The Role of Knowledge Management in Improving the Adoption and Implementation Practices of Industrialised Building System (IBS) in Malaysia

Abdullah, M.R.
University of Salford
(email: M.R.Abdullah@pgr.salford.ac.uk)
Egbu, C.
University of Salford
(email: C.O.Egbu@salford.ac.uk)

Abstract

In Malaysia, the strategic changes towards the promotion of the concept of Industrialized Building System (IBS) started in 1998. It is envisaged that the benefits expected from the adoption of IBS will have positive and dramatic impact on the culture of building practices. An important issue which is likely to influence the wider and successful implementation of IBS is the role that knowledge management plays in this regard. This relates to such issues as the knowledge ability and skills of the workforce, and the role that knowledge sharing plays in effective decision making processes to do with IBS implementation in its many and different disguises. Through a literature review, and from a knowledge management perspective, this paper highlights some of the main issues that may contribute to the implementation of IBS in Malaysia construction industry. This paper also reviews existing strategies associated with the adoption for IBS, especially as they relate to lack of knowledge and awareness among industry players and stakeholders. Some conclusions are offered relating to the level of knowledge needed to change the readiness and perception of key stakeholders toward successful and wide adoption of IBS. These include, inter alia, the need for improvement of existing university curricular related to design and construction process, continuous learning among professionals, training and knowledge sharing initiatives. This paper recommends that a robust and holistic approach to the adoption of IBS is needed and vital in order to tackle the many and related issues to do with both the adoption and implementation of IBS in Malaysia. This integrated approach should consider the knowledge awareness, strategic procurement, production process philosophies, contractual arrangement, strategic policy and decision making process to mention but a few.

Keywords: industrialized building system, knowledge management

1. Introduction

It is very unlikely that Industrialised Building System (IBS) has commonly been agreed and accepted in it definition (Hamid, 2008). Despite been argued by many researchers on the common term, generally the IBS could be seemed according to their stand. Elliot (2003) suggests that IBS should be seen from the philosophy rather than product or system. However some of the evidence shows that IBS undoubtedly can be define from the perspectives of process, product, technology, method, techniques, system or philosophy. According to Warszawski (1999) IBS can be viewed as a set of interrelated elements that act together to enable the designated performance of the building. It is also been supported that IBS can be defined as an investment in equipment, facilities and technology with the purpose of increasing output, manual labour saving and quality improvement. Gibb (1999) claims IBS as a process. It was described as incorporating prefabrication and preassembly that involves design and manufacturer of units of modules, usually remote from the work site and their installation to form a permanent work at site.

In Malaysia, it has been recorded by some authors that IBS is the system or techniques. Parid (1997) defines IBS as a system which uses industrial production techniques either in production of components or assembly of the building or both. In addition to that, Trikha (1999) claims that material assembling was used as IBS fundamentals in definition. It clearly suggested that IBS as a system in which concrete components prefabricated at site or factory are assembled to form a structure with minimum on site construction. Rahman and Omar (2006) outline IBS as a construction system that is built using pre fabricated components. Construction Industry Development Board (CIDB) also established their own definition for IBS to be known as a construction techniques in which components are manufactured in a controlled environment (On or Off site), transported, positioned and assembled into a structure with a minimal additional site works (CIDB,2003) IBS can be classified into four major sub structural system known as Conventional System, Cast insitu Formworks System, Prefab Panel System and Combination Composite System (Kadir *et al* 2006).

2. Literature review

2.1 Implementation of IBS project in Malaysia

It has been recorded that IBS has been used in Malaysia since 1964 when government took a role of introducing the IBS to pilot project in Kuala Lumpur when 3000 units of 7 blocks of 17 storey and 4 block of 4 storey flats and 40 units shop lots was constructed in 22.7 acres of Land at Jalan Pekeliling, Kuala Lumpur by Gammon/Larsen Nielson as contractor using Danish System of IBS (Thanoon *et al* 2003).

Since then, the implementation of IBS as a construction system in many projects has been generally developed. In 1980s when Malaysia economic stated the growth of construction industry at an average of 13%, Selangor State Development Corporation (PKNS) acquired precast concrete technology from Praton Haus International based on Germany to build low cost walk up flats and high cost bungalow in Selangor (CIDB,2003). In 1984, the usage of steel structure as once of IBS has gained attention to

construct the 36 storey of Dayabumi office complex by Takenaka Corporation of Japan (CIDB, 2003). In 1990s, the development of information technology (IT) was utilised to incorporate IBS design, production and site management. Rahman and Omar (2006) have claimed that the Brickfield Secondary School 1 in Kuala Lumpur as reference of IBS project used the IT facilities. It is recorded that prefabrication concrete panel was utilised using IT in planning the congested and limited site constraints.

The late 90s and early 2000 the government used the precast concrete load bearing wall as IBS type of construction. It was implemented to complete a serial of staff quarters and government accommodation in Senawang, Kuala Kangsar, Putrajaya (Rahman and Omar, 2006). The other testimonial of successful IBS projects constructed are Petronas Twin Towers in 1993; Monorail; Light Rail Transit; Vista Komenwel for 98 KL Commonwealth Games; Aquatic Stadium in Bukit Jalil; National Stadium in Bukit Jalil KL Tower; Putrajaya Bridge; Mutiara Damansara Shopping Centre; KL Central Station; Kuala Lumpur International Airport (KLIA); Putrajaya Housing; Teachers Quarters to mention but a few.

2.2 Issues and challenges

It is generally been agreed that few factors and issues are associated with the implementation of IBS. It has been highlighted by Meiling & Johnson (2008), that Lessing *et al* (2005) have outlined the characteristics or factors of IBS been successful among others are planning and control during the process; technical system developments; offsite manufacturing; long term relationship; supply chain management; customer focus; usage of information technology (IT); and systematic performance measure. Rahman and Omar (2006) highlight that mass construction method, lack of involvement from small contractors and lack of knowledge and exposure to IBS technology. Hussien (2007) elicits from the IBS Steering Committee of CIDB Malaysia 2003-2005 which identified the challenge of implementation among others are development of standard plans and standard component; apprentice training; testing and evaluation programme; vendor development program; and readiness of designers and consultants. Kamar et al (2009) enumerate the barriers to implement the IBS in Malaysia are readiness, cost issues, awareness and knowledge, planning and implementation and negative perception.

However, Abdullah & Egbu (2009) claim that economy development, nature of industry, perception of current conventional construction industry, stakeholder's readiness and research development are identified as an issues and challenges of adoption for IBS. The issues and challenges faced by the industry key players will reflect the level of IBS adoption in Malaysia. It has been revealed from the report by CIDB that the level of usage of IBS is only 15% in 2003 (CIDB, 2003). IBS Roadmap 2003-2010 outlines the structured and formal guideline for construction stakeholders to adopt total concept of IBS in Malaysia. Hence, that strategic planning is seems to achieved off targeted. Haron *et al* (2009) state that it generally has been accepted that the level usage and implementation of IBS in Malaysia is still very low.

2.2.1 Knowledge awareness of key players

Rahman & Omar (2006) highlight that lack of knowledge in structural analysis and design of pre fabricated components among civil engineers and those related to construction discourage the further implementation of IBS. Hence, the implementation of IBS is hindered by a lack of scientific information (Razali *et al*, 2005). Chung & Kadir (2007) observe that most of local authorities in Malaysia are unlikely to change local building regulation to comply the IBS element due to knowledge capacity. It is quite certain that implementation of Modular Coordination (MC) concept trough the amendment of Uniform Building by Low (UBBL) is yet to be executed due to limited knowledge and awareness (Kamar *et al*, 2009).

2.2.2 Level of workforce skill

Labour usage represents one of the critical elements in Malaysian construction industry due to severe shortage of local workers (Kadir *et al*, 2006). It is very unlikely that IBS required a high number of labours in it production and erection (Marsono *et al*, 2006). Some of the evidence show that IBS has reduced the numbers of workers on site due to mechanisation, automation and robotics system whenever the machinery is employed to ease the work of the labours (Richard, 2005). The effectiveness of labour productivity in IBS has been revealed by studies carried out by Kadir *et al* (2006). The used of information technology (IT) in design, production and erection has significantly required the knowledge and skills. Designers and managers in IBS production factory and on site required the knowledge of IT to plan and execute used the tools offer by IT such as simulation for components production, CAD/CAM Software, Project planning software. Technology can be used to improve firms/ ability in terms of the effective use of information (Jaafar *et al*, 2007). Rahmat *et al* (2004) highlighted that most important skill and knowledge for managers are communication, leadership and building regulations knowledge which lead to take up the IBS complexity to be implemented. Haron *et al (*2009) highlight that lack of skilled and knowledgeable manpower in IBS seems to be the barriers and hindrances of IBS adoption.

2.2.3 Policy and decision making process

The adoption and implementation of IBS or Prefabrication and modular construction should enhance environmental awareness through education and training focused by the government (Tam *et al* 2007). The role of government in establishing the policy for strategic level of implementation is a significant impact on the IBS issues. The incentives and promotion offered by statutory authorities and government policies are desirable through planning approval process whereby more floor areas are allowed to be built (Chaing *et al*, 2006). The demand and impact for prefabrication or IBS post war is significant due to changes of institutional environment been promoted the prefabrication or IBS to be taken up especially as policy option (Oonagh,1987).

Goodier & Gibb (2007) suggest that negative connotations and perception of offsite and IBS need to be conquered for more information to decision makers to make a consideration of IBS and offsite implementation especially cost comparisons with the traditional method. Rashid (2009) suggests that collaborative approach between designer and manufacturer to make joint decision making in

finalisation of IBS design is significant. The issues of decision making for best selection of IBS can be classified as the skill and competencies of project team. The appropriate type of IBS is depending on various perspectives.

3. Methodology

This research paper is based primarily on a literature review of IBS development and related issues in Malaysia. The main idea is to present the scenario of IBS implementation issues in term of the knowledge roles and contribution factors that affected the total adoption. This preliminary study is part of the conceptual framework of PhD research to further explore the most significance issues in IBS type of selection.

The study will be conducted through the qualitative method of research. The questionnaires will be designed to strengthen the proposed case studies from the IBS project stakeholders' perspectives. An analysis will help to justify the aims and objectives expected. Verification will be carried out with experts in the area through semi structured interviews and focus group session. The long term aim of the PhD research is to improve decision making process in selection of the type of IBS for housing and office buildings in Malaysia.

4. Discussion

4.1 IBS and knowledge management

Knowledge is an awareness of what one knows through study, reasoning, experience or association or through various type of learning (McInerney, 2002). Devenport and Prusak (1999) define knowledge as a fluid mix of framed expertise, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information. Knowledge Management (KM) is defined as any process or practice of creating, acquiring, capturing, sharing and using knowledge, wherever it resides, to enhance learning and performance in organisation (Scarborough *et al*, 1999). KM involves knowledge identification, creation, acquisition, transfer, sharing and exploitation. KM is vital for work efficiency in projects and for improving organisational competitiveness (Egbu, 2000&2001) and the need for KM in the construction industry is fuelled by the need for innovation, competency, improved business performance and client satisfaction.

Knowledge Sharing (KS) is one of the KM processes and also one of the main components in knowledge management system – KMS (Alavi, 2001; Earl, 2001). Ismail & Yusof (2008) describe that KS refers to any type of knowledge including explicit knowledge or information, 'know how' and 'know who' tacit knowledge in the forms of skill and competency.

4.2 KM roles in improving the implementation of IBS

It is generally agreed that KM plays a role as a process of knowledge and information sharing and transfer from individual to another or groups. Hence, the lack of knowledge from one party will not be

ensuring the other parties successful adoption of the knowledge and information. Much of KM focuses on the role of information technology (IT) and information systems (IS) and the tools that aid knowledge transfer and storage (Egbu, 2000; 1999).

It is been suggested that IT in 1990s plays a significant role in IBS in Malaysia when it showed improvement in structural performance (Kadir *et al,* 2005). Sexton *et al* (2006) also postulated Rogers (1995) that the adoption and implementation of new method of construction system shall require the consideration from knowledgeable designers and adequately persuaded the merits of Modern Method of Construction (MMC) in their decision making process of selecting the type of framing system. The argument been highlighted by Sexton *et al* (2006) assert the KM process must be recognised by the designers and project stakeholders to realise the viability of structural or building systems alternative through the application of Information Technology (IT) design support tools.

Rashid (2009) claims that examination conducted between designers and manufacturers of IBS in studying the collaboration revealed the miss matched between designing and manufacturing of local IBS products. It is suggested that improvement needs to be done. Hence, knowledge sharing and transfer initiatives in KM seems to be significant in this context.

4.2.1 Education curriculum and syllabus

According to various authors, the role of education curriculum and syllabus in higher education centre and universities related to engineering and construction process programs need to be enhanced with the advance and update technology in construction industry especially IBS (Rahman & Omar, 2006; Warszawski, 1999; Haron *et al,* 2009; Thanoon *et al,* 2003) .

Rahman & Omar (2006) suggest that subjects related to design and construction of precast concrete and other related IBS products should be offered as elective for graduated studies. It is also recommended that university curriculum and syllabus of construction and engineering shall consider adopting new topics of IBS. The academic curriculum in universities seldom incorporates courses on technology, organisation, construction and the design of IBS (Warszawski, 1999). Haron *et al* (2009) claim that knowledge level of IBS courses in engineering course based in Malaysia universities are lacking in exposure. The initiatives have been done on 9th May 2006 when a forum of Implementation of Syllabus for IBS was held by CIDB (CIDB, 2006). That knowledge sharing initiative seems to be successfully implemented.

4.2.2 Research and development

It has been generally accepted by various authors that the degree of research and development (R&D) in IBS is lacked behind in term of the development of new materials for IBS components, local design and manufactured building system, scientific information, modern method approaches and innovation (Haron *et al,* 2009; Kamar *et al,* 2009; Hamid, 2008; Rahman & Omar, 2006; Thanoon *et al,* 2003; Razali *et al,* 2002; Badir *et al,* 2002;).

There are few R&D of IBS activated in Malaysia universities such as IBS Centre of Construction Research Institute of Malaysia (CREAM) and CIDB in Kuala Lumpur; Housing Research Centre (HRC) of UPM Civil Engineering Faculty in Serdang, Selangor; Open Building Research and Consultancy Team of UTM Skudai in Johore. The potential of R&D in IBS has been vast discussed by several researchers in the area of materials and management. According to CREAM (2008), it is recorded that 32 R&D projects undertaken by CREAM and only 14 of these are IBS related.

4.2.3 Innovation

It is generally agreed that relationship between KM and innovation has been widely discussed by scholars and practitioners in literature (Tasmin & Woods, 2008). It is generally recognised that KM can promote innovation and business entrepreneurship; help in managing change, and for emancipating and empowering employees (Egbu, 2000). Egbu (2000) stated that construction has not been as innovative as other industries even historically been highly innovative. Egan Report (1996) has recommended that lesson learnt from manufacturing sector and innovative culture must be created. It is seemed to be a challenge of construction industry when innovation required powerful drivers and right people with right culture to take place (Egbu, 2000).

Innovation can be as new as improvement. In IBS, the new construction materials or new method of construction associated as innovation. Sumadi (2002) states that innovations in the areas of materials, Information Technology (IT) and robotics are improving building quality in terms of industrialisation process and construction method. It has been viewed that materials innovations can be classified into two general categories which are known as new and improved material such as high performance concrete and prefabricated composite elements.

4.2.4 Information technology

The innovation in IT has shown the significant effect on the development of construction industry. Gajamani & Varghese (2007) highlight that the used Radio Frequency Identification (RFID) in prefabricated building and IBS components would seems to improve the project scheduling and monitoring due to compatibility of working with the other software such as MS Project and AutoCAD. Rahman & Omar (2006) state that use of Information Technology (IT) in design and visualization software and facilities such as 3D, 4D, nD and Building Information Modeling (BIM) to improve the process of Feasibility Study, Cost Modeling, Site Layout, Project Planning & Control has shown a significant impact in IBS construction industry improvement especially the risk reduction exercises. The most lacked information such as new technology of IBS will gain higher risk. Hence, the application of IT in IBS would seem to be beneficial.

4.2.5 Knowledge base decision making and selection criteria

Uriel & Lozano (2004) has developed a knowledge base system (KBS) for house layout selection and it has been demonstrated that Computer Algebra System can be used to improve the design process. Hence, the roles of knowledge are significant to be take place in improvement process. The KBS was based on the criteria of local climate, building site and customization or end users needs. In this

relation, Pan (2006) outlines the criteria for build system selection into eight domains known as value for decision. The cost, time, quality, health and safety, sustainability, process, procurement and regulatory & statutory acceptance are identified as the selection criteria. These identified criteria seem to be critical factors for best selection of IBS type of product.

4.2.6 Knowledge sharing initiatives

The knowledge sharing initiatives among the professionals and stakeholders should be promoted to improve industry, organisation and individuals. Thus initiatives such as conference, seminars, symposium and dialog either locally or globally may contribute to the knowledge flows for participants to make informed and knowledge base decision making.

The sharing of knowledge among the manufacturing sectors and construction players has benefited construction industry when the improvement significantly takes part. The used of Just in Time (JIT) concepts or philosophy in precast concrete components has been proved to make a significant result in Japan construction industry. The JIT philosophy commonly known as Toyota production System originated from manufacturing sectors (Pheng & Chuan, 2001). That JIT concept then has been translated into English as lean production system dealt with right materials supply in right time, time place and right amount at every step of process. Hook & Stehn (2008) affirm the idea of Koskela & Ballard (2006) that lean construction is a test of conventional paradigm of project based on economics theories and adopt the theories of project management in production. IBS as defined earlier related to Offsite Manufacturing seems to be closed integrated with this concept.

4.2.7 Training and continuous learning

Continuous Professional Development (CPD) is a life-long learning process that maintains, enhances or increases the knowledge and skills of professionals to ensure their knowledge and ability are relevant to the needs of society (Board of Architect Malaysia, 2004) . This approaches in various professional bodies such as Board of Engineer and Board of Architect is to ensure the level of knowledge acquired and current issues related has been address in professionals and designers practices. Hence this will help professional to face spectrum changes and take advantage of the opportunities that may arises and also to underpin the value of their professional qualification. Ariffin and Torance (2008) quoted that one of the interviewees has been agreed that CPD will updated and exposed to the latest construction technologies. It also quoted that the sharing of experiences by these self-employed consultants at CPD activities allowed the non-consultant registered professional or designers to maintained their "true" professional knowledge.

The initiatives of CPD held by various professionals' board and bodies through serials of trainings, short courses and seminars will enhanced the professional designers and practices to share the knowledge. It has been agreed that an attendances in this continuous knowledge management and knowledge sharing activities is compulsory for renewal membership requirement. The series of seminar related to IBS held by universities, research centre and professional bodies with or collaboration of CIDB or others related partners has been actively recorded since 1998 until today. Hence the improvement of IBS total adoption is still been questioned.

5. Conclusion and discussion

This paper recommends that holistic and integrated approaches to adopt the IBS in Malaysia are significant. The issues arises to challenge the implementation of strategy, policy, procedures, method of IBS is a process of maturity of knowledge evolution for construction industry players. This robust approach in particularly from the KM perspective is considered as development of human capital which is prerequisite for industrialization process. The technology and human issues will lead the industry to achieve sustainable development. The significant roles of knowledge in any discipline including construction which has been perceived as lack of knowledge and skill awareness can overcome the dilemma by strategic planning from government and actives roles by industry players. The full commitment from project stakeholders to innovate and justify the risk is speculated to be as critical factors. An appropriated decision making model to facilitate the related parties to analyse and evaluate the best option of IBS in selecting the technology in IBS types and classification. Hence the perception of IBS as prefabricated and offsite only shall be widening up to the philosophical level in knowledge management desired. The role of knowledge management in improving any kind of activities has significantly affected the process and final products and must be reviewed in a holistic manner.

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