infrastructure problems in developing countries into account. Hence in order to elicit knowledge from professionals that will assist in developing a simple

and adoptable model of measurement, this study adopted Federal Capital Territory (FCT), Abuja focusing on key stakeholders in academia, ICT industry, and the City Administration as case study. FCT-Abuja is a typical emerging city in an emerging economy embarking on laudable Smart City initiatives (Jiriko, JY et al. 2015). The focus group interview with FCT Abuja Smart City stakeholders adopted an aspect of Q methodology that grouped the core components of Smart Cities into three (3) distinct components of smart infrastructure, smart institutions, and smart people respectively. Q methodology invented by William Stephenson (a British physicist/psychologist), permits the systematic study of subjectivity and communicating the subjective perceptions of the participants point of view central to its investigative procedures (Du Plessis 2005).

The remainder of this paper is organised as follows: section 2 gives the theoretical background and relevant literature review. Section 3, presents the proposed KPIs for measuring the smartness of cities and discuss the theoretical framework extensively while section 4 gives an overview of the methodology used for this work. Section 5 summarizes the result of the focus group (experts' interviews) leading to the proposed Smart Cities KPIs and section 6 gives a conclusion to the paper and discusses the proposed future work.

2. THEORETICAL BACKGROUND

2.1 Smart City Definition

Smart Cities represent an emerging area of research that is gaining a lot of attention. A number of definitions have been proposed and one such notable definitions was given by Forrester, who defined a Smart City as 'the use of smart computing technologies to make the critical infrastructure components and services of a city – which include city administration, education, healthcare, public safety, real estate, transportation, and utilities – more intelligent, interconnected, and efficient' (Washburn, Sindhu et al. 2009). Similarly, IBM (2009) gave a definition from an industry point of view- 'a Smarter City uses technology to transform its core systems and optimize resources. At the highest levels of maturity, a Smarter City is a knowledge-based system that provides real-time insights to stakeholders, as well as enabling decision-makers to proactively manage the city's subsystems. Effective information management is at the heart of this capability, and integration and analytics are seen as the key enablers' (ITU 2014).

According to Gartner as cited by Lee, Hancock et al. (2014) 'a Smart City is based on intelligent exchange of information that flow between its many different subsystems. This flow of information is analyzed and translated into citizen and commercial services. The city will act on this information flow to make its wider ecosystem more resource-efficient and sustainable. The information exchange is based on a smart governance operating framework designed for sustainable cities. The authors posited that Smart City is a concept that derives its definition from a combination of 'information city, knowledge city, intelligent city, ubiquitous city, and digital city'. After critical evaluation of different characteristics of the Smart City concept, these authors concluded that 'Smart Cities are envisioned as creating a better, more sustainable city, in which people's quality of life is higher, their environment more livable and their economic prospects stronger'.

In addition, Harrisson C. as cited in Chourabi, Nam et al. (2012) considered Smart City as the city connecting the physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city. According to

Batty, Axhausen et al. (2012), Smart Cities are simply ‘instruments for improving competitiveness in such a way that community and quality of life are enhanced’. The International Telecommunications Union (ITU) during its focused group analysis (ITU 2014) and in an effort to come up with a standardized definition for Smart and Sustainable Cities, analyzed over 100 publications and this gave different definitions of Smart Cities. From ITU’s analysis, the over 100 definitions of ‘Smart City’ kept revolving around 50 keywords like quality of life, ICT, Technology, innovations, management, systems, integrate, intelligent, etc., where the instance of about 726 of those keywords were analyzed to measure or compare the importance of those words on the subject matter.

In summary, the issue of improved services and quality of life are considered imperative in a Smart City. Thus, the concept of Smart City has the central objective of improving quality of life in today’s densely populated cities around the globe socially, politically, culturally, and economically with equal access devoid of any form of exclusion in terms of time and location. Hence, it is crucial for Smart Cities to create knowledge, as well as transfer knowledge, social innovations and a host of other services using the emerging technologies in Cloud Computing as a platform for solving environmental, ecological, social, and sustainability problems facing the ever-expanding cities today.

2.2 Smart Cities Standardization and the Framework for Measurement

A couple of Smart City scholarships have discussed the issue of standardization and the metrics for monitoring cities development from different perspectives. For instance, City Protocol (2015) developed an interesting hierarchical model for city governance, evaluation, and transformation. The City Protocol model incorporated the original City Anatomy CPA-I 001 body of knowledge, Anatomy Indicators CPA-PR 002, Anatomy Ontology CPAPR 003, and Livable District CPC 004, etc. It is important to note that every city in different regions of the world is unique with different development challenges depending on their experiences and history. In this context, while some cities are dealing with challenges of environmental pollution, others are faced with congestion, energy, and security related issues (Ceballos and Larios 2016). However, because of the interrelationship that exists amongst the indicators of Smart City systems, a number of standards have been proposed for monitoring performance of cities smartness. The existing standards include ISO-37120 standard for Sustainable Development and Resilience of Communities –Global City Indicators for Service and Quality of Life, ISO-37101 Sustainable Development and Resilience Communities –Management Systems, ITU Smart Sustainable Cities, Spanish Standards (AENOR) –UNE 178301 on Open Data and UNE 178303 Requirements for Municipal’s Asset Management, NIST – Internet of Things (IoT) Enabled Smart City Framework, etc.

The ISO 37120 standard for instance, established 46 core indicators and 54 supporting indicators for measuring smartness (Hernandez 2014). According to Hernandez (2014), the ISO-37120 indicators are applicable to any city and it can serve as tools for City Mayors, Urban planners, researchers, professionals and other stakeholders for benchmarking investment, building smart sustainable cities, impacts evaluation, comparison, and measuring effectiveness of city governance, etc. Overall, ISO-37120 standard introduces methodologies in the form of indicators for measuring performance of services in cities especially in the area of quality of life with a matrix that attempts to reveal key technologies that underpin many Smart Cities initiatives today. On the other hand, ITU introduced standard specification for Smart Sustainable cities. As revealed by Anthopoulos and Giannakidis (2016), the ITU

standard for Smart Sustainable Cities defines a set of primary smart services for cities. Further, the standard introduced a technical report that can form the basis for global Smart Sustainable City that can afterward, be adopted for developing a framework for measuring performance of Smart Cities (ITU, 2014).

At the sub-regional level, Spanish standard (AENOR) have adopted the ISO-37120, which correspond to its standardization efforts to introduce the UNE-178301 and UNE 178303 respectively. The Spanish standards address Open Data standardization and requirements for municipal asset's management. Similarly, in the USA the National Institute of Standards and Technology (NIST) embarked on a couple of Smart City related standards which include Internet of Things (IoT) Enabled Smart City Framework standard in an attempt to enhance interoperability of Smart City technologies across cities with cost effectiveness and convergence that will serve the global Smart City needs (NIST 2016). The NIST IoT standard was developed in collaboration with ANSI, MISP ITIA and ETSI. For further information on existing Smart City standard, see (Zdraveski et al., 2017, Lombardi et al., 2012, ISO IEC 2014, BSI 2014).

The standard defined in ISO-37120 above identified 17 key areas of measures with 100 indicators. In practice, Cohen (2015) proposed a Smart City model for measuring city performance with six dimensions i.e. Smart Economy, Smart Environment, Smart People, Smart Governance, Smart Mobility, and Smart Living (Cohen 2012). Cohen's model was based on ranking and benchmarking approaches using indicator average of the six dimensions of Smart Cities. The model relied on secondary data from different sources which includes IDC rankings of Smart Cities in Spain, Siemens Green City Index, Global Metro Monitor, and a host of international organisations (Benamrou et al. 2016). A couple of Smart City scholars have attempted to integrate the Boyd Cohen's model of Smart City KPIs with the ISO-37120 with the corresponding indicators to simplify the metrics for measuring cities see for instance (Ceballos and Larios 2016). Section 4.3 discusses the KPI models in details.

2.3 Key Performance Indicators (KPIs) for Measuring the Smartness of Cities and the Existing Smart City Wheels

The recent concerns on the need to identify metrics and key performance indicators (KPIs) that can measure the impact of Smart City solutions and platforms in order to improve city smartness characteristics, through well-articulated performance indicators, is receiving stakeholders support. Many cities are transitioning from traditional cities into Smart Cities and a main motivation for this trend is because of their perceived ability to improve the standard of living of the people residing in such cities. However, in order to justify this assertion, it is necessary to identify some relevant Key Performance Indicators (KPIs) through which we can analyze their impact.

In a comparative study by Giffinger, Fertner et al. (2007), on the role of city-rankings in a regional competition focused on operationalising Smart Cities, they identified a comprehensive catalogue of indicators for measuring developments in medium-size cities of Europe. Drawing from their findings, the authors summarised the characteristics of a Smart City into six (6) major headings, namely Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environment, and Smart Living. The study, which adopted the methodology of weighing the influence and importance of the factors or indicators, produced a framework model for analysing Smart Cities with thirty-three (33) factors described by a

number of indicators. Carli et al. (2013), in a similar framework for classifying performance indicators for measuring and managing the smartness of cities stressed further that to achieve the goal of making cities smarter, there is need to optimally and intelligently measure and monitor cities performance and analyse their competitiveness as well as evaluate their sustainability. Although the authors were of the view that there is no valid set of indicators for measuring performance of cities in each context and purpose, they proposed a novel two-dimensional framework (human and technological context) for classifying KPIs of a Smart City. This study also adopted the six (6) characteristics of Smart Economy, Smart People, Smart Governance, Smart Mobility, Smart Environment, and Smart Living in the framework to enable policy makers, planners and other stakeholders make intelligent decisions. Figure 4.1 highlights the six commonly used Smart City wheels proposed by Giffinger et al. (2007).

| |
|--------------------------|
| Smart Economy |
| Smart People |
| Smart Government |
| Smart Mobility |
| Smart Environment |
| Smart Living |

Figure.1: Characteristics of Smart City
Source: (Giffinger et al., 2007)

The model and the framework were discussed using the above six (6) characteristics extensively. Cohen and Giffinger’s model are similar in terms of the six characteristics and ranking/benchmarking approaches. However, measuring the six characteristics without infrastructure as a core component could result in ignoring a major issue in the context of emerging economies since many of these countries struggle to put the proper infrastructure in place that will drive Smart Cities. Similarly, the framework proposed by Carli et al. (2013) succeeded in re-grouping the characteristics and the corresponding indicators into objective and subjective dimensions but the basic issue of identifying the core indicators for measuring the impacts of Smart City in line with common taxonomy was not addressed. This ignores the challenges of infrastructure provisioning in emerging cities.

In an attempt to further streamline the existing Smart City wheels and indicators, (Chowdhury and Dhawan 2016) introduced the Delphi method to evaluate the set of Smart Cities performance indicators established by ITU. Chowdhury and Dhawan’s model also characterised the key performance indicators for Smart Cities into six similar dimensions identifying Information and Communication Technology (ICT), Environmental Sustainability, Productivity, Quality of Life, Equity and Social Inclusion, and Physical Infrastructure with the corresponding parameters for measuring performance. The authors attempted to further split the six dimensions into measurable categories with a test case study using the Delphi review in India.

In contrast, Ceballos and Larios (2016), adopted a Kano model to provide empirical support in planning a Smart City using the Cohen’s model of KPIs with comprehensive integration of the 17 metrics of measurement models identified in ISO-37120. Ceballos and Larios’s principle proposes a Smart City investment model that encourages improved identity of the people with the city by prioritising their service needs in terms of investment in Smart City and quality of life. The study adopted the use case of CUCEA UDG living Lab –Guadalajara to validate the model. For further information on the integration of ISO-37120 model with Cohen’s model of Smart Cities, see Ceballos and Larios (2016).

Further, numerous academic literature addresses Smart City development from different perspectives of characterising the core components of Smart Cities while a host of others attempted to develop taxonomies that are based on the drivers. In this area, Nam and Pardo (2011) developed a framework based on three (3) core components discussed earlier: technology, people and institutions, both in terms of dimension and factors. In another example, Lee, Hancock et al. (2014) taxonomised the characteristics of Smart City based on technological and institutional elements well represented in six (6) taxonomies: urban openness, service innovation, partnerships formation, urban proactiveness, Smart City infrastructure integration and Smart City governance. It is imperative to suggest that Smart Infrastructure should form the core characteristic of Smart Cities. In this direction, the six characteristics can be summarised and discussed under three core dimensions of Smart City (i.e. Smart Infrastructure, Smart Institutions and Smart People).

This study explores the findings from available research results in view of the dynamic nature of this field in order to identify the major drivers of Smart Cities and the practical challenges before proposing a model for measuring the impacts. The paper therefore aims to provide a novel framework model for measuring smartness, factoring in the core indicators that can be universal and meeting the major challenges of an emerging economy using primary data.

3. THEORETICAL FRAMEWORK FOR SMART CITY PERFORMANCE INDICATORS

Identifying appropriate performance indicators for measuring, managing, and monitoring the smartness of cities need to comply substantially with existing knowledge in the field of Smart City development. The imperative involves the development of a novel framework for measurement, but it goes beyond it to address the key challenges in detail. Building on existing knowledge in this field and the literature discussed earlier, this study identified three (3) core components of Smart Cities with comprehensive factors and key indicators to form the theoretical foundation to suggest a holistic view of metrics with which the KPIs of Smart Cities can be measured. The proposed core components include infrastructure, institution, and the people. Infrastructure is at the core of Smart City development. It is also the platform upon which Smart Economy, Smart Mobility, Smart Living and other dimensions introduced in the previous research are built.

In most emerging economies, cities are faced with the challenges of infrastructure provisioning (e.g. power, ICT, transport, water, etc.) that need to be measured. The factors and the specific indicators that drive the infrastructure component therefore need further consideration in order to produce an all-inclusive framework that can be adopted in an emerging economy. There is limited literature that explains infrastructure as a component in this manner; the proposed three dimensions of classifying Smart City factors and indicators are validated through a focus group exercise as summarised in the methodology. Table-1 presents the three (3) dimensional framework for measuring impacts of Smart City planning with more consideration for infrastructure as the foundation.

It is imperative to emphasise that the infrastructural performance of a city cannot be taken for granted because Smart Economy, effective management and the technological advancement that drives smartness in all dimensions depends on the existence of Smart infrastructure (Nam and Pardo 2011). Based on the focus group exercise, Smart Infrastructure, Smart Institutions, and Smart People were prioritized as the core components of Smart Cities upon which Smart

Economy can thrive. In this arrangement, core factors/indicators for Smart living were considered very relevant to people hence, the three agreed core components were used to identify the core factors/indicators of Smart Cities that can conveniently be used to analyze similar indicators used in Europe and America depending on the peculiarity of the city.

Table 1. The Proposed Framework for Measuring Impacts of Smart City

| Components | Factors | Indicators |
|---|---|--|
| Smart Infrastructure | Availability of smart grid/robust energy | Number of green energy sources and megawatts generated per inhabitant |
| | | Rate of uninterrupted power available per inhabitant |
| | Availability of ICTs Infrastructure (source: ITU, 2014) | Number of mobile phone as % of city population |
| | | Number of Internet access as % of city population |
| | Secured and innovative transport system (source: Giffinger et al, 2007) | Use of environmental friendly vehicles |
| | | Number of autonomous vehicles |
| | | Efficient transport network per inhabitant |
| | Availability of sustainable healthcare facilities (source: Giffinger et al, 2007) | Increased life expectancy |
| Number of hospital and hospital beds per inhabitant | | |
| Number of qualified doctors, nurses, and health attendants per inhabitant | | |
| Smart Institution | Environmental Sustainability (source: ITU, 2014) | Improved Air quality (CO, SO ₂ , NO ₂ reduction) |
| | | Reduction in noise pollution |
| | | Reduction in Greenhouse gas emission per capita |
| | Innovative and proactive security system | % reduction in crime rate |
| | | Number of crime profiled in real-time |
| | Tourist potential (source: Giffinger et al, 2007) | Number of visitors to tourist centres |
| | | Revenue generated in tourism as % of total revenue |
| | Entrepreneurship (source: Giffinger et al, 2007) | Increased number of new registered businesses |
| Increased number of innovation hubs | | |
| Smart People | Creativity (source: Cohen, 2015) | Number of creative industries as % total industries |
| | | Share of people working in creative industries |
| | Quality education (source: Giffinger et al, 2007) | Number of educated citizens at different levels of education |
| | | Number of skilled citizen as % of city population |
| | Increased productivity (source: Cohen, 2015) | GDP as % of employed citizen |
| | | Ratio of employed to unemployed citizens |

The six commonly used Smart City wheels have been discussed in various Smart City scholarship, thus this paper will not dwell on the entire six wheels in the theoretical framework since previous efforts have sufficiently discussed them in different perspectives as highlighted in the literature review. Although in some of the literature, institutional

arrangements were discussed under organization and governance but the emphasis on institutional capabilities remain unchanged. This paper therefore considers the need to contribute to the research gap by focusing on infrastructure, institution, and the people as key components of Smart Cities where there is need to identify factors and indicators for measuring smartness especially in an emerging economy.

3.1 Smart Infrastructure

Most of the existing literature on Smart City discussed the issue of infrastructure with a focus on ICT infrastructure. Although the perception or the alignment of infrastructure component with ICT is understandable because of the critical role that ICT plays in making the dream of building a sustainable city a reality; in other instances, infrastructure is seen as technological infrastructure or techno-ware (Schaffers et al. 2011). In contrast, ICT infrastructure cannot be singled out as the most critical component in measuring the impact of Smart Cities in that ICT as a component of Smart City requires the existence of other infrastructure like energy (Smart Grid), utilities, safety, etc. In addition, Schaffers et al. (2011), discussed infrastructure from a different perspective with the dimension of ICT and utilities introducing the concept of smart transportation, mobility and parking, broadband, embedded systems, energy and savings/smart grid, environment monitoring and safety.

In supporting the position of infrastructure as a critical component of Smart Cities, Forrester (Washburn et al. 2009) posited that “*Smart City is a collection of Smart Computing technologies applied to the seven critical infrastructure components and services*”. The study further identified seven (7) critical infrastructure components of Smart City and services which include education, healthcare, administration, public safety, transportation, real estate, and utilities. The authors presented these critical infrastructure components with real-life examples to assist stakeholders in visualizing Smartness of cities.

Education: The metrics for quality education range from availability of digital content, improved access to online resources, low cost of educational programmes to technological platforms for collaboration since these are factors that need to be identified and properly classified for measurement.

Healthcare: The metrics include the availability of accurate diagnosis, patient records, and a platform for quick response to emergency services, knowledge sharing amongst health workers, tele-medicine facilities, and the existence of various platforms for remote medical services. These also have infrastructure components that need to be identified for measurement.

Public Safety: The police and other security agencies (e.g. fire service men) are now leveraging innovative technologies to improve response rate to emergencies and threats. In this area, Washburn et al. (2009) cited an example of a 911 real-time dashboard providing information on emergency needs that have helped New York City to reduce crime rate by 27% with the aid of closed circuit television (CCTV) and video analytics. The factors affecting the rate of response and the outcome as cited in the New York case can be classified and measured.

Transportation: The financial and environmental impacts of transportation in Smart Cities as well as reduction in the congestion can be measured. In this topic, Stockholm, Sweden as

cited in (Naphade et al. 2011), implemented a system equipped with lasers and cameras that automatically charge drivers on a “pay as you go” basis, thereby reducing gas emission and congestion. See Washburn et al. (2009) for details on utilities, real-estate, and administrative components of Smart Infrastructure. See also Naphade et al. 2011 for use case examples.

In order to arrive at workable KPIs for measuring impacts of Smart Cities, factors/indicators for measuring the critical areas/components of infrastructure need to be identified and classified accordingly.

3.2 Smart Institutions

In defining the Smart Institution as a core component of Smart Cities, a good number of authors stresses the quality of political strategies, availability of public services, support of government and policy for governance (see for instance Nam and Parado, 2011, Giffinger et al, 2007). Smart governance in this context refers to our concept of Smart Institution that leverage technologies (ICTs, sensors, RFID, etc) for efficient service delivery (see also Komninos 2009). Further, (chourabi et al 2012) also discussed extensively the component of Smart governance from the perspective of public-private partnership (PPP), leadership and effective collaboration for quality decision making. In summary, the Smart Institution includes all the essential factors of institutional arrangements that strive to ensure improved quality of life for the citizenry and availability of the entire factor in different perspectives of governance, sustainability, and few other dimensions that only differ in terms of terminology. Some of the core themes defining the Smart Institution component are summarised below:

Environmental Sustainability: Environmental Sustainability is one of the most important issues in the urban environment that affects the quality of life of the people. A couple of Smart City scholarship have also addressed the issues of environment as a major characteristic/dimension of Smart Cities see for instance (Giffinger et al. 2007, Cohen, 2015). The metrics for quality of environment in this case ranges from improved air quality, climate change (e.g. CO, NO₂, SO₂, etc.) to traffic flow which can be measured with the emergence of Big Data analytics even in real-time. In Europe for instance, research findings (Penza, Suriano et al. 2014) revealed that a couple of Smart City scholars are experimenting solutions for measuring air quality in cities in line with EU’s Air Quality Directive 2008/50/EC. Dealing with environmental sustainability therefore is a critical challenge that smarter institutions must address.

Entrepreneurship: For cities to attain smartness, they key performance indicators relating to how they are entrepreunering are crucial and can be measured as part of the city’s image in maximizing their innovative spirit and creative potentials for global competitiveness. In this regards, access to innovation hubs/R&D as well as improved business environment are important parameters.

Productivity: Productivity parameters basically deal with measuring key performance indicators relating to income, trade balance at the city level, capital investment, job creation indices in both formal and informal sub-sectors of the city.

3.3 Smart People

In addition to the above two core components, the concept of Smart Cities includes the people as core components. The Smart People as a core component of Smart Cities have been addressed extensively in both academic journals and industry report within the domain of Smart Cities. The definition of people component stress the role of human capital and education in the innovative development in cities changing the patterns of citizen engagement to bottom-up rather than top-down (Batty, Axhausen et al. 2012). According to Glaeser (2005), one of the key characteristics of Smart Cities is the availability of a skilled workforce. Similarly, the transformation to Smart City environment entails capabilities for vibrant R&D (knowledge-base) driven by educational institutions for urban diversity, social inclusion, crime-free society, and a host of other societal values (Yigitcanlar et al. 2008). The component of “people” is further summarised as follows:

Quality of Life: WHO (1998) defines Quality of Life (QoL) as “individual perceptions of their position in life in the context of culture and value systems in which they live and in relation to their goals, expectations, standards and concerns”. In Smart Cities, improved quality of life of the people either in terms of emotional well-being, health status, financial status, and other aspects of life are of great concern. Quality of Life is beyond national GDP as measure of prosperity for national economies in the context of smart cities, it addresses key performance indicators relating to health, education, safety, and convenience (Chowdhury & Dhawan, 2016).

Equity and Social Inclusion: In Smart Cities, social cohesion is of utmost priority in city governance. Thus, the main concerns of equity and social inclusion parameters includes dealing with racial discrimination, gender inequalities, transparency (openness) and participatory system of governance. For instance, one of the major Smart City initiatives of Boston includes the Participatory China Town – A platform for public participation in policy making for urban planning (Chinatown 2017). The concept of Smart People is well discussed in a number of academic and industry-based Smart City journals (see for instance Giffinger et al, 2007, 2010). See also (Nam and Pardo, 2011, Edvinsson 2006).

4. METHODOLOGY

A systematic literature survey was conducted to elicit the knowledge required to meet the objective of this study. Current data on Smart City development and the key performance indicators for measuring smartness of a city were sourced from academic journals, reports from research institutions, and white papers of international/regional organisations in an effort to identify core indicators that are already being used as reference for Smart City impact assessment. The idea was to first generate a comprehensive list of factors/indicators based on the existing Smart City wheels and ISO-37120 resilient city standard for measuring the smartness of a city and subject these priority themes to a focus group to validate and refine the indicators for the purpose of analyzing them using Smart City stakeholders in Abuja. The focus group exercise started in Abuja from July 04, 2016 and was concluded July 20, 2016. Abuja was selected as a case study because the focus of this study is on emerging economies and FCT-Abuja had recently launched a vibrant campaign for smart growth (Jiriko, JY et al. 2015). Besides, Nigeria has been labelled an “emerging economy” in the league of the MINT nations i.e. Mexico, Indonesia, Nigeria and Turkey (Financier Worldwide Magazine 2014), (Akpan et al. 2014).

Recognizing the challenges of infrastructure deficit that still exist amongst the emerging economies, this research integrates from different sources of proposed KPI for Smart Cities and validates through 3-stages of focus group interviews. Firstly, from industry perspectives, secondly expert’s opinion in academia, and finally from the urban development perspectives dominated by FCT Administration. To articulate the focus, the study received valid feedbacks from the stakeholders based on the core objectives of the research. Doing so, a good number of changes to the existing core components of Smart Cities were made for ease of analysis at the same time to address the perceived interrelationship while the factors/indicators were streamlined in line with the priority dimensions. For instance, the need for Smart Infrastructure was prioritized and it was considered as a core component of Smart City amongst the three categories of stakeholders in Abuja (an emerging city) instead of “Smart Economy” as emphasized in the existing models.

The focus group interview adopted an aspect of Q-methodology to elicit knowledge from “data-rich” stakeholders in a more scientific manner in order to remove the researcher’s biasness (Stephenson 1953). In this procedure, the interview sessions were targeted at the top executives in core stakeholders organizations who were also asked to nominate experienced officers below the managerial cadre who are conversant with the Abuja Smart City initiative to participate in the ranking session. Prior to this, the key elements of the ISO-37120 resilient city standard and the proposed Smart City “wheels” retrieved from academic journals, industry reports, and standards were listed resulting in 29 components for consideration during the interviews with top executives. At the end of the interview phase, the list of components was pruned down to 18-components and transformed into statements for stakeholders to rank in line with their perception as well as priority Smart City themes that are relevant to the focus of the Abuja Smart City programme. The Q-methodology used in this study differ significantly from the usual Q-methodology that employ factor analysis (Uittenbroek et al. 2014). It also deviates a little from qualitative Q-methodology (de Wijs et al., 2016) such that a set of statements (Q-set) that need to be ranked were generated with an empty space for participants to name their own priority theme not mentioned in the comprehensive list (set) and rank them accordingly as shown in figure-2.

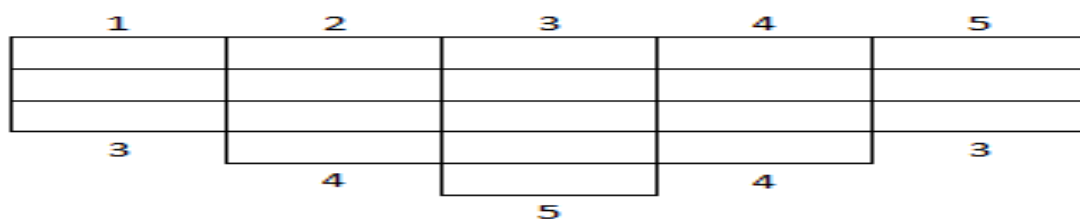


Figure.2: Q-Methodology Template for Ranking.

As summarized in Table-2, 15 experts representing 7 professionals from the ICT industry, 3 scholars from the academia, and 5 urban planners from FCT Administration participated in the Q-Methodology ranking exercise. Based on the composition of the professionals that participated in this exercise, IT Experts tends to outnumber other professions and this bears to the understanding of the top executives who did the nominations in line with their own perception of the Smart City concept. In addition, most of the participants nominated by the stakeholder organisations were at some points involved in the Nigerian Smart City Initiative stakeholders committee except one participant from a private university, which explains their level of awareness. For instance, none of the participants from ICT industry organisations and the academia were of transport background.

consensus were reached amongst the participants that adequate investment in the infrastructural component is needed to support the smart aspiration of FCT-Abuja as summarised in figure-3. Although several Smart City KPI models focus on Smart Economy, Smart Living, Smart Safety and a host of others; participants in this study perceived these categories of Smart City characteristics as important but emphasized the need to focus on the core components of infrastructure, institution, and people with core indicators that cut-across the supporting components for ease of management.

5.2 Smart Institution

The second component also ranked very high in this exercise is the Smart Institution. As noted in the literature review, for Smart Cities to improve entrepreneurial growth, improve city administration for quality of life of the citizen and so on, they require smarter institutions that will manage all governance issues. In which case, they will promote productivity (job creation), efficiency, sustainability (air quality and climate change), improved access to innovation hubs/R&Ds. In all the focus group interviews and Q-methodology ranking exercise with the stakeholders, the need for smarter institutions that will drive the smart initiatives in all sectors of the city is high on the agenda. As shown in figure-3, there was consensus in ranking by the participants confirming the positions of the interviewees that smarter institution is a priority and one of the most important components for all the group of stakeholders.

Interestingly, participants from the academia and their counterparts in urban planning agreed with the views of the “industry” participants on the three core components highlighted above but a couple of participants from these two groups considered the component of environment as very important theme in FCT-Abuja Smart City project. As shown in figure-3, the component of environment is regarded as one the popular priority areas for this group. This position largely aligns with the views of some of the interviewees who emphasized the need to identify the core indicators of environment as important indicators that smarter institutions can address. Specifically, these participants (academia/urban planning) highlighted the factors of “environmental pollution” and “environmental protection” as key issues for Smarter Abuja.

5.3 Smart People

Finally, the third priority component for Abuja Smart City stakeholders is the Smart People. This component as summarised in the literature review represents the social capital in Smart City initiatives. As shown in figure-3, the participants expressed in strong terms the central role of the people component during the ranking and interview exercise. Again, one of the interviewees in the academia group suggested that Smart City deployment in Abuja should start from serious investment in the people component in order to develop adequate human capacity that will drive the innovation and knowledge exchange in the envisioned smarter environment in the capital city of Abuja.

6. CONCLUSIONS AND FUTURE WORK

The importance of Smart Cities has been discussed and the social innovations that they bring and the impact that this has on the cities where they are implemented have been identified. An analysis of the KPIs that have been used to quantify the impact of Smart Cities in prior research has been carried out. Although this is an ongoing research, the immediate findings revealed that most KPIs took it for granted that the host cities already have the adequate infrastructure to support the deployment of Smart Cities.

This condition holds true in many developed countries but the dearth of appropriate infrastructure in developing countries makes a case for a review of the KPIs with a view to ensuring that the infrastructure challenge takes centre stage. The result of this work is the development of infrastructure-centric KPIs that can be readily used for assessing the impact of Smart Cities. With many cities around the globe adopting the concept of Smart City, it has become imperative to proactively identify the critical factors and indicators that will be useful to both developed and emerging economies for measuring how the smartness of a city impacts on its environment and citizens.

In the future, the conceptual framework will be used to conduct surveys covering larger stakeholder groups with a view to use the result of the empirical evidence in proposing a Smart City model based on the identified indicators for assessing the impacts of Smart Cities.

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ON EMERGING CIVIC SPACES' ROLE IN INNOVATIVE LOCAL SOCIO-ECONOMIC DEVELOPMENT, RIACE AS A CASE

Y. OU and A. Errigo

*Heritage, Architecture and Urban Planning Department (PAU), Mediterranean University of Reggio Calabria,
Via Salita Melissari, Feo di Vito, Reggio Calabria, 89124, Italy*

Email: yapeng.ou@unirc.it

Abstract: There seems to be a political inaction and stagnating local socio-economic development (LSED) in rural and peri-urban areas of Calabria Region in southern Italy. In response, this paper, based on literature review and case study, seeks to cast light on an innovative LSED pattern driven by emerging civic spaces. To this end, this paper carries out a case study of Riace so as to explore the dynamics, forms and socio-economic impacts of emerging civic spaces in relation to innovative LSED. By analysing the quantitative data collected from Istat and qualitative data collected from field studies and interviews of key stakeholders, it looks into the emerging multicultural civic spaces in Riace, focusing on their impacts on socio-economic innovation. Finally, based on the case study, the paper points out the viability of adopting a place-based and community-driven approach to LSED. It concludes that civic spaces, formed through the empowerment of local population and community collaboration, stimulates socio-cultural and economic innovation, which serves as a driver of LSED.

Keywords: Civic Spaces, Community Collaboration, Innovation, Local Socio-Economic Development (LSED), Territory.

1. INTRODUCTION

1.1. Literature Review

Civic spaces, where “civic entrepreneurship” occurs (Goldsmith *et al.*, 2010), are perceived mainly in two ways within the academia. On the one hand, civic spaces are physical spaces with an embedded value system. While they serve as physical sites for civil society to organise and function autonomously, they represent a value system composed of place-making ingredients, such as identity, meaning, memory, history and linkages with the rest of the world (Daniere & Douglass, 2008). Without these place-making ingredients, which are in essence social and cultural capital, a place tends to lose its vitality due to community decohesion. On the other hand, civic spaces are also popularly seen as a social construct with a political economic implication. Therefore, they are inclusive social spaces with a high degree of autonomy from the state and corporate economy (Daniere, 2003). According to Abrahamson (2008: 3), they describe “the social processes of defining membership and exclusion, rules of interaction, and the desired image of the civic process”. Indeed, inclusiveness of civic spaces is vital to the well-being of society, in that it contributes to “the social and political life of cities through public participation in place-making and governance” (Douglass & Daniere, 2008: 1).

In fact, a participatory planning process accompanied by a decentralisation process is commonly acknowledged as indispensable for the formation and functionality of civic spaces (Daniere, 2003; Balassiano, 2011). Meanwhile, civic spaces are important contexts to have a precise understanding of participation and the underlying processes of empowerment (Huq,

2013). In terms of local development, participatory approach is believed to contribute to sustainable development (Strzelecka, 2011). As contributing factors for the formation of a participatory community, community empowerment and institutional autonomy are principal preconditions for alternative approaches to local development—decentralised sectoral, local government, and community support approaches (Serrano *et al.*, 2010). To guarantee a quality community empowerment, Aswad proposes a combined approach that incorporates procedural justice in planning development and social learning in its implementation (Kolo, 2002; Aswad, 2013). The procedural justice implies a process of community involvement in policy making and implementation. In this process, social learning contributes to policy making and implementation by providing context-based evidence and building relationships among stakeholders (Cundill & Rodela, 2012). It is obvious that community involvement is impossible without community empowerment achieved with a participatory approach.

According to Daniere (2003), civic spaces emerge as a response to globally-linked economic growth and access to information. However, the existing literature does not overtly touch upon the relationship between civic spaces and LSED. Besides, their socio-cultural and economic impacts are barely discussed. As for Riace in Calabria Region in southern Italy, emerging civic spaces are more of a response to unfavourable external political-economic environment and resulting endogenous place-based local socio-economic development (LSED) led by the civil society. Just as Abrahamson (2008: 3) remarks, civic spaces represent “the role of the citizen in the operation and oversight of the government”. Taking into account the realities in Calabria Region and the limitation of the existing literature, the authors pose such questions as:

- 1) How do emerging civic spaces contribute to innovative LSED?;
- 2) Do civic spaces also represent the role of the non-citizens, namely, immigrants?

The following sections dedicated to the case study of Riace will help answer these two questions.

1.2. Objective and Significance

As mentioned earlier, currently academic discussions on civic spaces seldom deal with the socio-economic impacts of civic spaces, especially in a multicultural community. That is to say, the role of civic spaces in LSED is not explicitly discussed. Therefore, this paper is aimed to explore the dynamics, forms and socio-economic impacts of civic spaces in relation to innovative LSED.

It is desirable that this research invite more future discussions on the socio-economic impacts of civic spaces in relation to local development. In addition, it is also hoped that policy-makers, will be more willing to adopt an innovative approach to local development which is driven by emerging civic spaces.

1.3. Methodology

This research carried out a case study of Riace so as to explore the dynamics, forms and socio-economic impacts of emerging civic spaces in relation to innovative LSED. For this purpose, it adopted both quantitative and qualitative methods. It first of all carried out a literature review to build up the theoretical structure of the entire research. Then

quantitatively speaking, it collected secondary baseline data of 1991, 2001 and 2011 from Istat, especially those on demography and economic performance, such as population, rate of foreign residents, old age index, young household with children rate, potential vacancy of buildings and unemployment rate of Riace and Roghudi (the latter was chosen as a contrast). By comparing these quantitative data, the regenerative effect of emerging civic spaces is indicated, in terms of community structure, population rejuvenation, reuse of abandoned buildings, job creation, etc. Qualitatively speaking, it undertook field studies¹ so as to gather various visual observations with regard to the forms, functions, mechanism, etc. of civic spaces that appear in Riace. Besides, it administered semi-structured interviews with key stakeholders, especially the Mayor of Riace.

2. CIVIC SPACES AND SOCIO-ECONOMIC INNOVATION IN RIACE

2.1. Background

Calabria Region boasts many minor historic centres (MHCs) of Greek origins, which are well-known for their strong territorial identity and rich cultural and landscape heritage. Often located in mountainous inner areas, they are isolated from the urban basin, which partly explains their delicate socio-economic conditions. Over the past three decades, these MHCs have gone through a continuous socio-economic decline due to aging population accompanied by outbound migration and low birth rate, changes in productive patterns, natural disasters, and demographic concentration in new settlements of the towns along the coast. While these new settlements keep the name of the towns, they are often differentiated from the latter with the word “marina”, since they are coastal. Riace (the new settlement of the town is called Riace Marina), the focus of this paper, is one of these MHCs.

The name of Riace probably came from the Greek-Byzantine “*Ryaki*” which means small brook. Since the refugee crisis in Europe, Riace has gradually earned an international fame because of its innovative approach to dealing with refugees. From 2004 until today, it has been the centre of immigration policy. In 2016 only, more than 800 immigrants were hosted by the local community, which helped revitalise the town itself.

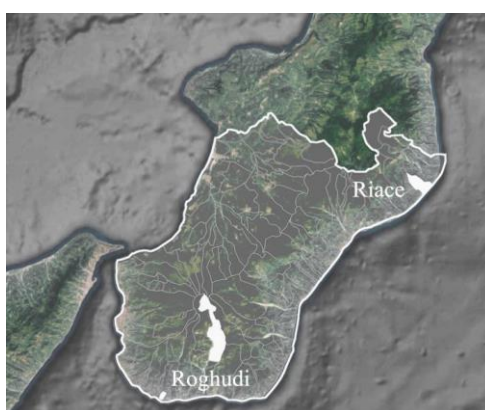
As mentioned above, Riace, like many other MHCs, has suffered from aging population and depopulation since the 1980s. To better illustrate its “demographic crisis”, Roghudi², having similar conditions, was chosen as a contrast. The geographic location of Riace and Roghudi is shown in the map below (see Map 1). The table below (see Table 1) shows their population, old age index, young household with children rate and potential vacancy of buildings in 1991, 2001 and 2011. While there is a constantly decreasing population and young household with children rate as well as a constantly increasing old age index in Roghudi, Riace saw an increasing population and young household with children rate as well as a decreasing old age index in 2011, which implies an increase of immigrants. This increase of immigrants is also confirmed by a significant decrease in potential vacancy of buildings in both towns.

¹ The co-author Antonio Errigo carried out all the field investigations and interviews.

² As an ancient settlement, Roghudi owes its name perhaps to the ancient Greek “Rochùdios”. The Old Roghudi (Roghudi Vecchio) enjoys a breath-taking landscape: it is located on the top of a hill about 500 meters above sea level which stands right in the middle of the seasonal river Amendolea. Following the floods in the early 1970s, the old town was abandoned and all of its inhabitants were relocated to the newly constructed town called New Roghudi (Roghudi Nuovo, hereinafter referred to as Roghudi) in Melito Porto Salvo, very close to the Ionian coast.

It is worth noting that in Riace, inverse changes have been happening since 2001. For example, its old age index increased from 1991 to 2001 and decreased from 2001 to 2011. Meanwhile, its population and young household with children rate decreased from 1991 to 2001 and increased from 2001 to 2011. Since civic spaces have started to emerge in Riace since 1999, which is to be discussed in detail in the following section, the year 2001 was considered as a baseline year to catch the trend before and after with the emergence of civic spaces. It therefore can be concluded that emerging civic spaces have helped rejuvenate the population of Riace and regenerate the town.

The emerging civic spaces in Riace are mainly represented and fostered by autonomous NGOs (under the coordination of the institutional leadership, namely, the mayor) and collaboration between the host community and the guest community. In the following sections, the dynamics, forms and socio-economic impacts of emerging civic spaces in relation to innovative LSED are discussed in detail.



Map 1: Geographic location of Roghudi and Riace³
Source: Google Map (2017).
Processed by A. Errigo.

Table 1⁴: Population, old age index, young household with children rate and potential vacancy of buildings in 1991, 2001 and 2011 in Roghudi and Riace

Source: Istat, 8000 Census. Retrieved from <http://ottomilacensus.istat.it/provincia/080/>, accessed on 26/05/2017.

| Town | Indicators | 1991 | 2001 | 2011 |
|-------------|------------------------------------|-------------|-------------|-------------|
| Roghudi | Population | 1,530 | 1,365 | 1,172 |
| Riace | | 1,694 | 1,605 | 1,793 |
| Roghudi | Old age index | 75.4 | 118.5 | 143.4 |
| Riace | | 103.5 | 117.2 | 116.8 |
| Roghudi | Young household with children rate | 20.1 | 14.5 | 8.1 |
| Riace | | 18.1 | 11.3 | 13.5 |
| Roghudi | Potential vacancy of buildings | NA | 23.3 | 18.3 |
| Riace | | NA | 11.7 | 8.2 |

³ The boundary in thick white line shows the metropolitan city of Reggio Calabria. The inner white boundaries are the administrative territorial divisions (i comuni).

⁴ Notes: Old age index: percentage of population aged 65 years old and over and that aged 0-14 years old; Unemployment rate: Percentage of residents seeking job in relation to active population (employed and job-hunting); Incidence of foreign residents: incidence of foreign residents per 1,000 Italian residents; Potential vacancy of buildings: percentage of unused buildings on total buildings.

2.2. Multicultural Community Building and Social Inclusion

Both Roghudi and Riace are hosting immigrants to rejuvenate their population and regenerate their urban fabrics, but it is Riace that has a longer tradition of being open to immigrants that dates back to the 1990s. As the table below (see Table 2) shows, the number of foreign residents is rocketing up in both towns, especially in Roghudi.

The drastically increasing number of immigrants, just like a double-edged sword, proves to be both an opportunity and a risk. Immigrants mean not only more labour force and cultural diversity, but also possible tension and even conflict between the host community and the guest community. When referring to the new patterns of migration to Pacific Asia's metropolitan regions, Douglass (2003) maintains that whether the accompanying cultural diversity can be accomplished in a socially just, inclusive manner is among the most important issues of this century. Often times, a so-called "crisis of inclusion" happens when there is a troubled access to public and civic spaces (Daniere, 2003). Indeed, how to foster a multicultural community that is socially and economically inclusive to all community members is undoubtedly an important but challenging task for Riace.

Table 2: Rate of foreign residents in Roghudi and Riace

Source: Istat, 8000 Census. Retrieved from <http://ottomilacensus.istat.it/provincia/080/>, accessed on 26/05/2017.

| Town | Indicators | 1991 | 2001 | 2011 |
|---------|---------------------------|------|------|-------|
| Roghudi | Rate of foreign residents | 3.9 | 58.6 | 120.3 |
| Riace | | 1.8 | 12.5 | 56.9 |

In Riace, grass-roots NGOs (under the coordination of the institutional leadership, namely, the mayor), such as associations and cooperatives, have played a significant role in promoting integration and inclusion of the immigrants, while building up the towns' social capital. NGOs often have a significant role to play in decentralisation (Balassiano, 2011). This can be evidenced by the autonomy of local associations in Riace in planning and implementing cultural initiatives aimed at the integration of immigrants. In 1999, the association *Città Futura* (Future City), the first of its type, was founded in Riace, echoed successively by four other associations A Sud di Lampedusa, Girasole, Real Riace and Riace Accoglie. These associations have collaboratively planned and carried out a series of welcome projects for immigrants, which has finally become a national and international prototype, the "Riace Model". In the following section, this paper will have a close look at the work of the leading non-profit organisation *Città Futura*, which is directed by the Mayor of Riace, Domenico Lucano⁵.

Città Futura is aimed at promoting and managing the activities related to the integration of immigrants. It also serves as a research institution for ethnographic history and culture. Its major objectives are:

- facilitating the socio-economic integration of foreigners present in Riace;
- creating jobs for unemployed young people;
- improving the local economy;
- making sure that the history of Riace can continue to live by means of folklore, traditions and handicrafts.

⁵ Currently serving his third term as Mayor of Riace, Domenico Lucano was listed by *Fortune* as one of the world's greatest leaders in 2016.

Basically speaking, *Città Futura* is dedicated to promoting the integration of immigrants in four ways: housing provision, conscious urban design, amenities improvement and public spaces diversification. To begin with, *Città Futura* developed a project of hospitality called Global Village (*Villaggio Globale*). Through the project, now completed, more than 20 abandoned houses were reclaimed, generating a total of more than 100 beds. With this project, the organisation has successfully combined the need of social integration and urban regeneration. It is worth noting that the Global Village is a very innovative project, in that it is not only aimed at improving housing for immigrants, but also creating new jobs. A typical design based on mixed use, Global Village, besides housing, also established bars, taverns, shops, etc. Actually, the Global Village, through the reclamation of abandoned buildings, is probably the key to foster civic spaces according to the Mayor. The shops, which sell different kinds of handicrafts, have contributed to regenerate and revitalise the historic centre of Riace, stimulate the local economic activities and allow immigrants to learn local skills necessary for making a living.

Secondly, with conscious considerations of the need to promote social inclusion of immigrants in public spaces, *Città Futura* has helped design public signs (see Figure 1) and decorative structures (see Figures 2-3) that all convey the value of tolerance and cultural diversity.



Figure 1: Public board showing nationalities present in Riace
© A. Errigo (2017)



Figure 2: “Welcome to Riace”, signs of welcome on the gate of Riace
© A. Errigo (2017)

Thirdly, to help deliver better public services, *Città Futura* promoted the provision of various public amenities, such as theatre (see Figure 4), where performances and citizen meetings take place, and oil mill with stone grinders for the production of extra virgin olive oil (see Figure 5).



Figure 3: Mural painting and “Global Village”, entrance arch to the shops
© A. Errigo (2017)



Figure 4: Theatre of Riace
© A. Errigo (2017)

In addition, to make sure that different ethnic groups can interact and socialise with each other, *Città Futura* has realised a series of projects focusing on public spaces. Some of the existing squares in the historic centre were rehabilitated with considerations of social integration promotion (see Figure 6).



Figure 5: Oil mill with stone grinders for the production of extra virgin olive oil
© A. Errigo (2017)



Figure 6: A small square in the historic centre transformed into a stage decorated with multi-ethnic paintings
© A. Errigo (2017)

2.3. Community Collaboration and Economic Inclusion

It is acknowledged that people’s capabilities to participate effectively in local development are determined not only by individual resource endowments, but also by social capital that provides the basis for collective action (Serrano *et al.*, 2010). As mentioned above, in Riace local NGOs have helped build up the community’s social capital by promoting integration and socio-cultural inclusion. This serves as a starting point for the host community and guest community to collaborate. In so doing, besides socio-cultural inclusion, economic inclusion is also achieved, since new jobs, especially jobs for immigrants, are created. As the table below (see Table 3) demonstrates, there was a constant decrease in unemployment rate in Roghudi. In contrast, Riace saw an increase in unemployment rate in 2011, which may be explained by the economic crisis across Europe.

Table 3: Unemployment rate in Roghudi and Riace

Source: Istat, 8000 Census. Retrieved from <http://ottomilacensus.istat.it/provincia/080/>, accessed on 26/05/2017.

| Town | Indicators | 1991 | 2001 | 2011 |
|---------|-------------------|------|------|------|
| Roghudi | Unemployment rate | 44.5 | 15.3 | 7.4 |
| Riace | | 39.4 | 19.8 | 22.9 |

Community collaboration is deemed as a rural restructuring strategy (Baker, 1993). According to interviews with key stakeholders, Riace has freed itself from an over-dependency on traditional agricultural economy and moved towards new economic sectors. Tourism is a good example. By adding value to the Heritage, both material and immaterial, the host community and guest community collaborate to help promote tourism development. In Riace, for example, various artistic laboratories were established where immigrants can work as apprentices to learn handicrafts (see Figure 7), just to name a few, laboratories of glassware, embroidery, weaving (with traditional wooden looms), jam, etc. The handicrafts normally bear strong territorial identity, and they are popular commodities on the tourism market (see Figure 8). Community collaboration of this kind has not only added value to local Heritage and promoted the territorial identity, but also generated income for both the host community and guest community. Needless to say, this has contributed to local economic development.

Apart from artistic laboratories, the host community and the guest community collaborate, under the guidance of *Città Futura*, to revitalise agricultural production by reclaiming abandoned farming lands. A good example is the “Didactic Farm” (see Figure 9) dedicated to immigrants. This “Didactic Farm” allows immigrants to take advantage of the tools and facilities needed for agricultural work. For examples, they are instructed how to raise domestic animals in the small buildings on the farm (as is shown on the picture below).



Figure 8: Boutique selling local handicrafts while promoting fair trade concept
© A. Errigo (2017)



Figure 7: Immigrant weaving in a laboratory
© A. Errigo (2017)

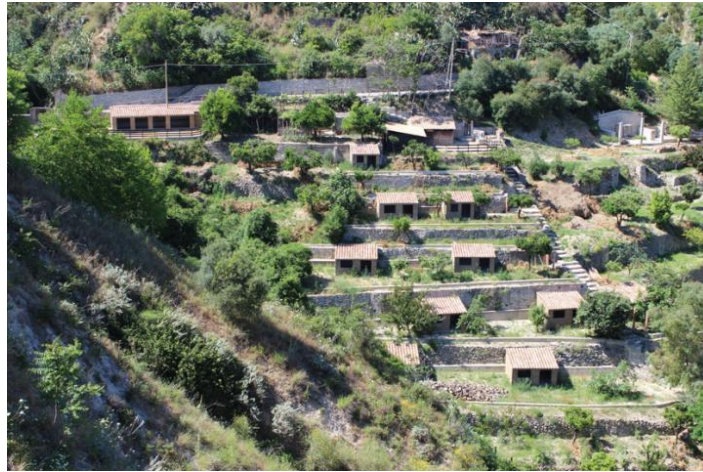


Figure 9: Panoramic view on the “Didactic Farm”
© A. Errigo (2017)


3. CONCLUSIONS

As the literature available demonstrates, currently academic discussions on civic spaces seldom deal with the socio-economic impacts of civic spaces, especially in a multicultural community. This research found that the emerging civic spaces in Riace are mainly represented and fostered by autonomous NGOs (under the coordination of the institutional leadership, namely, the mayor) and collaboration between the host community and the guest community. The emerging civic spaces do contribute to the integration of immigrants, and at the same time, the promotion of an innovative local socio-economic development. The socio-economic development in Riace proves to be innovative mainly because, firstly, local NGOs, *Città Futura* in particular, play a proactive role in promoting social and economic inclusion by building up a cohesive multicultural community. Housing provision for immigrants, conscious urban design, amenities improvement and public spaces diversification are crucial contributing factors leading to the success of Riace. Secondly, according to the needs of all community members, the historic centre of Riace has been regenerated and revitalised by mobilising the idle physical capital, namely, abandoned buildings. During the regeneration process, mixed use strategy, as the project Global Village shows, has been an effective, innovative tool for Riace to achieve both social integration and inclusive job creation. This strategy finally contributes to increasing community cohesion and local economic development through a value-adding of its Heritage (handicrafts for instance). Last but not the least, collaboration between the host community and the guest community has not only helped build up Riace’s social capital which is vital for its emerging civic spaces, but also contribute to its economic development, as the artistic laboratories and “Didactic Farm” demonstrate.

It is desirable that the findings of this research serve as an empirical reference for policy-making, especially for other communities in Calabria Region which have similar socio-economic challenges. Policy-makers would integrate into local development initiatives an innovative approach to local socio-economic development which is driven by emerging civic spaces. Besides, it is equally hoped that the role of civic spaces in innovative socio-economic development would be popularly acknowledged by both the academia and policy-makers, and more importantly, brought into play locally.

Due to space limitation, the research didn't discuss the role of the public sector in fostering the civic spaces, which is unarguably important in Riace. Future research may well fill this gap. In addition, it would be interesting to compare Riace to other minor historic centres which see emerging civic spaces as well. Finally, as Daniere (2003: 4) points out, that civic spaces "require rules of access and use if they are to function in an inclusive, fundamentally non-violent and civil manner", one more question for future research is, how should these civic spaces be properly managed and regulated?

4. ACKNOWLEDGMENT

 This research was undertaken within the MAPS-LED project, which has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 645651. Hereby, the authors would like to extend their sincere thanks to all participants in the interviews, especially to Mr. Domenico Lucano, the Mayor of R

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FROM BROWN-FIELDS TO INNOVATION DISTRICTS: A COMPREHENSIVE APPROACH TO SUSTAINABILITY

L. Biancuzzo

PAU Department, Università degli Studi Mediterranea di Reggio Calabria, Salita Melissari, 92124, Reggio Calabria, Italy

Email: laura.biancuzzo@unirc.it

Abstract: In the globalisation era, the future of older industrial cities will result from their expertise on investing into their underutilised assets in order to keep being competitive globally; it is therefore necessary to revitalise the land known as brown-field. An emerging urban model, the innovation district, puts forward ground breaking promises about its ability to cope with this specific challenge, standing as a driver for a sustainable and inclusive economic development. This paper aims to show the degree to which innovation is effective in giving a meaningful response to brown-field problems, first by considering a conceptual framework to assess the comprehensive approach aimed at improving the social, economic and physical issues inherent to post-industrial landscapes; then by testing it through empirical research work. To support the discussion with evidence, the Boston Innovation District case study will be investigated, pointing out the policies and planning initiatives undertaken in the Seaport area. Findings from this research highlight the innovative-led approach effectiveness in matching all the issues considered as relevant to sustainable brown-fields redevelopment, and useful lessons can be drawn in encouraging planners and policy-makers towards considering the role of innovation in urban regeneration initiatives targeting distressed areas.

Keywords: Brown-field Redevelopment, Innovation District, Local Economic Development, Sustainability.

1. INTRODUCTION

Deindustrialisation has left tangible traces on the territorial geography; thus, some of the areas where once vital industries used to thrive have been replaced by brown-fields (Bartsch & Collaton 1997). Nowadays, a wide consensus exists on the need to take actions - targeted at revitalising the stagnant economy in these distressed markets, while restoring a safer and uncontaminated urban environment, and ensuring environmental justice (Dernbach 1998; Ruthl 1998), within broader smart growth policies which promote compact development and land consumption reduction (Greenberg et al. 2001). Although several research studies attempted to face the challenge of how to plan, manage and assess brown-fields redevelopment complying with the principles of sustainability (Boer 1995; EPA 2015; RESCUE 2003), less emphasis has been placed on the potential key role of innovation, despite its recognised ability to foster economic growth (Katz & Wagner 2014). This paper puts the body of knowledge forward on the nexus between brown-field regeneration and innovation, by analysing the capability of the newly conceived “re-imagined urban areas” model to achieve the objectives of sustainable brown-field redevelopment. To do that, the paper investigates the Boston Innovation District case study, by focusing on the implementation process of the innovation-led strategy undertaken by the Boston Redevelopment Authority (BRA). Accordingly, the planning initiative sought to guide economic, social and physical changes in the Seaport area in order to create a neighbourhood consistent with the highly innovative Boston’s environment. This paper is organised in five

parts. Following this introduction, it provides a scientific background through an overview of theoretical approaches to brown-field redevelopment and prevailing assessment methodologies in terms of sustainability, introducing the concept of innovation in the sustainable development context. In the third part, the methodology that determined the objectives of each dimension for the sustainability assessment model is presented, followed by the description of the case study. Next, the Boston Innovation District achievements are analysed, and how these outcomes might affect the further planning practices is discussed. Finally, findings and conclusions are presented in the fifth part.

2. RESEARCH BACKGROUND

This paper aims to present one of the most common phenomenon lately facing communities in the Western countries: the land classified as brown-field, focusing on the outcomes of its regeneration process. Three issues of the growing literature, dealing with the abovementioned area of concern, focused on the United States perspective, make a significant contribution to the understanding of the topic: (1) the literature exploring the reasons brown-field regeneration is considered a strategy for local economic development, (2) studies examining the innovation district urban model as a powerful driver for a sustainable economic development, and (3) the literature attempting to assess the impacts of brown-field reclamation in heading towards sustainability.

2.1 Brown-field Redevelopment as a Local Economic Development Strategy

To set the context between brown-field redevelopment and urban regeneration, a preliminary investigation of the process which led to the creation of derelict land and sites is presented. Over the past few decades, the great economic powers, Europe and the United States, have experienced considerable processes of change in terms of spatial, social, environmental and economic arrangement. The glorious days of several industrial cities came to an end when the reallocation of many factories to foreign countries started the process of deindustrialisation. Even more significant in the context of globalisation, industrial activities have undergone substantial changes due to a shift from manufacturing to service economies, which has resulted in the downsizing of enterprises as well as the complete loss of whole production industries. These significant transformations have left tangible traces on the territorial geography; thus, some of the areas where once vital industries used to thrive have been replaced by vacant and most likely polluted land, strongly affecting the citizens who live close to them (Bartsch & Collaton 1997; Olivier et al. 2005; Adams et al. 2009). These sites are known as brown-fields. While individual nations hold independent definitions of brown-field sites, the American context commonly refers to “abandoned or underutilised industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived contamination” (Knox & McCarthy 2012). In addition, “The Environmental Protection Agency estimates the number of brown-fields located in the U.S. to be between 500,000 and 1,000,000” (EPA 2012).

Given the impressive figures, the presence of brown-field sites across the country represents a significant urban management problem; additionally, it has been documented that beyond the scale and spatial configuration, the existence of brown-fields has multiple adverse effects, not only over the environment, but also on the economic and social health of an entire region (COBRAMAN 2009). These sites have been held up as “blights of the neighbourhoods, able

of discouraging economic development and undermining local [government] tax bases” (Preston 2003); moreover, they often serve as gathering sites for the downtrodden citizens of a community, which inevitably leads to neighbourhoods in greater decline in pure economic terms (Sirmans & Macpherson 2003). Beside the economic and societal impacts, the concept of brown-field as an environmental issue has to be highlighted, due to the increasing number of abandoned areas with real or plausible hazardous contamination, representing a heartfelt public concern.

As a consequence of the afore mentioned reasons, in the last decades, federal, state, and local governments redirected their priorities to regenerate unproductive lands. As a matter of fact, brown-fields redevelopment is considered the preferable method to fight the decaying phenomenon of core inner urban areas, enhancing the quality of inner cities environments (Dixon et al. 2010); and a powerful smart growth policy which promotes compact development and significantly reduces land consumption (Greenberg et al. 2001). In support of this, it has been demonstrated that “putting clean land back into productive use brings with it a range of social and economic benefits that will strengthen those communities for years to come” (EPA 2015) by providing a remarkable opportunity for the redevelopment of the social equity, economic stability, and environmental equilibrium. Traditionally, brown-fields remediation results in a deep community economic revitalisation and job creation, significant neighbourhood restoration, not to mention the meaningful reduction of the development pressures on green-fields through the reuse of urban space (PCSD 1998). Moreover, cleaning up abandoned industrial sites leads to a twofold advantage in terms of economic opportunities and investments: on the one hand, the private sector benefits from the convenient chance to purchase properties at below market price and make profits thanks to the financial and technical assistance they obtain to clean them up; on the other hand, state and local governments create economic viability through a variety of financial incentives and fiscal exemptions which facilitates and accelerates the development process (Verbit 2001).

However, for years now, brown-fields run up against the increasing scepticism towards the revitalisation of neglected sites; strict environmental and economic policies are commonly considered to be a major barrier to redevelopment, combined with the expensiveness of assessment and rehabilitation practices, and the difficult management of such a significant scope projects (BenDor & Metcalf 2005). To overcome these obstacles, it is worth evaluating to what extent brown-field redevelopment programs "pay for themselves" by generating economic (jobs, wages, increases in property values) and fiscal (increased tax revenues without increasing tax rates) benefits (Frank 2014). The attempted literature highlights the potentially remarkable results of investments in the distressed areas, as emphasised by the United States Conference of Mayors report (2008), which provided data relative to a compilation of a questionnaire responded by more than 200 US cities - belonging to more than 41 different states - that have been involved in a brown-field redevelopment project. The cities were asked to identify the four most important benefits as a result of the regeneration: neighbourhood revitalisation was the most frequently cited benefit, along with job creation, and an increase in city's tax base and environmental protection. On the same line, the Chicago Metropolitan Agency for Planning (2008) gives credit to the wide-ranging benefits of bringing a site back to active use, focussing on the opportunity for businesses to thrive creating new jobs and attracting private investments. In sum, a single site intervention entails remarkable spill-over effects on the quality of life for people living in neighbourhoods with brown-field sites and on the economy of the entire region (Chilton et al. 2008).

2.2 Innovation Districts: a driver for a sustainable economic development

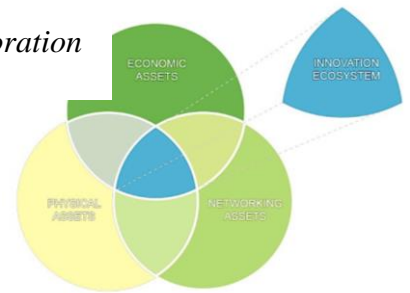
One sound argument in response to the challenge of post industrial sites comes from a new urban and economic redevelopment strategy: the creation of innovation districts. Innovation districts have been considered an emerging urban model, a product of the shift in the spatial geography of innovation occurred over the last few years in several cities and metropolitan areas in the United States and other countries (Feldman 1994). A growing number of talented workers and innovative firms chose to move from the spatially isolated suburban corridors - places best exemplified by the Silicon Valley in the San Francisco Bay Area - and cluster spatially in compact and more desirable areas in the inner city; at the same time, an increasing share of citizens is drawn to these districts, given the shifted location preferences toward more vibrant and amenity rich places to live and work (Audretsch & Feldman 2003).

The purposes behind the rise of innovation districts are clear: to create a dynamic place where entrepreneurs and knowledge-intensive businesses can share ideas, and benefit from the impact of proximity on learning and knowledge spill overs, increasing their competitive advantage (Boschma 2005). Nevertheless, the trend is still recent and, lacks a univocal definition due to its multi-dimensional nature. As stated in the influential Brookings Institution report, edited by Bruce Katz and Julie Wagner (2014), the term innovation district is mostly used to identify “geographic areas physically compact, transit-accessible, and technically-wired where leading- edge anchor institutions and companies cluster and connect with start-ups, business incubators, and accelerators. They also offer mixed use housing, office, and retail.” As the afore mentioned explanation suggests, these districts perfectly embody the comprehensive concept of “cityness” coined by Saskia Sassen (1991): the complex intersection of differences embedded in these urban spaces produces something new; proximity and density, together with diversity of people, subcultures, practices, lead to innovation indeed. The affirmation of this concept is translated into reality in “new or improved ideas, products, services, technologies, or processes creating new market demand or cutting-edge solutions to economic, social and environmental challenges” (Katz & Wagner 2014).

Additionally, innovation district urban forms and functions cannot be defined a priori; given their ability to leverage the economic strengths of the specific metropolitan area in which they locate, they significantly vary by type and size, but also differ in specializations for growth - some of them slant toward life sciences, while others are focused on the information technology sector or different highly creative industries (Read 2016). Whether the districts have been strategically planned or represent the spontaneous response to the market forces, they all contain a powerful and unique combination of economic, physical, and networking assets (see Figure 30) which, brought together in geographic proximity, stimulate the idea generation facilitating the entrepreneurial activity (Giuffrida et al. 2015).

| | | |
|-------------------|---|---|
| Economic Assets | firms, institutions and | i) innovation drivers |
| Networking Assets | relationships and social ties that connect employees and institutions | i) strong ties ii) weak ties |
| Physical Assets | relationships and social ties that connect employees and institutions | i) spaces in the public realm ii) spaces in the private realm iii) assets that join spaces together |

^A Figure 30: Common Features of Innovation Districts (Author's elaboration based on Katz & Wagner 2014)



All of these

observations highlight how

this new approach to economic development takes place. Under the assumption that innovation districts have the unique capabilities to foster an inclusive and sustainable economic development, they contribute to address three of the modern-day plagues: the stagnant economy of the post recession period, the growing inequality that is damaging today's social structure, and the environmental threat due to the extensive sprawl. To this end, the most convincing line of evidence supporting this theory, are observations drawn from the "re-imagined urban areas", one of the three general models of District (Katz & Wagner 2014; Montini 2014). Accordingly, historic waterfronts and de-industrialised areas are the subject of physical and economic transformations charting a new path of innovative growth (Clark & Moonen 2015).

2.3 Assessing the Sustainability of Brown-field Redevelopment

As the first sub-section suggests, brown-field land use strategies clearly fit in the sustainability paradigm; brown-field revitalisation became one of the main issues to take into account to achieve a sustainable development indeed (Boer 1995; Dorsey 2003). On this matter, the number of references the literature makes is relevant, as demonstrated by the several federal agencies' initiatives targeted at the promotion of brown-fields "sustainable reuse" (EPA 2015). These actions aim for economic growth in the distressed property market, while improving the living conditions of neighbouring residents - as known as environmental justice communities, extremely affected by economic, social and environmental inequalities. (Dernbach 1998; Ruthl 1998).

Although the idea of sustainable development has significantly changed over the past decades and it can be defined in many ways, broad consensus is reached on the triple bottom line framework (Elkington 1998). The comprehensive approach rests therefore on "three pillars: economic growth, social progress and protection of the environment and natural resources"(Annan 2002), representing the core of the sustainability vision of the widely cited Brundtland report (WCED 1987) that refers to the potential of meeting the "needs of the present without compromising the ability of future generations to meet their own needs." A particularly important milestone in the attempt of translating the sustainability concept into a "solid basis for decision making at all levels" (Capello & Nijkamp 2002), was the drafting of two documents: the Rio Declaration on Environment and Development (United Nations 1992b) and the Agenda 21 (United Nations 1992a); within the afore mentioned, a well structured framework has been defined, providing recommended actions and detailed activities the governments should undertake in order to achieve sustainable development practices, accordingly to the desired performances. From then on, several frameworks have been developed in the attempt of providing an exhaustive assessment of the sustainability

threefold component, but not without disputes over the choice and suitability of the aspects to be covered and their proper calculation (Huetting & Reijnders 2004).

However, in order to point out the uniqueness of a brown-field redevelopment effort, distinguishing it from a conventional urban redevelopment initiative, it is deemed necessary to properly define a sustainable brown-field redevelopment process as “the management, rehabilitation and return to beneficial use of brown-fields in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations in environmentally sensitive, economically viable, institutionally robust and socially acceptable ways within the particular regional context” (RESCUE 2003). The complex combination of planning policies, public and private initiatives, diverse stakeholder interests and technical skills, have an impact not only on the implementation process, but above all on the sustainability of the outcomes.

In support of the findings raised above, a great deal of uncertainty, regarding the measurement of the intended and unintended spill over effects of brown-fields regeneration, generated an impressive theoretical debate on the construction of sustainability frameworks in order to manage and assess the revitalisation of distressed areas. Some authors claim that, to successfully achieve a sustainable brown-field development, the holistic principle of sustainability has to be embedded in the entire process. One sound argument in support of this theory comes from the Model Framework devised by the Environmental Protection Agency (1999), that aims at guiding the stakeholders to properly structure the planning and development process, in order to direct their efforts towards a viable and sustainable brown-field redevelopment. Nijkamp et al. (2002) likewise propose a qualitative impact assessment model to provide a detailed description of the procedures to be followed, ensuring the critical success factors for a sustainable brownfield rehabilitation. According to this train of thought, the Redevelopment Assessment Framework provides a procedure that “informs stakeholders about the sustainability performance in a practical way” (Pediaditi et al. 2005) guaranteeing that sustainability is addressed and monitored across the life cycle of a brown-field site. Other scholars consider the evaluation a priori crucial to fulfil the sustainable brown-field development objectives. Specifically, the adoption of a decision-support system is seen as crucial to significantly reduce the uncertainties and the complex decision making process concerning the sustainability values of different land use scenarios for brown-fields. The computer-based module proposed by Bleicher & Gross (2010) deals precisely with this theory, as well as the approach chosen by Schädler et al. (2011). According to these assessment methods, through a comparative analysis of alternative brown-field rehabilitation options, the degree of sustainability is calculated, and the optimal redevelopment option is chosen. Still other authors place the emphasis on the methodology to be applied in order to measure the performance of brown-field regeneration processes according to sustainability principles. In this regard, the Principle - Criteria - Indicators framework approach describes the attempt to capture the complexity of the measurement starting from the definition of the three main sustainability dimensions, moving to the identification of specific objectives that have to be assessed through properly chosen indicators (Worrall et al. 2009). The Sustainability Assessment Tool is another good illustration of a three steps methodology which provides a wide range of qualitative and quantitative criteria to evaluate how sustainable a brown-field regeneration project is, on the basis of objectives, indicators and best practices (Franz et al. 2006). Accordingly, the framework built by Sardinha et al. (2013) consists in validating the achievement of six sustainability dimensions - environmental reconversion, cultural regeneration, social revalorisation, economic revitalisation, community reinforcement and strategic reframing - through the identification and application of some

categories for action. Furthermore, the measurement of sustainability is in many cases subject to a preliminary and well structured selection of indicators. This practice is well exemplified by the indicator based approach, applied by Hemphill et al. (2004), where the complex procedure of choosing the potentially relevant indicators is broken down into rigorous steps and followed by a points scoring phase, ensuring a comprehensive and transferable framework to quantify the sustainability of brown-fields revitalisation. Other researchers apply a similar methodology to select indicators capable of measuring the brown-field redevelopment success in terms of environment-health, finance, livability, and social-economic sustainability through a partially automated tool (Wedding & Crawford-Brown 2007), while still others consider the definition of economic and environmental performance indicators instrumental for measuring the unequivocal recognition of the sustainability achievements (Bacot 2006).

Despite the above mentioned debates, it appears commonly recognised that sustainability calls for context sensitive evaluation criteria, given its strict reliance on temporal, spatial and thematic context; thus, the selection of the most appropriate indicators lie with the local stakeholders and are tailored to reflect the site specific situation (Franz & Nathanail 2005; Olsson 2009). Hence, the local context dictates the specific sustainability needs, as defined by the local authorities and decision-makers' expectations. This implies that, on the one hand the stakeholders involved in the land reuse play a key role in the sustainability achievements, having a direct impact on whether the development is sustainable (Williams & Dair 2007); on the other hand, it determines the impossibility to apply a standardised list of indicators to measure "some unspecified type of sustainability brownfields" (Bleicher & Gross 2010).

In sum, while evaluating the current state of the art for the body of knowledge reviewed, it became clear that innovation, through the "re-imagined urban areas" model in particular, is potentially able to give a meaningful response to the problems shown by de-industrialised areas, leveraging the assets already present within the existing city limits. However, a gap in research about the nexus between brown-field and innovation district multiple positive effects (over the environment, on the economic and social health of the entire region) has been found. This paper puts forward the application of an objective-led framework designed to assess the sustainability of brown-fields development in order to capture the above mentioned relationship.

3. RESEARCH METHODOLOGY

In the light of the findings raised above, the inclination to measure brown-fields redevelopment sustainability according to specific indicators is quite misleading. A better understanding of the innovation multiple response can be achieved by approaching the research from a more comprehensive perspective, thus, by taking into consideration criteria that illustrate the general values recognised by the society.

The objectives-led approach adopted by Williams & Dair (2007) provides a framework broad enough to embrace the diverse contexts of brown-field redevelopment and the multidimensionality of impacts. It allows the author to effectively assess the sustainable development in the context of land reuse through a better insight of cause and effect; in addition, it also leads to the derivation of general principles from it, since it facilitates the transposition of abstract concepts - such as economic, social and environmental sustainability, into tangible practices. According to the method, all the range of potential key

stakeholders should be first identified in order to investigate what can be achieved in terms of sustainability by their participation in land reuse. Subsequently, the objectives-led model is devised, which relates to the development of several precise sustainability objectives, deduced from a sound knowledge of the state of the art, regarding the economic, social and environmental systems (see Table 7).

Table 7: Sustainability objectives to be met in brown-field developments (Source: Williams & Dair, 2007)

| |
|--|
| <p>Economic sustainability objectives</p> <ol style="list-style-type: none"> 1. To enable businesses to be efficient and competitive 2. To support local economic diversity 3. To provide employment opportunities |
| <p>Social sustainability objectives</p> <ol style="list-style-type: none"> 1. To adhere to ethical standards during the development process 2. To provide adequate local services and facilities to serve the development 3. To provide housing to meet local needs 4. To integrate the development within the locality 5. To provide high quality, liveable developments 6. To conserve local culture and heritage, if appropriate |
| <p>Environmental sustainability objectives</p> <ol style="list-style-type: none"> 1. To minimise the use of resources 2. To minimise pollution 3. To protect biodiversity and the natural environment |

First, as far as the sustainable economic development is concerned, the perspective adopted in the model reflects the prevailing approach of the last 20 years considering the brown-field revitalisation as an opportunity to foster sustainable economic growth through the objectives spelt out within the framework. Second, the model confirms its proper assessment methodology with regard to the social issue as related to the environmental conditions; hence, the factors affecting individuals and human well-being have been considered, together with the aspects associated with the development of social capital. Third, when it comes to environmental sustainability, the brown-field redevelopment is deemed to be, according to the well developed literature, a successful strategy to restore the natural ecosystem by the implementation of the objectives set out in the model.

By taking the abovementioned criteria as a starting point, an attempt of a qualitative evaluation of the impact of innovation on brown-field redevelopment sustainability is carried out. Therefore, the empirical research, developed on a purposely selected US area, aims to apply a methodology to examine to what extent the main sustainability outcomes have been achieved, through a qualitative direct analysis.

The conceptual model is tested on a case study that has been analysed in the framework of the wider international MAPS-LED Project, designed to investigate the spatial dimension of Smart Specialisation Strategies, with the purpose of exploring the key role of S3 implementation in placed-based regeneration policies. Accordingly, through a spatially-led approach, the urban dimension ability to foster knowledge dynamics promoting innovation within the Greater Boston area has been investigated. Thereby, the physical localisation of innovation within an urban territorial scale has resulted in the identification of several case

studies, among which the Boston Innovation District planning initiative has been chosen - given the outstanding implementation of an innovation-led brown-field redevelopment initiative. Therefore, this study adds an additional element to the original research, to allow a deeper understanding of how the Boston Innovation District fostered the process of brown-field revitalisation from a sustainable development perspective, with the aim to provide transferable instruments and recommendations.

The empirical analysis has been conducted with a research methodology based on a two-step approach. Initially, secondary data have been the subject of an in-depth analysis: the main urban attributes and key socio-economic indicators were collected in order to improve knowledge on the specific features of the context; in addition, qualitative planning and financial documents were gathered to retrace the urban development activities undertaken in the Boston Seaport area over the last few decades. A direct analysis of the case study, mostly based on field work and interviews, has been performed at a later stage: an active participation during meetings and events held in incubators was ensured, multiple valued visual analysis of the urban environment was carried out and supported by photographic evidence, as well as the organisation of semi-structured and informal interviews with key informants conveniently sampled. Finally, in order to test the conceptual model, each sustainability objective has been mapped on the findings of the extensive qualitative observations and data collection.

3.1 Case Study Description

The Boston Innovation District provides an outstanding case study of brown-field revitalisation project (Cohen 2014). The underused Boston's South Waterfront has been converted into a centre of knowledge economy: an urban environment that fosters innovation, collaboration, and entrepreneurship (Menino 2010b). The geographic area dates back to the 19th century when it was a hub of fast-growing industrial development, serving as home to rail yards and manufacturing companies for Boston's working port until about 1955. Successively, the development of transportation infrastructure, with the construction of the elevated Central Artery highway and the Interstate 93, made it hardly accessible, isolating the district and marking its decline. A radical change took place when the Seaport District has been integrated into Downtown Boston again, with the completion of the Big Dig project. Inspired by the successes of 22@, the world's first innovation district located in Barcelona, Mayor Thomas Menino, in the Inaugural address (2010a), announced his vision of redeveloping the large declined industrial waterfront, calling for a "more deliberate and more experimental approach" in order to create a "hub for knowledge workers and creative jobs." As in Barcelona, the Boston Innovation District has employed an economic development strategy where government operated as the regulatory and administrative gatekeeper, working collaboratively with cross-sector private enterprises to enhance the chances of succeeding and affecting such a large scale change. Key private-sector players have been personally engaged, and the public sector openly advocated for financial incentives in order to spur established companies and emerging entrepreneurs to move into the District, creating new jobs and providing tax revenues to fund public services. Hence, a dense community of innovators and entrepreneurs has been created increasing proximity and density, according to the notion that "people in clusters innovate at a quicker rate, sharing technologies and knowledge easier" (Muro & Katz 2011). In line with Brookings Institution researchers' thought, the Boston Innovation District represents a remarkable example of sustainable economic development aimed at revitalising an underutilised parcel of land. It provides a favourable environment for

the launch and growth of firms by helping entrepreneurs and investors, universities and researchers generate new findings for the market; at the same time, it fosters employment expansion through a massive job creation phenomenon densifying the employment patterns; additionally, it facilitates the repopulation of an influential urban area, encouraging a dense residential structure and strengthening mass transit.

4. CASE STUDY RESULTS AND DISCUSSION

The objective-led model has been used as a research tool in the case study of the Boston Seaport regeneration. An extensive analysis, carried out between April 2016 and today in the Boston metropolitan area, allowed the author to assess the brown-field redevelopment against the above mentioned criteria related to the threefold sustainability objectives. The main purpose was to advance the body of knowledge on the nexus between brown-field and innovation, by assessing the degree of sustainability achievements and giving credit to the trend that considers innovation as a comprehensive strategy that invests on the cities underutilised assets in order to boost an inclusive and sustainable growth. The findings from the investigation are summarised and discussed in the following sub-sections.

4.1 Economic sustainability objectives

The South Boston Waterfront Public Realm Plan (BRA 1999), followed by the Municipal Harbour Plan (BRA 2009), have been issued with the specific purpose of supporting businesses to be efficient and competitive through the Seaport physical environment adaptation. Specifically, the underutilised land was the planning context for the development of a 24-hour neighbourhood providing a place for business expansion, supported by an attractive open space network and a strong urban design character. Furthermore, the construction of the Central Artery Tunnel Project, the Silver Line completion, and the strengthening of the MBTA buses have been instrumental in providing a convenient system of transport infrastructure, ensuring links from the site to the main transport corridors. Another success factor for the sustainable economy of the area is represented by the willingness to welcome every kind of industries; the area is indeed characterised by a broad inclusivity of established companies and small enterprises providing a wide range of economic activities which maximise job opportunities for local workforces. “More than 5,000 new jobs have been created in the Innovation District since 2010, as over 200 startups have set up shop in the area. From software and digital marketing to manufacturing and design, the Innovation District’s young firms span a wide array of industries and business models. The support infrastructure that these young companies need to grow, including incubators and accelerators, as well as law, design, advertising, and other professional services firms, has also moved to the District, providing a healthy ecosystem for innovative companies to thrive” (TIP 2014). Moreover, to ensure an adequate accommodation for companies, maximum flexibility for the use of the buildings is assured; most of the buildings are therefore designed to accommodate different types of groups and gatherings, concept best exemplified by the District Hall (see Figure 31) and the Innovation & Design Building.

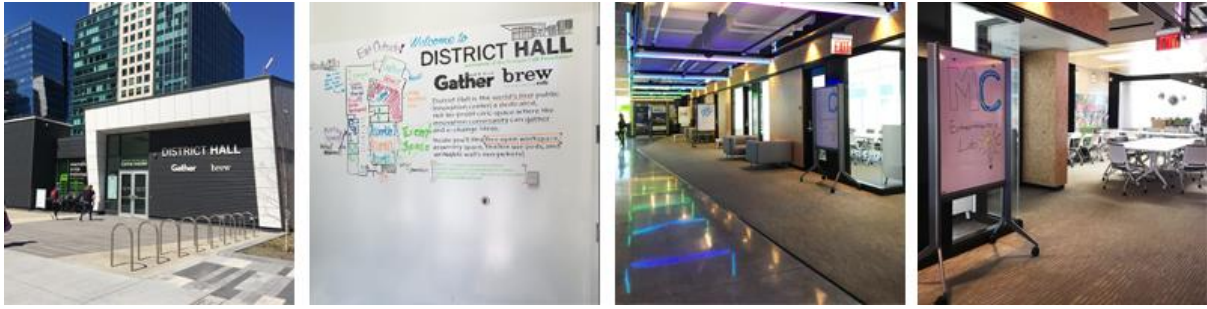


Figure 31: District Hall (Author's pictures)

4.2 Social sustainability objectives

The factors affecting individuals and human well-being, together with the aspects associated with the development of social capital are at the core of the strategic plan that identifies key actions and initiatives to transform the Seaport area into a healthy, thriving and innovative district. Expanding Opportunities stands for the citizens' vision coupled with the Mayor's priorities and research, guiding the growth of the district towards creating a liveable neighbourhood for all residents and generations to come (Image Boston 2016). At the same time, Boston Creates strives to encourage the city's arts and culture sector in order to make it more inclusive and equitable (Boston Creates 2016). The Go Boston 2030 (2015) initiative actively engages the community envisioning a bold transportation system. A high quality architectural design and a master plan well integrated with the context, capable to attract people and businesses to live, work and play, are the result of the InnovationBoston vision (BRA 2010). The liveability is achieved by a diverse and dense complement of offices, retail, restaurant, residences and entertainment uses - as highlighted by the newly conceived Seaport Square (SSDC 2017), in order to meet people's needs for education, healthcare and leisure, but also to help communities develop social capital by providing space for formal and informal social interaction. Numerous cultural and civic institutions are located in the Innovation District, including the Children's Museum and the Institute for Contemporary Art, while numbers of experimental event landscape, such as The Lawn On D and the Fan Pier Park, have been successfully realised to bring together different communities, encouraging social interaction and fostering creativity (see Figure 32)



Figure 32: Seaport District (Courtesy of BRA); Fan Pier (Author's pictures)

The Boston Innovation District also provides a mix of housing types including residents' apartments, condominiums, and micro-unit options - without ignoring the affordability issue. With the specific purpose of providing flexible housing options to meet the needs of local people and entrepreneurs, the Boston Redevelopment Authority launched the Innovation Housing Unit Experience (BRA 2010a) allowing developers to build 300 micro apartments to help young professionals collaborate more effectively; such units can be found just in the

Seaport area at buildings like Pier 4, Flats on D, Watermark Seaport and Factory 63. The efforts of meeting the growing and changing transportation needs of the Seaport, while ensuring good connections to the rest of the city led to the South Boston Waterfront Sustainable Transportation Plan (BRA 2015). The mobility and access to local services for all has been improved, relying on a development design that considers a wide range of users including children, people with disabilities and older people (BRA 2017). Furthermore, the local culture and heritage related to the historic harbour have been firmly preserved (see Figure 33), as demonstrated by the Seaport World Trade Centre, as well as the Massachusetts Port Authority efforts towards the Boston Fish Pier conservation - a social and culturally significant space that still represents the epicentre of Boston's seafood industry after more than a century; the original buildings' structures are currently home to fishing vessels and seafood processing businesses, several maritime industrial office tenants, and the Exchange Conference Center (Massport 1976). Other historic brick warehouses are equally subject to rehabilitation in order to host the headquarters of resonant companies, such as General Electric (BRA 2016).

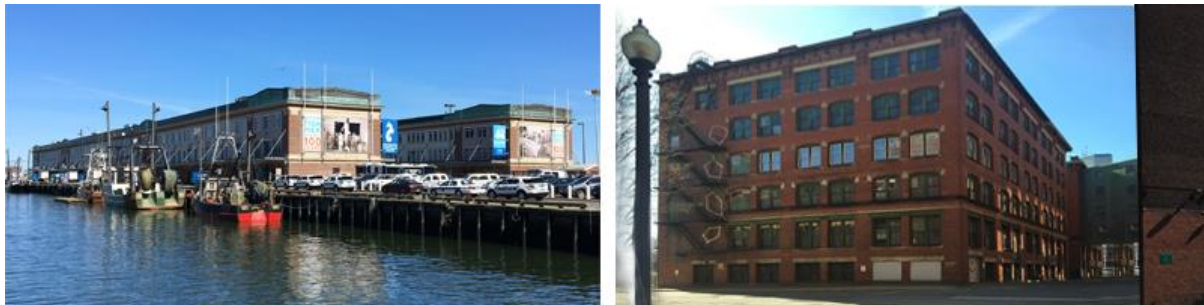


Figure 33: Boston Fish Pier and General Electric site (Author's picture)

4.3 Environmental sustainability objectives

Minimising the use of resources and pollution throughout the life cycle of the brown-field redevelopment has been one of the main concerns of the innovation-led strategy. Indeed, with the Boston Zoning Code Article 37 (BRA 2015a), the city requires that all large-scale projects meet certain LEED certification standards. Accordingly, the Seaport District is home to several green building best practices - such as the Fraunhofer Centre, Boston Design Centre, District Hall, Waterside Place Apartments, The Boston Convention and Exhibition Centre, which awarded high LEED ratings for their commitment in minimising negative environmental impacts because of the way they were planned, designed, constructed, and managed (USGBC 2017). Compliance with the environmental sustainability objectives is ensured by the Seaport Square development project in which energy efficient building design are complemented by infrastructure encouraging people to walk and cycle, direct access to public transportation, and thoughtful consideration to open and green spaces that connect with pathways to the waterfront.

4.4 Discussing the BID innovation-led brown-field redevelopment

The nexus between brown-field and innovation district has been proven through the application of a robust and theoretically grounded objective-led model for assessing the sustainability of brown-fields redevelopment. Based on the investigation of the secondary data collected and the direct analysis performed, the planning initiatives and development

projects put in place within the Boston Innovation District have been slotted into the three sustainability dimensions, as required by the structure of the framework proposed. As illustrated above, innovation was able to physically and economically revitalise a disused post industrial landscape, creating an attractive place and a vibrant ecosystem for wide-ranging business expansions and job opportunities maximisation. Moreover, it provided adequate housing, facilities and local services to meet individuals' needs - thanks also to a fruitful collaboration with the community, fostering social capital development and contributing to residents well-being. Finally, regardless of the massive intervention, a particular attention to the use of resources and pollution minimisation has been paid, together with a thoughtful protection of the harbour as a shared natural resource. Hence, the case study proved evidence of the effectiveness of innovative-led approach in matching all the issues considered as relevant to the redevelopment of brown-fields. Useful lessons can be drawn in encouraging planners and policy-makers towards considering the role of innovation in urban regeneration initiatives targeting distressed areas, given its capability to turn an underutilised property into an economic and environmental asset that yields dividends for the entire region.

5. CONCLUSIONS

The research is grounded on the widely recognised principle that older industrial cities have to invest into their underutilised assets to become globally competitive again; therefore, the effectiveness of the “re-imagined urban areas” model has been analysed according to the objectives of sustainable brown-fields redevelopment. Thus, a purposely chosen methodology to assess the Boston Innovation District sustainability has been applied, highlighting how innovation is experimented with within a brown-field revitalisation context. This study confirms the cities current propensity to issue innovation-oriented urban policies which, in the specific case of Boston, seek to rehabilitate urban distressed areas operating as main development driver after the economic downturn.

However, some findings raise legitimate questions about transferability issues. The Boston Innovation District took shape in a geographically privileged area - the core of the historical harbour, open to the surrounding urban grid and easy to be connected and integrated with it; moreover, the Seaport area was not affected by relevant contamination problems, as well as significant social deprivation issues. Also the significant critical mass played a key role; the Greater Boston area, indeed, has been repeatedly mentioned as one of the most innovative hubs within the US context, supported by the conspicuous presence of companies, educational institutions, business incubators and accelerators that boost the innovative ecosystem. Another relevant component that might have influenced the innovation-led strategy was the strong continuity in the planning and management policies, despite a change in the local administration and the long lead times for the project implementation; as a matter of fact, the experimental framework characterised by high planning flexibility and expedited decision making keeps being the leitmotif of the intervention.

In this respect, further research studies could attempt to provide a quantitative evaluation regarding compliance of innovation with brown-fields redevelopment in terms of sustainability achievements, by creating a set of indicators to both give a weight and prioritise the objectives, so as to grade the performance, allowing the comparison with other cases. It would be also worthwhile to explore other case studies, in order to observe the potential of innovation as a driver for a sustainable economic development in brown-fields characterised

by real hazardous contamination and social decline, as well as to examine further areas where the innovation component is less ingrained in the economic structure of the city.

6. ACKNOWLEDGEMENTS



This paper is based on research realised in the scope of the MAPS-LED Project, Multidisciplinary Approach to Plan Smart specialisation strategies for Local Economic Development, founded by the European Commission through the Horizon 2020 Research Programme - Marie Skłodowska Curie Actions RISE under the Grant Agreement No. 645651.

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PRODUCTIVE STRUCTURE AND SPATIAL INEQUALITIES: THE ROLE OF INNOVATIVE CLUSTERS

F. Parente

Department of Economics and Law, Sapienza University of Rome, via del Castro Laurenziano 9, 00161, Italy

Email: francesca.parente@uniroma1.it

Abstract: This paper focuses on the interactions among socio-economic inequalities and the spaces they concern, investigating the connections between economic production, social capital and inequality in a region. Main research questions are about the spatial relations between the demand side of labour market and multidimensional inequality, especially looking at the role of innovative clusters. The production structure and social capital endowments of 205 selected EU15 regions have been reviewed for the time range 2000-2011. Available data have been synthesised by explorative Principal Component Analysis. Extracted indicators for the two selected economic and social dimensions have been compared to the levels of the estimated multidimensional measure of inequality in the regions. Results say that spatial distributions of considered domains share similar patterns, opposing north to south of Europe.

Keywords: Clusters, Europe, Inequality, Region, Social-Capital.

1. INTRODUCTION:

A theory of territorial inequality does not exist as such, but in the wide range of spatial approaches to territorial analysis, valuable contributions to this research field have been produced by many economists, sociologists, and geographers among others. These complementary approaches have, however, rarely been combined in regional studies. One aim of this piece of research is to contribute to fill this gap, drawing from several theoretical references and bringing together their separate objects of analysis in a multidisciplinary approach to the study of territorial inequality. The final goal is to produce a multidimensional analysis of socio-economic inequalities based on different regional traits. Specific focuses are business structure and production clusters' specialisation, along with levels of social capital. The definition of clusters assumed in this article refers to the concept of agglomeration of firms, and especially to the extensive research carried out by the Center for Strategy and Competitiveness (CSC) at the Stockholm School of Economics and the European Cluster Observatory (Sölvell et al., 2007; Ketels, Protsiv, 2013). Due to the several approaches available for the measurement of inequality itself, it is worth clarifying also that the inequality here used is defined as inequality of outcomes, specifically with regards to the multidimensional framework of human development economics and capability approach.

Main questions to be answered in this paper are then the following: how EU15 regions position themselves with respect to multidimensional inequality when it comes to the interaction among production structure and social endowments? what is the role of innovative business clusters in respect to these spatial distributions? In the search for the answers, an overarching assumption implies that the economic engines of inequality are not enough to explain its trends. Some other aspect such as spatial, cultural and social elements has to be taken into consideration, together, so to identify the latent factors in these complex dynamics. In order to get a complete picture and a better understanding of the relationship between man,

community and space, and how to study their joint development (eventually unequal), considering the spatial context seems vital. The relations in place between the considered dynamics of regional development, based on economic production and specialisation, have not been totally clarified yet- not with specific attention to their implications in terms of innovation and social inclusiveness either. The exercise here proposed tries to find other evidence of the spatial disparities in their interactions. Drawing on the mentioned strands of literature and available databases for the EU Member States, 205 regions have been considered over the period from 2000 to 2011. Statistics about regional production clusters and social capital endowments have been reduced to synthetic indicators by applying a Principal Component Analysis. Results have been mapped together with the level of multidimensional inequality, in order to explore their spatial distribution.

This paper is then structured as follows: next section reflects on the importance of considering the spatial dimension in the study of inequality; the third section provides a brief overview of the relevant contributions in the literature about regional disparities in Europe, focusing on the role of social capital and production clusters; the fourth section explains data and methodology applied in the analysis carried out; the fifth section discusses the results of this explorative study; and the last one introduces some preliminary conclusions.

2. WHY SPACE MATTERS IN THE INEQUALITY ANALYSIS

The Oxford Dictionary of Human Geography defines *spatial inequality* as “the geographical expression of social inequality, recognising that space is both the medium and outcome of social relations” (2013). Inequality means also spatial disparity, and this is so because each territory has a set of geographic, social, cultural, institutional and human resources that constitutes the space of its own set of resources and potential for development at the same time. Disparities exist also because socio-economic and policy dynamics of regions and cities are different from each other, and often they are particular to a specific geographic area: that is the reason why the spatial dimension has to be considered when studying inequality (OECD, 2016). Generally speaking, inequality is a matter of uneven distribution of resources among members of a certain community, and that is why it has always been a topic of interest for scholars of distribution theory indeed, within both economics and sociology.

About the multidimensional inequality assumed in this article, it is defined as inequality of outcomes, and it relates mainly to what has been extensively wrote about it by Amartya Sen and Anthony Atkinson. Sen is the main representatives of the *capability approach* in the frame of the human development economics, which has had the remarkable merit of driving the crucial shift “beyond GDP” in economic development studies. It is an intrinsically multidimensional approach that focuses on people and their empowerment in an all-round process of development throughout their lives within the society (about the approach and its operationalisation has been further developed by Alkire, Deneulin, et al. at UNDP). Atkinson has been one of the most prominent scholars of economics of inequality in Europe. He dealt with technical issues of measurement, but also with the definition of inequality and some specific aspects about the labour market mechanisms- notably wage inequality and top income shares (1983, 2007, 2013). His contribution is here relevant also because, even if still in the framework of income inequality studies, he addressed the importance of a multidimensional approach when dealing with distributive justice issues (1983). Clarifying this is important in order to frame the way it has been here measured either development or inequality: focusing on outcome instead than input variables. Attention has so been given to

individuals and their well-being, focusing on personal distribution of achievements. But importance is recognised to the spatial context too, because people's life and their *capabilities* are influenced also by the space they live in.

Specifically looking at the European case, regional studies in all of the above mentioned disciplines have variously contributed to the analysis of disparities between regions of the Union. Stress has been alternatively placed on innovation, geography, institutions, labour market dynamics, business clusters, and so on. Economists are usually more concerned with income inequalities or GDP growth rate differentials, looking at convergence processes between regions and the decomposition of these trends. Sociologists are instead more prone to consider the local processes in terms of territorial systems triggered by –or coming up with– social ties and collaborative activities. Geographers have generally dealt with the spatial dynamics of agglomeration and localisation choice's process. Although such a variety of approaches contributes to improve our understanding of the persistence of inequalities in several domains, along with some of its possible drivers, there has been limited mutual enrichment between these different, but nevertheless complementary strands of literature. Finally, a comprehensive picture of the specific relationships between economic cluster policies and human development across European regions is still missing.

Thinking about all of the possible ways that well-being and its dimensions can be related, it appears clear that many different domains contribute to the level of (unequal) development, and also that they are all related to each other. One way to tackle the analysis is restricting the focus to the employment dimension only. And this is at least for two reasons. First, employment is acknowledged by all theories as one of the main domains enabling people to actively participate in the society and so to realise their aspirations. Second, at the same time the labour market is the main place where different kinds of inequality involving several domains take place and reinforce themselves (of course wage inequalities, but also educational and gender inequality can be faced there). Moreover, here policy interventions can have a substantial as well as immediate impact. Most of the inequality studies dealing with labour market structure and its functionings often focus on the labour supply side only, investigating wage inequalities and top income shares, investments in human capital and returns to education, welfare institutions and workers, just to name a few examples. A lot has been written about how the labour force performs, how it allocates and relocates, how it is employed and rewarded. Plenty has been published even on the mechanisms governing social networks, or the intergenerational transmission of wage inequality (Atkinson, 2007, 2013). Less has been studied about the influence of the labour demand side on different sorts of inequalities. Furthermore, even if Atkinson himself focused more on the labour supply, he recognised the importance of looking at the demand side in order to fill our gaps in knowledge about the economic inequality mechanisms (Atkinson, 1983).

Especially, when it comes to territorial inequalities, the studies focusing on regional employment and production structures are still intrigued mostly by the possible ways for boosting growth towards regional convergence, rather than jointly considering some other related social implications. In addition, the EU regional Cohesion Policy is always more concerned with innovative clusters, as a good way of boosting growth and promoting local development (2014). Can we say these growth spill-overs are actually inclusive though? Based on this, regions are called on always more attention to locally established strong specialisation and innovations, and may be classified in leaders and followers according to their innovation pace (Regional Innovation Scoreboard, 2014). But what about the effects on the multidimensional inequalities in the regions these industries are located in? If we agree

that territories are made of people and they are the last recipients of any policy intervention in the end, the development of a territory can be considered equitable or not based on the implications for citizens' well-being. Finally, inequalities between territories may mean inequality of opportunities for their inhabitants, which may lead to low social mobility: too often socio-economic issues are faced without taking into account their territorial aspects, while the consideration of the spatial context may be crucial for a correct analysis.

3. UNEQUAL DEVELOPMENT, CLUSTERS AND SOCIAL CAPITAL

Spatially contextualising this study at a subnational scale is important because a local system is probably the best territorial unit of analysis to gather and practice new policies, as well as the one where human and social capital are more likely to emerge as driving forces of development. There is evidence that the real engines of world's economy are still established at the local level. And since the localisation of people and activities determines nature and quality of our lives, in recent decades local development has become a central issue in both the national public policy and the international development cooperation (Glaeser, 2003).

Historically, localisation choices have variously been analysed by economic theory, especially with respect to agglomeration dynamics and related externalities. From the first models of localisation theory, through those of regional growth, to the more recent local development ones, the mechanisms locally determined by proximity, complementarity or functionality factors have always interested economists and geographers (Capello, 2004). The spatial diffusion of economic development can indeed produce amazingly beneficial spin-offs, but also powerful agglomeration diseconomies that hold back and eventually stop the growth of poles (Prager, Thisse, 2012). The specificity of the last theories is the strong spatial feature of development, which is affected and reinforced itself by the connection to a specific territory. Furthermore, high importance is given to intangible elements, such as knowledge exchange, know-how, social and institutional relations. These characteristics seemed more likely to occur within regional economic systems, and -when present- to be as well the main reason of the local economies resilience to possible external shocks.

In the frame of regional studies' spatial analysis, the role of firms' clusters as engines of development has therefore become relevant. Different approaches have been elaborated, and their impact on growth and regional progress further studied (Porter 2003, 2013; Becattini, 1990, 2000; Boschma, 2014). Dating back to Alfred Marshall (1890, 1921), the social characteristics and business environment –i.e. the territorial milieu- typical of areas where geographic concentration of production activities occur was clear. Since then, it has been approached and analysed in depth by different point of views, and it became central again during the 90s, after Porter's and Krugman's works (1990, 1991). Object of the study has come to be the relation between presence of clusters and local (and national) economic performance, and the positive association between the two has been emphasised.

One aspect that is still mostly unclear is the trigger for a favourable environment to turn into a successful cluster location. And here the local endowments of social capital come into play: their importance as driver of the performance difference across locations has been increasingly recognised (Rodriguez-Pose, Crescenzi, 2008). Social capital is a complex concept, for which several definitions have been developed. It can include a variety of elements, such as the level of trust (Fukuyama, 1995); the civic involvement and participation of citizens (Putnam, 1993); and different kinds of social relations (Bourdieu, 1986; Coleman,

1988). In the end, all of these aspects have an impact on either the public or private actors, both at the individual and collective level, and eventually seem to make it more likely that “mere co-location is leveraged through active collaboration and that beneficial local conditions are strengthened through coordinated or joint action” (Ketels, Protsiv, 2013). Furthermore, as Rodriguez-Pose wrote years ago about the role of “local social structures” in explaining the persistence of regional disparities in Europe (1998): the existing social conditions may play an essential role in an area’s receptivity to -and assimilation of- technological change and economic processes.

Looking more closely at social endowments of regions and their relation with local economic structure, an interesting more recent piece of research by Boschma et al. (2016) tries to infer the role of different kinds of social capital (and of quality of institutions) on regional diversification and production specialisation. Drawing on previous work about the different economic payoffs of either bridging or bonding social capital by Knack and Keefer (1997) and Beugelsdijk et al. (2005, 2009), they analyse the role of informal institutions in more than one hundred European regions from 2004 to 2012. First of all, they find the relatedness of regional specialisations to be positively linked to existing strong industries in the region. Second of all, they show that informal institutions have a big play in this development path, and that bridging social capital is a key driver for regional diversification with significant levels of “trust and active participation in bridging type of groups increase the probability of regions to diversity into new sectors”. Bonding social capital, instead, seems to have no impact, or even a negative one where the quality of local government is poor.

While being more widely analysed in its (positive) relation to economic growth, social capital has also been studied in its relation to economic inequality, in both directions: what is the effect of different kinds of social capital on the level of inequality? And how does the extent of inequality affect the formation of social capital in a region? Here a generally negative association has been suggested, but the direction of the effects results less clear. Interesting evidence in both sense has been produced by De Blasio and Nuzzo about Italian regions (2005, 2012). They found a significant association between several inequality measures and social capital indicators, highlighting that different social capital definitions may produce different results: the relation is negative in the case of bridging and linking ones, while positive for the bonding networks (which, favouring their members only, may foster the persistence of existing disparities). An interesting aspect is that these associations seem to pass through –and be then more evident in- the labour market. There may be several drivers, which may explain the negative association that goes from low level of social capital (or a bonding one stronger than the bridging/linking ones) to higher level of inequality. These may be, for example, a lower productivity due to professionally unfair behaviour and higher costs borne by firms to counter them; inefficient job-matching because of the prominent use of personal network in the job search; poor propensity to entrepreneurship in an unfavourable business environment; strong family ties that hampers women’s employment. Even on the other side, when inequality is lower, pro-social behaviours are more likely to occur. A broader look at the European situation suggests similar considerations, as emerge from the last Reports on Economic, Social and Territorial Cohesion in the EU (2014). The mutual influence of territorial characteristics and social unrest is stated, highlighting an eroded social capital where inequality is spatially concentrated, along with the need for place-based policies to tackle social exclusion (2010).

When talking about regional disparities and policy interventions tackling them, the EU Cohesion Policy is actually the related tool for European regions. Main objective is stated as

helping less developed regions to catch up and “to reduce the economic, social and territorial disparities that still exist in the EU” (EC, 2014). Recently, it has been always more concerned with innovative industries and their role within place-based Smart Specialisations Strategies (S3). These are currently intended as the mainstream for regional development policy planning, as well as the necessary step to get access to related communitarian funding in Europe (EC, 2015). Further details about S3 and their application to EU Cohesion Policy are provided by McCann., Ortega-Argilés, 2011, and Boschma, Giannelle, 2014).

Finally, some interesting contributions specific to the role of clusters in a sustainable regional growth in the EU have been produced in the direction of a compound approach, aiming at jointly consider different dimensions of analysis and coming up with some policy recommendations. In 2013, Ketels and Protsiv provided background research to the WWWforEurope project. Beside other relevant studies previously produced (INNOVA, 2006), here they have specifically contributed to the evaluation of the role of clusters and cluster-based policies in the overall EU strategy for a New Growth Path (i.e. more sustainable and balanced between economic, social and environmental domains). Drawing on related US literature and evidence framework (Porter, 2003), their goal was to test if European regions where clusters and cluster initiatives are present have better performance in economic, environmental and social outcomes. They found confirmed that average wages are significantly and positively influenced by the presence of clusters in the regions, suggesting that specialisation and industry concentration have a role in lifting economic performance. Specifically looking at the implications also for social and environmental components, they were able to draw six different typologies of regions, based on the combinations between performances in the three domains. A general conclusion is that regions with strong clusters tend to follow a more balanced development path, and so clusters can be considered as an indicator for conditions that contribute to the outcomes of a more sustainable growth, even though not being their root cause. Furthermore, a big effort in these works has been put on establishing a new comprehensive database for European NUTS2 regions with the European Cluster Observatory (launched in 2007), and designing a new Regional Competitiveness Index. This measure is intended to assess “the ability of a region to offer an attractive and sustainable environment for firms and residents to live and work” and so to better summarise the business environments of regions, going beyond the mere economic productivity of their business structures (Dijkstra et al, 2011). These are some of the reasons why production clusters and related social environment are still central in local development, and it so may be of interest to further analyse their role on regional disparities.

4. AN EXPLORATION OF EUROPEAN REGIONS

Data used in this study come from several sources and regional databases. As regards regional inequalities, the main measure here used as proxy for multidimensional inequality is the percentage *loss in human development* due to the inequalities present in the society (Alkire and Foster, 2010) calculated on OECD and Eurostat databases, and EU-SILC survey. Detailed methodology and results from this previous section of the study are not object of this paper, but it is here worth it to mention how this measure has been statistically derived per 205 selected regions: comparing the estimated Human Development Index (HDI) to its adjustment to within-region inequalities (related statistical analysis is part of the work developed within the PhD dissertation this paper relates to as well- and whose conclusions and publishing are forthcoming). Following the related literature and the most recently applied UNDP methodology (HDR, 2016), regional HDIs and Inequality-adjusted Human

Development indices have been calculated over a span of time of twelve years, from 2000 to 2011. The territorial unit of analysis has been set at the Eurostat NUTS2 regions, within the EU15 only and excluding the extra-continental regions (French, Spanish and Portuguese overseas departments). This level of detail has been preferred for at least two reasons: wider and more homogeneous availability of human development variables in the selected span of time for countries of interest; comparability to other regional performance and innovation indicators not available yet at a lower territorial specification. Results say that despite a general increase in the potential human development across regions, the levels of its loss due to inequality have not significantly improved over the selected period. Especially, its spatial distribution reveals complex dynamics, showing an increasing concentration of better performances around some more advanced and educated core regions (e.g. in southern UK and Germany, and around the French and Scandinavian capital cities) and confirming the well-known North-South contrast.

For the same 205 regions, trends of production structure have been here explored. Among the available business structure statistics, the distribution of employment across sectors and industries has been considered, and especially looking at regional diversification and clusters' specialisation. Specific data about forty-one production clusters collected by the European Cluster Observatory are available at the level of detail of 4-digits NACE2 industries per region. Related *Location Quotients* (LQs) help explore some territorial paths of economic production, to discover if a region has developed one or more core industries over time, and in which sector. LQ considers the level of employment in a "x" sector in the selected region compared to the national level in the same sector. If the measure is: lower than 0, that sector is not present in the region; equal to 1, region and country specialised at the same level; higher than 1, the region is specialised; over 2, the region is highly specialised. The local level of social capital endowments refers to some measures from the European Social Survey (2014): the level of inter-human trust, along with two items on the perception of helpfulness and fairness of citizens; also, the rate of participation in voluntary activities implying bridging/bonding networks has been considered. The innovation performance relates to the Regional Innovation Scoreboard by Eurostat (2014). The quality of local institutions has been included as captured by the European Quality of Governance Index (EQI) produced by the Quality of Government Institute (2013). Another predictor, used to spatially characterise these regions and account for geography, is the degree of urbanisation.

The methodology applied in the study here reported draws on the social sciences research methods and is an exploratory factor analysis by Principal Component Analysis method (PCA) (Di Franco, Marradi, 2013). Originally conceived by psychologists and sociologists straddling the 19th and 20th centuries, this method uses multivariate analysis' techniques to synthesise variance of processed variables into a reduced number of factors. Underling hypothesis is that selected variables have a substantial degree of association and especially share a common semantic meaning. For these reasons, extracted components can be used as synthetic indicators for common latent variables that capture more dense information about them. In this case, it allows to include condensed information on innovative clusters in the analysis aiming at better understanding their possible relation with levels of inequality and other regional characteristics- to be further explored by additional quantitative models. Due to the high number of items available to represent the production structure, drawing on some recent similar application on the Italian case (Gemmiti, Santini, 2016) a PCA has been performed on the clusters LQs database first. This has allowed to construct a synthetic measure summarising main traits of regional production, and reduce the original number of forty-one variables (e.g. the 41 industries' clusters). Moreover, a second PCA has been

separately applied to the five available social capital items referred to above. Results of these applications are presented in the following paragraph, after a brief overview of the interactions between considered variables and levels of estimated inequality.

5. SOME RESULTS AND DISCUSSION

As explained in the second paragraph, one underlying assumption is that inequality is influenced by different specialisation paths, and these are related to regional specific characteristics such as the social capital endowments. As the following Charts 1. to 5. show, a first comparison between the previously estimated measure of inequality and the values of selected predictors in the 205 regions reveals that relations in place are not necessarily linear, and some State-effects may also be considerable. Different colours of dots stand for different EU Member States, and vertical and horizontal lines –when present- respectively mark the average levels of indicators either on y- or x- axis.

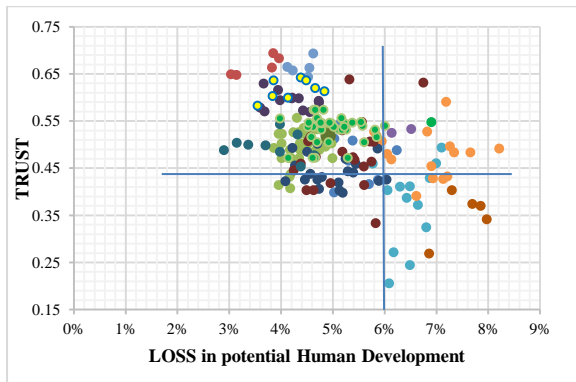


Chart 1. Trust and Inequality

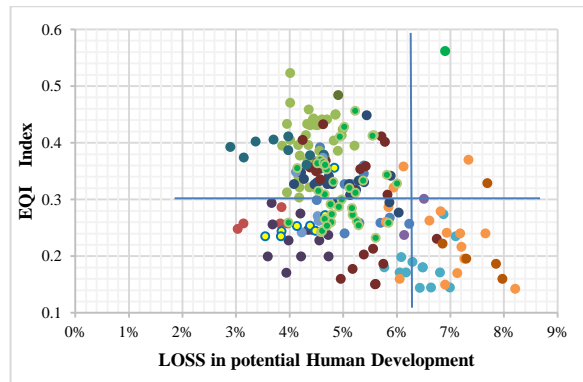


Chart 2

. Quality of Government and Inequality

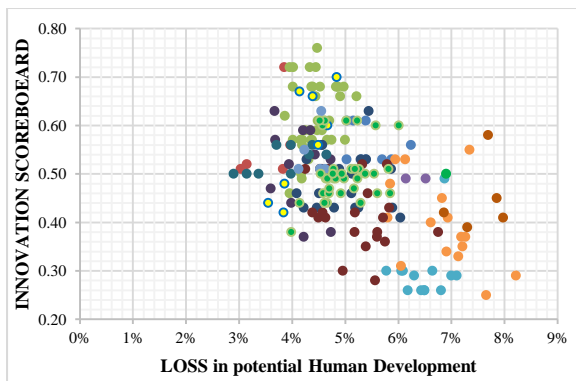


Chart 3. Innovation and Inequality

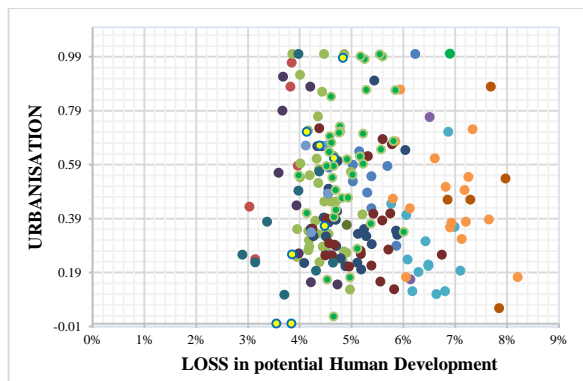


Chart 4. Degree of urbanisation

and Inequality

Regions where levels of trust are higher than average (in the upper-left quarter of Chart 1) tend to have lower value of loss in human development. While for those below the average level of trust indicator (in the same Chart 1), the performances in inequality are bad only (they all fall within the right-end side marked by the vertical line). Regions where the quality of local institutions is higher than average (those above the horizontal line in Chart 2), show concentration of multidimensional inequality below its average value (all regions are on the left-end side defined by the vertical line). At the same time, for those below the EQI index average, the pattern is more scattered and a slightly negative correlation emerges, associating

better performances of institutions to lower level of inequality. Still with some probable State-effect different dynamics, a higher level of inequality tends to appear in regions where the performances in terms of innovation are poorer (see Chart 3). Finally, all of this is more or less regardless of the degree of urbanisation, as evident from Chart 4.

As introduced in previous paragraph 4, a PCA has been applied to the clusters database. The first two components extracted reproduce one third of the variance of selected variables together, so are not sufficient to provide a comprehensive picture of the regional business structure alone. But they are already informative on a first interpretation of the ties between the domains object of this work. The components have been interpreted based both on the loading components recorded on each of the 41 clusters, and on the measured correlation to regional characteristics. The first component seems to relate to the degree of diversification of regional business structures and to have a double polarity- opposing industry to services. Its correlation with the count of industries in which regions have LQ values higher than 2 is 60%. The second component pertains more to the business environment features, and has a single polarity probably ranging from low to higher content of innovation- showing a strong correlation with both the Regional Innovation Scoreboard (55%) and the number of patents (43%, when the correlation between these two is 50%). Drawing on this, Chart 5. can be read looking at the combinations of the characteristics of the two components resulting in the plane quarters, and the relative placement of analysed regions.

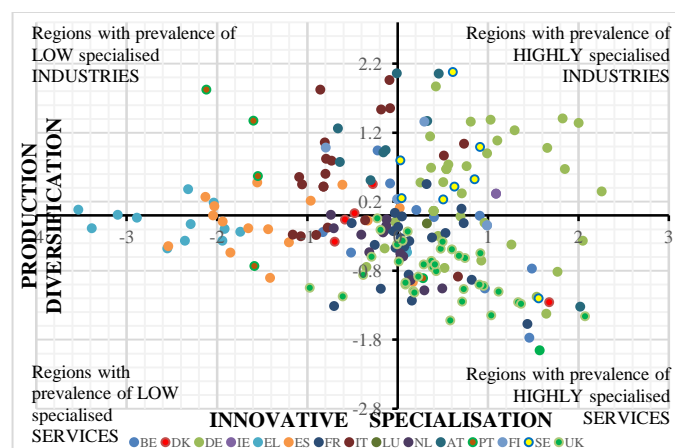


Chart 5. First two components extracted by PCA on clusters' LQs, 2011

Running the same analysis on each year, and comparing the scores of extracted factorial components at the beginning to the end of the considered period, the variation seems in line with the given interpretation. Plotted data are shown below in Chart 6. and 7. Production diversification looks relatively stable and regions tend to maintain their core industries. Chart 6. shows an almost perfect overlapping of scores in first and last year of the period by the linear correlation shape of the dots cloud. Degree of specialisation and innovation in clusters, instead, have changed generally more over time- even in a relatively short period of twelve years. The pattern in Chart 7. appears more scattered indeed.

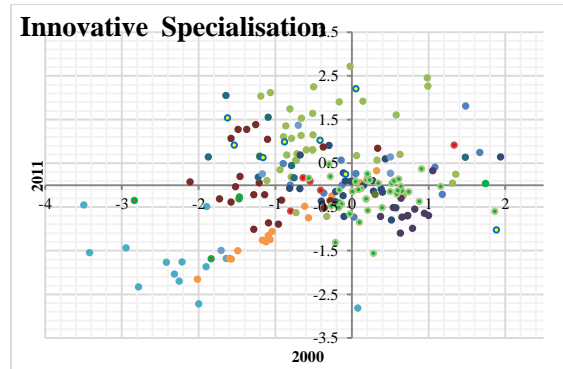
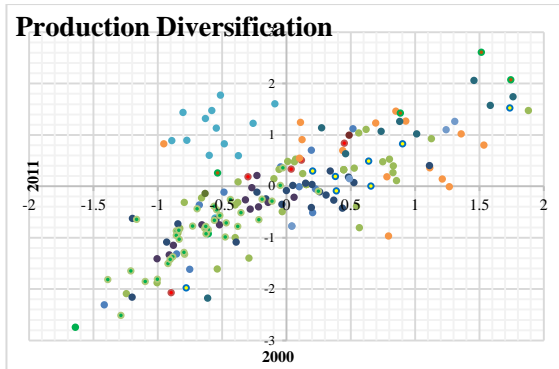


Chart 6. First component in 2000 and 2011 Chart 7. Second component in 2000 and 2011

Plotted regional PCA scores (Chart 5.) provide a first picture of the spatial distribution of some production structure characteristics (in 2011), which can be better explored by a map. Figure 1. shows the spatial pattern of the groupings based on the four combinations of first two extracted PCs. In addition, the multidimensional inequality introduced in the previous paragraph can be here visualised by a grid (Fig. 2.). This exercise can allow the search for common typologies to group regions based on their production structure characteristics, and so may serve as a first basis to recognise shared spatial patterns. The adherence to inequality categories (split by distribution's quartiles) appears not to be perfectly exact, but some traits to be further explored (e.g. by means of a Cluster Analysis) can be traced. More unequal regions are those of southern Europe (thicker grid in Fig. 2.), and correspond mainly to territories with low production diversification and weak innovative specialisation (red in Fig. 1.). Regions with lower level of inequality instead (coarser grid in Fig. 2.), generally present higher values of industries' diversification and cluster specialisation (light green in Fig. 1.).

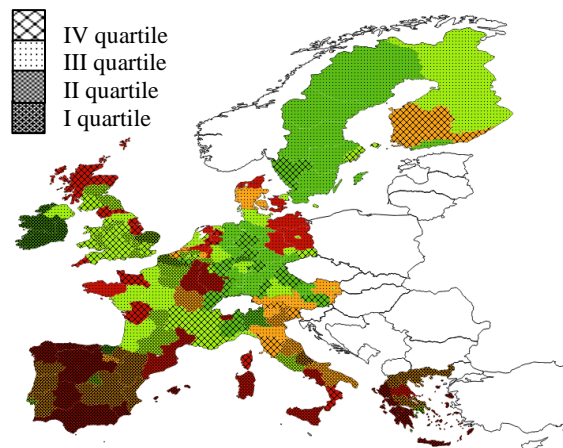
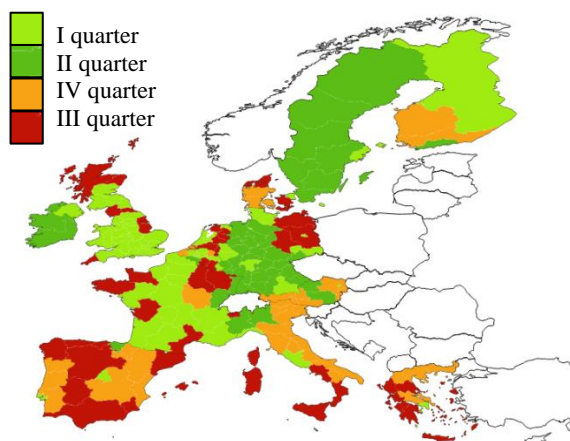


Figure 1. PCA combinations based 4 groupings Figure 2. Addition of inequality-based 4 groupings

Same levels of multidimensional inequality can be looked at in comparison to social capital and quality of government measures. The two extracted PCs for social capital reproduce the whole variance of original five survey items, and clearly pertain to two different traits of social capital: trust and networks. Results confirm the conclusions suggested by the literature. Trust components of social capital, along with the level of fairness and helpfulness themselves, are negatively associated with inequality indices (significantly around -60%) and positively with quality of government measures (69%). Networks' ties are instead controversial. Being generally not much significant (with values either a bit lower or higher than zero), when they are considered in the distinction between bridging (volunteering for

non-profit organisations) or bonding (volunteering for political parties) differences emerge. Once again confirming the aforementioned findings from the literature, the first one is inversely associated with both inequality (around 40% for the income one) and quality of government, while the second one is always directly correlated with it.

Finally, these first matches between production structure and social capital on one side, and with quality of local government on the other, have been mapped. They are shown in Figure 3. and 4. respectively. Distribution of these variables has been split in four groupings by quartiles. Size of the grids goes from thicker to coarser standing for worst to better regional scores, for both indicators. Patterns revealed by the two grids are almost overlapping, and the opposition between northern and southern Europe appears here more evident.

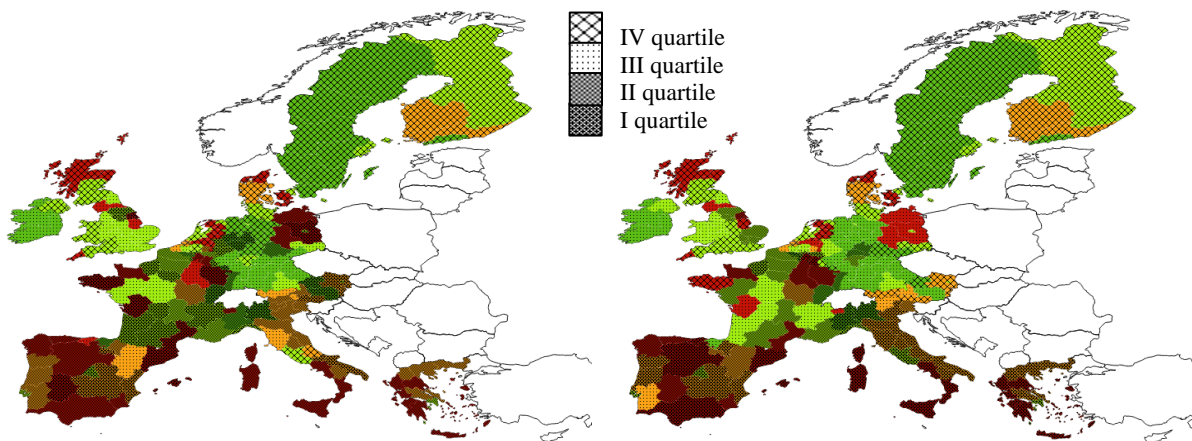


Figure 3. Trust extracted component groupings Figure 4. Quality of Government Index groupings

6. CONCLUSIONS

Literature contributions within several disciplines have suggested and variously investigated the relations between territorial inequalities, production structure and social capital. The work presented in this paper is an exploratory analysis of these possible relations in place at the regional level within the EU. Data here used to characterise the business structures of analysed regions are specifically about the production clusters' presence and specialisation, as collected by the European Cluster Observatory. Information about 41 clusters have been reduced by a PCA, and an exercise on the first two factorials component extracted tells something about the level of clusters' diversification and the innovative specialisation in the regions. Mappings show that there is room for a more in depth analysis of the selected data, since these results give only an intuition of the complex pattern in place between the considered domains over space.

Preliminary findings say that regions with low production diversification and weak innovative specialisation are mainly those of southern Europe, which are at the same time relatively more unequal. Regions with lower level of inequality instead generally present higher values of industries' diversification and cluster specialisation. In addition, a more prominent contrast between north and south appears when introducing social capital into the mappings. In order to better capture the underlying factors of the explored spatial distributions, some further research is needed. Following steps foresee the application of econometric methodologies to estimate quantitative models, using inequality as a dependent

variable and the other listed predictors as explanatory variables. A multiple linear regression, a longitudinal analysis over the twelve years' time (Wooldridge, 2002), and finally a geographically weighted regression (Fotheringham, 2002) are just a few examples useful to better explain the findings and the spatial relations between them.

In the light of the links between production structure, social capital and inequality suggested in the literature, some first hypothesis to be tested suppose that relations between inequality and social capital may be mediated by the interaction with local business environment and specialisation. Especially, different production specialisations allow to foster diverse kinds of social relations and cultural effects. These effects can engender the spatial interactions within the concerned territories, whose degree of urbanisation can be very different. In addition, policies to address land use and infrastructures' asset can have substantial impacts on the overall pattern: lowering or increasing inequalities, depending on the level of inclusiveness and relatedness they can facilitate, and the localisation of different industries they can favour.

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PUBLIC-PRIVATE PARTNERSHIPS FOR THE KNOWLEDGE ECONOMY: THE CASE OF INNOVATION CENTERS

A. Morisson

PAU Department, Mediterranean University of Reggio Calabria, Reggio Calabria, 89124, Italy

Email: arnault.morisson@unirc.it

Abstract: In the late 2000s, new spaces—such as co-working, maker spaces, and co-living spaces—have been emerging in the knowledge-based post-industrial cities. The paper investigates the emergence of innovation centers through the use of public-private partnerships. The research methodology is based on a multiple case-study approach in which three cases were selected: Barcelona Growth Center in Barcelona (Spain), District Hall in Boston (USA), and Edney Innovation Center in Chattanooga (USA). Innovation centers, which consist of widely diverse creative and knowledge-based activities located within the same building, participate in the urban regeneration of downtown areas through the promotion of entrepreneurship. The paper finds that the local governments, which adopt public-private partnerships to create innovation centers, are entrepreneurial and are aligning their actions and visions with those of the entrepreneurs they are trying to attract. For the entrepreneurial local governments, innovation centers are anchor spaces incorporated in a broader vision of making “innovation districts”.

Keywords: Creative City, Innovation Districts, Public-Private Partnership, Knowledge Economy, Urban Regeneration.

1. INTRODUCTION

In the late 2000s, new spaces—such as hacker spaces, maker spaces, Living Labs, Fab Labs, and co-working spaces—have been emerging in concert with the rise of the knowledge and collaborative economy (Botsman & Rogers, 2011; Capdevila, 2015). Civic and innovation-driven entrepreneurs are the main beneficiaries of these new spaces. Entrepreneurs and outsiders are the engine of creative destruction, job creation, economic growth, and the initiators of radical innovations (Christensen, 1997; Kane, 2010; Saxenian, 1994; Schumpeter, 1942). Entrepreneurs have also become, for local governments, the center of attention since the publication by Richard Florida (2002) of *The Rise of the Creative Class*. Chatterji, Glaeser, and Kerr (2013) point out that place-based policies to attract and retain entrepreneurs and startups are positively seen by economists who can be skeptics to the ability of policymakers in picking winners but believe in their ability of picking winning sectors.

Local and regional governments are promoting policies, like the creation of innovation centers, to promote their local entrepreneurial ecosystems. Since 2000, local and regional governments are implementing policies to create innovation districts, which are place-based initiatives that aim to regenerate downtown districts through the promotion of innovative companies and startups, to accelerate their cities’ transitions into the knowledge economy (Katz & Wagner, 2014; Morisson, 2014). Innovation centers are anchor spaces in innovation districts that aim to accelerate the innovation process through promoting collaboration, serendipity, proximity, face-to-face interactions, and the exchange of tacit knowledge between diverse actors through different activities.

The paper investigates the creation of innovation centers through public-private partnerships. Three case studies have been selected: Barcelona Growth Center in Barcelona (Spain), District Hall in Boston (USA), and Edney Innovation Center in Chattanooga (USA). The research conducted for this paper is based on three sources of data: semi-structured interviews, secondary data, and direct observation. Innovation centers are the outcomes of innovative private-public partnerships between entrepreneurial public organizations, entrepreneurial mayors, and private partners (see table 1. for an overview of each case-study). Innovation centers align the vision of local governments with the vision of the entrepreneurial community. As a result, the creation innovation centers through innovative public-private partnerships contribute to reinforce local governments' entrepreneurial spirits.

2. KNOWLEDGE ECONOMY AND PUBLIC-PRIVATE PARTNERSHIPS

In the 1990s, capitalist countries started to undergo an economic transition towards post-Fordism or knowledge-based economies (Amin, 1994; Drucker, 1998). The knowledge-based economy recognizes the importance of knowledge as the driver of productivity and economic growth, emphasizing the role of information, technology and learning in economic performance (OECD, 1996). In the knowledge economy, technological innovation is essential for economic prosperity. The academic literature provides, both across nations and over time, a solid theoretical background linking technological innovation to the progress of countries, regions, cities, and firms (Fagerberg, 1988; Freeman, 1987; Rosenberg, 1982, 2004; Schumpeter, 1934; Solow, 1957).

In this economic transitions, with the rise of the global economy and the revolutionary nature of ICT, metropolitan areas are the key units to produce technological innovations (Castells, 1989; Florida, Adler, & Mellander, 2017). Indeed, patents and innovations are heavily concentrated in space (Acs & Audretsch, 1988; Carlino, 2001; Jaffe, Trajtenberg, & Henderson, 1993). In introducing the concept of knowledge-based urban development, Knight (1995) correctly recognized that as the economic structure becomes more knowledge-based, the basic nature of urban development changes. Building the "next Silicon Valley" and knowledge-based development initiatives that involve public institutions, universities, and private firms are the epitome of contemporary economic development strategies due to their strong multiplier effect (Etzkowitz, 2015; Moretti, 2012; Sturgeon, 2000).

Metropolitan regions are seen as the most appropriate entity for designing supportive competitive and innovative environments for companies compared to nation states, which in an increasingly borderless world, are increasingly becoming dysfunctional (Cooke, 1997; Krugman, 1995; Ohmae, 1995). In the European Union and the United States, central governments are devolving power and regulatory tasks to subnational institutions, which are becoming more entrepreneurial in order to deliver public services and foster economic growth (Brenner, 2004; Hall & Hubbard, 1996).

One of the tools that local governments are increasingly embracing are public-private partnerships (PPP). Indeed, since the 1990s, public-private partnerships have been used as a key tool of the new public governance for delivering and implementing public policies around the world (Osborne, 2002; Osborne, 2006). In the United States and in the European Union, local and regional governments are taking advantage of private-public partnerships as a way to innovate in times where Federal funds and central governments subsidies are

declining (Sagalyn, 2007). Public-private partnerships are defined as “cooperation of some sort of durability between public and private actors in which they jointly develop products and services and share risks, costs and resources which are connected with these products” (Van Ham & Koppenjan, 2001, p. 598).

In the United States, public-private partnerships have extensively been used in urban development, most notably for the regeneration of Central Business Districts (CBDs) and downtown areas (Harding, 1990; McQuaid, 2000). The limited resources at the disposal of local governments have forced them to take advantage of multiple sources of funding and to work with a wide range of actors, such as the central or federal government, the regional government, the private sector, and the local community, in order to deal with multifaceted local economic development challenges (McQuaid, 2000; Newman & Verpraet, 1999). Lately, local governments are promoting knowledge-based activities out of the desire of generating high-growth activities and high-quality jobs in their cities. Local governments use public-private partnerships to deliver knowledge-based policies and programs, like innovation centers, in very entrepreneurial and innovative manners. Indeed, public-private partnerships can be used in a variety of ways since Mayors and local development offices are only limited by their “imagination” (Lyons & Hamlin, 1991, p. 55).

3. TACIT KNOWLEDGE AND COLLABORATION

Innovation centers are spaces whose objectives are to promote collaboration and face-to-face interactions between diverse organizations, stakeholders, and innovative actors. Innovation centers aim to accelerate the diffusion of tacit knowledge by being open to external and diverse sources of knowledge and to reinforce as a result, the innovative capacities of startups, individuals, and innovative companies located in the building and the district.

In *The Tacit Dimension*, Michael Polanyi (1966) disseminates the concept of tacit knowledge, when he famously observed: “we can know more than we can tell”. Tacit knowledge, in opposition to codified knowledge, refers to the knowledge, ideas, concepts, or insights that individuals possess but cannot be fully expressed. Tacit knowledge is largely transferred through repeated face-to-face, formal and informal, interactions that can only take place at the level of the city or even the district, and is as a result, highly localized. The academic literature widely recognizes the importance of tacit knowledge in the innovation process and in the clustering of high-technology companies (Bathelt, Malmberg, & Maskell, 2004; Gertler, 2003; Howell, 2002; Morgan, 2004, Rodríguez-Pose, & Crescenzi, 2008; Von Hippel, 1994). The general assumption is that by its difficulty of being codified and its dependence on context-specificity, tacit knowledge is more difficult to transfer through distance, and thus, more ‘sticky’ (Von Hippel, 1994). Indeed, while codified knowledge can be disseminated globally at a low cost, due to the process of ubiquitification, tacit knowledge becomes even more critical for competitiveness (Maskell & Malmberg, 1999). Proximity—geographical, cognitive, organizational, social, and institutional—affects the quality of face-to-face interactions and the diffusion of tacit knowledge (Boschma, 2005).

The concepts of the national innovation system (Lundvall, 1992), the sectoral innovation system (Breschi & Malerba, 1997) the regional innovation system (Braczyk, Cooke, & Heidenreich, 1998), the learning region (Florida, 1995; Morgan, 1997), the innovative milieu (Aydalot & Keeble, 1988), and the industrial district (Becattini, 1992), all point out the importance of intraregional networks and interactions in enhancing industrial innovativeness

and regional competitiveness. Collaboration is thus, seen as an important driver in accelerating the innovation process. The interactions between companies and organizations not only in similar economic sectors but also diverse ones can be beneficial to the innovation process thanks to knowledge spillovers (Jacobs, 1969). The concept of open innovation acknowledges the importance of inflows and outflows of ideas and tacit knowledge in the process of innovation (Chesbrough, 2003). Interactions and cooperation between university-industry-government and the civil society are necessary preconditions for regional competitiveness in the context of the knowledge economy (Carayannis & Campbell, 2009; Leydesdorff & Etzkowitz, 1996).

4. METHODOLOGY

The research methodology is based on a qualitative multiple case-study approach, using primary and secondary data. The author uses case studies “out of the desire to understand complex social phenomena” (Yin, 1994, p. 4). Indeed, this research investigates in an exploratory manner a contemporary phenomenon in which the researcher has no control on the actual phenomenon (Eisenhardt, 1989). Moreover, the investigation of public-private partnerships for the creation of innovation centers has not been fully examined. A qualitative approach is as a result, the most appropriate method (Eisenhardt, 1989). The researcher uses a comparative exploratory multiple case-study approach in order to generalize findings on the new concept studied. The three innovation centers selected are located in three different cities in developed countries, they are: Barcelona Growth Center in Barcelona (Spain), District Hall in Boston (USA), and Edney Innovation Center in Chattanooga (USA).

The research conducted for this paper is based on three sources of data: semi-structured interviews, secondary data, and direct observation. The semi-structured interviews were conducted for each innovation center in person and over the phone with the key stakeholders who have directly participated in the innovation center’s design and/or implementation. In total, seven interviews were conducted: three interviews for Barcelona Growth Center, two interviews for District Hall, and two interviews for Edney Innovation Center. The persons interviewed were: the District Hall’s director, Chattanooga’s strategic planner, 22@ Barcelona’s employees and director, university professors, and the City of Boston Mayor’s Office. The stakeholders were selected according to their strong knowledge and diverse perspectives on the phenomena studied (Eisenhardt & Graebner, 2007). The secondary data that were used for the research are, but were not limited to: innovation centers’ websites, namely District Hall, Edney Innovation Center, and 22@ Barcelona; the municipal organizations’ websites, namely Boston Redevelopment Authority, The Enterprise Center, and 22@ Barcelona; the government websites of the City of Barcelona, Boston, and Chattanooga; real-estate developers’ websites such as WS Development, Consorci de la Zona Franca de Barcelona; articles in news websites, newspapers, and magazines such as nooga.com, New York Times, Boston Globe, La Vanguardia, and Boston.com; annual reports from The Enterprise Center, and official planning documents from 22@ Barcelona and Boston Redevelopment Authority. The direct observations involved non-participatory observations in each of the innovation center. In total, the researcher conducted about 6 hours of formal and informal observations. The data were then, converged in a triangulating fashion in order to “assure that the right information and interpretations have been obtained” (Stake, 2013, p. 36).

5. CASE-STUDIES

5.1 Barcelona Growth Center - Barcelona, Spain

The Barcelona Growth Center, previously known as the MediaTic building, is at the center of the innovation district—22@ Barcelona. In 2000, under Mayor Joan Clos, the City of Barcelona launched the innovation district, 22@ Barcelona, in order to accelerate the city's transition into the knowledge economy (Barceló & Oliva, 2002; Trullén, 2001). The innovation district is located in the district of Poblenou, a former industrial district, used to be known as the “Manchester of Catalonia” (López, Romani, Sagarra, & Piqué, 2011). The objectives of 22@ Barcelona were: to redevelop the district of Poblenou, to promote industries in five clusters—media, ICT, medical technologies, energy, and design—and to accelerate Barcelona's transition into the knowledge economy (Trullén, 2001; López et al., 2011). A municipal company, 22 ARROBA BCN S.A., was created by Mayor Joan Clos with the sole purpose to transform the Poblenou district into an innovation district

The Barcelona Growth Center is a nine-story and 15,000-square-meter building located in the center of the district—22@ Barcelona. The users and activities of the innovation center are: a business support office; the Cibernàrium, a public-sponsored program that offers training for professionals, students, and residents; the Mobile StartUp Barcelona, a co-working space for entrepreneurs and startup accelerators; the Mobile World Capital Barcelona, a public organization that organizes the Mobile World Congress in Barcelona; the GSMA, which is the global trade association for mobile phone operators, manufacturers and suppliers; Accenture Mobile Knowledge; Deloitte; the Technological Circle of Catalonia (CTecno), a foundation that unites companies and professionals in the Information and Communications Technology sector; Softonic, a software company; previous tenants included the Open University of Catalonia; the Internet Interdisciplinary Institute (IN3); and an eLearning Center. The Barcelona Growth Center is today a hub and meeting point for entrepreneurs, accelerators, public institutions, students, and private companies in the sectors of ICT and Media (Barcelona Activa, 2012).

The Barcelona Growth Center was opened in 2010 to serve as the center for 22@ Barcelona's Media and ICT clusters (Barceló & Guillot, 2013). The public-private partnership that led to the creation of the innovation center followed a complex two-step process. In the first step, the land, which was privately-owned, was transferred to the municipal company, 22 ARROBA BCN S.A., due to the compulsory land transfer in the innovation district. In 22@ Barcelona, the zoning laws were modified in 2000 to give an incentive for real estate developers to build more by providing them additional zoning rights under certain conditions. First, real-estate developers were obliged to dedicate twenty percent of the total built area to “@” activities, which are knowledge-based activities as defined by the OECD (Barceló & Guillot, 2013; Barcelona, 2000). Second, real estate developers had to transfer 30 percent of the built land to 22 ARROBA BCN S.A. (Barceló & Guillot, 2013; Barcelona, 2000). The municipal company was then allocating the land to provide parks, public housing, and “7@ amenities” like the Barcelona Growth Center, which are spaces to accommodate knowledge activities and diffuse new technologies (Barcelona, 2000). In the second step, a joint-venture was created between the municipal company, 22 ARROBA BCN S.A., and a quasi-public real estate developer, the Consorci of Zona Franca de Barcelona, in order to build “7@ amenities” on the land transferred by a private real estate developer to the municipal company. The joint-venture negotiated to determine the architectural aspects, the activities, and uses of the building. It was agreed that the Consorci of Zona Franca de Barcelona would finance the construction of the Barcelona Growth Center and would have the right to use the

building for a period of 70 years before transferring back the right to use the building to the city. The city would have the right to use three floors of the building to promote knowledge activities for the same period of 70 years.

In Barcelona, the public-private partnership that led to the creation of the innovation center consisted of a joint-venture and negotiations between 22 ARROBA BCN S.A. and the Consorci of Zona Franca de Barcelona. The municipal company, 22 ARROBA BCN S.A., consisted of public entrepreneurs who had a certain degree of autonomy and flexibility to form innovative public-private partnerships in order to transform the district into an innovation district. The local government in Barcelona through its entrepreneurial spinoff, 22 ARROBA BCN S.A., was using the codes of the entrepreneur community to create a space dedicated to entrepreneurship and innovative activities.

5.2 District Hall - Boston, United States

The District Hall is a flagship program at the center of Mayor Menino's vision to build an innovation district in the South Boston waterfront, a former industrial district in Boston. Boston's Innovation District was the outcome of a negotiation between real-estate companies and the City of Boston (BRA, 2010). The Boston Redevelopment Authority (BRA) negotiated with Gale International, Morgan Stanley, and W/S Development Associates, to include, in their plans for developing the Seaport Square, a real estate megaproject, a range of public benefits consisting of "Innovation Uses", civic and cultural spaces (BRA, 2010). The Innovation Uses include: laboratories, small business incubators, public event spaces for exhibitions, rooftop gardens, the District Hall, retail businesses, hotels, innovation transportation and energy, and public, common, or shared spaces within innovation/workforce housing (BRA, 2010).

The District Hall is a single-story and 1,115-square-meter located in the heart of Boston's Innovation District. The innovation center claims to be "the world's first free-standing public innovation center and a dedicated civic space where the innovation community can gather and exchange ideas" (www.districthallboston.org). The activities located in the innovation center are: a restaurant, a coffee shop; a lounge, which is completely open to the public; a large and flexible conference room; and 3 flexible meeting rooms. The users of the innovation center are: startups, entrepreneurs, students, nonprofit organizations, local associations, local residents, and corporate companies.

The District Hall was opened in 2013 to serve as an anchor institution that contributes to the visibility of Boston's Innovation District. The District Hall was created as a public benefit through Boston's incentive zoning rights. In Boston, the Boston Redevelopment Authority, Boston's urban planning department, which is supervised by the Mayor's office, confers property rights, such as additional density, to real estate developers in exchange for public benefits to the community. The innovation center is the outcome of a yearlong negotiation between real estate companies that asked for additional density in the Seaport Square's project, the largest real estate development in Boston's history, and the Boston Redevelopment Authority that requested for specific public benefits, namely innovation uses (BRA, 2010). In the public-private partnership, the real estate companies built the District Hall and granted a lease to Boston Redevelopment Authority for \$1 per year for a minimum period of 5 years with renewable rights for an additional period of 5 years (BRA, 2010). The Boston Redevelopment Authority transferred the right to use the building to a nonprofit

organization, Venture Café Foundation, which was created in 2010 by Timothy Rowe, the founder of the Cambridge Innovation Center in Kendall Square. In exchange, the Venture Café Foundation agrees to organize programming and events in the innovation center. The Boston Redevelopment Authority evaluates on a quarterly basis the activities of the innovation center. The funding to operate the innovation center comes from corporate sponsors, corporate events, and the rents given by a restaurant and a coffee shop located in the building that are operated by the Briar Group. Additionally, Venture Café Foundation doesn't pay taxes to the City of Boston for innovation-related events and activities.

In Boston, the public-private partnership that led to the creation of the innovation center consisted of a yearlong negotiation between Boston Redevelopment Authority and real estate developers. The Boston Redevelopment Authority then partnered with a nonprofit organization, which is funded through the rents given by the restaurant and coffee shop located in the building, in order to run events and operate the innovation center. The Mayor's office used multidimensional and creative partnerships in order to spur the creation of its innovation center.

5.3 Edney Innovation Center - Chattanooga, United States

Chattanooga is a mid-sized city located in Tennessee in the United States. Since the 1970s, Chattanooga has reinvented itself from being "America's Dirtiest City" into becoming an emerging innovation hub (Motoyama, Fetsch, Jackson, & Wiens, 2016). The city has built upon its capacity to generate successful public-private partnerships with philanthropic foundations, entrepreneurs, and public organizations, to redevelop its waterfront and its Central Business District. In 2010, the Electricity Power Board (EPB), a public-owned utility company owned by the City of Chattanooga, launched the fastest fiber-optic Internet network in the United States, dubbed as the "Gig", that provided residents with one gigabit speed Internet (Motoyama et al., 2016).

In 2015, Mayor Berke announced the creation of an innovation district and an innovation center in downtown Chattanooga that was to be piloted by the Enterprise Center. The Enterprise Center is a nonprofit public-private partnership that focus on promoting the innovation economy in Chattanooga. The Enterprise Center was created in 2014 to build upon the the opportunities that could be leveraged from the Gig upon the recommendations of the Chattanooga Forward Gig, Entrepreneurship and Technology Task Force Report.

The Edney Innovation Center is a 10-story and 8,360-square-meter building located in the heart of Chattanooga's innovation district. The tenants of the innovation center are: CO.LAB, a nonprofit startup accelerator; Tech Town, a technology learning center; Society of Work, a co-working space; private companies, and the Enterprise Center. The building includes a community space open to the public, a rooftop gathering space, and proximately a restaurant, a coffee shop, and an open space on the ground floor. The users of the building are: entrepreneurs, community and nonprofit organizations, private companies, and students. The Enterprise Center, which is located on the fifth floor, organizes networking events, workshops, and public and private events in its community space. The innovation center aims to become the catalyst connector for Chattanooga's entrepreneurial ecosystem.

The Edney Innovation Center was opened in late 2015 and is at the center of Mayor's Berke's vision to establish an innovation district in Chattanooga. The creation of the innovation center

was the outcome of negotiations between a wide range of different actors. The building was owned by the Tennessee Valley Authority (TVA), a Federally-owned utility agency. Mayor Berke and Harold DePriest, the CEO of the Electricity Power Board, facilitated the purchase of the building to the Enterprise Center for favorable terms due to EPB's and the City of Chattanooga's historical partnerships with TVA on the condition that the building be used as an innovation center (The Enterprise Center, 2015). The Mayor's office funded the inspection of the building before the purchase by the Enterprise Center. In early 2015, the Enterprise Center issued a *Request for Proposal* (RFP) in order to identify a real estate developer to retrofit the building into an innovation center (The Enterprise Center, 2015). The *Request of Proposal* stated that Co.Lab was to lease the eastern section of the first floor of the building and the Enterprise Center was to lease the western section of the first floor and an additional floor at market rate for a period of 5 years, with a 5 year option (The Enterprise Center, 2015). Co.Lab and the Enterprise Center would assist the real estate developer in the creation and programming of the innovation center. The real estate developer selected was to become a full partner in supporting the innovation center's vision by selecting tenants and promoting uses relevant for the knowledge economy (The Enterprise Center, 2015). In 2015, a local real estate developer, DEW Edney LLC, was selected to retrofit the building (Motoyama et al., 2016).

In Chattanooga, the Enterprise Center played the role of coordinating, planning, and implementing the Mayor's vision of an innovation center in the city. The Enterprise Center is a nonprofit public-private partnership that receives its funding from the City of Chattanooga, Federal grants, foundations, and private companies (The Enterprise Center, 2016). The Enterprise Center is to some extent, the entrepreneurial arm of the Mayor's office. The public-private partnership that led to the creation of the innovation center consisted of a *Request for Proposal* and negotiations between the Enterprise Center and the local real estate developer, Dew Edney LLC.

6. DISCUSSION

Innovation centers are being created in diverse cities around the world to accommodate entrepreneurs and knowledge workers. While innovation centers are often built with private funds by entrepreneurs, this paper shows that innovation centers can also be the outcome of public-private partnerships in which local governments act as public entrepreneurs. Innovation centers are innovation districts' anchor institutions that participate in knowledge-based development and the urban regeneration of previously industrial or manufacturing urban districts. Local governments that build innovation centers aim to provide their local entrepreneurial ecosystems with the required informal infrastructures to facilitate face-to-face interactions, collaboration, and the exchange of tacit knowledge in order to accelerate the process of innovation. As Peter Hall (1998) showed, innovative city-regions not only have few, if not any, barriers to the diffusion of innovations, but have also strong but informal structures for exchanges of ideas and knowledge. Local policymakers are more and more keen to embrace innovation policies for their cities. Innovation centers are not however, a "one-size-fits-all" innovation policy. Indeed, innovation centers participate in the making of an innovation district and as a result, should only be promoted when an existing innovation ecosystem already or potentially exists.

Table 1. Overview of the Case-Studies

| | Innovation Centers | | |
|-------------------------------------|--|---|--|
| Name | Edney Innovation Center | District Hall | Barcelona Growth Center |
| Location | Chattanooga-Tennessee-USA | Boston-Massachusetts-USA | Barcelona-Spain |
| Creation Date | 2015 | 2013 | 2010 |
| Type of Partnership | Public-Private Partnership - RFP-Legal Agreement | Public-Private Partnership - Public Benefit | Public-Private Partnership - Joint Venture |
| Lead Coordinating Organization | The Enterprise Center | Boston Redevelopment Authority | 22 ARROBA BCN S.A. |
| Floor Area | 8,360 Square Meters | 1,115 Square Meters | 15,000 Square Meters |
| Purpose | Anchor space for Chattanooga's Innovation District | Anchor space for Boston's Innovation District | Anchor space for 22@ Barcelona's Media and ICT clusters |
| Key Actors | The Enterprise Center; The Mayor's Office; Private Foundations; Real Estate Developer; Tennessee Valley Authority | The Boston Redevelopment Authority; The Mayor's Office; Real Estate Developers; The Venture Foundation; Briar Group | 22 ARROBA BCN S.A.; The Mayor's Office; Barcelona Activa; Consorci Zona Franca de Barcelona |
| Activities in the Innovation Center | Coffee Shop (opening soon), Restaurant (opening soon), Co-Working Spaces, Accelerators, Collision Space, Office Space, Public and Private Events | Coffee Shop, Restaurant, Conference Rooms, Meeting Rooms, Open Co-working Spaces, Public and Private Events | Conference Rooms, Co-Working Spaces, Accelerators, Cibernarium Training Center, Business Support Office, Office Spaces, Parking, Public and Private Events |

6. CONCLUSIONS

The paper finds that an innovation center can be the outcome of creative and innovative private-public partnerships as it was the case in Barcelona, Boston, and Chattanooga. In each case-study, the local government had a strong direct or indirect leadership role in negotiating or providing resources and incentives to build their innovation centers. More importantly, Mayors were critical in communicating their visions for the creation an innovation center to a wide range of potential partners. Mayors took advantage of or created entrepreneurial organizations, such as 22 ARROBA BCN S.A. in Barcelona, the Boston Redevelopment Authority in Boston, and the Enterprise Center in Chattanooga, in order to gain in flexibility and to remove bureaucratic processes, and thus, facilitated the implementation of their entrepreneurial visions.

Entrepreneurial mayors support the creation of entrepreneurial organizations to endorse public-private partnerships in order to rapidly and efficiently create innovation centers and accelerate their cities' transition into the knowledge-based economy. In endorsing creative and innovative public-private partnerships, local governments are adopting the codes of the entrepreneurial community. In doing so, this new wave of public entrepreneurialism enhances the legitimacy and signals the local governments' commitment to improving their local innovation ecosystems to the entrepreneurial community. The new wave of entrepreneurial mayors and public organizations participate in the current debate of the supposedly superior local government's advantages in finding innovation solutions to local economic development challenges (Pike, Rodríguez-Pose, & Tomaney, 2017). The paper has however, a limited scope since it deals with the creation of innovation centers through public-private

partnerships in developed and relatively large cities with efficient public institutions, and as a result, offers little relevance to urban policymakers in lower-income countries.

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CLUSTERS IN DESIGNING S3-ORIENTED POLICIES

C. Bevilacqua and G. Pronestì

PAU Department, Università Mediterranea di Reggio Calabria, Salita Melissari, 89124, Italy

Email: cbevilac@unirc.it

Abstract: Enhancing economic performances of regions is currently perceived as a priority. Given these needs, the role of regional clusters has been recently coupled with the concept of Smart Specialization Strategy (S3). This paper aims at contributing to the debate on the role of clusters in the arduous implementation of S3, towards investigating the potentials of the clusters life cycle (CLC) and spatial analysis to guide the Entrepreneurial Discovery Process (EDP). This argument is theoretically discussed on the base of literature evidence. Firstly, the concept of S3, its relation to clusters and the emerging EDP gaps are presented. Secondly, the potentials of CLC and spatial analysis are investigated by (i) studying the literature and selecting a set of indicators, accounting for clusters stage-specific and spatial attributes. (ii) framing the indicators into a model and providing a qualitative judgment of their strength at each stage of the CLC (iii) interpreting the model towards testing whether the CLC and spatial analysis display the potential to input EDP.

The authors find that CLC and spatial analysis can play a significant role towards supporting EDP operationalization. This finding calls for the consideration of policymakers as a valuable source of information towards tackling EDP gaps.

Keywords: Clusters, Design, Maps-Led, Policy, S3.

1. INTRODUCTION

During the last decades, the concepts of competitiveness and innovation, at the regional level, gained a growing consideration becoming key topics of both academic and political debates. The urge to enhance regional economic performances, through the creation of appropriate context-conditions, is perceived as a priority, which would enable territories to tackle the challenges posed by globalisation (Farrell et al., 1999; Doloreux and Parto, 2005; Foray et al., 2009; Camagni and Capello, 2013). Given these emerging needs, the role of regional clusters has become progressively more significant (Porter, 2000, 2003; Martin and Sunley, 2003) and recently it has been coupled with the policy concept of Smart Specialization Strategy (S3). The latter is a relatively new academic idea, which has enjoyed a fast success towards suddenly turning into a crucial element of the EU 2020 innovation plan (Dominique Foray, David, and Hall, 2011). S3 brings into prominence an innovative territorial development policy framework, which enhances the place-based approach. S3 policies are mainly advocated in EU regions. The attention is pushed on whether the core toolkit provided by the experience with clusters and cluster policies could potentially guide the challenging design and implementation of S3. As much research confirms, while Cluster policy and S3 are not completely corresponding, it is still reasonable identifying many synergies between the two policy constructs (Foray, David, and Hall, 2011; Foray et al., 2012; Aranguren and Wilson, 2013; Castillo, Paton and Saez, 2013; Ketels et al., 2013). Notwithstanding the valuable contribution of many scholars on the subject of Cluster and S3, the academic debate still falls somewhat short of addressing some issues. In particular, various scholars observed that one of the S3's policy principles, the so-called Entrepreneurial Discovery Process (EDP), is affected by significant implementation gaps (Hermosa and Elorduy, 2015; Rodríguez-Pose

and Wilkie, 2015; Gheorghiu, Andreescu, and Curaj, 2015; Capello and Kroll, 2016). The emerging issue, mentioned above, calls attention to the need to disclose new perspectives on the relationship between Cluster and S3.

This work aims at exploring new perspectives on the role of clusters in S3 design and implementation, with a focus on EDP. The theoretical constructs, presented in the following sections, are meant to provide policymakers with valuable insights to adequately tackle EDP-related challenges. The authors believe that S3 and, particularly, EDP implementation could highly benefit clusters' stage-specific and spatial analysis. Considering the research purpose, the article structure is the following. The second section reflects on the concept of S3, its relation with clusters and the emerging EDP gap. The third section investigates the potential role of the clusters life cycle (CLC) and spatial analysis in the way of EDP. The fourth section presents the conclusions.

2. A BACKGROUND ON S3 AND CLUSTERS: CONCEPTS AND CHALLENGES

The discussion on S3 has originated from the work of the Knowledge for growth experts group, which highlighted the need for re-thinking EU regional development policies to bridge the so-called transatlantic gap. Accordingly, the academic concept of S3 defines an innovative, place-based development policy framework. S3 primary objectives pertain to (i) production of smart, sustainable and inclusive growth, (ii) promotion of research potential, and (iii) maximisation of the usage of innovations (Foray et al., 2009, 2012; Foray and Goenega, 2013). This strategy also emphasises the urge to prioritise policy initiatives by operating with a vertical logic and defining methods to “*identify (...) desirable areas for (...) intervention*”(Foray and Goenega, 2013: p.1). Since its birth, the concept of S3 has had an extraordinary career and rapidly became a crucial element of the EU 2020 innovation plan. However, translating such academic idea in practice is not a trivial matter and poses many implementation barriers. In the way of facilitating the operationalization of S3, the EU Commission has produced a sort of implementation handbook, entitled “*Guide to Research and Innovation Strategies for Smart Specialization (RIS3)*” (Foray et al., 2012). This guide sets a quite demarcated implementation framework, including six steps (Foray et al., 2012): (i) analysis of the national/regional context and the potential for innovation, (ii) set-up of a sound and inclusive governance structure, (iii) production of a shared vision for the future of the country/region, (iv) selection of a limited number of priorities for national/regional development, (v) establishment of suitable policy mixes, and (vi) integration of monitoring and evaluation mechanisms (Foray et al., 2012). Besides the implementation steps mentioned above, the work of Foray et al. (2012) also offers an important reflection on the relationship between clusters and S3. Clusters are intended by the authors as a valuable source of knowledge, which has to be cautiously deployed in the way of S3. EU Regions' experience with clusters and cluster policies is seen as an essential "building block" to implementing S3 policies. The importance of clusters' contribution to S3, is particularly acknowledged for: (i) identifying regional competencies and assets, (ii) meeting the objectives of S3, and (iii) reinforcing local and international cooperation (Foray et al., 2012). Comparable arguments are later recalled in the EU Commission's report on “*The role of clusters in Smart Specialisation Strategy*” authored by Ketels et al. (2013), which defines similarities and differences between clusters and S3. This report claims that, while both clusters and S3 focus specifically on productivity and innovation as drivers of competitiveness and aim to foster regional embeddedness, there are still many differences in emphasis between the two policy constructs. Clusters, it is said, focus more on: (i) the critical mass of economic activities, ii)

the performance of a set of linked companies (iii) the external effects through shared infrastructure and input markets, and (iv) the groups of companies operating in related industries (Ketels et al.; 2013). Instead, S3 refers to (i) the exploration of emerging market opportunities, (ii) the facilitation of knowledge spillovers between knowledge domains, (iii) the exploitation of related variety, and (iv) the generation of structural changes in regional economies (Ketels et al.; 2013). After comparing clusters and S3, the report of Ketels et al. (2013) streamlines clusters' potential support to S3 implementation, through a six-leverage-point framework. The latter includes : (i) prioritization process (ii), design of integrated policy mixes, (iii) evidence-based policy-making, (iv) multi-level governance, (v) cross-border dimension, and (vi) stakeholders engagement (Ketels *et al.*, 2013: p.5). Finally, the report on "The role of clusters in Smart Specialisation Strategy" provides some early suggestions on the need to take into consideration the level of clusters development as an element potentially supportive to S3 implementation. On a similar line of thoughts, Araguren and Wilson (2013) observed correspondences and distinctions between Cluster and S3. The latter authors report three key differences between the two policy constructs, namely (i) scale, (ii) focus and (iii) tools. Araguren and Wilson noticed that cluster policies usually aim at supporting cooperation among distinct groups of agents, focusing on the enhancement of competitiveness at the cluster level by employing relatively narrow tools. Instead, S3 has a broader scope than cluster policies and aim at fostering processes of economic prioritisation which will eventually lead regions towards economic restructuring. However, Araguren and Wilson (2013) still affirm that there are potential synergies between clusters and S3. Indeed, the two scholars observed that both the policy constructs have a place-specific feature, seek to promote cooperation among actors that develop complementary economic activities and aim to support the existent and building new competitive advantages. In conclusion, Aranguren and Wilson (2013) actualize the study about clusters and S3 on the case of the Basque country. In contrast whit the studies mentioned above, an on-field analysis conducted by Perlo (2015), in the Polish regions, reveals that *"the development of clusters with smart specialisations (...) proves that it is difficult to detect a practical correlation between these concepts"*(Perlo, 2015: p.107).

Despite the extensive literature on the subject, the operationalization of S3 remains arduous. The difficulties are due both to the experimental nature of the concept, and the complexity of the policy construct itself. The most severe challenges seem to concern the EDP, which is discussed in the next subsection.

2.2 EDP: process and gaps

EDP is undoubtedly the peculiar element of S3 policies. According to Foray's perspective, EDP is the key engine enabling the success of S3 by disclosing regions' hidden potential to specialise (Foray et al., 2009, 2012; Foray and Goenega, 2013; Bevilacqua et al., 2015). Foray stresses that the key EDP inputs are *"framework conditions for innovation"*, *"relational density"*, and *"diversity of economic actors"* (Foray, 2015: p.61). These inputs should drive EDP towards the (i) integration of entrepreneurial and economic knowledge, (ii) engagement of stakeholders, and (iii) exploration of new economic domains at the regional level. Tersely, EDP is meant to territorially detect economic priorities, by engaging a broad group of local stakeholders (entrepreneurial agents, policy makers and the remainder of the society), to enlarge the local knowledge-base and produce relevant information to S3. Given these considerations, it has to be observed that EDP requires a bottom-up approach, which implies a paradigmatic shift in the traditional conception of *"administration and politics [as]*

omniscient planners” (Foray, 2015: p.3). Accordingly, the significance of administrators' role is downscaled, while the position of other local actors (particularly, entrepreneurial agents) is enhanced. Because of its very nature, EDP is as much essential as challenging to S3. Foray first, observed that the identification of entrepreneurial discoveries “[is] not [an] easy empirical investigation” (Foray, 2015: p.61). Since then, various academics noted the difficulties associated with EDP implementation. Recently, Capello and Kroll (2016) extensively discussed the barriers limiting S3 implementation. The same academics highlighted that, among other factors, “*the lack of concrete elaboration of the entrepreneurial discovery process (...) c[o]me[s] to play a hindering factor*”(Capello and Kroll, 2016: p.6). Gheorghiu, Andreescu, and Curaj (2015) offer a similar finding, by lamenting the lack of a “*functional blueprint for the entrepreneurial discovery process*” (p.2). The pieces of evidence, mentioned above, call for consideration from both scholars and practitioners to tackle such EDP-related issues. It reasonable to affirm that disclosing new perspective on the relationship between clusters and S3, could potentially contribute towards resolving EDP implementation gaps.

3. EXPLORING NEW PERSPECTIVES: CLUSTERS' LIFE CYCLE AND SPATIAL ANALYSIS

The processes of policy design and implementation are rarely concerned with the different phases of the clusters life cycle. However, considering that clusters dynamics and spatial configurations change over time, it is expectable “*that different policy measures vary in their effectiveness over the clusters life cycle*” (Brenner and Schlump, 2011: p.1364). The latter idea seems to apply, to some extent, also to S3. Consistently, it is reasonable to suppose that some clusters' stage-specific attributes (in term of innovative dynamism, cooperation among firms, diversity of knowledge and actors, and spatial significance) can be considered, much then others, suitable to support the operationalization of S3, and in particular of EDP. This theoretical argument, which is the core of the present study, is tested through the methodological approach that follows. Firstly, the study of the literature on the CLC allows the authors to understand which are the leading indicators accounting for the evolution of clusters. Secondly, the indicators drawn from the literature study, are used to build a theoretical model, and a qualitative judgment is assigned by the authors to each indicator at every stage of the CLC. Thirdly, the discussion on the model logically compares stage-specific features (in term of innovative dynamism, cooperation among firms, diversity of knowledge and actors, and spatial significance) of clusters with key inputs and characteristics (according to Foray) of EDP, in order to test if and which stage of the CLC display a potential towards inputting EDP.

3.1 Literature study

While the academic literature has plenty of studies dissecting the functioning of clusters, there are still relatively few pieces of work adequately explaining the dynamics of clusters evolution. Various academics claim that clusters evolve through a precise life cycle consisting of different stages. However, such stages are not univocally identified yet. The literature indeed, offers different models, which treat clusters' evolution according to three-stage- (Bianchi, Miller and Bertini, 1997; Mario A Maggioni, 2004; Maskell and Kebir, 2006), four-stage- (Press, 2006; Bergman, 2008; Menzel and Fornahl, 2009; Handayani et al., 2012) or even five-stage-based frameworks (Andersson et al., 2004; Brenner and Schlump,

2011). This article describes the CLC, according to a three-stage taxonomy, including the phases of (i) emergence, (ii) development and (iii) maturity of clusters. This study does not consider the stage after maturity as it is not precisely predictable whether clusters are going to transform or decline after reaching the mature stage.

Emergence. This stage is usually triggered by an exogenous economic shock, caused by the introduction of a process- or product- innovation (Mario A. Maggioni, 2004). The exogenous shock induces the take-off of the clustering process and consequently drives a limited number of small companies to agglomerate in certain geographical areas (Bianchi, Miller, and Bertini, 1997; Andersson et al., 2004; Maggioni, 2004; Menzel and Fornahl, 2009). Such early agglomeration phenomenon presents a scattered spatial configuration and lacks consistency because the locational benefits are not evident yet (Mario A Maggioni, 2004). However, the more the innovation, which sparked the clustering process, spreads out, the more firms enter the cluster being encouraged by involuntary knowledge spillover. Indeed, the flow of knowledge and information at this stage is mainly involuntary and informal as it does not rely on structured networks neither on consolidated partnerships. Despite the lack of sharpened inter-firm organisational forms, nonetheless, a stock of heterogeneous knowledge circulates among insider businesses. At this stage, it is reasonable to identify four key factors potentially leading the new-born cluster to success, namely: (i) number of start-ups and imitative businesses entering the market (Brenner and Schlump, 2011; Suire and Vicente, 2014); (ii) heterogeneity of accessible knowledge which “*facilitates continuous adjustment to changing external circumstances*” (Shin and Hassink, 2011: p.1390); (iii) local political/institutional context, in terms of policy environment and the presence of high quality Public Institutions, Universities and research centres (Menzel and Fornahl, 2009); (iv) local industrial context, in terms of the presence of related industries (Porter, 1998). The two former factors function actively to support clusters development. Instead the two latter play a background role (Brenner and Schlump, 2011). This explorative stage of the CLC is also characterised by significant Venture Capital (VC) and Research and Development (R&D) investments. To summarise, the emergence is a very early, upstream and explorative phase of the CLC and it is featured by a marked tendency of firms towards innovativeness. The role of start-ups, as well as the values of creativity, and willingness to risk added by entrepreneurs, are crucial to further the prosperity of clusters. The benefits deriving from network activities and knowledge spillovers are somehow available, and the stock of accessible knowledge is highly heterogeneous.

Development. In this stage clusters expand through both a substantial proliferation of the companies entering the market and a significant increase in employment. The locational benefits become incredibly high towards fostering up the spatial agglomeration phenomenon. Accordingly, the profitability of insider businesses rises, reaching its peak. In this phase, the agglomeration economies, theorised by Marshall, are the key engine enabling the endogenous growth of the cluster (Mario A Maggioni, 2004). Consequently, many positive externalities take place, including (i) specialised labour pooling; (ii) interactions among stakeholder, and (iii) knowledge spillovers. In addition to the Marshallian externalities, another factor contributing to the cluster prosperity is the medium/high level of heterogeneity of available knowledge within the clusters’ environment (Shin and Hassink, 2011). Tersely, the success of clusters at this stage seems boldly rooted in regional self-reinforcing processes (such as networking activities, interactions, and cooperation) occurring among local firms and institutions. The number of Start-ups and entrepreneurs is still relevant but no longer crucial. The R&D and VC investments remain significant as well as the level of heterogeneity of accessible knowledge.

Maturity. In this stage clusters reach a stable configuration, towards focusing on specific business segments, consolidating networks' structure and acquiring cooperative routines (Menzel and Fornahl, 2009; Brenner and Schlump, 2011). This state of quasi-equilibrium of clusters is featured by a severe decrease in frequency and number of entries, which in turn makes the clusters' growth rate dropping down. At this point, while locational benefits and self-reinforcing effects are still somehow accessible, they tend inevitably to attenuate and slowly dissolve (Mario A. Maggioni, 2004; Brenner and Schlump, 2011). Moreover, clusters at this stage are usually featured by a tendency towards high specialisation (if not over-specialisation), which narrows the variety of economic activities as well as the heterogeneity of available knowledge (Shin and Hassink, 2011). To sum up, in the maturity clusters reach the maximum size, have a well-shaped network structure, and a precisely-defined core business. In this context, the entry of Start-ups in the clusters becomes irrelevant, R&D and VC investments decrease, and the knowledge accessible becomes homogeneous.

In conclusion this literature study provides a description of clusters stage-specific attributes, allowing the authors at deducing that clusters evolution can be explained, to some extent, by variations in the following indicators: R&D investment; VC investment, new firms (start-ups) birth rate (Bergman, 2008; Brenner and Schlump, 2011); intensity of network activities (Brenner and Schlump, 2011); heterogeneity of available knowledge (Menzel and Fornahl, 2009; Shin and Hassink, 2011); specialization and agglomeration (Maggioni, 2002; Maggioni, 2004). These elements will be deployed to outline a theoretical model which is ultimately meant to present the potential of CLC and spatial analysis in inputting EDP.

3.2 Theoretical model

Outlining such a theoretical model presents some difficulties. Firstly, because the lack of established conventions on indicators for the study of clusters makes the selection of the variables a relatively arbitrary process. Secondly, because nor clusters neither the CLC can be satisfyingly explicated through a single model. Given these premises, while the model cannot fully explain the CLC and the related spatial dynamics, it can still adequately present the potential of CLC and spatial analysis in inputting EDP. Accordingly, the model is designed as follows: (i) a set of indicators is selected by drawing insights from the literature study (see subsection 3.1). This set includes: R&D investment, VC investment, new firms birth rate as indicators of clusters dynamism (Bergman, 2008; Brenner and Schlump, 2011), intensity of network activities as indicator of cooperation (Brenner and Schlump, 2011), heterogeneity of available knowledge (Menzel and Fornahl, 2009; Shin and Hassink, 2011) specialization and agglomeration as indicator of spatial significance (Maggioni, 2002; Mario A Maggioni, 2004); (ii) the strength of each indicator at each stage of the CLC is qualitatively scored. The scores are assigned by the authors on the base of the insights drawn from the literature. For the scoring, the authors used a scale based on five degrees of intensity: low, medium/low, medium, medium/high and high.

Tersely, the model both systematises clusters' stage-specific and spatial attributes, and opens to a discussion.

Table 1: Strength of the indicators by CLC stage

| DYNAMISM | COOPER | VARIET | SPATIAL |
|-----------------|---------------|---------------|----------------|
|-----------------|---------------|---------------|----------------|

| | | | | ATION | Y | SIGNIFICANCE | |
|-------------|----------------|---------------|----------------------|---------------------------------|--------------------------------------|----------------|---------------|
| | R&D investment | VC investment | Start-ups birth rate | Intensity of network activities | Heterogeneity of available knowledge | Specialization | Agglomeration |
| Emergence | high | high | high | medium | high | low | low |
| Development | medium/high | medium/high | medium/high | medium/high | medium/high | medium | medium/high |
| Maturity | low | low | low | medium/high | low | high | high |

3.3 Discussion on the model

The model presented in Table 1 opens to a discussion: firstly, provides an interpretation of the indicators and their variation in strength over the CLC stages, and secondly, highlights the relevance of clusters stage-specific and spatial features relatively to EDP's key inputs and characteristics (according to Foray). The finding emerging from the discussion are summarised in Table 2.

Table 2: Findings

| | DYNAMISM | | | COOPERATION | VARIE TY | SPATIAL SIGNIFICANCE | | COMPARISON TO EDP |
|-------------|----------------|---------------|----------------------|---------------------------------|--------------------------------------|----------------------|---------------|------------------------|
| | R&D investment | VC investment | Start-ups birth rate | Intensity of network activities | Heterogeneity of available knowledge | Specialization | Agglomeration | Potential input to EDP |
| Emergence | high | high | high | medium | high | low | low | high |
| Development | medium/high | medium/high | medium/high | medium/high | medium/high | medium | medium/high | high |
| Maturity | low | low | low | medium/high | low | high | high | low |

R&D investments target a broad range of creative activities, including “*basic research, applied research, and experimental development*” (OECD, 2013: p.1). These activities aim at expanding “*the stock of knowledge (...) and the use of this knowledge to devise new applications*”(OECD, 2013: p.1). According to the literature R&D investment is considered as a reliable indicator of clusters innovativeness (Davis et al., 2006), and as a determinant of entrepreneurship (OECD, 2013, 2016). Tersely, R&D catalyses the generation and diffusion of new knowledge, towards creating a vibrant entrepreneurial environment and supporting inventions. The benefits of R&D spread over regions by availing entire groups of firms. However, it has been found that R&D seems to play a particularly prominent role “*during the*

early life course of (...) firms” (Stam and Wennberg, 2009: p.79). Furthermore, new-born firms (such as start-ups) tend to use the innovative inputs (investment on R&D) more efficiently than the old ones. Consequently, clusters featured by a high number of start-ups, attract and call for R&D investment, which in turn generate remarkable innovative outputs. Given these considerations, it seems logically more convenient to operate R&D investments during the initial phases of the CLC, namely emergence and development. These two initial stages appear to be more suitable for entrepreneurial discoveries, because of a high start-ups' birth rate (which will be discussed in the next paragraph) within a flourishing innovative environment. Conversely, clusters in their maturity rely on aged firms, which operate according to consolidated, if not stagnating, industrial practices. Henceforth, envisioning that EDP is meant to “(...) *logically identify (...) the domains where new R&D and innovation projects will (...) create future domestic capability*” (Dominique Foray, David and Hall, 2011: p.4), it is reasonable to conclude that emergent and developing clusters offer optimal context conditions for EDP implementation. The same conclusion is also valid when taking in consideration Venture Capital (VC) investments. VC investments refer to “*a form of equity financing particularly important for young companies with innovation and growth potential but untested business models and no track record*”(OECD, 2016: p.142). This funding system is seen both as a marker of clusters innovative potential, as well as an essential factor nourishing clusters' entrepreneurial environment (Breschi and Malerba, 2005). Indeed, VC is especially advocated in, and attracted by, highly pioneering territorial contexts (Bevilacqua, Pizzimenti and Maione, 2017). Such setting coincides with those of emerging and developing clusters. Therefore, VC investments, by focusing especially on the explorative stages of the CLC (Bergman, 2008), trigger potential innovations which could be intercepted in the way of EDP. Both the indicators discussed so far, R&D and VC investments, are tightly related to the presence of entrepreneurs and new businesses within the clusters' environment. Specifically, the incidence of start-ups birth rate, within clusters' environment, seems to be particularly relevant. Start-ups include all newly born firms that are up to two years old (OECD, 2016). Such “young” and usually small-sized businesses, because of their very explorative, and potentially innovative nature, are crucial endogenous drivers of territorial development. Indeed, start-ups birth rate is an important indicator signalling both the dynamism of clusters (Davis et al., 2006) and the overall goodness of the entrepreneurial environment (OECD, 2016). High values of the indicator start-ups birth rate also mean that entrepreneurial actors (the holders of entrepreneurial knowledge) are particularly active. To sum up, there is a positive correlation at the territorial level between high values of the indicator start-ups birth rate (which usually attributes emerging and developing clusters), high density of entrepreneurs and high availability of entrepreneurial knowledge. Given that EDP has a “(...) *special focus on the regional entrepreneurial environment, assessing whether it is lively and can generate a significant flow of experiments, innovation ideas (...)*” (Foray et al., 2012: p.20), it is reasonable to deduce that emerging and developing clusters could provide valuable inputs in the way of entrepreneurial discoveries. As already stressed, high values of the indicator start-ups birth rate are a marked feature of clusters' emergence and development stage. Instead, the entry of start-ups, and their importance in the functioning of the cluster, drastically decreases during maturity. This theoretical evidence suggests that EDP can be effectively supported by the bold entrepreneurial, innovation-oriented, cross-sectoral environment manifested at the two initial stages of clusters' evolution.

Networks activities embrace the broad range of actions aiming at generating or nourishing “*organisational forms] of economic activities that may allow firms to cope with market failures (...)*.” (OECD, 2004: p.20). The intensity of network activities provides a measure of knowledge exchange and firms connectedness, within certain geographic boundaries (which

are mutable and permeable). Empirical studies demonstrate that increases in network activities are positively correlated with the rise of firms' innovativeness (OECD, 2001). However, the same studies also prove that the willingness to engage in knowledge-based networks has a negative correlation with firms' size. These two latter pieces of evidence, suggest that network activities are more intense in the presence of new-born, small-sized firms (such as start-ups). The latter (usually concentrating in emergent or developing clusters) orientate towards more flexible, sometimes informal, network forms. On the contrary, big firms (usually concentrating in mature clusters) rely on routine-based, formally-regulated networks. These differences in the structure and willingness to engage in networks make small firms' more innovative, more adaptable and less sector-specific than big ones. The features of networks are also tightly tied to Marshallian spillovers. In a life cycle perspective, one should consider that networks and the related knowledge spillover evolve over the different stages of the CLC. As previously highlighted (see subsection 3.1), networks are mostly informal, and spillovers often happen involuntarily during clusters' emergence. This is due both to the scattered configuration of the spatial agglomeration of firms and to the explorative nature of the businesses entering the market (mainly start-ups). When clusters move on to the development stage, networks get gradually more structured and spillovers more formal. This condition evolves further on during the maturity stage. At this point clusters are composed mainly of big firms, there is no start-ups entry, and consequently, networks become rigid and spillovers significantly decrease. Given these considerations, it is reasonable to affirm that EDP should focus on emergent and eventually developing clusters, which are featured by the “*relational density*” postulated by Foray. Indeed, the significant density of start-ups and entrepreneurs, the marked attitude of firms towards innovative activities and knowledge sharing, make emergent and developing clusters an exceptional source of various entrepreneurial and economic knowledge.

The heterogeneity of knowledge (Shin and Hassink, 2011), indicates the variety of the available knowledge-stock inside clusters. Considering that knowledge is detained by entrepreneurial actors, the variety of accessible knowledge seems also indicating, to some extent, the assortment of entrepreneurial actors. The more such assortment is diversified, the more clusters manifest a marked attitude towards adjusting to changing conditions. It has been said (see subsection 3.1) that the heterogeneity of knowledge and actors evolve over the CLC. Specifically, while the initial phases of the CLC are featured by high and medium heterogeneity of accessible knowledge, during maturity, this variety tends to attenuate toward homogenization. This shift from heterogeneous to homogeneous knowledge is due both to a decrease in the number of diverse entrepreneurial actors entering the clusters and to an increase in specialisation. Considering that EDP calls for a diversity of economic actors and knowledge, the best match in the way of EDP operationalization seems to be manifested by the features of emerging and developing clusters.

Specialisation is expressed through a location quotient. The latter defines the share of regional employment in a sector, relative to the national context. This indicator is widely endorsed in literature as a marker of spatial concentration of industries (Mayer, 2003; Mario A Maggioni, 2004; Maggioni and Riggi, 2008). The discourse on specialisation presents a split-screen view. On the one hand, low specialization: (i) prevents clustered firms from exploiting the full potential of competitive advantages and (ii) allows clustered firms to benefit a vibrant, cross-sectoral and diversified entrepreneurial environment (typical attribute of emergent and developing clusters). On the other hand, high specialisation leads clustered firms to exploit competitive advantages fully, while eventually leading to stagnation and lock-in (a common attribute of mature clusters). Tersely, high specialisation can lead towards

flattening clusters' economic vibrancy and innovativeness as well as losing the positive effects of the variety externalities theorised by Jacob. Once again, the best fitting ecosystem for EDP is expectedly the one provided by emergent and developing clusters. Indeed, considering that EDP pertains to the detection of potential domains for future regional specialisation, targeting already specialised clusters would mean pointing out traditional industrial sectors instead of S3-type domains. Another indicator accounting for the spatial configuration of clusters is the agglomeration. The latter indicates the number of firms concentrating in some geographical regions (Mario A Maggioni, 2004). This indicator's value increases as clusters get holder, till reaching its peak during the maturity stage. At this point, the mass of economic activities located in a specific geographic area reaches its maximum. As a consequence, the attractiveness of such areas starts decreasing due to a scarce availability of locational benefits (Mario A Maggioni, 2004). Conversely, in cases when spatial agglomeration presents a configuration not saturated yet, businesses from outside are encouraged to locate inside clusters because of potentially high locational benefits. These considerations reveal that the locational attractiveness should be found in clusters that have not reached the spatial agglomeration peak yet, namely: emerging and developing clusters.

In conclusion, this discussion theoretically confirmed that the CLC and spatial analysis have a potential to impact EDP operationalization. In detail, the authors find that emergent and developing clusters can provide a number of significant inputs towards implementing EDP: (i) the significant strength (medium and high) of dynamism and innovativeness (in terms of R&D and VC investment, and start-ups' birth rate) signal high quality framework conditions for innovation; (ii) the medium and high strength in intensity of network activities indicates a significant relational density among clusters insiders and a tendency towards innovative, cross-sectoral cooperation; (iii) the medium and high heterogeneity of available knowledge, which also indicate the variety in the assortment of economic actors, enables the opportunity to enlarge the regional knowledge-base, gathering economic and entrepreneurial knowledge; finally, (iv) the low/medium levels of firms' agglomeration and specialization suggest the existence of a territorially localized economic potential, which has not been fully exploited yet.

4. CONCLUSION

This article presented a theoretical discussion on the role of clusters and cluster policies to support S3 and specifically EDP implementation. Although a significant body of scientific literature confirms that EU experience with clusters and cluster policies is a crucial element towards supporting the implementation of S3, nonetheless many operational gaps keep standing out. One of the most problematic factors pertains to the operationalization of the EDP. Consistently the authors intended to test whether the CLC and spatial analysis could eventually guide the discovery of regional economic potentials. This problem is approached theoretically and discussed on the base of literature evidence. Firstly, the concept of S3, its relation to clusters and the emerging EDP gap is presented. Secondly, the potentials of clusters' life cycle and spatial analysis is tested by: (i) deducing from a literature study a set of indicators accounting for clusters stage-specific and spatial attributes. (ii) framing the indicators into a model and providing a qualitative judgment of their strength at each stage of the CLC, finally (iii) interpreting the model to test if and which stages of the CLC display a potential towards inputting EDP.

The authors conclude that the EDP implementation could significantly benefit the framework conditions for innovation, relational density, and diversity of knowledge and actors provided

by some specific stages of the CLC. Moreover, the identification of the variations in the spatial configuration of clusters, during different phases of the CLC, can offer valuable information about the existence of a territorially localised economic potential. Particularly, the authors find that, according to the logical comparison of clusters' stage-specific attributes and EDP's key inputs and features, it is reasonable to target emerging and developing clusters as a suitable breeding ground towards favouring EDP implementation. These findings call for consideration of policy-makers, to reflect more consciously both on clusters' evolution and spatial configuration, to overcome EDP implementation issues, and consequently get to a fully effective implementation of S3.

5. LIMITATIONS OF THE STUDY

The main limitations of this study pertain to the theoretical model presented. Firstly, because the lack of established conventions on the indicators for the study of cluster makes the selection of the variables a relatively arbitrary process. Secondly because nor clusters neither their life cycle can be satisfyingly explicated through a single model. Given these considerations, some potentially influential factors are ignored (for example the propensity of the big companies to internalise the functions of R&D, the consequences of the global crisis on investment flows, and others), while the variables that are most frequently endorsed in the literature are included. Moreover, given that industries are not alike, and that different variables have different importance in the industries, it might be that the model does not represent the mechanism of some industrial sector (for example the industrial sectors controlled by monopolist holdings and others). However, the theoretical literature provides evidence that a detailed modelling of all relevant processes might not be of crucial importance. From this, it is reasonable to conclude that while the model is not fully explanatory, it still reflects appropriately the potential contribution of the CLC and spatial analysis in the way of S3 and EDP.

6. ACKNOWLEDGMENTS



The MAPS-LED project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 645651.

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A FOURTH WAY: CULTURAL HERITAGE AS THE KEY TO UNLOCKING SUSTAINABLE PLACE-DRIVEN INNOVATION

C. Devaney

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: clare@claredevaney.com

Abstract: Set against a powerful context of political instability and global economic uncertainty, and driven in part as a response to unprecedented challenges including Brexit and UK regional devolution, the paradigm of ‘place’ has seen rapid incorporation into national and global policy making and practice. Interpretation, development and evaluation of place has thus far been dominated by two fairly static definitions: a physical understanding of ‘a place’ as a defined, geographic territory and a socio-economic understanding of place as a self-contained economic and social system. This paper introduces cultural heritage as a third and critical criterion in realising a more comprehensive understanding of place. Through pragmatic application of mixed methods including ethnographic interview, questionnaire and survey, design science and action research, and utilising cutting-edge ‘living platform’ mapping techniques in analysis and visualisation, the research seeks to interrogate the inter-relationship between place and innovation, exploring that nexus through a cultural heritage lens. Through integrating critical factors of space and time, it creates a new conceptual framework for sustainable place-driven development and presents a new ‘place-driven’ economic paradigm, within which a whole series of previously accepted tripartite models can be elevated; presented collectively as ‘a fourth way’.

Keywords: Culture, Heritage, Innovation, Place, Sustainability.

1. INTRODUCTION/BACKGROUND

The paradigm of ‘place’ has seen rapid incorporation into policy making and practice, in the UK and across the world. The speed at which its incorporation has occurred has arguably, and in some cases demonstrably, led to the concept’s application while not being fully formed. To some extent as a result of this, and an associated need for anchoring it as a concept, its interpretation, development and evaluation has thus far relied on and been dominated by two fairly static definitions: a physical understanding of ‘a place’ as a defined, geographic territory and a socio-economic understanding of place as a self-contained economic and social system.

These well-practiced tenets fit ‘place’ comfortably within the current and predominantly capital-driven economic paradigm, in which the spatial/territorial understanding of place fits neatly with the notion of capital ‘spatial fix’ (Harvey, 2001) and the socio-economic application of ‘place’ mimics the defined parameters of a capital labour market.

Less comfortable is the interaction between these static definitions of ‘place’ and the inherently dynamic innovation landscape. The construct of ‘embeddedness’ is critical to this nexus (as, for example, applied to the Smart Specialisation innovation process, which requires ‘an accent on fostering regional embeddedness’ (Ketels, 2013b)), and its application in this sense tends to refer to a deep immersion in one or more acknowledged industrial, geographic or economic strengths of a particular place; characterised as ‘place-based’ innovation.

This paper introduces cultural heritage as a critical criterion in realising a more comprehensive understanding of place, and in effect as a key driver in catalysing a less constrained and more fluid and reciprocal interaction between place and innovation.

2. LITERATURE

2.1 The innovation-place nexus: Smart Specialisation

Smart Specialisation is a central concept in the ESRC's vision for Europe's innovative future (EC 2016). It is based on the principle of defined economic systems (predominantly regions) generating new specialisms through a process of discovery which builds on unique local assets and competences, toward economic growth. Smart Specialisation Strategies (S3) (Foray 2015) translate the academic concept of Smart Specialisation into policy, allowing regions to prioritise concentration of resources as the basis for competitive advantage. S3 is based on five core design principles: entrepreneurial discovery, mid-level (predominantly regional) granularity, inclusiveness, an expectation of progress (specifically in that priorities will not be supported forever) and the promotion of experimentation and risk. S3 is now firmly established as a key feature in European innovation policy. Since 2013, it has been a compulsory ex-ante conditionality requirement for EU member states and regions accessing EU funds to have an S3 in place (EC 2013a).

The rapid rise of S3 from academic theory to legal requirement has mirrored its own design principles. It is an experimental strategy which has made extraordinarily fast-paced and dynamic progress, benefiting from and contributing to a focus on entrepreneurialism, innovation and inclusion, and the growing movement toward regional, devolved and 'place-based' development. Whilst there is clear ideological synergy between the regional focus of S3 and the place-based approach, "Smart Specialisation Strategies... were initially developed from an a-spatial concept (and) have needed to be reworked and redefined in the context of regional analysis" (EC 2013b: 12). The EC's 2013 report on S3 and cluster policy, based on the findings of a special advisory group chaired by Ketels (EC 2013b) advocates for regionally distinct, place-based approaches to S3, as opposed to "place-blind interventions", setting out a desired logic for S3 delivery which prioritises regional context, participation and ownership and place-specific future visioning. The report identifies a lack of stakeholder engagement, insufficient analysis of regional assets and a "Tendency for regional strategies to chase the same "bandwagon" sectors" (EC 2013b:11) as key S3 policy flaws.

Place is implicit in the level of granularity required by S3. The co-relation between place and innovation, via S3, is made explicit by the 2009 Barca report (and has been recently restated by McCann, 2015). The Barca report defines a place-based approach as "a long term strategy aimed at tackling persistent underutilization of potential and reducing persistent social exclusion in specific places through external interventions and multi-level governance" (2009:3). Whilst this is a useful definition, and of its time, both S3 and place-based concepts have since continued to evolve, and whilst the concept of 'place' remains "incompletely developed" (Taylor & Devaney 2014: 6), in emerging just ahead of the place-based paradigm, S3 has been able to respond to and absorb a deepening understanding of what 'place' means.

2.2 Place-based innovation

A portfolio of work from The Brookings Institute's Bass Initiative has been seminal in framing emerging thinking around the interconnectivity between innovation and place. Katz and Wagner (2014) assert a typology based around three models of 'innovation districts' in cities: the 'anchor-plus' model, in which a clustering of assets and infrastructure occurs around the presence of an anchor institution, such as a university; the 're-imagined urban areas model', in which former industrial or warehousing sites undergo large-scale regeneration (often, Katz and Wagner observe, to be found in historic waterfront districts); and the 'urbanized science park' model, which sees new industry and commercial activity in suburban or ex-urban areas growing around clustered scientific activity.

In a later review of this predominantly spatial analysis of innovation strategy, Katz, Vey and Wagner (2015) introduce "the imperative to combine and activate physical assets in ways that create vibrant "places", quoting Ethan Kent, Chief Executive of The Project for Public Spaces' description of place as "environments in which people have invested meaning over time. A place has its own history—a unique cultural and social identity that is defined by the way it is used and the people who use it." (Katz, Vey and Wagner, 2015: 3).

2.3 Place-based innovation and cultural heritage

Place-based innovation, and S3, tends to focus on the acknowledged strengths of a place. Often, these strengths are so acknowledged because they have a basis in a place's industrial or cultural heritage. Greater Manchester (GM), for example, is pioneering innovative models of advanced manufacture in its work with Graphene, building on its recognised historic strength in manufacturing.

As with the dominant understandings of 'place', heritage too tends to be characterised as a fixed and static concept, based primarily on the 1972 UNESCO World Heritage Convention definition of cultural heritage as 'monuments, groups of monuments and sites'. The ICOMOS Nara Document in 1994, which called for cultural context in regards to permanence, recognising, for example, the cultural heritage value - but impermanence - of ritually rebuilt wooden temples and mud huts, pioneered a school of thought which has since introduced a more fluid understanding, particularly in regard to cultural heritage, and which was underscored by the formal recognition of 'intangible heritage' by UNESCO in 2003. This thinking continues to influence contemporary cultural heritage research, such as the Royal Society of Arts' advocacy for 'Networked Heritage' and 'Heritage Citizens' in its 'Heritage, Identity and Place' portfolio of work, co-sponsored by the Heritage Lottery Fund (RSA, 2016) While there is a wealth of emergent academic literature on cultural heritage and place, the relationship between cultural heritage and innovation is a relatively fresh domain. From a policy perspective, where a relationship is noted, the focus tends to be on the economic value of cultural heritage, principally through tourism. The report of the EC Horizon 2020 expert group on cultural heritage (EC 2015) asserts that "modest investment in cultural heritage can pay substantial dividends" and that the EU should "vigorously promote the innovative use of cultural heritage for economic growth." (EC 2015:8).

2.4 Embeddedness

Ketels, as previously noted, calls for ‘an accent on fostering regional embeddedness’ (Ketels, 2013b) in his 2013 review of European S3 and cluster policy. The call is made in mitigation of a number of noted policy flaws, principally the tendency for regions to choose ‘bandwagon’ sectors, such as digital and bioscience, as S3 specialisms. It marks a pivotal point in the development of S3, and in the developing ‘place’ paradigm, as both move from superficial ‘place-based’ strategies to strategies ‘embedded’ and demonstrably grounded in place.

There is some tension between this call for ‘embeddedness’ and the short-term risk taking and learning, regenerative shedding and re-definition of priorities which is actively encouraged in the process of Smart Specialisation (Foray, 2015). This regenerative process in support of innovation has a long and rich provenance, dating from Schumpeter’s “gale of creative destruction”, the “process of industrial mutation that incessantly revolutionizes the economic structure from within” (1994: 82) and its rise to prominence in the 1950s. More recently, Schumpeter’s influence can be seen in Harvey’s ‘spatial fix’ (2001), Castells’ ‘space of flows’ (2010), and in the explicit incorporation of ‘creative destruction’ as a key driver in Smart Specialisation itself (Foray 2015).

A better fit can arguably be found in the sociological, neo-substantivist paradigm around ‘embeddedness’ brought forward by Grannoveter (1985), the central tenet of which is based on the theory of individual economic agency being “embedded in concrete, ongoing systems of social relations” (Grannoveter, 1985). This delicate balance between a static, ‘concrete’ embeddedness and dynamic, ongoing systemic change resonates well with the required relationship between place and innovation. Application of this more fluid and culturally aware definition of ‘embeddedness’ as a key construct in both the place and innovation paradigms challenges the place/innovation nexus to respond.

3. METHODOLOGY

The research has employed a hybrid methodology of design science and action research, augmented through literature review, questionnaire, interview and case study.

3.1 The design science model

The methodology has drawn primarily on the design science model, which incorporates six sequential stages (explicate problem, define requirements, design and develop artefact, demonstration, evaluation and communication of knowledge), and which focusses on the development of an artefact. Action research methods have been integrated into this overarching design science framework in support of the demonstration and evaluation stages.

The sequential nature of design science approach offers a flexibility and adaptability that is supremely necessary in a project of this nature, which is not only focussed on fast-changing concepts such as place and innovation, but which is current and as such susceptible to political, economic and external influences. Already, the research has been required to adapt in the face of Brexit and subsequent potential changes to European policy (and in particular to the UK’s S3 policy), in addition to other unforeseen circumstances affecting the selected case studies, including a hurricane and a political protest. The approach adopted has not only

supported the research in meeting these challenges, but has also allowed for the research to respond to emerging thinking in the field. Adopting a dual focus on the artefact and the context has also been helpful maintaining a balance, and in ensuring neither aspect overly dominates the research; the two aspects in fact reciprocally ‘feed off each other’, ensuring freshness and relevance.

For the purposes of the research, ‘the artefact’ in question is a novel method for articulating and evaluating innovation strategies, incorporating cultural heritage as a critical criterion. ‘The requirements’, the contextual conditions for the artefact, focus on ‘place’ and are represented by the emerging hierarchal place taxonomy.

The first stage of the research (relating to stage one of the design science methodology, ‘Explication of the problem’) saw findings from the literature review synthesised to create a core research framework. That framework was tested and refined through a pilot case study focussed on Greater Manchester (GM)’s S3 strategy, incorporating a series of scoping interviews with key GM public sector, private sector and academic stakeholders.

3.2 ‘The artefact’ – the ‘Sustainable S3 Wheel’

Based on preliminary findings from the literature review and scoping stage, an initial sketch of a novel evaluation tool for innovation strategies (‘the artefact’) was conceived. The sketch visualised an inherently complex concept through a user-friendly metaphor, the “Sustainable S3 Wheel”, in which the wheel is representative of an innovation economy, structurally supported by three axes of ‘place’, two of which represent the traditional concepts of spatial and social considerations, and introducing a third axis to represent cultural factors (see Figure 1).

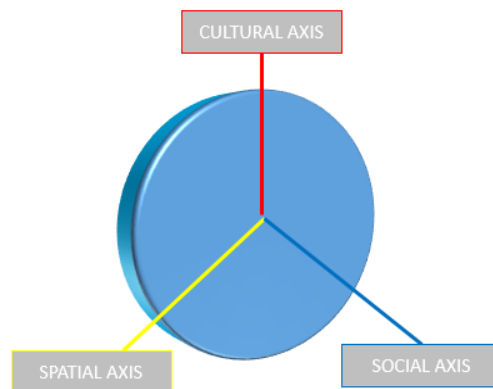


Figure 1: The “Sustainable S3 Wheel” (sketch)

3.3 ‘The requirements’ – case studies in ‘place’

A series of case studies was selected to further test and refine the structure of the artefact, and to generate an initial understanding of the requirements, that is, the contextual role of ‘place’. Case study selection drew on the work of Katz and Wagner (2014), focussing in the US on Boston (Kendall Square) and Seattle (South Lake Union), and in the UK on Manchester’s Oxford Road Corridor as examples, respectively, of the ‘anchor plus’, ‘re-imagined urban

areas’ and ‘urbanized science park’ models of innovation district. Case studies were conducted through a mix of quantitative and qualitative methods supported primarily by four analytical tools: survey, questionnaire, interview and presentation of the case study results themselves.

A second phase of case studies, looking in more depth at Manchester’s Oxford Road Corridor and including other selected ‘innovation districts’ across GM such as The Sharp Project, The Federation and Salford’s Media City UK is in progress to allow development, testing and application of an emerging ‘place hierarchy’ taxonomy and of the nascent evaluation tool (based on spatial, social and cultural criteria), enabling critical assessment of these areas as ‘innovation districts’ in relation to the findings from the earlier case studies.

3.4 Action Research – M4

The development, demonstration and evaluation stages of the research have been augmented by adoption of action research methods, principally centring on an ambitious practical project which has responded to emerging findings to establish ‘M4’, a civic innovation space designed to represent the emerging ‘fourth typology’ of innovation district. Launched in May 2017, M4 operates as a network, and while not confined to a geographic space, its administrative base is located in The Federation in central Manchester, which also houses a number of tech and social enterprises. The M4 project will incorporate an in-motion evaluation of the effects of its introduction on the GM innovation ecosystem over a twelve-month period.

3.5 The ‘Living Platform’

A cutting-edge data visualisation technique, the ‘Living Platform’, developed by the University of Salford’s ThinkLab and School of the Built Environment (SoBE) and launched in June 2017 is being utilised to collate and demonstrate the results of the second phase of case study, enabling evaluation of the spatial, social and cultural aspects of the selected innovation district to be cross-referenced, analysed and presented via a real-time, dynamic platform, and allowing for spatial and temporal factors, emerging as critical to the research, to be factored into results. A still showing ‘innovation hotspots’ displayed on the platform from the in-progress case study focussing on MediaCityUK in Salford, Greater Manchester, is shown as Figure 2.

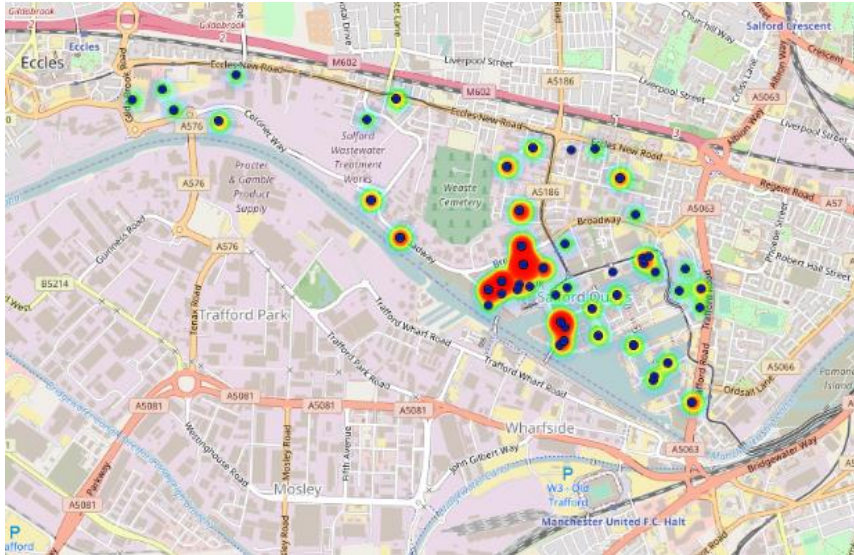


Figure 2: Still from *The Living Platform* showing ‘innovation hotspots’ at MediaCityUK

4. RESULTS AND DISCUSSION

4.1 The ‘Sustainable Innovation Wheel’

“The Sustainable Innovation Wheel”, a prototype tool for the evaluation of innovation economies (piloted in its initial stages with a focus on S3 strategies) has been developed as both an output and tool for the research (see Figure 3).

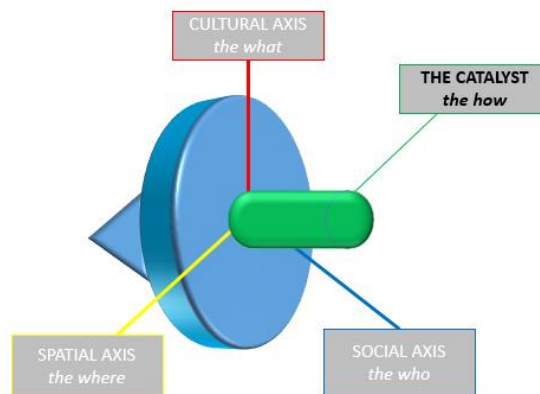


Figure 3: *The Sustainable Innovation Wheel*

In this novel evaluation model, each axis represents a critical quality in successful innovation economies. The first axis – the *where* – represents spatial factors, incorporating granularity, proximity and built environment considerations; the second axis – the *who* – represents social factors, incorporating inclusivity, participation and stakeholder engagement, and the third axis, completing the spokes in the wheel, represents cultural factors – the *what* – those aspects of place such as heritage, identity and culture, that make a place distinctive and its S3 specialisms unique. The fourth aspect, the catalyst to make the wheel spin is the *how*.

Too often, the perception – and reality – of innovation sees an overly-dominant focus only on the strengths of a particular place. This tends to come at the expense of the application of innovation capacity in addressing place-based weaknesses, social demands or issues of need. Successful and sustainable innovation has the opportunity to bring a vast range of different actors together in addressing a whole range of collective place-based goals. Instead, the

dynamic nature of the “Sustainable Innovation Wheel” allows for and predicts an innovation economy which not only responds to, but feeds off, all aspects of a place, and the entire spectrum of place-related indicators; a ‘place-driven’ innovation economy (see Figure 4)

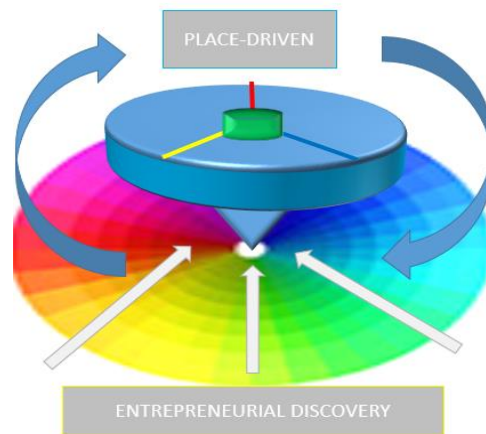


Figure 4: A ‘place-driven’ innovation economy

4.2 An emerging ‘place’ hierarchy

Exploring the conceptual relationships between the *where*, *what*, *who* and *how* of the “Sustainable S3 Wheel”, and considering their individual and collective application to both the ideological development of S3 and the nature of the three established (Katz and Wagner, 2014) innovation districts allows us to assert and observe an emerging hierarchy of ‘place’, as shown in Table 1.

Table 1: An emerging ‘place’ hierarchy

| INNOVATION DISTRICT | DRIVER | CONSTRUCT | CONCEPT | PLACE |
|----------------------------|-----------------|------------------|----------------|----------------|
| Urbanized Science Park | Private | Spatial | Where | Place-blind |
| Regenerated Urban Areas | Social/ 3rd | Social | Who | Place-based |
| Anchor Hub | Public/Academic | Cultural | What | Place-grounded |
| Citizen-led | People | Civic | How | Place-driven |

The introduction of a cultural construct unlocks a dynamism in the innate characteristics of place-related innovation, which in turn asserts a fourth type of quasi-spatial innovation district; the civic space; an assertion which introduces ‘people’ as catalytic agents at the nexus of place and innovation, and – conceiving of the movement between concepts along a vertical axis - introduces ‘time’ as a key consideration in understanding how all of those dynamic dependencies interact.

4.3 Culture and place-grounded innovation

Evidence from both the Boston and Seattle case studies demonstrates the dominance of large, private companies in the selected areas of those cities (Kendall Square and South Lake Union, respectively), identified in the Katz and Wagner piece (2014) as exemplars of ‘innovation districts’. Both districts are physically located at some distance to the urban core (and in Boston’s case separated by a river), and show limited resonance with each city’s distinctive cultural heritage, which is demonstrably better integrated into more organic innovation offers emerging in ‘downtown’ areas such as Pioneer Square, in Seattle, and the Seaport District, in Boston, both of which are driven by a nascent small enterprise scene. Greater Manchester’s ‘Oxford Road Corridor’, representing the ‘urbanized science park’ typology also demonstrates a marked literal and figurative distance from Manchester’s city centre.

Key stakeholders in both US cities have, however, acknowledged the importance of cultural activity to innovation, with one civic leader in Boston commenting that “Innovation happens when culture and the economy clash together”. In support of this assertion, the Boston Mayor’s Office is currently supporting a programme of micro-grants through its *Boston Creates* initiative specifically for artists and creatives working in the innovation space, described by Interviewee A as “watering the innovation seedlings”.

Cultural appropriation is evident in a number of case studies in the second phase of the research, including for example, The Sharp Project and its strong heritage links to the Sharp processing plant, an industrial brand synonymous with Manchester and the former occupier of its site (the site layout forms The Sharp Project logo), and at The Federation, where local street artists Nomad Clan have recently been commissioned to create art on the walls of the central collaborative workspace, shown in Figure 5. The art depicts ‘worker bees’ (symbolic of Manchester) and incorporates various cultural references including Manchester United and City football strips, Coronation Street characters and famous Mancunian musicians. The artwork also includes quotes from Tony Walsh’s poem (writing under the pen-name of Longfella) ‘This is the Place’, which came to particular prominence as an anthem for the city following the terrorist attack at Manchester Arena in May 2017.

4.4 Place-driven innovation in practice

Evidence from the Boston and Seattle case studies demonstrates how both cities are beginning to apply their acknowledged innovation strengths to tackling their key urban and social challenges. In Boston, widely acknowledged as a global leader in innovation thanks largely to the presence of Harvard University and MIT and the clustering effect of large corporate tech and biotech firms around those anchor points, there is a growing sense of the need to better connect its anchor institutions and citizens, and to apply the city’s vast knowledge capital to its ‘wicked problems’. Positioned on the Atlantic coast, and with much of its development along that coastline built on landfill, climate change and rising water levels are of particular concern. 2016 saw the inaugural Hub Week, a ‘festival of innovation’ which included a series of open-sourced, place-based challenges inviting innovative responses to issues around the city’s bodies of water, generating a range of actionable and multiple-bottom line ideas, including water cleansing bio-pellets made from the city’s significant food waste.

In Seattle's Pioneer Square district, fast-emerging as a grassroots innovation 'hotspot', Impact Hub Seattle acts as a centre-point for the district's social enterprise, digital and creative businesses. It is currently hosting a collaborative work programme to focus the district's collective innovation capacity on the city's homelessness crisis, declared as a 'state of emergency' by the city's Mayor in 2016. Steve Johnson, CEO of Impact Hub Seattle describes the hub's role in the programme as "a catalytic convenor between the place and the people". The importance of people as citizens in Seattle's emerging 'place-driven' innovation ecosystem was noted by several civic leaders, with one describing "the role of government" as "empowering people on the ground so that those solutions that citizens already have, which have been lying dormant, can be brought to life".

Findings from both the pilot case study in GM (January 2016), and the second phase of case study research, in-progress, suggest that while a number of social enterprises and initiatives exist with a focus on the city-region's social challenges, there is a distinct lack of understanding of this activity as being in the innovation space, alongside a continued ideological and fiscal investment focus on the Oxford Road Corridor. There is little too in terms of infrastructure and networks designed to enable GM's citizens to participate in this innovation space. The M4 project, launched in May 2017, has been designed as a citizen-led civic innovation space with the stated mission of filling these gaps. It is an ambitious piece of action research, and includes an in-motion evaluation of its introduction to the GM innovation ecosystem, which will report in September 2018.

5. CONCLUSIONS

5.1 Place, innovation and embeddedness

There is a clear tension between the static (spatial and socio-economic) definitions of 'place' and the inherent dynamism of innovation. At the heart of this tension is a problematic spatiotemporal relationship, which sees the defined characteristics and spatial territory of place juxtaposed against the fluidity and incompleteness of the innovation process. To date, this tension has been alleviated – and arguably avoided – by employing only a very superficial understanding of place in innovation spaces. Urbanized science parks, the first typology of innovation district identified by Katz and Wagner (2014), and still stereotypical 'go to' in the concept of places for innovation, have historically shown little resonance with place and have maintained a cultural and geographical distance.

Ketels' call for 'regional embeddedness' (Ketels, 2013b) in Smart Specialisation strategies, a principal driver in European innovation policy, brought this tension into sharp focus, and marks a pivotal point in both the innovation and place paradigms, and where they intersect. The concept of embeddedness had existed implicitly in the 'place-based' strategic space, but its explicit introduction via this intervention, particularly as a response to regions selecting 'bandwagon' specialisms (pointing to the superficiality of the 'place-based' approach), came as a challenge to the innovation landscape to incorporate and demonstrate a deeper understanding of place.

This 'cultural awakening' of the innovation space has coincided with a developing understanding of cultural institutions as 'anchor hubs', as markers and stewards of a place and its heritage, alongside the predominantly academic institutions traditionally identified as 'Anchor Hubs' (as in the 2014 Katz and Wagner piece). This in turn has led to an 'opening up' of those, historically isolated, academic institutions, and their pro-actively seeking out

more progressive and active roles in local communities (Jackson & McInroy, 2016). As academic institutions continue to better integrate with place, so too we can see a move away from innovation as the acknowledged domain of universities, through culture, and toward the civic space.

5.2 Cultural heritage and place-driven innovation

Evidence from the case studies suggests we are at a particular ‘point in time’ in the integration of cultural aspects in the place/innovation nexus. That point sits between the ‘place-grounded’ and ‘place-driven’ concepts presented in Table 1. There is evidence in some case studies of place-driven activity, specifically innovation in response to a broader place spectrum (incorporating weaknesses as well as strengths), and also evidence of a growing acknowledgement of the potential role for citizens – people – as innovators.

Cultural *heritage* is key at and for this ‘point in time’ juncture. The dual effect of heritage, recently defined by the RSA (2015) as “anything inherited from the past that helps us, collectively or individually, to understand the present, and create a better future” is both to underscore the temporal nature of that juncture in relation to the innovation/time axis, and, through its inter-relationship with ‘identity’ to introduce people into the space/place equation. That said, there remains a current fixation on districts and spaces ‘for innovation’, buildings and places in which innovation happens, and in some instances, a sense of overcompensation through cultural re-appropriation. The general direction evidenced across the case studies, however, is toward this more fluid and responsive ‘place-driven’ innovation model. By reversing the concept from the (conceptually insular) constraints of ‘place-based’ to the (conceptually open) movement of ‘place-driven’, the initial spatiotemporal tension is effectively eliminated.

5.3 Place-driven innovation and sustainability

Elimination of this conflict would in itself suggest that the ‘place-driven’ model is more sustainable than previous approaches. At a basic level, the model contributes to the sustainability of place through the inclusion of people as catalysts, an inarguably renewable resource, and by its advocacy for innovation to address needs and challenges.

There is a more complex relationship between the model and sustainability in terms of permanence. Clearly, the model calls for openness, fluidity and dynamism, and advocates for responsiveness to people and place over time as key to sustainability. It is not, however, a rejection of permanence, or prioritising one over the other. Conceptually speaking, the “Sustainable Innovation Wheel” requires all ‘fixed’, ‘permanent’ elements – including the *where*, the *who* and the *what* (spatial, social and cultural), to be in place and balanced in order to turn; it cannot turn on the *how* alone.

5.4 A Fourth Way

Taken cumulatively, the evidence asserts a ‘place-driven’ fourth typology of innovation district; a citizen-led, people-driven, civic innovation space. This quasi-spatial district is non-territorial, eschewing to some extent the notion of ‘districts’ and ‘hubs’, in favour of an open and dynamic interconnected network. By transcending the territorial boundaries of place, it avoids the ‘unintended impacts’ of hyper-investment in specific geographic districts, promoting instead a new and democratised approach to innovation, at the heart of an inclusive, and people-driven economy. Over the next twelve months, the ‘M4’ action research programme will seek to test the viability and validity of the fourth innovation space in practice, using a series of human-centred value metrics related to the four constructs (spatial, social, cultural and civic). This is an innovation economy, liberated. A fourth way.

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THE URBAN DIMENSION OF INNOVATION POLICY: ROXBURY INNOVATION CENTER

C. Bevilacqua, C. Maione, V. Borrello and L. Parisi

PAU Department, Università degli Studi Mediterranea di Reggio Calabria, Salita Melissari, 89124 Reggio Calabria, Italia

Email: cbevilac@unirc.it

Abstract: The paper intends to explore a new paradigm of urban development process driven by the increasing demand of innovation. The aim is to demonstrate how innovation has become part of the urban settlement dynamics towards regeneration processes. Spurring innovation through knowledge-based economy has been driving the design of public development policies. Knowledge generates economic growth by stimulating the potential of entrepreneurship and innovation. In this context, cities are emerging as knowledge hubs, able to attract high-skilled workers, generate creativity and innovation and provide advanced services and infrastructures connected through formal and informal network systems. Findings from the MAPS-LED project (Horizon-2020) show how in specific urban areas the knowledge dynamics in activating the concentration of innovation generate spillover effects, which supported by urban planning tools, allow the expansion of innovation and the generation of physical transformations. Among the case studies of the MAPS-LED project, the Roxbury Innovation Center (Boston, MA) has been investigated as an emblematic case of public initiative to spur economic development and urban regeneration processes through innovation. The public authority of the city of Boston, through the creation of this public Innovation Center is trying to generate a positive impact on the local community by providing the necessary tools, workspaces, connections and programs to enhance the development of the knowledge-based economy and support startups and entrepreneurs.

Keywords: Cities, Innovation Ecosystem, Innovation Space, MAPS-LED, Urban Regeneration.

1. INTRODUCTION

In response to the past and the ongoing economic crisis, the primary challenge for National and Regional Government, both in Europe and in the USA, is to promote policies and actions focused on fostering creativity and innovation aiming at repositioning cities in a competitive scenario. New geographical, political, economic dynamics generated by the global crisis have reformulated the significance of Innovation, which becomes a process able to intercept the market opportunities based on the exploitation of endogenous resources and potential local assets.

In 2007, the OECD (Organization for Economic Co-operation and Development) sustained that new strategies to reduce the degree of social exclusion and improve the economic growth in deprived contexts should focus on promoting innovation as the main engine to enhance competitiveness and foster social and economic development (OECD, 2007). A few years later, the World Bank recognized innovation as a key factor for socioeconomic progress, generating wealth and skilled jobs, promoting the development of the urban systems, and increasing the level of competitiveness between cities (The World Bank, 2010).

“In the global knowledge economy, knowledge-intensive industries and knowledge workers are extensively seen as the primary factors needed to improve the welfare and competitiveness of cities” (Yigitcanlar, 2011a, p.22).

In order to support these dynamics, the public strategies are promoting the discovery of niches of innovation and knowledge hubs, in which the entrepreneurial phenomena can evolve towards a specialized diversification, by producing competitive advantages in urban contexts (del Castillo Hermosa, Elorduy and Eguia, 2015). According to the emerging change within the development and innovation policies, Smart Specialisation has been introduced in 2006 by Foray as a new innovation policy framework designed to promote an effective use of public resources by investing in the local assets to foster innovation and create competitive advantages. The goal is to make European regions able to achieve economic growth and prosperity to compete in the globalization era.

In order to reduce the increasing gap between the EU and the U.S. in terms of producing and using innovation for economic growth, the Smart Specialisation Strategies (S3) have gained relevance within the EU2020 framework. The Regional Plan for S3 became an ex-ante conditionality in the new Programming Period 2014-2020 (Del Castillo, Paton and Barroeta, 2015) in order to invest structural funds towards innovation strengthening.

S3s are considered as key factors for enhancing place-based innovation policies. In the report “Implementing Smart Specialisation Strategies: A Handbook” (2016), the European Commission recognized the Entrepreneurial Discovery Process (EDP) as a key driver of Smart Specialisation Strategies, considered as an inclusive and interactive process where the ‘entrepreneurial knowledge’ is at the core of the innovation-based development. Therefore, the EDP can be interpreted also as a learning process for regions. The involvement of entrepreneurs in the design and implementation of Smart Specialisation Strategies is crucial to recognize the competitive advantages of cities (Pinna, 2016).

In this context, cities have emerged as knowledge hubs (center of knowledge creation), since they are able to attract high-skilled workers, generate creativity and innovation and provide advanced services and infrastructures connected through formal and informal networking systems (Penco, 2011).

Cities stimulate innovation through the creation of favorable ecosystems, which boost competitiveness, foster knowledge production, innovation and socioeconomic development (Spinosa, Schlemm and Reis, 2015), being also able to revitalize urban distressed areas. In some cases, these ecosystems develop spontaneously thanks to existing conditions, such as the presence of strong anchor institutions and the proximity to infrastructures, while in some other cases they need a consistent push from the public or private sector.

The challenge for cities in today’s knowledge economy lies in creating and supporting innovation ecosystems, that consist of a set of complex relationships among different actors, entities, and intangible resources “whose functional goal is to enable technology development and innovation” (Jackson, 2011, p.2).

In order to understand how cities are facing this challenge, the MAPS-LED project (a Marie Skłodowska-Curie RISE research project funded by the European Union’s HORIZON 2020 program) has observed how innovation-oriented policy initiatives may affect the knowledge concentration process, considering also the exogenous dynamics acting on the specific

neighborhoods. For this purpose, the research activities focused on the investigation of different case studies in the cities of Boston and Cambridge (MA), identified by overlapping urban regeneration initiatives with the innovation-oriented policy initiatives, including the occurrence of the geographic concentration of interconnected firms (according to the definition of clusters by Porter, 1998). The innovation spaces have been investigated as physical facilities that provide workspaces, equipment and business services to innovators, hosting networking events, training and mentoring programs to increase workers' skills and facilitate connections between the different actors involved in the innovation process.

The paper aims at pointing out how, in specific urban areas, innovation spaces stimulate knowledge dynamics in order to favor the concentration of innovation in generating spillover effects due to the implementation of specific urban planning tools. The phenomenon of innovation concentration in particular places characterized by the presence of mutual factors (anchor institutions, startupper centers, physical transformations towards the demand of innovation) has created a regeneration process in backward urban areas, by triggering a process that can be called 'expansion of innovation'.

This contribution is articulated into three main sections: the first explores the role of the Innovation spaces as an expression of knowledge dynamics; the second investigates the main innovation policies spurring regeneration processes at the city level in the U.S.; the last section presents the results of the case study of the Roxbury Innovation Center, a public innovation space considered as an engine for the socioeconomic and urban growth of Roxbury, a deprived neighborhood of the city of Boston (MA). The paper further investigates the policy initiatives and tools implemented by the public authorities to support the creation of an innovation ecosystem.

The Roxbury Innovation Center represents an emblematic case study, since it is among the new generation of urban planning tools and initiatives focused on innovation that has been promoted to spur urban regeneration processes. The innovation center has helped to realize the willingness of the Local Administration to revitalize, economically and socially, the multi-ethnic and disadvantaged neighborhood of Roxbury. The public authority through the creation of this innovation facility aims to generate a ripple effect on the creation of jobs and the development of an innovation ecosystem that will spur the growth of the local economy.

The emphasis on Innovation Spaces, that is becoming common both in the European and the U.S. cities, highlights the need to focus on supporting interaction, cooperation and knowledge flows even with the support of urban planning tools and economic development measures. This approach could be crucial for the urban and economic growth and the development of the knowledge economy, especially where the innovation community is just beginning to evolve.

2. THE ROLE OF INNOVATION SPACES AS AN EXPRESSION OF KNOWLEDGE DYNAMICS

In the literature, from Alfred Marshall (1920) to Robert Park (1925), cities have been considered as melting pots of diversity and sources of creativity and innovation (Florida, 2003). Jane Jacobs (1969) has long pointed to the role of the urban environment as an incubator for creativity, innovation and entrepreneurship. Her theoretical approach, together with the one of Joseph Schumpeter (1934) about on the relevance of innovation and

entrepreneurship for cities, today stands again at the heart of the scientific and political debate.

Urban areas, in fact, by offering proximity to services, density, variety, knowledge institutions and specialized labor force, facilitate the networking process (Athey, Nathan, Webber and Mahroum, 2008) and create the right atmosphere for spurring the knowledge dynamics, that involve higher research institutions, local organizations and communities, comprehending both entrepreneurs and citizens.

Both in Europe and America, cities are implementing a new urban innovation-oriented development paradigm, characterized by the creation of innovation ecosystems, supported by the urban policies and the spatial planning. The combination of the two has the potential to economically regenerate specific urban areas, promoting the existing local assets (material and immaterial) and identifying the new ones.

In this context, innovation spaces (innovation centers, co-working, research labs, accelerators, etc..) are emerging as important instruments to enhance local development and support the creation of innovation ecosystems by encouraging exchanges of knowledge between different actors, assisting entrepreneurs, and promoting cross-fertilization of ideas and cross-sectoral collaborations. They accomplish these missions by providing affordable offices, business services, networking events, training and mentoring programs for local startups, entrepreneurs and innovators.

Innovation spaces are attracting entrepreneurs, startups, innovators and investors in cities, generating new knowledge dynamics and spurring urban and economic development. They represent an emerging factor of the new demand of innovation-oriented physical transformations that recall the specific requirement of the Entrepreneurial Discovery Process about catalyzing the entrepreneurial knowledge dynamics.

In recent years, policymakers recognized the potential of these spaces as enablers of innovation and they are supporting them by stimulating a favorable environment for innovation (Rodriguez, Congdon and Ampelas, 2015).

3. THE PUBLIC POLICY EFFORT TO ENHANCE THE ECONOMIC DEVELOPMENT THROUGH INNOVATION

The City of Boston is actively enhancing the socioeconomic development by exploiting the potential of innovation. As a matter of fact, over the past years, different innovation initiatives have been implemented to generate urban transformation processes able to trigger the territorial growth. Together with the urban planning, they have acted in a complementary way for supporting the knowledge dynamics and the regeneration of the local economy. A sample of these innovation-oriented policy initiatives are illustrated in Table 1.

Table 1: Innovation-oriented policy initiatives in Boston

Source: Authors' elaboration, data from City of Boston (2013, 2015a) and Boston Redevelopment Authority (2013a).

| Geographical level | Innovation-oriented policy initiative | Main objective | Start Year |
|--------------------|---------------------------------------|--|------------|
| City of Boston | LifeTech Boston | Foster the growth of Boston's life sciences and high technology sectors, support existing LifeTech companies and attract national and international businesses to join the main cluster areas in the City. | 2004 |
| | Boston Innovation District | Transform the South Boston waterfront area in an urban environment that fosters innovation, collaboration, and entrepreneurship. | 2010 |
| | Neighborhood Innovation District | Support neighborhood residents, existing business and startups in the creation of innovations by providing information, training, connections and physical locations for innovators and entrepreneurs. | 2014 |

In 2010, the City of Boston together with the Boston Redevelopment Authority has promoted the renovation of a former industrial, underutilized area close to the city center, namely the Seaport District, launching the so-called Boston Innovation District initiative aimed at creating “an ecosystem of innovation and entrepreneurship” (Rodriguez et al., 2015, p.6). The Public entity supported the project by implementing the infrastructures and creating a gathering spot to attract the community of innovators, including both consolidated and emerging companies. Over the past years, the Boston Innovation District has created over 4,000 new jobs and attracted 200 new companies (City of Boston, 2013), catalyzing investments and new partnerships that boosted the transformation of the area.

“Building on the successes and lessons learned from the Seaport Innovation District” (City of Boston, 2015a, para.1), the City explored the possibility to push the innovation dynamics spurring the development of either deprived or underdeveloped neighborhoods.

For this purpose, it launched the Neighborhood Innovation District initiative to “help create new jobs, support existing business owners and well-established businesses, and encourage new investments” (City of Boston, 2015a, para.6).

The initiative aims to create different Innovation Districts across the city, which should promote an inclusive growth, invest on people (through training and mentoring programs) and provide the necessary infrastructures (e.g. affordable gathering spaces for innovators, access to public transportation, affordable housing, high-speed internet) to create a hub of creativity and innovation for enhancing the local entrepreneurship (City of Boston, 2015a).

Nevertheless, Neighborhood Innovation Districts are different from Innovation Districts, since they specifically target the local residents “from both a human capital perspective as well as a product perspective” (Maher, 2015).

4. THE CASE STUDY: ROXBURY INNOVATION CENTER

The pilot project of the Neighborhood Innovation District has been launched in 2014, focused on the neighborhood of Roxbury, located just 3 miles South West from downtown Boston. Roxbury is one of the poorest and most densely populated neighborhoods of the city, where the percentage of population below the poverty level is about 33%, compared to the 21% of Boston (City-data, 2013), while the unemployment level is 17% versus 10% of the whole city (Boston Redevelopment Authority, 2014).

It is a multiethnic neighborhood, representing the nucleus of the Afro-American community in Boston (The Boston Indicators Project, 2010, e.g. see Figure 1). The median household income ranged from \$18,000 to \$44,000 between 2009 and 2013, compared to the \$53,601 of the city average (Hartman and Zhu, 2013).

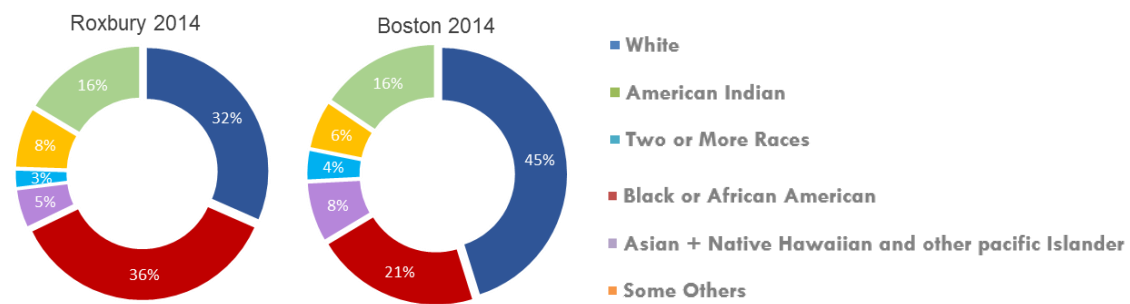


Figure 1: Population Breakdown by Race.
Source: Authors' elaboration. Data from U.S. Census Bureau, 2016.

The Dudley Square area (e.g. see Figure 2), belonging to the neighborhood of Roxbury, has been selected as the preferred location for the implementation of the pilot project “due to its economic vitality and the opportunity to use the infrastructure already established to create a hub of innovation and entrepreneurship” (City of Boston, 2015 a, para.8).

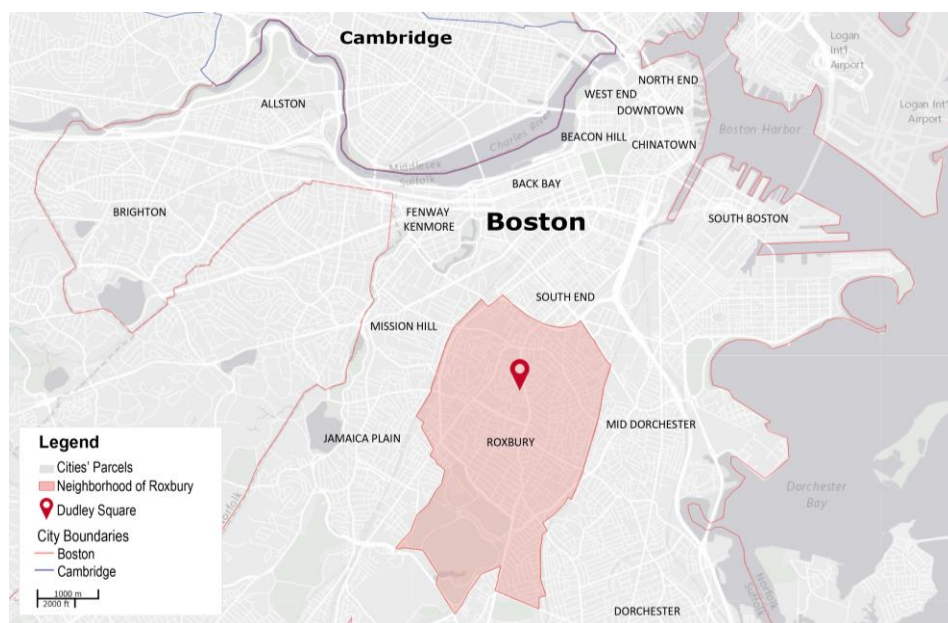


Figure 2: Dudley Square area. Source: Authors' elaboration.

Since the 2000s, Dudley Square has been the focus of several urban regeneration initiatives, aiming at providing new housing, commercial facilities and public services, including the enhancement of the transportation system. The following table shows the main urban planning initiatives that have been implemented in the last years to revitalize the area.

Table 2: Dudley Square Planning Initiatives

Source: Authors' elaboration, data from the Boston Redevelopment Authority (2017a).

| Target area | Planning Initiative | Planning Type | Description | Start Year |
|------------------------|--|-------------------------|--|-------------------|
| Dudley Square, Roxbury | Dudley Square Transportation & Air Quality Study | Transportation Planning | The Dudley Square Transportation & Air Quality Study provides a set of recommendations upon transportation network, environment and quality of life in Dudley Square outlining development options supported by the community. | 2001 |
| | Dudley Square Vision | Economic Development | The planning initiative includes: real estate development; creation of a comprehensive Retail Strategy to enhance the commercial district; traffic improvements. | 2007 |
| | Dudley Square Municipal Office Facility | Economic Development | Redevelopment of an historic municipal facility located in the hearth of Dudley Square. It will be the new Boston Public Schools headquarters, and will include retail and office spaces. | 2012 |
| | Plan: Dudley Square | Community Planning | The planning initiative will revisit the recommendations presented in the 'Dudley Square Vision' to align them with current community goals. | 2016 |

In relation to the urban planning initiatives activated in the area, a gradual change in the explanatory variables of regenerative effects is observed: increases in the number of inhabitants, housing values and the number of adults with college degree (e.g. see Figures 3, 4, 5).

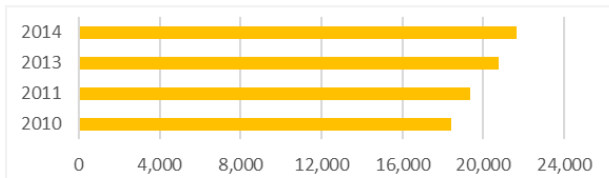


Figure 3: Population. Source: Authors' elaboration. Data from U.S. Census Bureau, 2016.

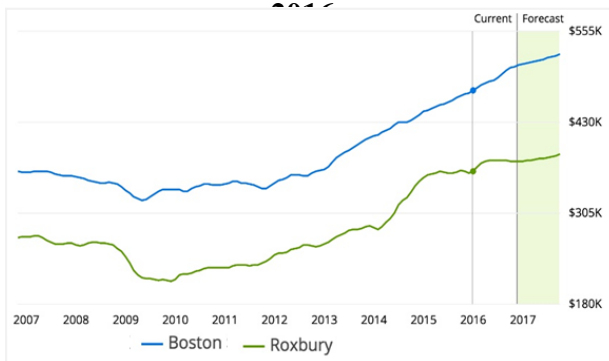


Figure 4: Housing values. Source: Zillow (2016).

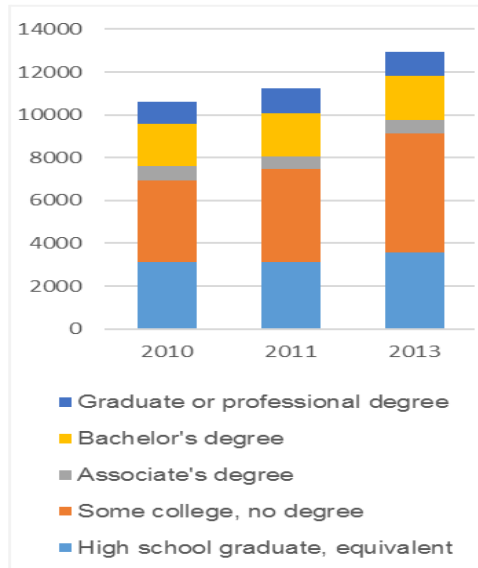


Figure 5: Level of education attainment. Source: Authors' elaboration. Data from U.S. Census Bureau, 2016.

The engine of the Neighborhood Innovation District initiative has been the creation of the Roxbury Innovation Center (RIC), a civic innovation space which opened in 2015, providing business services, working spaces, networking opportunities and educational programs to the local community. This physical facility, located in the hearth of Dudley Square, will represent “a catalyst for economic development” and will lift “the entire community”, as stated by Martin J. Walsh, Mayor of Boston (City of Boston, 2015 b, para.2).

The case study of the Roxbury Innovation Center has been investigated through a mixed methodology, comprehending both qualitative and quantitative approaches, in order to examine the link between innovation spaces, urban regeneration processes and local development. The research has been grounded on both on-desk and on-field analysis. In particular, the socioeconomic data have been collected for the years 2009-2014 from different official sources, while several exploratory visits and different targeted interviews to key informants have been carried out between April and July 2016. The main tools used to investigate the case study were the interview form and the survey form. The interview form allowed to gather information about the issues of governance, management and organization, territorial network and mission of the Roxbury Innovation Center. A specific Survey Form has further been developed in order to investigate in depth the social, economic and physical aspects of the area surrounding the case study. It focused, in particular, on: infrastructures, services, public and innovation-related facilities. The main sources considered for the on-desk data are: the City-data official website and the U.S. Census Bureau, which data have been used to perform a preliminary analysis of the local context and the websites of the City of Boston and the Boston Redevelopment Authority, useful for extrapolating the urban planning initiatives and tools investigated in this study.

In order to create the Roxbury Innovation Center and to seek out an operator of the facility, in 2014, a Request for Interest, Ideas and Innovation (RFI) and, subsequently, a Request for Proposals (RFP) have been launched by the Public Authority (City of Boston, 2014).

The City of Boston selected The Venture Café Foundation (VCF) to operate the Innovation Center as a “mission-driven not-for-profit gathering and event space to connect the innovation community, expand the definition of innovation, and build a more inclusive innovation economy” (Roxbury Innovation Center, 2015, para.1).

The Venture Café, besides running the space, organizes free networking events, mentoring and training programs for both adults and young people, and educational initiatives together with Public, Private and no-profit organizations to provide community-driven activities (Roxbury Innovation Center, 2015). As a matter of fact, the VCF is also focused on avoiding people’s displacement and maximizing the benefits of the local community. Private and public actors have been involved in the development of the space, demonstrating the willingness to create an ecosystem of innovation (and not simply a facility) that will enhance innovation and economic growth in this deprived area. The RIC will represent the anchor institution of this ecosystem. In particular, the Massachusetts Technology Collaborative (MassTech), a State-funded Agency supporting cluster development, has provided \$150,000 grant funding to support the management and programming of the Innovation Center (City of Boston, 2014).

The 3,000 square feet of the RIC, offer free co-working areas, affordable private office spaces, flexible conferences and event rooms available for renting. In particular, the physical capital provided consists of: the Think Space (a large multi-purpose event room), the Learn Lab (medium-sized room for classes and workshops), the Team Room (a small room for meetings of 4/8 people). In addition to those renting spaces, RIC is equipped with a digital Fabrication Laboratory (FabLab) and an open co-working area, which are available to the local community. The Roxbury Innovation Center is a dynamic, interactive space, where innovators, investors, students, entrepreneurs and startups from different sectors (not just technology) can run into each other, share ideas and learn.

The Innovation Center is housed inside the Bruce C. Bolling Municipal Building, that hosts also the headquarters of the Boston Public Schools (BPS). The BPS and the Venture Café Foundation work together to support and connect people “so that every person with an idea can build it, grow it, [and] become a successful entrepreneur” (City of Boston, 2014, para.5).

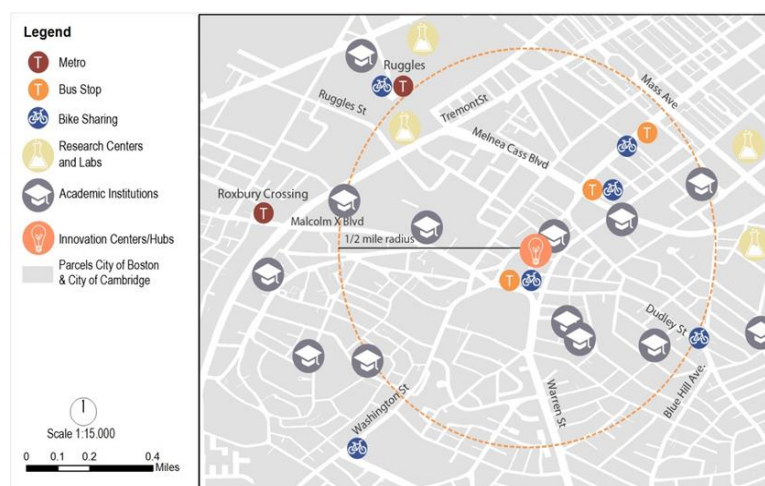


Figure 6: Development Projects and Transportation system of the area. Source: Authors’ elaboration.

The building is near several innovation centers and education facilities (such as the Northeastern University) and close to two subway stations and the Dudley Square transportation hub (e.g. see Figure 6). This proximity helps to enhance the connection between entrepreneurs, students, graduates and academia, and encourages the access to the Innovation Center. The following maps illustrate respectively the transportation system with the main completed and planned development projects implemented by the Boston Redevelopment Authority (BRA) in the area (e.g. see Figure 6) and its built environment, including the research centers and labs, the academic institutions and the innovation centers (e.g. see Figure 7), detectable within half-mile radius (about 800m) of the Innovation Center.

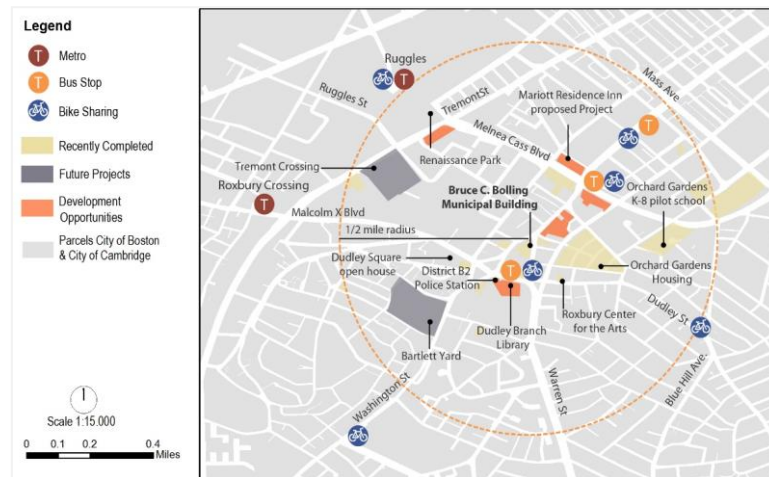


Figure 7: Map of the Built Environment. Source: Authors' elaboration.

The above-mentioned development projects are implemented through specific regulatory actions that are hierarchically organized as follows:

- Metropolitan Area Planning, which promotes Smart Growth and Regional Collaboration. The Metropolitan Area Planning Council (MAPC), the regional planning agency that is responsible for the Metropolitan plan of Boston, works towards “sound municipal management, sustainable land use, protection of natural resources, efficient and affordable transportation, a diverse housing stock, public safety, economic development, clean energy, healthy communities, an informed public, and equity and opportunity among people of all backgrounds” (MAPC, 2014);
- City Comprehensive Plan, that implements “ordinances, such as Zoning or subdivision” within the urban contexts (American Planning Association, 2017);
- Downtown districts, neighborhood districts, Harborpark District and Special Purpose Overlay Zoning Districts, among others (Boston Redevelopment Authority, 2017b).

Within the Roxbury Neighborhood District, the Article 50 of the Boston Zoning Code has established a specific Economic Development Area (EDA) in Dudley Square, called “Dudley Square EDA”, to encourage economic development and commercial activities, with a specific focus on the interests of the community (Boston Redevelopment Authority, 2013b). A particular attention is given to the promotion of innovation by requiring a certain amount of research and development uses in the area, intended the same way as the usual urban land use category of the zoning.

As a matter of fact, the amount of space dedicated to innovation acquires a sort of "service" implication, becoming a requirement of the zoning, like the spaces for commercial facilities, residential areas, education, etc.

According to the Article 50, the 30% of the gross floor area of any new development plan proposed within the area must be dedicated, or must support the following uses:

- "Research, development, and production of pharmaceutical and biomedical products;
- The design, development, fabricating, and testing of instruments for engineering, medical, dental, scientific, optical, or other similar professional use;
- Other scientific Research and Development Uses, including laboratories and facilities for theoretical, basic, and applied research, product development and testing, prototype fabrication, or production of experimental products" (Boston Redevelopment Authority, 2013b).

These spaces of innovation can be managed by either private, public, or governmental entities (Boston Redevelopment Authority, 2013b). The city of Boston is trying to push innovation through the above-mentioned tools and planning initiatives in Dudley Square, among which the Roxbury Innovation Center represents an interesting case. This facility, as a pilot project of the Neighborhood Innovation Initiative, aims to create a positive impact on the local community by providing the necessary skills, tools, workspaces, connections and programs to enhance the development of innovation and support new entrepreneurs to start and grow new companies. This, in turn, acts towards bridging the existing gap between the disadvantaged neighborhood of Roxbury and the rest of the city, by strengthening and expanding the innovation economy (Pagonos, 2015). This is one of the most difficult challenges that the Boston administration is called to face, for bucking the trend of the traditional urban strategies, disrupting the patterns of inequality.

5. CONCLUSIONS

Quoted Yigitcanlar (2011b), in the emerging role of intensive-knowledge economy, cities produce various development strategies. Such strategising is an important development mechanism for cities to complete their transformation into knowledge cities. The case study of Roxbury Innovation Center is an example of how innovation policy supports urban innovation-led initiative to attract companies, research institution, startups, accelerators in creating a dense community of innovators, in other words to contribute in building an innovation ecosystem. Alongside the emerging rise of innovation districts across the U.S. and EU with a specific and recognizable connotation, the urban regeneration initiatives encompass also those planning activities that include innovation as a characterization of the area under zoning rules. More in particular, the case study is paradigmatic in the way in which innovation turns on urban regeneration planning initiative to transform a backward urban area into a vibrant neighborhood. The phenomenon of innovation concentration in particular places of Boston characterized by the presence of mutual factors (anchor institutions, startupper centers, physical transformations towards the demand of innovation) has created a regeneration process in backward urban areas, like Roxbury, by triggering a process that can be called "expansion of innovation".

"There has been a huge plan to connect Roxbury to the rest of the city. The Administration hopes that the neighborhood will be the next Innovation District, making sure that people go back there with their families attracted by the new opportunities that will arise" (personal

communication, June 30, 2016). Differently from the other innovation spaces spread all over the city, the Roxbury Innovation Center is more locally focused and represents a great opportunity for the specific deprived neighborhood to change its path (personal communication, June 25, 2016). As the Director of the Roxbury Innovation Center Alessandra Brown stated “we are hoping to assist the growth of entrepreneurship and helping people really to sustain themselves and their small businesses . . . We are giving them the ability to choose to stay in the community” (2016). One of the main aim of the Innovation Center is to provide a gathering point for people, providing them several local community outreach activities, so that “people can come in and feel engaged in very productive programs” (personal communication, June 25, 2016). The Boston Planning Authority contributed to the implementation of this innovation space in Roxbury by providing new public services and including specific requirements within the zoning code of the area to support local innovation, that, in turn, can spur the Urban Regeneration processes across the city. This public effort, sustained by specific planning tools, can be considered a good practice of how to trigger these processes and augment innovation also in the most lagging regions of Europe, bridging the existing “innovation gap”. As a matter of fact, Europe still presents deep differences: on the one hand, there are regions that are able to compete in the globalized market by focusing mainly on the high tech sectors (Borrás, 2011) and, on the other hand, regions with unsolved structural economic weaknesses. In these last ones, in fact, there are several barriers to innovation linked to the shortage of high-skilled workers, innovators, research and technological infrastructures, the poor cooperation between businesses, universities, and research centers, as well as the lack of support to startups and entrepreneurs. As in the case of Roxbury, one of the measures implemented by the Public Authorities to overcome these deficiencies and enhance innovation and competitiveness, is the creation of Innovation Spaces that can emerge as promoters of urban and economic growth, supporting the local communities to express their potential. At the city level, they are conceived to stimulate the knowledge convergence by endorsing the local organizations. It is interesting to observe how the urban policies supporting these initiatives, can be considered the input of these Knowledge concentration processes, which, in turn, trigger the Entrepreneurial Discovery Process (EDP), important for the implementation of the innovation ecosystem and the coordination of the efforts of different actors (public administrations, research institutions, entrepreneurs, communities). These measures can support the enhancement of the Smart Specialization Strategy (S3) for designing the changes of the Cohesion Policy 2014-2020, which aim is to reduce the disparities among the European regions (Barca, 2009). The S3 process needs to be translated into Regional Plans (RIS3), that can contribute to understand where innovation occurs and how to boost it in order to reach a smart, inclusive and sustainable growth. The major challenge for an effective RIS3 implementation is the territorialisation of the urban redevelopment strategies. Thus, the place-based approach allows to build virtuous regeneration projects, spurring the potential of the “territorial DNA” for identifying, recovering and increasing the values of the local specificities. For this purpose, the planning process has the potential to become a key-driver for enhancing innovation. The case study of the Roxbury Innovation Center emphasizes the importance of these factors that should be comprised within the public policies in order to foster the S3 in lagging regions, where the creation of an ecosystem of innovation can trigger the EDP, by overcoming the conventional barriers to growth.

6. ACKNOWLEDGEMENTS



The MAPS-LED project has received funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 645651.

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GREEN ECONOMY AS A DRIVER FOR URBAN REGENERATION: INSIGHTS FROM GREENTOWN LABS, USA

G. U. Cantafio

PAU Department, Università degli Studi Mediterranea di Reggio Calabria, Salita Melissari, 92124, Reggio Calabria, Italy

Email: Giuseppe.cantafio@unirc.it

Abstract: The objective of this study is to investigate the linkages between economic development, innovation and environmental sustainability inside urban areas. To achieve this goal, this paper adopts a case study strategy, by drawing inspiration from an incubator located in the Boston metropolitan area, named Greentown Labs. The case study is discussed by analysing the different stages the Greentown Labs went through, relocating from Cambridge to Boston and then from Boston to Somerville. The present contribution will give some recommendations considering the creation of incubators as facilitator of growth of innovative start-ups that can be essential for spurring innovation and economic development within urban centres.

Keywords: MAPS-LED, Greentown Labs, Sustainability, Innovation, Incubator.

1. INTRODUCTION

Innovation is a procedure that brings to a result: this result is, by definition, new in the sense that it is a thing or a way of making something that before was not there (Godin, B., 2008). Innovation is a proxy of the generation of new knowledge and it happens by means of several causes: project and engineering activities, specialization courses organized by the production divisions, interactions with customers and contractors, re-utilization of existing knowledge coming from outside the firm (Katz, J., 2004). Innovation must be distinguished from invention. Many theorists have defended this argument over the course of the years. Innovation is essential to all economic activity: it is an invention, activity, market, source of supply or business group that is not only created, but put in action, utilized or promoted by a firm (OECD, 2005).

The incubator of Greentown Labs, in Somerville, MA (USA) has an important role for the innovation, being an incubator for start-ups with the mission of enabling a vibrant community of entrepreneurs to work on their visions and to provide access to the space, funding, a prototyping lab and co-located office space and other facilities to enable start-ups to rapidly grow their networks and their companies.

MAPS LED is a European research project aimed at examining how innovation happens spatially. This project has first mapped at the urban level the most performing clusters in the Boston metropolitan area and then identified within this area the initiatives, where creation and use of innovation happen. Figure 1 shows the initiatives selected for the project. Among them, Greentown Labs has been chosen for this paper, since it is focused on the Green tech sector, or more in general on the Green Economy. The case study will be discussed by analysing all the steps of its development, exploring the different locations where Greentown Labs was placed through the years. Finally, lesson learned will be discussed, lesson transfer,

justification for the case study selected, benchmarking across indicators, possible elements of transferability, limitations and constraints.

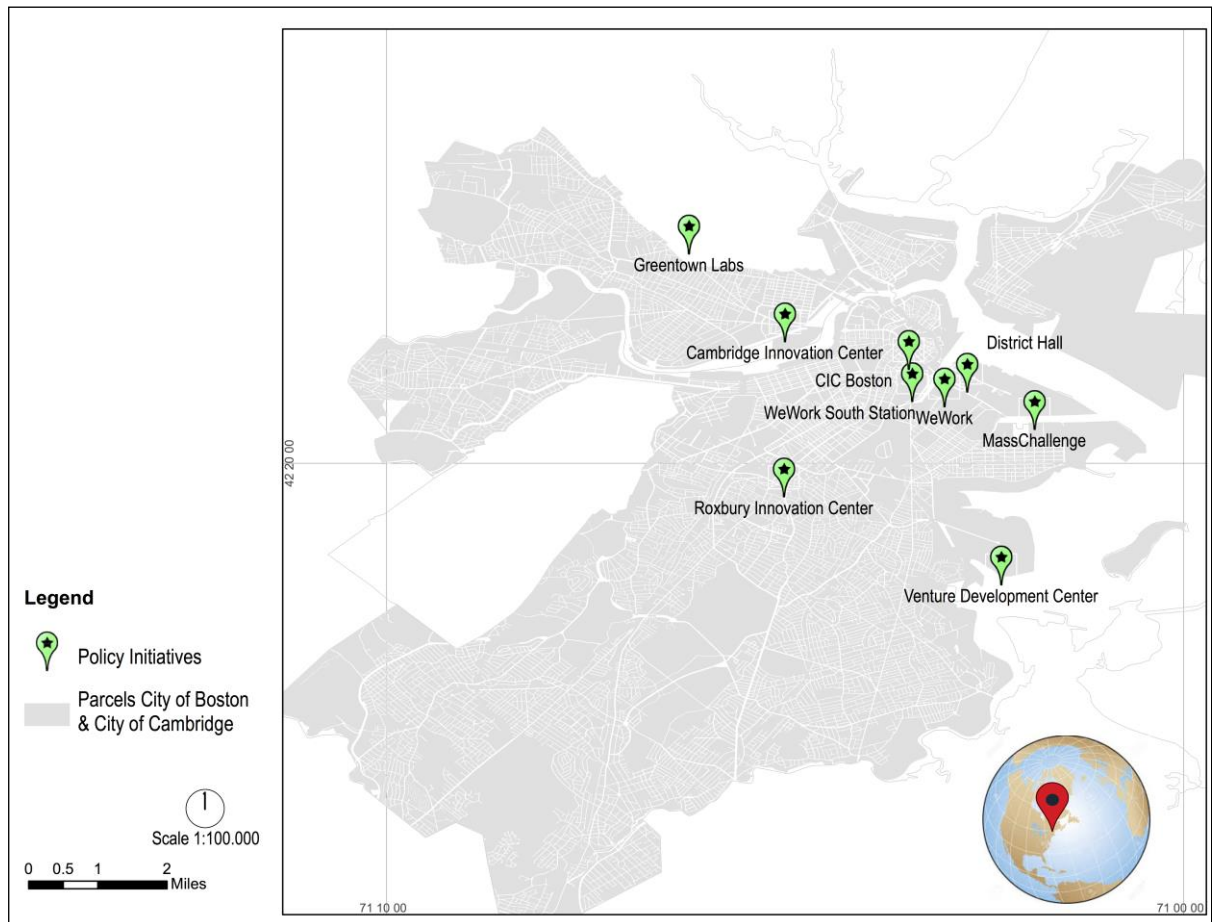


Figure 1: Selected initiatives in the Boston area

2. GREENTOWN LABS

Green Town Labs (GL) is located in Somerville, inside the Boston Metropolitan Area. The case study of Greentown Labs has been analysed under eight factors of success: Constant City Leadership, Supportive National Policy, Focus on city specific issues, Intellectual capital, Public engagement, Strong partnerships, History of global trading, Financial incentives. These eight factors of success have allowed this case study to be successful in attracting investment in the so-called “green tech” sector and in tackling key environmental challenges. Some of these factors are a result of the city’s history and context, rather than having been developed exclusively for the purposes of encouraging the green tech. These factors are important for creating an ideal process to implement this sector in the city (Power, S., 2015).

Greentown Labs is an incubator for start-ups that enables entrepreneurs to solve the world's biggest energy and environmental challenges. The mission of this laboratory is to enable a vibrant community of entrepreneurs to work on their visions and to provide access to the space, resources, and funding that allows their early-stage companies to thrive. They offer 40,000 sq. ft. of prototyping lab and co-located office space, a shared machine shop, immersion in a growing community of energy and clean technology entrepreneurs, and on-

site events and programs designed to enable start-ups to rapidly grow their networks and their companies.

Most of the companies located into GL have already raised some money; they are not in their first phase. It is different than an accelerator like the other present in Boston, e.g. Mass Challenge. Companies located inside GL get some benefits from locating into the incubator, apart from knowledge sharing with other companies and casual networking, companies also get discounts for software purchasing and discount for shipping. GL does not have formal agreements with educational institutions and does not get money from them. GL has a good survival rate regarding start-ups. Among 102 total companies that have been incubated inside GL from 2011, just 18 did not make it until 2016. This means that the 82% of the companies after 5 years was still operating, and this rate is way higher than the one relative to the entire Finance/Insurance/Real Estate Industry which has in US 58% of start-ups still operating after 4 years, while the average rate of start-ups still operating after 4 years among all the industries in US is 50,5% (statisticbrain.com). To have a more general data on the average survival rate of establishments, after 5 years in US it was 56.3 % in the period 2011-2016, while the average survival rate of establishments after 4 years was 61,6% in the period 2010-2014 (Bureau of Labour Statistics, 2016). Other data say that in the U.S. the Percentage of firms that remained in operation through their first five years was 43,2 % in 2012, 45,95% in 2013 and 48,73% in 2014 (Kauffman Index, 2016).

The impact on job creation of GL is impressive, producing currently about 528 jobs. After incubating companies, the incubator tries to retain companies in Boston area, trying to struggle against the migration of the companies elsewhere, in order to keep on generating economic development in the area.

GL collaborates with several agencies and networks for improving its network and receiving funding:

- Mass Development, which is a quasi-governmental agency, supporting manufacturing in Massachusetts. Mass Development, is a state's economic development and finance agency, works with businesses, non-profits, financial institutions, and communities to stimulate economic growth across the Commonwealth. Through these collaborations they help create jobs, increase the number of housing units, revitalize urban environments, and address factors limiting economic growth including transportation, energy, and infrastructure deficiencies.
- The Department of Energy, though it does not receive any money from it.
- The Incubate Energy Network, which is accelerating the transition to a sustainable economy through national coordination of incubator resources supporting entrepreneurs focused on clean energy innovation and deployment. The network has supported more than 500 companies to date and has a significant pipeline.

2.1 The relocations of Greentown Labs

GL started as a start-up in the Kendall Square Area in 2011, and then it grew until it needed more space for developing. To fulfil its needs of more space, it moved into the Boston Seaport district, where it remained for about six months and finally relocated again into Somerville, in a vibrant and large area, seat of already existing up and coming firms.

In order to have a brief idea of the first two areas in which has been located GL, will be provided a brief description. In the Boston Seaport district there has been a huge amount of

public investments by the city of Boston in the last decade, with the intention to regenerate the area and make the district more attractive for business and foster innovation. The Kendall Square area, located in the City of Cambridge, MA, U.S.A., very close to the Massachusetts Institute of Technology (MIT), is one of the most successful international innovation hubs where the integrated approach made possible to create a development processes in social, economic, and physical terms.

Three factors mainly caused the relocation of Green Town labs from South Boston to Somerville:

1) One of the factors that caused the relocation of GL from Boston Innovation District to Somerville is the price of the land. The rent went from 8\$/sq. ft. to \$52/sq. ft. in the Seaport district (South Boston) in a year and a half. The median home value in 2012 in South Boston was \$374,000, while in Somerville in 2012 was \$362,000 (Zillow.com). Now in 2017, the average office space price for sale in the neighbourhood of South Boston is about \$ 650/ sq. ft. while in the city of Somerville is \$ 535/ sq. ft. (Officespace.com). The Commercial Real Estate average rental rate now in South Boston is almost \$37/ sq. ft., while in Somerville is \$32/ sq. ft. (Loopnet.com). This means that still there is a gap in the real estate market between the two areas.

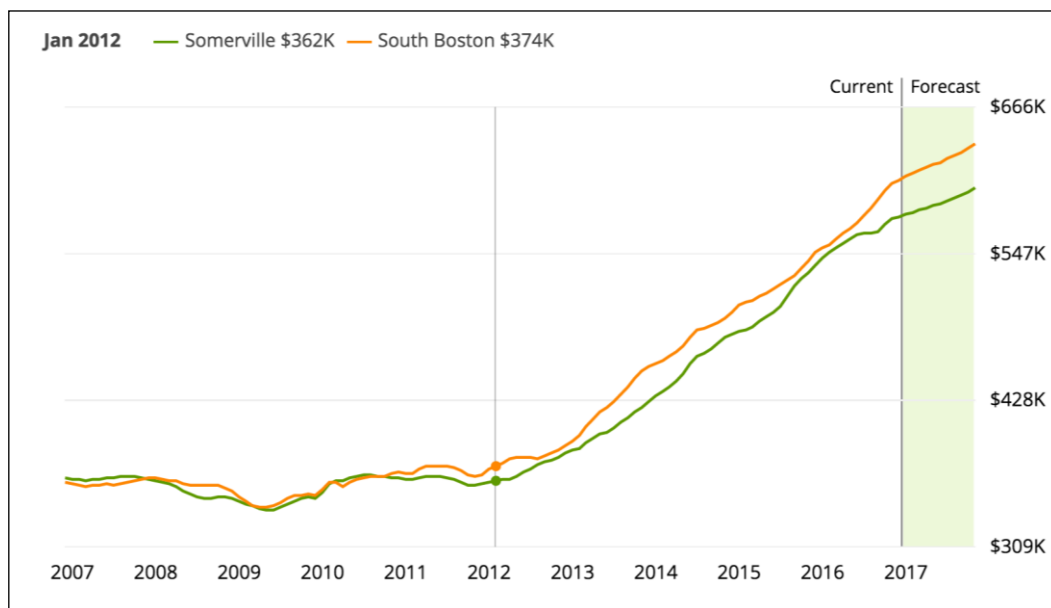


Figure 2 - Median listing price comparison between Somerville (green curve) and South Boston (orange curve). Source: <http://www.zillow.com/somerville-ma/home-values/>

2) Another important factor that emerged from qualitative research carried out by means of interviews was the investment into innovation done by the city of Somerville through “Somervision”, the local plan utilized by the city for the economic development of the area in the long run. It was a flexible document about the new economy, encouraging the growth.

3) The last factor that caused the relocation of the incubator into Somerville was the intention from the city of moving the laboratories much closer to the places where the young professional lived, since the creative class that worked into the incubator stayed in Somerville. By relocating GL into the community, the intention from the city was to create a vibrant community, much more liveable for the workers, that in this way had the possibility to commute to work in shorter time, by walking or bicycling.

At that time, next to the location where GL would have moved, Artisan Asylum was located, a non-profit community fabrication centre including workspaces for local craftsmen. On the other side, there was Brooklyn Boulders, a community space for climbers. The warehouse was a former envelopes factory.

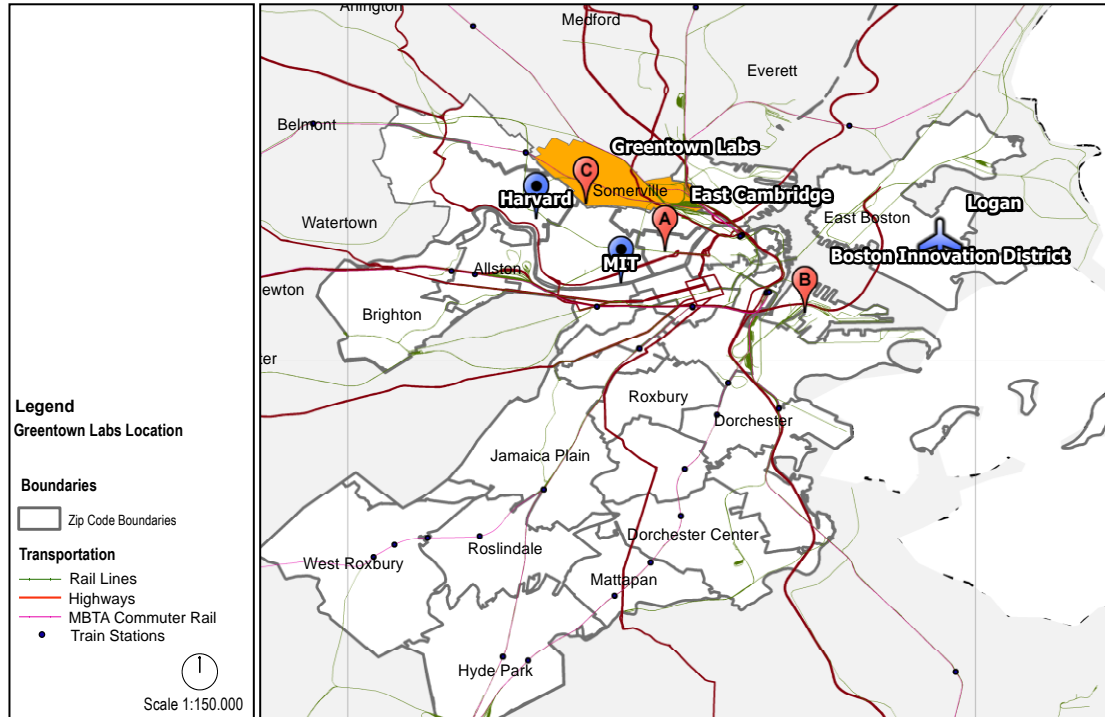


Figure 3 - Greentown Labs Locations over the years: A (Cambridge), B (Boston Innovation District) and C (Somerville)

3. DISCUSSION

In this section it will be analysed the lessons learned from the GL case study, the lessons transfer, the justification of the case study selected for lesson transfer and the possible elements of transferability, limitations and constraints.

In terms of lessons learned from the GL case study, it can be highlighted that the presence of an incubator related to a growing sector like the green tech can work as an attractor for investments, both at the local level and at the national level. The success of this initiative has been favoured also by the presence of significant anchor institutions such as important universities like the MIT and Harvard. These two universities, with the other universities present in the Boston area, played a key role not only because of the high supply of skilled and educated workforce which they furnish, but also because of their essential role in the local community and their strategic influence to the local economy and the consistent relationship which they form together with the local government and the philanthropic sector.

In terms of lesson transfer, the analysis will be conducted by referring to Rose (1991), i.e. under what circumstances and to what extent can a programme that is effective in one place transfer to another.

Moreover, Rose (2005) proposed ten steps that policy makers could undertake in order to deduce lessons from foreign experience:

- 1) Learn the key concepts;
- 2) Catch the attention of policymakers;
- 3) Scan alternatives and see where to look for policy lessons;
- 4) Learn by traveling abroad;
- 5) Theorize a generalized model of how a program or policy works;
- 6) Turn the model into a lesson fitting your own national context;
- 7) Decide whether is a good lesson and if it should be implemented;
- 8) Decide whether the lesson should be applied;
- 9) Simplify the means and conclusions for a greater chance of succeeding;
- 10) Evaluate a lesson's outcome prospectively as it evolves over time.

Policymakers can draw lessons from the GL. The collaboration among different actors and stakeholders can be taken into account as a positive example for lagging regions. The fertile innovation ecosystem present in the Boston area has favoured the rise of several innovation hubs, like GL. The justification of the choice of the GL is briefly explained. This is an exploratory study and implements a case study research of a green tech incubator and it helps in the process of decisions making for the implementation of innovation hubs and incubators in lagging regions, trying to draw possible elements that can be transferred and less positive elements that should be analysed more in depth before being transferred in lagging regions.

The benchmarking process across the context indicators of the two cases consists of comparing indicators and it can be used as a tool to understand if GL can be considered as a positive case study.

In the period 2011-2016 the 82% of the companies incubated in GL after 5 years was still operating. This survival rate of the companies is impressive if compared with the U.S. average rate of start-ups still operating after 4 years among all the industries, which is 50,5%, and with the average survival rates of establishments in the U.S., which was 61,6% in the period 2010-2014. In Europe the average survival rate of firms after 4 years in the period 2010-2014 was 50,6%, while in Italy the survival rate for companies after 4 years in 2014 was 50% in the same period (Eurostat, 2017). These data show that the survival rate for firms in Europe and in Italy are lower than the U.S. average and way lower than the Greentown Labs survival rate. The higher survival rate of firms incubated can represent a success factor due to a better supply of services for the firms inside the incubator, and a better source of investments for entrepreneurs who decided to place their firm inside an incubator in the green tech sector.

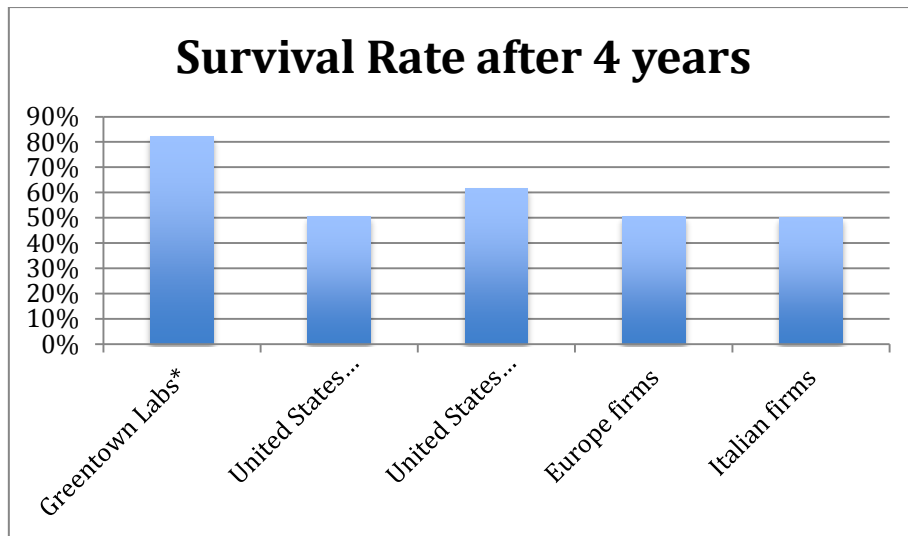


Figure 4 – Survival rate of start-ups incubated into Greentown Labs vs. survival rate of U.S. start-ups, U.S. establishments, European firms and Italian firms (Bureau of Labour Statistics, 2017; Eurostat; Istat; Statisticbrain.com)
*For Greentown Labs the survival rate is calculated after 5 years

Another indicator for the benchmarking is the entrepreneurship level. The success of GL can be explained also as the effect of a high level of entrepreneurship in the United States in general, advantaged by all the aforementioned factors. The United States have the highest Global Entrepreneurship Index, resulting first in the 2017 Global Entrepreneurship Index rankings, which considers data on entrepreneurial attitudes, skills and aspirations of the local population. This resulted in a GEI Score of 83,4 for the U.S. versus lower GEI Scores for all the other countries, comprising European countries from Switzerland (GEI score 78) to Bulgaria (GEI score 22,7) (GEDI, 2017). Moreover, it has to be taken into account an historical American tendency to entrepreneurship.

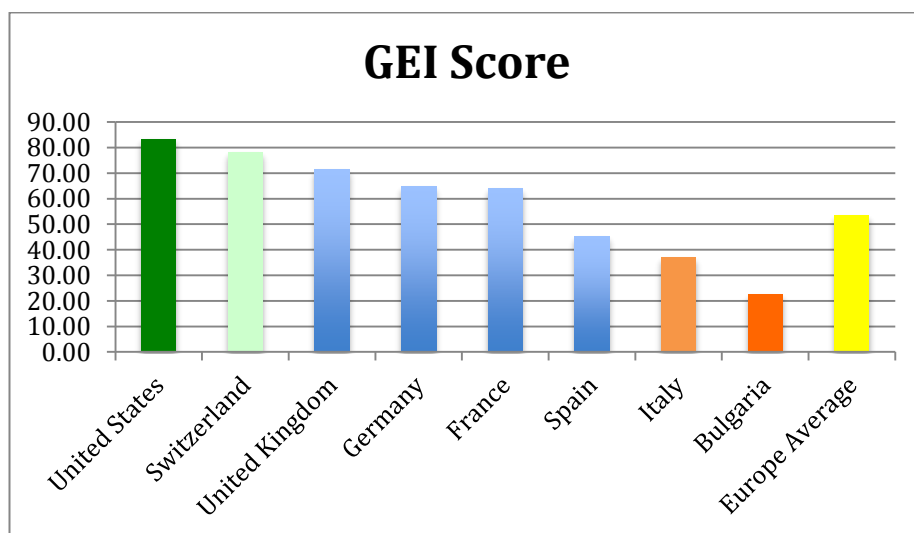


Figure 5 – Global Entrepreneurship Index in the United States and Europe - Author's elaboration based on GEDI, 2017

The installation of more incubators like GL could spur the entrepreneurship level and the number of start-ups in lagging behind regions, especially in a growing sector like the green tech. This kind of incubators work well if there is a highly educated workforce and if there is

the presence of anchor institutions. To some extent the presence of incubators or accelerators could exploit the high number of educated people in lagging regions, functioning also as a brake to the persistent phenomenon of out-migration, which is strangling some lagging regions like the European peripheral regions.

In order to understand the possible elements of transferability of the model in a different context like the one of lagging behind regions, the Italian start-ups environment will be analysed. Following this rationale, we do not assume a policy or an investment in a specific sector to be transferred like an emulative process from one place to another without social and historical background, and institutions being taken into account.

In Italy, at the end of September 2016, the number of innovative start-ups (entered in the special section of the Register of Companies in accordance with Decree-Law 179/2012) amounted to 6,363 with an increase of 420 units respect to the end of June (+7,07%). Start-ups represent 0.4% of the Million and a half active capital companies. Moreover, in Italy at the end of June the incidence of the phenomenon was equal to 0.38%, while it represented a 0.35% in March (Union Camere et al., 2016).

These data show how an innovation led entrepreneurial ecosystem is growing according to national wide indicators, although important gaps are still existing among the North and the South of the nation, where the lagging regions are mostly located, both in terms of economy and innovation. For example, the total share of start-ups of the Southern regions and Islands (Campania, Basilicata, Puglia, Calabria, Sicily and Sardinia) does not even reach the National share of start-ups of Lombardy region alone, which is by far the most innovative region (20,27% of the south versus 21,82% of Lombardy) (Union Camere et al., 2016).

| Distribuzione e densità regionale - Classifica delle regioni | | | | |
|--|-----------------------|-----------------|---|--|
| Classifica | Regione | Valore assoluto | % rapporto sul totale nazionale startup | % rapporto sul totale societa' di capitale della regione |
| 1 | LOMBARDIA | 1122 | 21,82 | 0,35 |
| 2 | EMILIA-ROMAGNA | 578 | 11,24 | 0,53 |
| 3 | LAZIO | 501 | 9,74 | 0,19 |
| 4 | VENETO | 384 | 7,47 | 0,33 |
| 5 | PIEMONTE | 357 | 6,94 | 0,49 |
| 6 | CAMPANIA | 309 | 6,01 | 0,21 |
| 7 | TOSCANA | 302 | 5,87 | 0,30 |
| 8 | SICILIA | 245 | 4,76 | 0,28 |
| 9 | MARCHE | 239 | 4,65 | 0,63 |
| 10 | PUGLIA | 200 | 3,89 | 0,25 |
| 11 | TRENTINO-ALTO ADIGE | 176 | 3,42 | 0,95 |
| 12 | FRIULI-VENEZIA GIULIA | 137 | 2,66 | 0,58 |
| 13 | SARDEGNA | 137 | 2,66 | 0,41 |
| 14 | CALABRIA | 117 | 2,27 | 0,37 |
| 15 | ABRUZZO | 112 | 2,18 | 0,34 |
| 16 | LIGURIA | 85 | 1,65 | 0,27 |
| 17 | UMBRIA | 76 | 1,48 | 0,37 |
| 18 | BASILICATA | 35 | 0,68 | 0,34 |
| 19 | MOLISE | 20 | 0,39 | 0,31 |
| 20 | VALLE D'AOSTA | 11 | 0,21 | 0,48 |

Figure 6 - Number of start-ups per region in Italy and regional density - regional ranking. (Union Camere et al., 2016)

Possible element of transferability can be represented by the collaboration among all the different actors, so as to create a vibrant innovation ecosystem that can favour the growth of several business and innovation hubs. The success of GL in the Boston area would not have been possible without a cooperative environment among anchor institutions, local government, third sector and private investors.

In order to understand where it is possible to find resources for the implementation of innovation hubs, the potential of some European Funds will be assessed, by considering the Calabria region as a sample amongst lagging behind regions. Some important actions can be undertaken at local level by means of European Structural Funds, coordinated by the region.

The European Regional Development Fund (ERDF), in the framework of the cohesion policy, in furtherance of the economic growth and attractiveness of the regional territory, represents the principal investment instrument of the European Union. The targets arranged by the Europe 2020 strategy are Job creation, competitiveness between enterprises, economic growth, sustainable development and improvement of the quality of life of citizens. For the 2014-2020 period, almost one third of the EU investments, amounting to 352 billion euro, are dedicated to this strategy, which is applied by means of three principal funds: European Regional Development Fund, European Social Fund, Cohesion Fund which, in common with European Agricultural Fund for Rural Development and European Fund for Maritime Affairs and Fisheries, compose the EU Structural & Investment Funds. European Regional Development Fund (ERDF) intends to reinforce regional economic and social cohesion, by subsidizing projects to increase competitiveness and generate jobs. ERDF invests also in integration projects among member nations, with the European territorial collaboration.

Within the axis 1, the objective 1.1 has the goal of increasing the companies' innovation activities, especially increasing the indicator of researchers working in enterprises in the total number of employees, representing the specialization rate of the lagging regions. In 2012 the indicator was the 0,05%, and has to increase to the target value of 0,32% by 2023 (Regione Calabria, 2015).

Another important action is the Action 1.4.1, which aims at supporting the creation and consolidation of innovative start-ups-intensive application of knowledge and the spin-offs of research initiatives. This action supports the development and qualification of the regional production system through the promotion and creation of innovative enterprises (spin off of the research, innovative start-ups and micro-enterprises), in S3 innovation areas. This action aims at increasing the incidence of innovative specialization in application perimeters with high knowledge intensity. The actions of the European development funds have the objective of increasing the indicators. In particular, the action 1.4.1 aims at increasing the indicator of the birth rate of enterprises in knowledge-intensive sectors. This indicator is rather low in Calabria, if compared to other southern Italy regions. It was 10,6% in 2011 (Istat data) and by means of European Funds it is intended to rise to 18% by 2023 according to the Regional plan.

4. CONCLUSIONS

The case study of GL has shown how the cooperation among different actors such as innovation spaces, governmental agencies, non-profits, and private investors can bring more people to participate to the innovation process, inside a growing sector like the green tech. The case study has revealed also that innovation centres, incubators, and co-working spaces can increase the innovation level and the employment within urban areas, if there are some favourable conditions promoted by the implementation of the right actions in the right time in the right locations.

All the urban processes and actors involved can be summed up in a term: Innovation Ecosystem (IE). The IE is defined as the assorted array of members and capitals that contribute to and are essential for on-going innovation in a contemporary economy (World Economic Forum, 2016). GL represents a space where all the aforementioned actors converge and can meet in order to share knowledge, create innovation and contribute to economic growth. These innovative structures embedded within the urban framework, can increase the level of engagement of people, who can be empowered to actively participate by means of a collaborative innovative process, helping to leverage the innovation capacity.

The presence of an incubator in a growing sector like the green tech can work as an attractor for investments, both at the local level and at the national level. The success of this initiative has been favoured also by the presence of significant anchor institutions such as important universities like the MIT and Harvard. These two universities, with the other universities present in the Boston area, played a key role not only because of the high supply of skilled and educated workforce which they furnish, but also because of their essential role in the local community and their strategic ability to influence to the local economy and the consistent relationship with the local government and the philanthropic sector. GL also mirrors the high level of entrepreneurship in the Boston area, advantaged by all the aforementioned factors. Reasonably, the presence of incubators or accelerators could also take advantage of the high number of educated people in lagging behind regions, working as a brake to the persistent phenomenon of out-migration, which is suffocating some lagging regions like the European peripheral regions.

5. ACKNOWLEDGEMENTS



The MAPS-LED project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 645651.

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POSTERS

CRITICAL REVIEW OF OCCUPATIONAL ACCIDENTS DATA AND STATISTICS IN OIL AND GAS INDUSTRY IN BAHRAIN

M. Alkhaldi, C. Pathirage and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: m.alkhaldi1@edu.salford.ac.uk

Abstract: Occupational accidents data and statistics in Oil and Gas (O&G) industry are published annually in many countries. Having accurate, reliable and standardized accidents data and statistics is a starting point for any safety work. Unfortunately, these official published numbers are unreliable and unstandardized, however; these data are missing for many countries. Therefore, attention should be paid for providing reliable and standardize accidents data and statistics in O&G industry particularly as there is a countless serious occupational accidents yearly in this industry. The importance of deflecting the attention countries regarding the reliability of accident data and statistics is increasing incrementally. Therefore, this poster is an attempt to examine the role and importance of accurate accident data and statistics in O&G industry in Bahrain. A critical review of literature on the occupational accident statistics in Bahrain, status of occupational health and safety in Bahrain, and challenges in O&G industry in the developing countries reveals that O&G industry in Bahrain is confronting with a challenge of unreliable and unstandardized accident data and statistics. In other words, the published occupational accidents data in Bahrain do not contain a lot of data about the root causes and the published occupational accidents statistics in Bahrain do not reflect the actual situation of occupational health and safety. On top of that, the overall occupational health and safety framework in Bahrain is not suitable now to depend on and it needs serious redesigning plans to promote more consistency, transparency and fairness. Improving accident reporting system in O&G industry in Bahrain and having a standardized one will help in achieving a high level of reliability and standardization in occupational accidents data and statistics and will have a strong foothold in term more effective safety policy, procedures, and practices, lower accident rate in this industry and higher safety performance.

Keywords: Accident Reporting System, Occupational Accident, Oil and Gas Industry and Safety.

STATISTICS ABOUT TERRORIST OPERATIONS IN IRAQ

H. Al-Dahash and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: H.F.Al-Dahash@edu.salford.ac.uk

Abstract: Iraq is exposed to numerous types of natural and man-made disasters. Regarding human-made disasters, terrorism is considered the most salient hazard due to a remarkable upsurge in terrorist acts during the past decade, particularly in Iraq. Therefore, terrorist attacks have become an increasingly serious concern and need more attention especially in the Middle Eastern countries and in Iraq specifically. Accordingly, reviewing statistics about terrorist operations can provide useful insights into the context of Iraq. Such statistics contains a wealth of information about a country, and indeed a region of the world, which does not receive adequate coverage in the disaster literature. At the same time, they do not likely exist anywhere else in the world. As a result, these statistics would be an important contribution to the literature. Further, by conducting this review, disaster response management in the context of terrorism could be conceptualized.

Keywords: Disaster Response Management, Statistics, Terrorism, Iraq.

MAPPING STREAM FLOW CHANGES AND ITS IMPLICATIONS ON IRRIGATION INFRASTRUCTURE IN AGRARIAN COMMUNITIES OF NIGERIA

S. Goyol, C. Pathirage and U. Kulatunga

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: S.Goyol@edu.salford.ac.uk

Abstract: Climate change, a global environmental challenge driving natural hazards is a threat to socio-economic development. Changes in average weather conditions, alongside unpredictable temperature and rainfall patterns are altering the climate system resulting to floods and droughts on two different ends of an extreme. Persistent alteration of the climate system is already affecting water levels as evident in stream flow changes and the drying water bodies. These changes are increasingly affecting the availability of water for irrigation purposes and having impacts on irrigation infrastructure. This can have future implications on agricultural production, food security and poverty levels if left unchecked. This study aims to assess stream flow changes and its impacts on irrigation infrastructures by mapping how different types of irrigation infrastructures respond to changes in stream flow. A multiple case study approach of three (3) agrarian communities first identified the types of irrigation infrastructure in each case study. Secondly, an assessment of the stream flow during both the dry and rainy season was achieved to obtain the pattern of stream discharge. Then, using maps of case study communities, irrigation infrastructures sensitive to stream flow changes due to extremes is presented. Findings reveal that erratic and heavier rains are increasing stream flows in rainy seasons affecting irrigation infrastructures in flood prone areas, while drier periods and water shortages are causing decreased stream flows in the dry seasons thereby affecting the yield of irrigation infrastructures due to lower water levels. Findings will provide decision makers with information to plan ahead of future climate changes/ stream flow changes and its effects irrigation agriculture.

Keywords: Agrarian Communities, Climate Change, Irrigation Infrastructure, Mapping, Stream Flow.

DEVELOPMENT OF A RESILIENCY FRAMEWORK FOR CRITICAL INFRASTRUCTURE IN EXTREME WEATHER EVENTS

R. DeMel, U. Kulatunga and C. Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: r.c.demel@edu.salford.ac.uk

Abstract: Meteorologically speaking, the UK has had a large number of near misses in terms of extreme weather events (EWEs). Be it luck or chance, the EWEs of the last few decades have not occurred in severity within concentrated critical infrastructure regions, or within financial hubs, and while multiple EWEs have topped loss and damages in the billions (GBP), the UK remains untested for EWE worst case scenarios.

Nevertheless, in terms of extreme weather events, the UK is exposed to considerably large portfolio of hazards: from localised freak events, to large scale weather phenomena, such as floods or heavy snowfall, heat waves and cold snaps, wind storms and gales, and less frequently from droughts. Any of these events could potentially impact critical infrastructures, having potentially far-reaching consequences, including the loss of life, property, goods, or the disruption to services, from tertiary services to essential services (such as hospitals and emergency management services). A large number of interconnected factors feed into the increasing risk, intensity and loss and damages from EWEs, particularly where CI is affected.

The proposed research methodology, therefore, to develop a resiliency framework for these EWEs therefore initially involves a multiple case-study of the impact of past EWEs, combined with semi-structured interviews of a range of stakeholders, both within CI infrastructure, government, as well as the public. The research aims to develop a framework to evaluate the resilience of critical infrastructure specifically to EWEs, their direct and indirect impacts, and determine ways to mitigate these impacts. The purpose of the research is to consider different aspects of the development and evolution of the resiliency frameworks, as well as the concept of criticality and critical infrastructure, whilst also looking at existing standards and technical guidance, as well as policy documents, on critical infrastructure.

Keywords: Critical Infrastructure, Extreme Weather Events, Resilience.

CHALLENGES FACED THE UK CONSTRUCTION INDUSTRIES, THE MOTIVATION, BENEFITS OF ADOPTING OF STRATEGIES ALLIANCES STRATEGY

W. Hameed and C. Abbott

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: w.hameed@edu.salford.ac.uk

Abstract: The construction industry considered one of the biggest sectors around the world generally and in the UK especially; however, it faces a large number of challenges such as construction processes, cost, achieving sustainability of products, a pressure to achieve sustainable goals through improving the utilisation of natural resources, etc. These challenges decrease the level of profits and growth in overall business and lower overall construction industry performance. One response to these challenges is the adoption of a strategic alliance strategy. An adopting a strategic alliance strategy in construction sector can provide substantial benefits to all stakeholders. In addition, this strategy avoids a number of negative behaviours such as opportunism and conflict, as well as enabling those construction actors to develop long-term relationships and commitments. This literature review will provide a systematic review regarding those challenges which face the UK construction industries and the consequent to adopt strategic alliances strategy as well as illustrating the benefits of applying such a strategy in this sector.

Keywords: Strategic Construction Alliances, Construction Industries Challenges, Motivations Benefits.

BUSINESS MODEL INNOVATION FOR THE DELIVERY OF SUSTAINABLE HOUSING IN THE KINGDOM OF SAUDI ARABIA

A. Alshahrani and C. Abbot

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: a.y.alshahrani@edu.salford.ac.uk

Abstract: In recent years, sustainable housing (SH) has been the subject of significant innovations, resolving former housing problems and reducing the negative effects of the built environment. Many of these innovations have targeted efficient use of energy during housing design, construction, operation, renovation or destruction, etc. Owing to the challenges associated with sustainability the industry over the world, to date has recorded a limited number of SH's being built meeting verifiable sustainable performance standards. In developing countries, such as Saudi Arabia, that experience rapid urbanization and a scarcity of resources, the government is motivating the construction industry especially the housing sector to implement sustainable ideas through the initiation of a number of regulations and polices. In the Saudi market, much of the SH available is costly, partly arising from flawed business model (BM). BM in the past have failed to understand that SH will preserve Saudi Arabia's resources and ensure people can depend on renewable energy sources, thereby benefitting future generations. This research therefore reviews the main strategies considered essential in reducing costs and ensuring feasibility such as: low and zero carbon housing, smart housing, social housing, low cost housing and net zero energy housing. Furthermore, the reviews identify main challenges based on the PESTEL analytical framework. Investigates the conceptual framework of business models for SH. Nine key elements of the business model are identified include value proposition, target customer, distribution channel, customer relationship, value configurations, core capabilities, partner network, cost and revenue model. Finally, the results of the conceptual framework presented to help address the challenges of the delivery of SH.

Keywords: Sustainable Housing, Business Model, PESTEL Analysis, Saudi Arabia.

RE-INTERPRETATION OF THE CONTEXTUAL VALUES INNOVATIVE CAMPUS OUTDOORS AS A PLATFORM FOR ENHANCING STUDENT EXPERIENCE IN UK HIGHER EDUCATION SECTOR

M. Gabr and H. Elkadi

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: M.gabr@edu.salford.ac.uk

Abstract: University campuses are 40 billion pounds business. 2.28 million students spent most of their times in more than 170 university campus outdoors in the UK; the 2nd most wanted destination (after US) and top overall student satisfaction (86%). 11.7% (£4 Billion/year) of UK spending are on maintaining campuses. Universities are ranked by their Academic prestige, the research and scholar excellence. Part of this is also the attractiveness of campus and the amount and quality of extracurricular activities and facilities provided. Moreover, the identification and implementation of satisfactory design parameters, relevant in particular to outdoor learning spaces, is likely to provide an opportunity to maximize students' creativity and awareness for social and environmental issues. So on campus, where and how should students invest their time and efforts? What are the most relevant and effective space features? Which outdoor spaces, with what improvements, would have the greatest impact?

This poster presents dynamics of the use of campus outdoor spaces at the University Of Salford (UOS) that reveal aspects of possible development towards capitalize on the context environmental characteristics for the improvement of the students' creativity and awareness and the desired student-faculty interaction. The unique contribution is towards drawing attention to the effectiveness and space potentials for the most dominant outdoor student activities for challenging questions that face urban university campus planners. It will define effective as well as problematic areas related to current spaces use compared with the planner's design philosophy and intentions.

Keywords: Outdoor Space Design, Campus Outdoor Planning, On-Campus Experiences.

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THE RELATIONSHIPS BETWEEN TRAVEL PATTERNS AND URBAN LANDUSE: REALISING THE 21ST CENTURY GAZA CITY?

A. Shabat and C. Udejaja

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: A.Y.Shabat@edu.salford.ac.uk

Abstract: Cities are like human bodies. Their success and liveability depends on their homogeneity of residents, workers, supplies and services being able to move about. Particularly in a rapidly growing cities, it is certainly effective for the process of re-developing our cities to start from insight into the complex relationship that exists between the transportation system as a service function and all the other land use activities in the city. A kind of 'x-ray' view that can see where their arterial structure is strong enough to support transportation as a functional system that consists of different modes, interacts with different activities and influences land use side of the transport/land use relationship form, and hence the character of the city.

Gaza is a revolutionary city with a set of challenges which is largely being influenced by the effects and shifts in population growth, economic development and high political pressures. This poster brings together in a systematic way the results of many recent studies on transportation/land use strategies to alleviate congestion and urban problems. It presents the emerging trends and challenges that confront to the 21st Century City, and Gaza in particular. As well as this systematic approach, other key aspects of this review paper include the identification of where research has been concentrated (and where there are gaps in research), and the focuses in some detail on the interaction of socio-economic factors with urban form and travel patterns.

Keywords: Transportation Planning, Land Use, Travel Patterns, Urban Growth.

THE CHALLENGES TOWARDS PROVIDING AFFORDABLE HOUSING TO THE INTERNALLY DISPLACED PEOPLE IN MAIDUGURI, NIGERIA

Y. A. Abdu and C. Pathirage

School of the Built Environment, University of Salford, Salford, M5 4WT, UK

Email: abdulkadirabubakar@yahoo.com

Abstract: In the past many have been displaced as a result of religious, ethnic, tribal conflicts in Nigeria, but the number of people displaced due to Boko Haram conflict is high in the history of Nigeria with over 5 million people displaced. The Nigerian government is now left with the task of providing affordable housing to this group of people and there are number of challenges towards providing housing to the internally displaced people in Maiduguri, Nigeria. These challenges include corruption, government bureaucracy, insecurity, and lack of funds, lack of commitments, relocation, urgency, and reintegration of the IDPs among others. The aim of this poster presentation is to examine the challenges towards providing affordable housing to the internally displaced people in Maiduguri, Nigeria. The critical literature reviewed on the challenges and barriers towards providing affordable housing to the internally displaced people in Maiduguri shows that there are number of challenges which include corruption, insecurity, lack of funds, and lack of commitments, urgency, and relocation among others. The above mentioned challenges are considered as major challenges Nigerian government must overcome in order to provide affordable housing to the internally displaced people in Maiduguri.

Keywords: Affordable Housing, Boko Haram, Conflict, Maiduguri, Nigeria.

Generously supported by:



THINKlab

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Dr Chaminda Pathirage

Conference Co-Chairs
Dr Udayangani Kulatunga
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Dr Claudia Trillo
Dr Mohammad Takhtravanchi
Dr Belqais Allali

The University of Salford
Salford, M5 4WT
t: +44 (0)161 295 5000
www.salford.ac.uk

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