The Need to be E-Ready: Framework development for E-Readiness in Construction (ERiC) for UK SMEs

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Abstract

The ability of the construction industry to innovate in order to improve its practice has been widely debated over the years. As more and more organisations in other sectors, globally, are addressing 21st century technology challenges, is the UK construction industry at large e-ready? Of particular concern is the plethora of SMEs that constitute a vast proportion of the UK construction industry. There appears to be noticeable laggards with its SMEs in the uptake of new processes and technologies. This paper presents the findings of three case studies that are used to identify the critical success factors necessary for organisations to be e-ready, proffering lessons for SMEs and the industry at large. The resultant self-assessment ERiC framework enables construction organisations to quantify and measure organisational e-readiness from an organisation, technical and process perspective.

Keywords: construction industry, SME, e-readiness, IT, critical success factors (CSFs)

1. Introduction

The UK construction industry needs to improve its practices (Alwan et al., 2017). It has, since the 1940s, been ongoingly criticised for its less than optimal performance by several government and institutional reports such as Simon (1944), Emmerson (1962), Banwell (1964), Latham (1994), Egan (1998) and Fairclough (2002). The majority of these reports conclude, time and time again, that the fragmented nature of the industry, lack of co-ordination and communication between parties, the informal and unstructured learning processes, adversarial contractual relationships and lack of customer focus is what inhibits the industry's performance. Egan (1998) purported: '…there is a deep concern that the industry as a whole is under-achieving.' Construction projects are also often seen as unpredictable in terms of delivery time, cost, profitability and quality, and in addition, investment into research and development is usually seen as expensive when compared to other industries (Fairclough, 2002; Xia *et al.*, 2018). The repeated critique of all of these reports thus questions the ability of the construction industry to innovate and manage change to improve its practices (Gale and Fellows, 1990; Barrett, 2002; Gambatese and Hallowell, 2011). Furthermore, the image of construction is rather 'bleak' as it struggles to address these ongoing challenges. According to Howell (1999), the 'inefficiency' of the construction industry has tended to be the way of life. This may be due to the fact that none of the reports have been significantly acted upon. As Latham (1994) points out '…some of the recommendations of the reports were implemented …but other problems persisted, and to this day, even the structure of the industry and nature of many of its clients has not changed dramatically.' This stance remains presently in 2018. So, is change in the industry's structure plausible or even appropriate to bring about widespread improvement/ innovation?

This paper argues that the UK construction industry must change. Organisations in differing sectors are moving ahead in terms of harness the benefits of IT. The UK government released the Government Construction Strategy that sets out a vision of how the country could lead the way in global construction over the next 10 years (HM Government, 2013). Among other aspirations, the strategy aims for a 'smart' UK construction industry by 2025 that is efficient and technologically advanced. However, there was no detail provided on how the industry could achieve this; e-readiness refers to a country's capacity and state of preparedness of information technology (IT) infrastructure and its ability for sustainable development. Organisations within the construction industry have heavily invested in IT, the result of which has led to a level of innovation and business improvement. Whilst it can be argued that the industry's main functions and processes are still relatively unchanged, there has been a real challenge to improve performance and reduce costs using IT as the lever of change (Brewer and Gajendran, 2012; Olawumi and Chan, 2018). However, efforts have often been hampered due to several barriers, not least the industry's structure, the fragmented supply chain, lack of investment in IT, and limited IT 'champions' who are able to understand IT-based innovation challenges and have the support and empowerment of senior decision makers within the organisation to sanction, augment, and drive forward this change particular for its SMEs which make-up a vast proportion of the industry (BIS, 2013). This paper proposes a new e-readiness self-assessment framework for construction SMEs from the findings of critical success factors pertinent to the UK construction sector as a means to provide guidance for the industry at large, this will enable organisations to enter new markets – aware of both the revenue potential and the possible bottlenecks to development.

2. UK Construction Industry and SMEs

The UK Construction Industry is the country's third largest employer, with a 2.9 million workforce and accounting for approximately 10% of employment in 2014 (Anwyl, 2017). Recent data from the first quarter of 2014 showed that the private sector contributed more than 74% of construction output. Housing and commercial projects let the way with a combination of 56% of the total value (Rhodes, 2014). The scale of small organisation activity in the UK construction industry is considerable, with in 2014, accounting to 40% of GDP and is a major contributor to local economies (BIS, 2013). The predominance of small and medium sized enterprises in the UK construction

industry (please note: this paper will adopt the European Commission's definition of SME whereby micro enterprises represent 0-9 employees, small enterprises represent 10-49 employees, and medium enterprises represent 50-249 employees, with the exception of agriculture, hunting, forestry and fishing organisations; over large-sized organisations may be attributed to the fact that large contracts require specialist work and the specialist contractors are pre-dominantly self-employed and, where necessary, employ a few additional hands (Gale and Fellows, 1990; Love *et al*., 2016). According to Robbins *et al*. (2000), SMEs are important to the economic vitality of cities, states and countries due to their significant number and employees. However, they tend to display vulnerability in facing up to various conditions prevailing in a country's economy resulting in business failure. The ability of SMEs to turnaround their organisation is often constrained due to limited access to financial resources and capital (Kirchhoff, 1994; Wong *et al.*, 2018). Historically, it has been recognised that the SME sector poses various challenges for implementing policies, transfer of good practice and various Government agendas – strategic horizons and organisational capabilities of SMEs do not allow sufficient 'organisational slack' to conduct activities outside their main business activities (Sexton and Barrett, 2003). Further, the fragmented and diverse nature of the industry illustrates the inconsistent level of IT among organisations in the construction industry. Current practice indicates that the implementation of IT is undertaken on an ad-hoc basis and there is no formalisation of IT into mainstream business activities. It is therefore pertinent to investigate the e-readiness of SMEs in adopting and embracing IT.

Specifically, there is no strategy on how organisations could be e-ready or how to harness the power of IT. The UK National Federation of Builders (NFB, 2012) reported on the readiness of organisations to adopt Building Information Modelling (BIM) confirms that the industry is not ready to achieve BIM Level 3 as set out in the Government Construction Strategy. Findings demonstrated high interested in BIM and accepted that BIM will be central importance to the organisation, but only 10% of SMEs are planning to invest in training.

3. E-readiness

IT holds tremendous potential for improving construction businesses. While the industry is facing globalisation and an expanded knowledge-based economy, the capability of IT is undeniable for achieving competitive advantage (Cartelli, 2007; Gunasekaran *et al.*, 2017). Understanding e-readiness enables organisations to enter new markets: be aware of both the revenue potential and the possible bottlenecks to growth. The notion of e-readiness means different things to different people, in different contexts, and for different purposes (Lou and Goulding, 2010). As a result, a gap exists between ideas and concepts on the one hand, and the practical applications and implications on the other (bridges.org, 2017; United Nations, 2014). In spite of all the differences in definitions and opinions, this research takes the position of e-readiness *'as a measure of the degree to which an organisation may be ready, prepared or willing to obtain benefits which arise from the digital economy'.* E-readiness research is fragmented, diverse, not specifically targeted for the construction industry, and is not designed for organisational issues; while organisational e-readiness is still very much in its infancy with only four known academic organisation-based readiness tools available – BEACON (Khalfan *et al.*, 2001), VERDICT (Ruikar *et al.,*2006), GPIS/NICE (Salah, 2003), BIM Maturity Matrix (Succar, 2009) and Technology Readiness Levels (Banke, 2017). With the unavailability of a specific e-readiness critical success factors (CSF) for the construction industry, there is a need for such a framework to guide construction organisation to be ready to harness the full potential of their current and future IT system(s).

The rubrics to access the critical success factors of e-readiness for construction organisations started with the identification of people, process and technology themes (Lou and Goulding, 2010), and ranking of the five key e-readiness enablers (Goulding and Lou, 2013). This paper will further refine the five key enablers to general CSF through case studies.

- Leadership and Empowerment (People)
- Change Management (People)

- Business and Information Process (Process)
- Policy/Strategy/Vision (Process)
- ICT Sharability/Interoperability (Technology)

The role of senior management to support the development of an e-society on the organisational level is crucial to as to 'set an example' for other to follow, both within and outside the organisation (Amoretti, 2007; Hanna, 2010). Leadership plays a vital role in directing efforts towards success. The importance of leadership stems from its role in providing a clear vision of the future, communicating the vision, being able to involve other people in the implementation efforts, being prepared to provide sufficient commitments to the overall efforts and bearing the ability to motivate people rather than directly guiding them (DeRue and Ashford, 2010; Podolny *et al.*, 2010). The need to change is usually driven by external factors such as new legislation or increased competition, or internal factors such as the implementation of new technologies (Craig and Sommerville, 2006). Literature further describes various types of change – crisis change, chosen change, developmental change, transitional change and transformational change (Margherita and Petti, 2010). Understanding the organisation's business and information process is critical for the success of any new changes in the organisation (Berente *et al.*, 2009). The existence of an effective communication and information process reflects transparency and predictability of regulatory implementation, openness of organisational policies and (political and business) stability of the organisation (Halabi *et al.*, 2017). Mulcahy (1990) observes: to be successful, a construction organisation must have clear objectives recognising the markets it wishes to address, services it wish to provide, risk it may carry, structure it use, the environment it operate within, controls it put in place, and the returns it wishes to achieve. To successfully achieve them, the organisation needs to have a fitting structure, on-going communication, a team of skilled and motivated people and a culture for performance and satisfaction (Hadjithoma-Garstka, 2011; Zhang and Fielden, 2017). IT has progress immensely in the past years from a stand-alone individual machine to mass-market product openly used by all. This drives the need for IT hardware and software to 'talk' and be compatible to each other, and ultimately embed our everyday action with IT (Lou and Alshawi, 2009). In this context, IT sharabillity and interoperability is being increasingly used to support business strategies as an enabler to leverage its potential to gain a competitive advantage and therefore new markets and clients (Fitzgerald and Pappalardo, 2010; Leenen *et al.*, 2009). The potential e-readiness critical success factors from the literature are as listed in Table 1.

[insert Table 1]

4. Case Studies

Three case studies were conducted with selected built environment SME organisations based in the UK. Three personnel were interviewed for each case study, including a senior manager, a technical (IT) representative and a member of the operations team (construction). Additional discussions were also held informally with other employees whilst on-site. Interviewees were questioned on the five e-readiness enablers and the ten potential sub-enablers for each key-indicator (Table 1). The differing representatives from each organisation were to provide a holistic overview on the organisation, and the thoughts from the different departments.

Case Study 1 (CS1) is a real estate services provider is in the process of developing international networks of offices worldwide, offering a broad range of specialist advisory, management and transactional services. The organisation wants to be e-ready, but do not know how and have not tools to do so. Staffs are open for changes and are willing to learn more and are awaiting leadership from senior management. To ensure e-readiness practices are warranted within the organisation, there must be a clear vision or policy from senior management; and this must be filtered down to all staff, or this practice will remain a paper document sat on the shelf. A well-written vision/policy must derive from the analysis, understanding and appreciation within the organisation and external

forces – foresight is critical; this will then be able to empower individuals and groups to achieve further in the right direction.

Case Study 2 (CS2) is a leading specialist in property design, fit-out, refurbishment and maintenance company. CS2 has in excess of 1,000 projects conceived and successfully delivered throughout the UK, working in over 100 different towns and cities but communication between the site offices and head office is very poor. Another issue is the accessibility to the most up-to-date data and work files as there is no direct connection to the head office, there are always discrepancy on the most recent files to be used. This case study presented a thought-provoking insight to an organisation that has a failed IT system and is now in the process of creating another. This demonstrated that the organisation and the senior management understand that IT is an integral element in the organisation for it to continuously grow. With business expansions anticipated for the Middle East, CS2 has no option but to invest in its IT system. This system is carefully planned, designed and programmed to meet internal and external needs and requirements. Change management within the organisation is a crucial element to manage any future changes, perception and expectation.

Case Study 3 (CS3) is a privately owned property solutions business, employing over 150 people who work on sites and offices. The organisation is undergoing change in all departments and there is a sense of urgency to improve internal processes, negotiate external IT responsibilities with clients and taking the business forward with IT. All interviewees agree that The Board understands, appreciates and acknowledges the benefits of IT, but there is little investments or improvements to the current system. However, there was a conflict of interest as the employees feel that IT is at its minimum and there is incentive for The Board to further improve or invest. It is clear that the organisation's IT strategy in place but it is often neglected or unknown, as it is not integrated or tied to other organisational strategies. The rubrics for the organisation to change are in place; only The Board are to be convinced to make the investments.

From the three case studies conducted, nine dedicated semi-structured interview sessions were carried out with representatives from differing departments/ organisational hierarchy; they were subsequently followed by informal discussions with other members within each case study organisation. It is evident from the findings that every organisation behaves differently, have differing business priorities and different internal process. Throughout the case studies, there were no objections or addition towards the five pre-defined key indicators. Data collected is compiled into Table 2, where each Case Study involved three separate interview sessions (eg CSx-C1, CSx-C2, CSx-C3) and one informal interview session with members of the organisation (eg. CSx-IF). The understanding of the term 'e-readiness' brought a whole new phenomenon, as different people understand it varying ways. Data collected from different individuals with different responsibilities showed that the understanding gap could not be wider – evidence from role of the interviewees (management, technical and operational) – as shown in Table 3.

[insert table 2 here]

[insert table 3 here]

The leadership and empowerment key indicator was mentioned in every case study, and in particular in CS2 and CS3. CS3 highlighted that the senior management was unsure of readiness, hence withholding further investment, while the CS2 emphasised the importance of leadership to bounce back from a poor IT experience. From the data collected, the three highest frequencies mentioned were: Foresight/Vision, Improve and Inspire.

Business and Information Process represents the inner-operations of the organisation. This explains how things are done, what to be done, when to do it, where to do it, why to do it and who is responsible – the process is especially critical for larger organisation due to the large number of

staff and geographic spread. This is also to enable process automation, system integration and data exchange/ interchange. CS1 and CS2 indicated the importance of a process mapping and documentation through a Quality Management System or similar, to ensure process standardisation and to make information available to all. The critical success factors (CFSs) were Automation, Data exchange/ Interchange and Standards.

IT Sharability/ Interoperarbility is topical among the technical staff interviewees, and quite appropriately so. The only method to encourage uptake or usage of the IT systems is to ensure seamlessness between different systems and software – to ensure they 'talk' to each other. Discussions also led towards the availability of internationally accepted standards (e.g. ISO, EU, BS, etc.) towards system development, technical knowledge towards the standards and the availability of system sources (e.g. coding, development toolkits, etc.). Another cause for concern is the legality of the IT system/software (e.g. open source, proprietary, etc.) and the complication of data sharing (e.g. BIM, extranets, etc.). Most importantly, senior management must understand the technical and management of IT systems/software is a major issue for the industry as a whole. Access/Uptake, Legal Framework and Standards were identified as CSFs.

The issue of change was particularly heightened in CS1, where staffs were ready to change, willing to learn more and open to new experiences, but they did not know how to proceed. This shows that change management is more than culture; it is about the organisation's willingness to improve as a collective unit from all levels in the organisation. Data reported CSF of Strategy/Strategic Framework, Interaction/Communication and Support/Executive Sponsorship for Change Management. This is evidence from the necessity of a change management strategic framework in place, an integrated implementation plan, well-documented business process, executive sponsorship and well communicated to all staff.

All case study organisations investigated are looking into the future and have the vision of using IT to expand their business to have competitive advantage. Organisational foresight is essential as a tool to integrate organisational strategy and action plans. The key to achieving forward planning is for the organisation to identify 'what they want to achieve' and involve staff in the planning process. This will in turn empower staffs to improve themselves to meet the challenges (that they help to plan) in the future, which was heavily evidenced from CS3. Also, the appetite in learning, experimenting and predicting future technologies is seen as important. CSFs were identified as Policy/ Strategy/Vision were Foresight, Inspiration/ Empowerment and New Technologies. The findings from the case studies are thus presented in Table 3. Although the 5 key CSFs pertinent in the literature (see Table 1) of: leadership and empowerment; change management; business and information process; policy/ strategy/ vision; and IT sharability/ interoperability; their application in the construction sector has circumvented differing issues that are pertinent to construction. Findings of the case studies have been used to inform the development of an e-readiness framework.

6. Framework development

The development of an e-readiness in construction (ERiC) framework will incorporate key indicators (KI) and sub-key indicators (SK) as part of a self-assessment framework, which provides a step-by-step guide for the user to evaluate their business holistically in order to secure e-readiness best practice. The framework then calculates and presents a final score to the user. To obtain a better assessment of the organisation, the framework administrator may choose a few users to complete the framework and take an average score. The ultimate goal of this framework is to provide the administrator/ user with a score – this can be used to undertake benchmarking exercises in order to position themselves in the marketplace. The framework will also be able to assist user in identifying 'the next course of action' to improve their e-readiness stature. Sample cases were created to assist users to understand the maturity statements; sample cases are described to provide the most accurate scenario for each statement. Each case evolves around IT application, software, technology or general management related scenarios.

A scoring system provide the users with a tangible figure or number for benchmarking. ERiC carries a final score of 100%, of which, two scoring system is proposed, and the framework user or administrator have to options to user either Tier 1 or Tier 2 scoring, or both at the same time. Tier 1 scoring consist of weightings for five KI only and Tier 2 scoring represents the twenty-five SKs. Each Tier must be scored to a total of 100% respectively. The choice of going into the details or simply to stretch the surface is in the hands of the assessor. Senior Management (CEOs, COOs, Directors, etc.) may opt for the more Tier 1 scoring, while managers and operational staff (IT Managers, Business Managers, etc.) may select Tier 2 scoring. Sample scoring systems are presented in Table 4 and Table 5.

ERiC is developed based on the concepts of maturity modelling, where the maturity concept is based on the notion that a distinction could be made in regard to levels of maturity of organisations based on pre-set characteristics. It provides a step-by-step guide and explains the incremental readiness levels for executives to evaluate their business holistically in order to secure e-readiness best practice. This can also be used to undertake benchmarking exercises in order to position themselves in the marketplace; to demonstrate their past, current and future situation. Maturity levels show a sequential development, from an initial level with basic requirements (Level 1), through to a maximum maturity level (Level 5), categorised as the optimum performance level. The operationalisation of this approach follows the principles of Sarshar *et al.* (2004), where progression from one level to the next represents a step change in maturity. In this respect, organisations in Level 5 are classified as “Future proof”; at Level 4 “Advanced Level”, Level 3 “Intermediate Level”, Level 2 “Low Level”, and at Level 1 “Unprepared”.

Leadership and Empowerment (KI1)

The leadership and empowerment key indicator was mentioned in every case study, and is echoed throughout literature review. Leadership plays a vital role in directing efforts towards success and stems from its role in providing a clear vision of the future, communicating the vision, being able to involve other people in the implementation efforts, being prepared to provide sufficient commitments to the overall efforts and bearing the ability to motivate people rather than directly guiding them (DeRue and Ashford, 2010; Podolny *et al*., 2010).

Foresight/Vision (SK1.1): Organisations must a vision to move forward (Schein, 1993) - forward thinking vision for technology to support and enhance organisational aims in terms of supporting the administration, management, employees and the wider built environment industry (Sarros *et al*., 2011). The highest level of maturity in IT vision reflects a world-leader in providing ideas, forward thinking and continuous improvement; through extensive research and development done within the organisation, and often hailed the as a global champion; while the lowest level will see Senior Management with no concern in improving current work practice and/or no interest joining the digital economy but maintaining a paper intensive organisation.

Involve (SK1.2): High-involvement leaders view employees at all levels as true partners - such practices allow the organisation to tap into the creativity and energy of their employees to an extent that is not possible with traditional forms of management (Bel, 2010; Randel *at el*., 2018). High-involvement leaders will require efficient and accurate methods of communication for successful partnerships with colleagues and employees, thus, boosting productivity of the business (Cannatelli *et al*., 2017).

Inspire (SK1.3): The ability to inspire people to reach great heights of performance and success – passion, purpose, listening and meaning help make a leader inspirational (Bruch and Vogel, 2011). Inspired leaders will rub off inspiration to their employees, to continuously improve and develop in their responsibilities, which in turn employees will give their enthusiasm and commitment to achieve organisational goals (Murnieks *et al.,* 2016). The ability of the leaders to deliver inspirational speeches or delivery personal success stories has its impact on employees – and this also reflects leadership by example.

Integrity (SK1.4): Leaders with strong integrity are demonstrated through their strength of character – walking the talk, doing what was promised – authentic, straightforward, open, honest and direct in their dealings with others (Charles, 2010). A leader's personal integrity will indirectly represent the organisation, to be respected by employees and the public or otherwise. Integrity speaks for itself and will directly reflect on the leaders' action and decision. Employees in return will be more approachable and will be more willing to accept critics (as positive feedback) and will always try to improve (Bazzy and Woehr, 2017).

Improve (SK1.5): Improvement, to change for the better. Continually increasing the effectiveness and/or efficiency of the organisation, to fulfil its policies and objectives with a focus satisfaction (Wu *et al.*, 2017). Leading and empowering employees is critical as they will need to absorb, understand and execute the organisational values and goals in the best possible manner, and in the same time to improve themselves. Personal improvement could only come when the employee welcomes change (Lou and Alshawi, 2009).

Change Management (KI2)

Organisations, large and small, need to change and develop if they are to remain competitive and satisfy clients' ever-increasing expectations (Corso *et al.*, 2009). The need to change is usually driven by external factors such as new legislation or increased competition, or internal factors such as the implementation of new technologies (Craig and Sommerville, 2006).

Strategy/Strategic Framework (SK2.1): A strategic framework allows the organisation and its supply chain to create a roadmap for change (Comte and Pendelton, 2018). This will drive the change process from the highest level (vision, goals and objectives) to the day-to-day work. Implementation is the essence of how change management could be successful in organisations (Ahuja *et al.*, 2010). With a strategic framework in place, Senior Management will be able to lead in accordance to the framework and staff will know the process and the anticipated goal.

Implementation (SK2.2): Implementation is the essence of how change management could be successful in organisations in activities such as change management development and deployment, techniques, project management, organisational resources, managerial style, communication and coordination (Margherita and Petti, 2010). Successful change management requires a large commitment from Top Management, to provide leadership, support and resources – to champion the cause for change (Lines *et al.*, 2015).

Support/Executive Sponsorship (SK2.3): The role of the executive sponsor is not only critical to the success of each project but also critical to successful delivery of beneficial outcomes and for feeding that information back to the executive and to portfolio management (Lee *et al.*, 2011). At times, the attendance of the Senior Management demonstrates their commitment to change, indicating that 'we are all in this together', and will inspire employees to achieve and do more.

Practice (SK2.4): Business practice management is the collection of activities that corresponds to the planning and observing the effectiveness of a certain construction business process, method, or solution. In` adapting change, current business practices must support business needs – every practice should be 'correct first time', provide value-added services, supporting organisational vision and strategies (Amalia and Nugroho, 2011; Gardner and Ash, 2003).

Interaction/Communication (SK2.5): The primary aim of communications in any change programme is to develop support for the foreseeable changes as part of the organisational change programme, providing the changes to be successfully implemented, conveying change means getting employees to change their way of thinking, their way of working or their way of completing tasks, and this change could only take place with the employee (Fox, 2011). To facilitate this, the communication aspect is of the highest importance and targeted at key employees whom could really make a change. This could be dealt more effectively if strategic change management communication is established from the start of the project (Williams and Williams, 2007).

Business & Information Process (KI3)

This represents the inner-operations of the organisation, the lifeline of the organisation. This explains how things are done, what to be done, when to do it, where to do it, why to do it and who is responsible. This enables process automation, system integration and data interchange. Understanding the organisation's business and information process is critical for the success of any new changes in the organisation (Berente *et al.*, 2009).

Access/Availability (SK3.1): The availability, formalisation and documentation of business and information process enable employees to comply with a standard set of repeatable work process to ensure a smooth and congruent business processes, as well as capturing organisational knowledge. This is demonstrated by having data, applications and systems working exactly as they should, as and when it is needed (Bacic and Fadlalla, 2016).

Automation (SK3.2): This illustrates the degree of human component that could be removed from the organisational business and information processes (Trkman, 2010). Highly matured organisations have their business and information automated, where these can be captured by external stakeholders and supply chain. The repeatability of the process is also reinforced with value-added services as the process improves through time (Samaranayake, 2009).

Data Exchange/Interchange *(SK3.3)*: The interchange of information and data, through structured business processes and seamless data transaction, feeds into organisational intelligence for management to make their informed decisions (Rainer and Cegielski, 2011). The lowest level of maturity indicates the organisation has no process or data interchange in the organisation; different individuals in the organisation own different information.

External Parties/Integration (SK3.4): The capability of the organisation to connect people, tasks and information with disparate technology or systems – to streamline the transfer of business information to and from various technology resources (Wang *et al.*, 2015). Berente *et al.* (2009) describes integrated business process as 'one in which the effort associated with information flows between activities is minimised, and business process integration describes the practices associated with the minimisation of this effort, or the tighter coupling of organisational activities in a business process'.

Standards (SK3.5): This factor examines to what extent business and information process standards (international and national) and methods are used in the organisation. Standards are essential to provide a guideline and guidance for best practice; and in this case, to provide a standard platform for business and information exchange (Blind, 2011; Succar, 2009).

Policy/Strategy/Vision (KI4)

All organisations involved with the interviews are looking into the future and have the vision of using IT to expand its business and have competitive advantage. Organisational foresight is essential as a tool to integrate organisational strategy and action plans. The key to achieving forward planning is for the organisation to identify 'what they want to achieve' and involve staff in the planning process. This will in turn empower staff to improve themselves to meet the challenges (that they help to plan) in the future.

Dissemination/Involvement (SK4.1): The involvement and engagement of employees in the creation of policy/strategy/vision provides the sense of belonging and ownership to employees in the organisation (Paton and Karunaratne, 2009). This involvement must filter and engage employees at all levels – dissemination to every department, project team and the supply chain – to enable employees to understand their role, responsibility and importance to the organisation's success (Parida and Kumar, 2006).

Foresight (SK4.2): Organisational foresight provides futures planning and looking into potential risks – this could only be done through an in-depth understanding of its business and industry, technology and culture of the organisation (Warnke and Heimeriks, 2008).

Foresighting is especially essential as organisational IT investment could be front-loaded and benefits could only be visible in the long run (Misuraca *et al.*, 2010).

Inspiration/Empowerment (SK4.3): Leaders could continually empower employees through demonstrating the true value of intellectual capital with employees; sharing leadership vision; communicate organisational goals and direction; putting trust on employees; providing the best information for decision making; inspiration for all; delegating authority and impact opportunities to employees; and to provide frequent feedback (regardless if is positive or negative) (Liu *et al.*, 2007; Mansell, 2010)

New Technologies (SK4.4): The vision of new technologies is essential for organisations to plan for IT investments, provisions of maintenance and to research into prospecting technologies (Pietrobelli and Puppato, 2016). To achieve this, the organisation will need to blend two major sets of technical and management capabilities. Firstly, it is important for the organisation to understand the capability organisational IT, understanding current capacity and the needs of the organisation in the future. Secondly, the organisation must set targets for technology research, development and exploration (Gressgard, 2011).

Recognition/Identification (SK4.5): The recognition or identification process is to know what is important for the organisation and is the fundamental building block in the production of organisational policy/strategy/vision (Stark, 2005). This process provides the organisation with a clear understanding of the desired future (where were yesterday, where they are today, and where they intend to be tomorrow), and with the ability to identify the specific sectors of the organisation where improvements may be needed (Misuraca *et al.*, 2010).

IT Sharability/ Interoperability (KI5)

The organisation's capability to communicate, execute programs, or transfer data among various functional units in a manner that requires the user to have little or no knowledge of the unique characteristics of those units (ISO 2382, 1993). This can enhance collaboration with the supply chain by eliminating the geographic factor, improve transaction speed and accuracy, better decision-making through the most up-to-date data and a higher pace of IT development (Agdas and Ellis, 2010).

Access/Uptake *(SK5.1)*: The uptake and trial of new technologies and be integrated and 'talking' with existing IT is essential for an organisation to maintain its business competitive advantage; where IT is seen as a core business driver (Lam *et al.*, 2010). The most matured organisations are that whom prioritise IT sharability and interoperability as key business drivers in the organisatio; an unprepared organisation continues in its daily routine and refuses to try new technology to fit into existing systems, and no knowledge of IT sharability/interoperability exists in the organisation.

Existing/Availability (SK5.2): Organisations with IT available 24/7/366 as a pre-requisite, irrespective of geographical location and free from technical bugs would be considered a highly matured organisations in terms of availability. Mid-level maturity organisations have their employees free to use the system, but only within geographical boundaries and only inside the time-frame (work hours) of the organisation. Internal systems are technically sound and reliable, but there is no provision for help shall any users requires it.

Legal Framework (SK5/3): It is essential for the organisation to identify, analyse and develop the legal and regulatory framework for IT interoperability, to include issues such as open standards, interpretation of data across diverse architectures, data/information exchange, reuse and storage (Kog, 2010). Organisation that does not have any legal framework for IT but is aware of its legal obligation is seen as worst-case scenario. Advanced level maturity organisations enforce its IT legal framework to its stakeholders and supply chain, and all parties must comply before work is set in motion.

Skill/Knowledge (SK5.4): Organisational IT sharability and interoperability knowledge is essential to optimise and align corporate IT strategy (technical) with business needs (process). Often in the organisation, there are individual leaders or champions in either the IT technical domain, or the organisational business needs – individuals now must champion both domains (Rezgui *et al.*, 2011).

Standards *(SK5.5)*: Standards provide the common platform for data, information and intelligence to be interoperable and sharable within the organisation, and also with stakeholders and supply chain. According to Papazoglou and Ribbers (2006), interoperability requires standardisation in four dimensions – technology, syntax, semantics, and pragmatics; and Gottschalk (2009) describes interoperability in digital government in five maturity levels – computer, process, knowledge, value and goal.

7. Framework Evaluation and Validation

The evaluation process invited 16 UK and international construction academics and practitioners to provide feedback on the framework is and around the areas of: usability, clarity and simplicity of the framework; flexibility and elasticity of the framework; scoring system of the framework; writing style, design and interface and framework presentation; possible use of framework in their organisation; applicability for the construction industry; applicability in their county (international experts only); and finally, personal and professional comments on the framework. Feedback included:

- Inclusion of a glossary of terms for the user of the framework as some terms may be too technical, or the meaning may differ to different individuals.
- Based on the hardcopy, the design could be simplified – yes, the words are important but a good design will make it look interesting without reading.
- Framework score provided benchmarks for the various departments within the same organisation to compared against and achieve.
- Framework *look and feel* do not reflect an academic piece of work, rather a commercial product. This is both a positive and a negative, depending how the framework is designed to be for.
- Framework scope is too wide, and there is a need to target the right audience. The framework now lacks focus – it could be designed as a tool for Senior Management or Executives and use the results to formulate strategic vision and strategy for the organisation; or the research could also design the framework to be sector specific (eg. construction, engineering, oil and gas, etc.), or hierarchy specific (eg. executives, middle management, operations, etc.).
- The framework gave an interesting insight into the readiness of organisations to adopt IT. The questions remain, “Are we ready for today’s technology? Is technology used to its full potential? Or is technology just a fashion accessory?”.

Feedback from externals were brought into context and changes to the framework include interface redesigned and simplified; key Indicator is colour coded for identification purposes to simplify the usability of the framework, and to act as a content guide; short description on Key Indicator is written to present a short introduction to the topic area; Sub-Key Indicator headline are re-worded to provide a more accurate representation of the indicator; each Sub-Key Indicator maturity is given keywords to provide users with a ‘one word’ explanation of the Sub-Key Indicator, and an extended summary to represent the maturity of the Sub-Key Indicator (eg. hands-on, open door, filtered, restrictive, non-existent); long and difficult to understand sentences and changed or removed; and IT jargons and construction terms changed or removed. The corrected KIs and SKs are presented in Table 6. Part of the completed ERiC Framework is shown in Figures 1, 2, 3 and 4.

[insert Table 6]

[Insert Figure 1]

[Insert Figure 2]

[Insert Figure 3]

[Insert Figure 4]

This framework has contributed towards the thinking and future direction of e-readiness within the UK CI. The industry remains to be fragmented, stubborn and paper-intensive – but the future will be going digital and the longer constructions shy away from IT or new technologies, their future will be subdued. More work can be done on:

- Global e-readiness index – with the framework now completed, it was strongly suggested by industry practitioners to create a global e-readiness index for construction organisations. There is no such index available at the moment. The framework should be transformed into an online version and distributed worldwide. As an independent research, this may open various doors for data collection and attract organisational participation. With help and assistance from academic researchers worldwide, there is the opportunity to publish an e-readiness index. Moving forward, this index could be the benchmark between different industries or between practices in different countries.
- Sector specific – the framework could be further refined to incorporate factors from other sectors (eg. manufacturing, petrochemicals etc.). The concepts remain similar, but the changes in the language, industry specific jargon and samples could be aligned to the specific industry need. From a research perspective, this provides the opportunity to assess the disparity between different industries. Also, SME organisations should also be considered.
- Hierarchy or department specific – the framework could also be altered to fit the needs of the various hierarchy levels and the myriad of departments in the organisation. Future work could include an assessment for level of management in the organisation, where Senior Management takes a different assessment from the operatives. This will provide a gap assessment between the hierarchies in the organisation. Another option is to provide different department with different assessments, and this could also show gaps between the departments.

8. Conclusion

The construction industry (CI) is continuing to operate in a fragmented but dynamic and highly competitive environment. In this respect, Senior Management and key decision makers can continually try to find new ways of driving forward their businesses. With unprecedented levels of technological change now increasingly being used as a means through which competitive advantage can be leveraged, this research aimed to determine the UK CI's perception on how businesses will have to change, from the way they are currently doing business to a more direct, structured and proactive approach (if they are going to be in a strong position to leverage e-readiness opportunities in the future). The alarming increase of expensive IT failures is also added the fear – IT should be considered a partner, not a foe.

This paper, using data collected from 3 case studies, proffers the critical success factors (CSF) necessary for the assessment of e-readiness for construction industry SMEs to reap business efficiencies, growth and development associated with technology. The 5 CSFs commonly referred to in literature of: leadership and empowerment; change management; business and information process; policy/ strategy/ vision; and IT sharability/ interoperability; were notably sub-divided into sub-CSFs that were fitting for the construction industry that are relevant for SMEs to harness the potential of IT. In the construction sector across the world, SMEs make-up a large proportion. Therefore, for the industry to become e-ready, SMEs must have organisational capability as inevitably they will form part of each and every construction project.

The development of the framework is to enable users to implement the e-readiness framework based on the researched key indicators and sub-key indicators. To assist organisations to implement the framework, a scoring system is proposed to provide a quantifiable result and a

standard benchmark. To achieve this, each sub-key indicator is given a five-level maturity based on the notion that a distinction could be made in regard to levels of maturity of organisations based on pre-set characteristics. The completed Final Framework consisted of 5 key indicators, 25 sub-key indicators and 125 sub-key indicators maturity statements and sample cases.

The product of this paper is the E-Readiness for Construction (ERiC) framework, which enables construction organisations to quantify and measure organisational e-readiness from an organisation, technical and process perspective. During the research lifespan, it witnessed the construction boom at the start of the research and witnessed the bust of the industry towards the end of the research. This saw the shift in e-readiness thinking from complacent to essential tool needed now; and the shift in e-readiness practice from unnecessary to a significant practice to determine gaps for organisations to be e-ready. Again we ask, ‘ Are you e-ready? ’

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Table 1: Potential e-readiness critical success factors

Leadership and Empowerment	• Authoritarian • Encourage • Engage • Foresight/Vision • Improve	• Inspire • Instigate • Integrity • Involve • Revelation
Change Management	• Business Process Reengineering • Implementation • Interaction • Methods • Patron/ Champion	• People management • Practice • Revolution • Strategy / Strategic framework • Support / Executive Sponsorship
Business and Information Process	• Access / Availability • Assimilation • Automation • Data exchange / Integration • Existent	• External parties / Integration • Guidelines • Internal employees • Reengineer • Standards
Policy/ Strategy/ Vision	• Diffusion • Dissemination • Foresight • Futurist • Inspiration / Empowerment	• New technologies • Organisation • Outcome • Recognition / Identification • Strategy
IT Sharability / Interoperability	• Access / Uptake • Agreement • BIM/IFC • Existing / Availability • Information	• Legal • Open source • Skill / Knowledge • Standards • Understanding

Table 2: Case study matrix of potential e-readiness sub-key indicators

	Potential Sub-Enabler	CS1-C1	CS1-C2	CS1-C3	CS1-IF	CS2-C1	CS2-C2	CS2-C3	CS2-IF	CS3-C1	CS3-C2	CS3-C3	CS3-IF	Frequency
Leadership and Empowerment	Authoritarian			□			□							2
	Encourage	□	□										□	3
	Engage	□				□					□			3
	Foresight/ vision	□	□	□			□	□		□	□	□		8
	Improve	□	□		□	□		□		□	□		□	8
	Inspire		□	□		□	□	□	□				□	7
	Instigate	□		□						□				3
	Integrity			□	□	□		□	□	□			□	7
	Involve	□	□		□			□		□	□	□		7
	Revelation						□					□		2
Change Management	BPR		□	□			□							3
	Implement	□			□	□	□	□			□	□		7
	Interaction/ Communicate	□	□	□				□	□	□	□	□		8
	Methods			□						□			□	3
	Patron/ Champion	□					□			□				3
	People management		□						□				□	3
	Practice		□	□	□			□	□	□	□			7
	Revolution			□			□							2
	Strategy/ Strategic framework	□	□	□	□	□	□	□			□	□		9
	Support/ Executive Sponsorship	□			□	□		□	□		□	□		7
Business and Information Process	Access/ Availability	□		□	□	□			□	□		□		7
	Assimilation			□								□		2
	Automation	□	□			□	□	□			□	□	□	8
	Data exchange/ Integration		□	□	□	□				□	□	□	□	8
	Existent					□				□				2
	External parties / Integration		□		□		□	□		□	□	□		7
	Guidelines	□		□										2
	Internal employees			□			□		□				□	4
	Reengineer		□			□								2
	Standards	□	□		□		□	□		□	□	□		8
Policy/Strategy/Vision	Diffusion					□				□				2
	Dissemination/ Involvement		□		□	□			□	□	□	□	□	8
	Foresight	□			□	□	□	□		□	□		□	8
	Futurist		□				□				□			3
	Inspiration/ Empowerment	□		□				□	□	□	□	□	□	8
	New technologies		□			□	□	□	□		□	□	□	8
	Organisation	□		□				□						3
	Outcome	□									□			2
	Recognition/ Identification		□		□	□			□	□		□	□	7
	Strategy	□	□	□			□							4
IT Sharability/ Interoperability	Access/Uptake	□	□	□	□	□		□		□	□	□	□	10
	Agreement	□					□							2
	BIM/IFC		□	□			□		□	□				5
	Existing/ Availability		□	□		□	□				□	□	□	7
	Information			□						□				2
	Legal Framework				□	□	□	□	□	□	□	□	□	9
	Open Source				□						□			2
	Skill/ Knowledge	□			□	□			□		□	□	□	7
	Standards	□	□	□		□	□	□		□		□	□	9
	Understanding	□											□	2

Table 3: Data tabulation by e-readiness key indicators

Key Indicator	Case Study 1	Case Study 2	Case Study 3
Leadership & Empowerment	• Example to employee • Grassroots problems • Hands on • Long term aim/vision • Standard platform • To staff, Division and organisation	• Forward thinking • Hands on • IT for business expansion • Keen interest • Look up upon	• Ability to inspire through example • Acknowledge the need to continuously improve • Believe in The Board • Bridge between client and internal software/system • Delivers on promises (so far) • Great debater/speeches • Inspiration with vision • It strategy written with staff • Looking ahead but unsure what to do • More said than done • Staff empowerment • Strategy lack of management support
Change Management	• Best practice • Change management framework • Culture • Employee to process • Lead by example • Open to employee • Push from top • Staff buy-in	• Ability to change as needed • Change by example • Change Champion • Expectations • Fluent in process change • Leadership • Manage change, perception & expectation • Organisational implementation plan • Quality Assurance System (QAS) • Senior Management & employees open to change • Trying new things • Where, when, what, who, why how • Would be ideal is available	• Bridge gap between site and HQ • Communication plan needed • Need to get involve more • Organisational strategy (integrated) • Strategy + implementation plans • Strategy available, not IT specific • The Board do not understand

Business & Information Process	• Common standards • No human error • Increase efficiency • Process integration • Data interchange • Standards	• 24/7/365 • Available worldwide via the Internet • Business expansion • Internal push, external pull • Known flow • Known process • New software for data interchange • Old software to share data • Processes mapped • QAS (common standard) • QAS (known processes) • QAS (staff knows who to approach) • QAS (standards specified) • Staff information interchange	• Address gap between site and HQ • Can be easily monitored • International standards required • Known business & information process • Staff to know where information/data is
Policy/Strategy/ Vision	• Achieve more in the right direction • Foresight • Internal and external forces	• Business and IT strategy aligned • Business needs supporting through IT • Inter-department appreciation • Understand the organisation & business • Business foresight to predict future technologies	• Business strategy + IT strategy • Identify the details • Involve staff (experience, expertise, empowerment) • IT identified as strategic instrument • Staff self-empower to learn IT • To be more involved in organisation • The Board recognise IT • The Board unsure to invest, or not • Staff & The Board to try new things
IT Sharability/ Interoperability	• Changing standards • International standards • New technologies • Only now considered (BIM) • Software to fit business • Standard platform/dashboard • Techie solutions • Technical and process	• Different systems (open system, programming language) • International partners. • Lack of standards • Seamless & efficient with accurate results • Software integration	• Data sensitivity • Increased uptake • Integrate software into single system • Islands of automation • Lack of technical and academic knowledge • Legality in sharing, exchanging and editing data • Need to integrate internally • No common international standard • Numerous owners/provides with different ownership levels • Single point for information capture & dissemination • Unknown standards

Table 4: Tier 1 Key Indicator (KI) default and variation scoring weightage

Key Indicator	Default Weighting Option	Variation Weighting Option
KI1	20%	25%
KI2	20%	25%
KI3	20%	20%
KI4	20%	15%
KI5	20%	15%
Total	100%	100%

Table 5: Tier 2 Sub Key Indicator (SK) default and variation scoring weightage

Sub-key Indicator	Default Weighting
SK1.1	4%
SK1.2	4%
SK1.3	4%
SK1.4	4%
SK1.5	4%
SK2.1	4%
SK2.2	4%
SK2.3	4%
SK2.4	4%
SK2.5	4%
SK3.1	4%
SK3.2	4%
SK3.3	4%
SK3.4	4%
SK3.5	4%
SK4.1	4%
SK4.2	4%
SK4.3	4%
SK4.4	4%
SK4.5	4%
SK5.1	4%
SK5.2	4%
SK5.3	4%
SK5.4	4%
SK5.5	4%
Total	100%

Sub-key Indicator	Variation Weighting
SK1.1	3%
SK1.2	4%
SK1.3	3%
SK1.4	3%
SK1.5	4%
SK2.1	2%
SK2.2	7%
SK2.3	1%
SK2.4	3%
SK2.5	4%
SK3.1	5%
SK3.2	3%
SK3.3	5%
SK3.4	3%
SK3.5	5%
SK4.1	7%
SK4.2	4%
SK4.3	5%
SK4.4	5%
SK4.5	4%
SK5.1	8%
SK5.2	3%
SK5.3	4%
SK5.4	1%
SK5.5	4%
Total	100%

Table 6: The final version of the key indicators (KI) and sub-key indicators (SK).

Key Indicator (KI)		Sub-Key Indicator (SK)	
KI1	Leadership & Empowerment	SK1.1	IT vision
		SK1.2	Involvement
		SK1.3	Inspiration
		SK1.4	Integrity
		SK1.5	Improvement
KI2	Change Management	SK2.1	Strategic framework
		SK2.2	Implementation
		SK2.3	Executive sponsorship
		SK2.4	Business practices
		SK2.5	Communication
KI3	Business & Information Process	SK3.1	Standardisation
		SK3.2	Automation
		SK3.3	Availability
		SK3.4	Integration
		SK3.5	Interchange
KI4	Policy/Strategy/Vision	SK4.1	Collaboration
		SK4.2	Identification
		SK4.3	Dissemination
		SK4.4	Empowerment
		SK4.5	Future technologies
KI5	IT Sharability/ Interoperability	SK5.1	Uptake
		SK5.2	Standards
		SK5.3	Availability
		SK5.4	Knowledge
		SK5.5	Legal framework

Figure 1: ERiC Framework summary interface

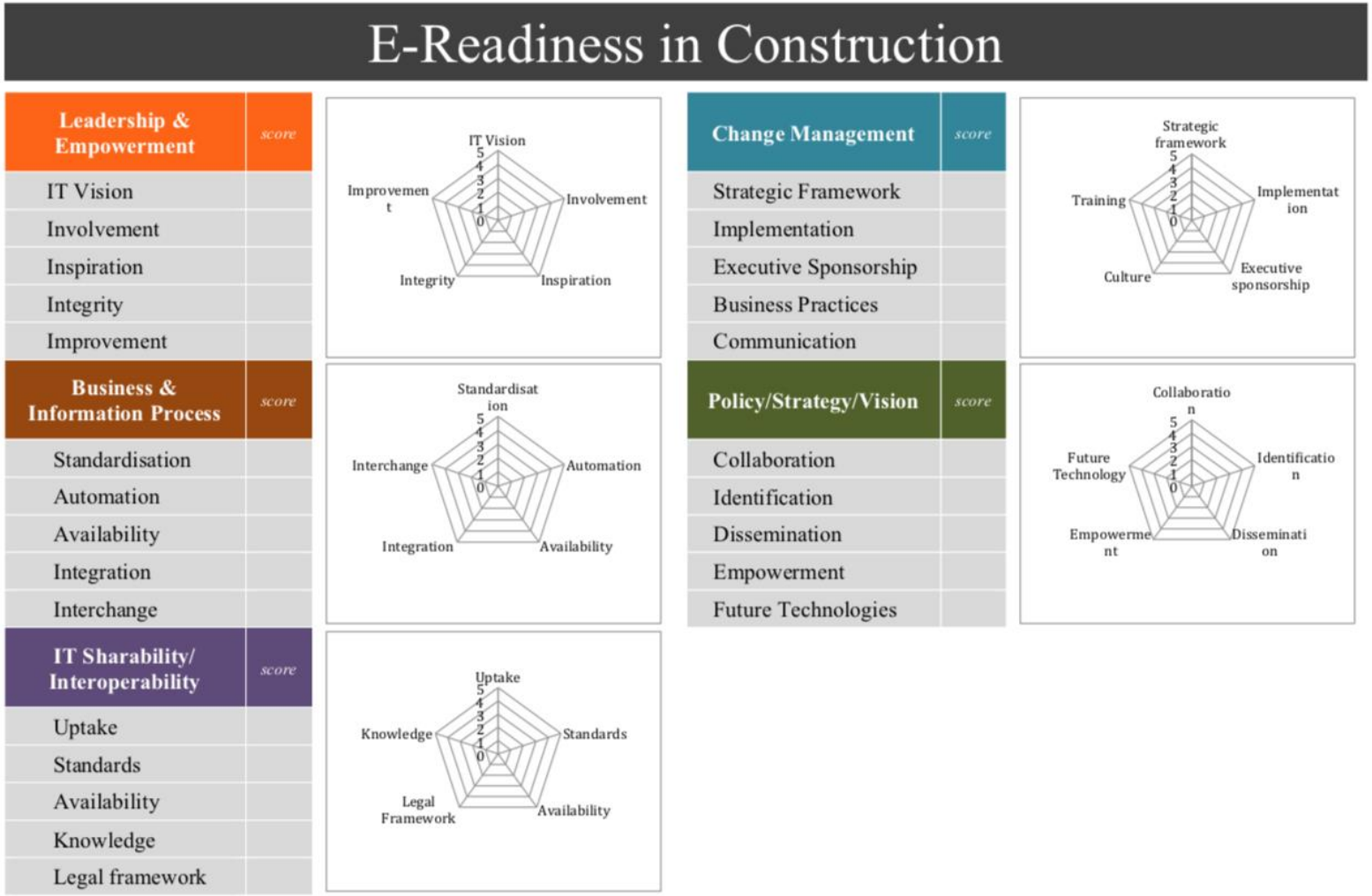

Figure 2: IT Vision (SK1.1) sub-key indicator within the ERiC framework.

Key Indicator	Maturity Level				
Leadership & Empowerment					
IT Vision					
The forward thinking vision for technology to support and enhance organisational aims in terms of supporting the administration, management, employees and the wider built environment industry.	**Global engagement**	**National champion**	**Transformation**	**Obsolete and isolated**	**Non-existent**
	World-leader in providing ideas, forward thinking and continuous improvement. This reflects extensive research and development done within the organisation, and often hailed the as a global champion.	Leading organisational vision inline with national/governmental strategies and policies, with regards to the future of IT. This level of maturity, confidence and forward thinking demonstrates the current and future needs of the organisation and the industry.	Transformation within the organisation is apparent – people, process and technology from the myriad of departments are working/changing inline with organisational IT vision.	Much is talked about by Top Management to introduce, educate, re-engineer and implement IT-enabled practices in the organisation; but nothing is done. Individual departments within the organisation are happy to work in silos.	Top Management has no concern in improving current work practice and/or no interest joining the digital economy – maintaining a paper intensive organisation.
	Example (E-tendering usage)				
	Global use of e-tendering solution for the organisation, and enforcing e-tendering to its sub-contractors and supply chain. The organisation is able to streamline and optimise business practices with e-tendering; and be in the position to introduce new and innovative tendering/ procurement methods.	Nation-wide use of e-tendering within the various departments of the organisation – data is shared within the organisation in a single country; the organisation is now matured enough to enforce e-tendering through its sub-contractors and national supply chain.	Organisational-wide implementation and usage of e-tendering system – tender information and data is shared by colleagues within the locality of the organisation.	Only individual departments (eg. tendering department) in the organisation are using e-tendering; some organisations are force into using e-tendering by prospective Clients.	Organisation maintains the paper intensive traditional (manual) tendering methods, with no interest and missing out on existing e-tendering opportunities.
	[Score] 5	*4*	*3*	*2*	*1*
	Notes				

Figure 3 Strategic Framework (SK2.1) sub-key indicator within the ERiC framework.

Key Indicator | Maturity Level

Change Management

Strategic Framework

A strategic framework allows the organisation and its supply chain to create a roadmap for change. This will drive the change process from the highest level (vision, goals and objectives) to the day-to-day work.	Advanced	Competent	Transformation	Isolated	Non-existent
	The matured strategic framework acts as a standard for the organisation and its stakeholders, enabling continuous improvement, adding to intellectual property and increasing competitive edge.	Top Management established an organisational-wide strategic framework for change management as a standard framework for all departments – this provides the vision and awareness all employees and organisational supply chain.	A standard IT change management framework is established and shared between various departments in the organisation. Top Management realises the need for a change management strategic framework.	Individual departments create isolated methodology for IT change management, and led by individual employees.	There is no strategic framework for change management in the organisation, and there is no intention of creating one.
	Example (Change management strategic framework for supply chain IT logistics integration)				
	The change management framework provides a platform for the organisation and its supply chain to implement IT logistics and the ability to share construction logistics for the project team and as competitive tool in its global business.	The organisation put into place its strategic framework into practice – this foresees a standard IT logistics integration for its departments and supply chain to follow.	Various departments within the organisation (eg. purchasing, contracts, accounting) share a common change management framework for change, and begin to attract attention from Top Management.	The purchasing department starts its own change management methods to try to integrate IT practices with its supply chain – unknown to Top Management.	There is no change management framework for IT logistics integration for organisational supply chain – all IT integration is done at an ad-hoc basis.
	[Score] 5	*4*	*3*	*2*	*1*
	Notes				

Figure 4 Automation (SK3.2) sub-key indicator within the ERiC framework.

Key Indicator	Maturity Level				
Business & Information Process					
Automation					
Automation illustrates the degree of human component that could be removed from the organisational business and information processes.	**Seamless**	**Advanced**	**Intermediate**	**Initiate**	**Non-existent**
	Organisational business and information-automated processes are captured by external stakeholders and supply chain. This improves the accuracy of the information transferred and ensures the repeatability of the value-added tasks performed.	An organisational-wide business and information process automation is implemented – this aims at replacing human error and resulting in the limitation of mistakes, cost reduction, transparency and increased work efficiency.	Inter-department business and information processes are starting to be automated, led by department managers, and Top Management begins to take attention to automate processes.	Individual department begins to analyse, document, optimise and then automating business processes for isolated projects (often on an ad-hoc basis) by a myriad of methods and no vision for the future.	Work is completed without technology components to substitute and/or supplement manual processes.
	Example (Usage of construction estimating/taking-off software)				
	All stakeholders and supply chain within the project is able to share and automate processes. The shared information provides managers the ability to make an accurate informed decision, throughout the project lifecycle.	All departments in the organisation shares and obtain data from the Tendering department. This enables the organisation to better share resources, estimate organisational budgets, etc.; reduces human error and increases competence.	The Purchasing, Accounting and Procurement department shares and obtain data from the Tendering department for project costing, estimates and contract preparation.	The Tendering department uses estimating software to compile quantities and take-off directly from drawings – cost estimates are prepared instantly.	All quantities and taking off are completed manually, with the help of a calculator.
	[Score] 5	*4*	*3*	*2*	*1*
	Notes				