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Full Length Research Paper

Dimensions of information technology infrastructure flexibility in improving management efficacy of construction industry perspective: A conceptual study

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As technologies change rapidly, improved information technology (IT) products and services are released daily throughout the world. This phenomenon gives tremendous pressure on organization managers to plan, implement and adopt new technology solution in accommodating such changes. Thus, one of the most significant current discussions is IT infrastructure flexibility. Most of the studies in IT infrastructure flexibility have been carried out across industries; however less attention has been paid to measure flexibility of IT infrastructure in construction industry. The purpose of this paper is to provide a conceptual understanding on how IT infrastructure flexibility responds in changing the business demand by exploring the dimensions that could be used to measure IT within construction industry. The study is based on textual reading in a range of recently published works, of which majority of them are from 2000 to 2010. The findings will provide potential variables about each dimension in measuring IT infrastructure flexibility, indicating factors that can be used for future development of an IT infrastructure flexibility maturity model. In this context, the maturity model will be useful for construction organisations to determine where they are. It also offers a benchmark for assessing different organisations for equivalent comparison.

Key words: IT infrastructure flexibility, technical infrastructure flexibility, human infrastructure flexibility, IS flexibility.

INTRODUCTION

In the current economic climate, people has realised the importance of IT in altering and improving the way businesses operate. In construction industry, IT is perceived as a driver for many of the construction business and operational processes (Aouad et al., 1999; Eadie et al., 2010). The establishment of e-business in the industry such as e-tendering, e-procurement, e-portal, and other electronic transaction process is a proof that there has been a technological shift in construction sector from IT driven solutions to IT enabling ones. Nevertheless, IT environments today are dramatically different from the host-centric systems of 20 years ago. Today, IT systems span complex networks with multiple access points and servers, hundreds of software components and thousands of computing devices (Raad et al., 2010). IT changes rapidly and due to the e-commerce revolution, it may be changing faster than ever. The industry has started to realise how IT infrastructure can be managed to best achieve today's business goals under ever-changing business environments, in the midst of rapid changes of technology (Abukhder et al., 2004; Ahmad et al., 2002; Alam, 2009; Aouad, et al., 1999).

Few researchers agree that the development of a flexible IT infrastructure is important (Boar, 1997; Brancheau et al., 1996; Niederman et al., 1991). Despite

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Abbreviations: ITIF, IT infrastructure flexibility; **IT,** information technology; **IS,** information system.

the global financial crisis in early September 2009, the recent report by the Forrester Research (2009) indicated that the IT investment increases in late 2009 and 2010. The Gartner Group (2010b) confirms this with a prediction that worldwide enterprise IT spending across all industry markets will rise 4.1% in 2010, surpassing USD2.4 trillion. Construction industry, however, has always become one of the lowest investor in IT (Kennet, 2010). For instance, Construct IT recently reported that the UK construction industry's spending on IT stands at £2,556 (USD3,870) per head and this make up a total annual spending on IT in the industry in 2009 to be £1.2 billion (USD1.82 billion) only (Kennet, 2010). This finding is consistent with data found by Gartner Group (2010a) where the industry spent the lowest amount in IT. This figure, nevertheless, is much improved if compared to 20 years ago (Kennet, 2010). A group of researchers from Canada found out that construction organisations were spending a relatively very small proportion of their total budget on IT, which about up to 1% of total revenue (Hewage et al., 2008).

Out of this small investment of construction organisations on IT, its adoptions are still facing failure even after years of IT introduction in the industry (KPMG IT Advisory, 2008; Standish Group, 2009). The fragmented nature of construction industry is the core explanation of why IT meets challenges in its adoption. Construction involves various parties in one project, and the team changes for every project. Furthermore, every party has its different needs and different functions in using IT. That is why, the technology providers face difficulties in understanding the needs of the construction firms and how to address the overall IT integration to successfully increase the level of communication (Hewage et al., 2008). The industry also has discontinuous nature of the building design and construction supply chain, for instant, design and construction teams form for a single project and then, dissolve. Hence, there is no way to use the same type of technology for all types of construction projects, as every construction project is unique and complex. Moreover, it is impossible to select tailor-made IT for each and every construction project because it would be very extremely costly. These reasons answer a question of why is IT investment is much less intensive in construction than the other sectors even though many evidence have been found that IT highly impact on construction organisation's performance (Gaith et al., 2009). With these character-ristics, how is construction industry coping with the changes in IT?

Unlike other engineering projects, once an IT application has been developed or packaged for commercialization, it will not only have to be further maintained but it will also have to be enhanced, extended, and adapted to new or changing platforms (Al-Ahmad, et al., 2009). Besides the fragmented nature of construction industry, Hewage et al. (2008) found that 35% of respondents who were construction managers did not believe the construction industry is ready for rapid changes in IT. This is because, upgrading or adopting new technology consumes large investment, and if they do so, they have to bear a risk towards the failure of upgraded or new adopted IT. Additionally, the findings also reported that construction managers are concerned about how the workers will respond to the addition of IT because they are not willing to invest in adding a technology assistance department at present (Hewage et al., 2008). This issue does not only bother construction industry; it worries other industries as well. Acccording to the latest KPMG Survey (2010), it shows that 450 Chief Information Officers worldwide who had responded have agreed that IT needs to have an ability to react to changes. Not just that, many gigantic companies have embarked in research concerning this issue such as IBM, Butlergroup, Oracle and Forrester Research. In academic journals as well, there has been an increasing interest in measuring the ability of IT to handle changes as it is the particular characteristic in IT infrastructure which has a critical impact on the enterprise's ability to use IT competitively (Allen and Boynton, 1991; Byrd and Turner, 2000; Chung et al., 2005; Chung, et al., 2003; Davenport and Linder, 1994; Duncan, 1995; Gibson, 1993; Masrek and Jusoff, 2009; Rockart et al., 1996; Weill, 1993).

Researchers have been investigating the strategic value of IT infrastructure flexibility (ITIF) since the mid 1990s (Paschke et al., 2008). The concept of ITIF is based on Duncan's (1995) works that measured ITIF through shareable and reusable IT resources. Previous researchers investigated ITIF by assessing it across industries and none has ever attempted to examine the ITIF focusing at construction industry level, therefore, the understanding of ITIF in construction industry remain poorly understood. This represents the first theoretical gap in the extant literature. This paper would further deepen our understanding on factors that contribute towards the success of the IT implementation in construction industry considering that it has several unique features which distinguishes it from other industries; namely the fragmental nature, one-off projects, and multi-participants, as discussed before. Thus this paper will not contradict, but it will complement existing research. On top of that, as many researchers have discussed dimensions to measure ITIF, yet there is no study known to the authors that investigated the dimensions of ITIF particularly for construction industry. Understanding this issue is important for both practice and research because of its potential to provide information about each dimension in ITIF for the future development of an ITIF maturity model. This paper is addressing these research gaps; guided by the following research question; with the unique features of construction industry, what are the suitable dimensions to be used to measure ITIF?

DEFINING IT INFRASTRUCTURE FLEXIBILITY (ITIF)

There are many other terms that have similar meaning to ITIF. Ness (2005) has compiled many terms used within the industry and research which are "IT elasticity, on-demand, utility-based computing, virtual IT, agile IT, IT transformation, real-time enterprise and organic IT, and grid computing (Hietter, 2008)". These terms vary based on their focus regarding the scope of IT processes, strategies, methods, and/or tools to achieve true ITIF (Ness, 2005). In literature, however, a term commonly used is 'IT infrastructure flexibility'. Although not all researchers have referred directly to the term ITIF, their concepts and items are relevant to the flexibility of IT infrastructures.

The term "infrastructure" is referred to the networking and platform components of the technical architecture (Ness, 2005). Its meaning has been broadly applied within research to indicate the rapid deployment of technology through an organization's existing technology and personnel-based resources (Byrd and Turner, 2000; Tallon and Kraemer, 2003). Further, "IT infrastructure" has been defined from two perspectives:

(1) An aggregation of technology components (Duncan, 1995).
(2) A combination of technology components and human factors, including resource planning and management factors that affect the capabilities of IT (Byrd and Turner, 2000).

In applying the term "flexibility", there is no single definition that can be appropriately apply to all resources, but in general, the term is used to reflect such characteristics as the ability to control outside environment effectively (De Leeuw and Volberda, 1996) which it able to be used for a variety of tasks, responsiveness to change, or able to be easily transformed (Gross and Raymond, 1993). Gross and Raymond (1993) stated that flexibility is emerging as a key characteristic of all types of resources that involve hard and soft matters. These include people and tools, and processes. Furthermore, few researchers added that flexibility is also the ability to predict and sense environmental change (Whitworth and Zaic, 2003). With flexibility, businesses are able to effectively use IT in dynamic environments. From these explanations, Byrd and Turner (2000) have come out with ITIF definition:

"ITIF is the ability to easily and readily diffuse or support a wide variety of hardware, software, communication technologies, data, core applications, skills and competencies, commitments, and values within the technical physical base and the human component of the existing IT infrastructure".

Later, (Byrd and Turner, 2000) have comprehended the ITIF definition.

"ITIF is the ability of the infrastructure to support a wide variety of hardware, software and other technologies that can be easily diffused into the overall technological platform, to distribute any type of information (data, text, voice, image, video) to anywhere inside of an organisation and beyond, and to support the design, development and implementation of a heterogeneity of business applications".

As many researchers in their literature used these definitions, this paper therefore is based on Byrd and Turner's as well.

RESEARCH METHODOLOGY

The data and findings presented in this paper are mostly taken from secondary sources. The information was gathered from journals and literature books with a focus on the IT infrastructure flexibility research from when it was introduced until the current research approach. It apparently does not cover all areas comprehensively, this paper focuses mainly on IT infrastructure issues of IS projects embedded within construction industries. Majority of them are from 2000 to 2010. The source materials of the data were obtained from libraries' databases of Malaysian universities. In order to update the information for the findings, the Internet was used as an important source.

You have explained more with an outline of limitations. This work has a number of limitations that you must need to acknowledge

BENEFITS OF IT INFRASTRUCTURE FLEXIBILITY

The concept of ITIF comes from a need to have IT that is able to face the rapid technology changes. To some point, previous studies agreed that ITIF is a key to success of IT during periods of intense change, particularly where flexibility in IT infrastructure acts as a foundation for overall IT flexibility (Davenport and Linder, 1994; Tallon and Kraemer, 2003). In this situation, ITIF is believed to benefit from construction organisations in four aspects as thus explained.

Cost saving

Generally, many researchers believe that a flexible IT infrastructure helps the organization in handling increased customer and market demands without increasing costs (Davenport and Linder, 1994; Weill, 1993). As improved IT products and services are released every day, it is difficult for construction organisations to implement new IT without a large re-investment. Hence, by having flexible IT infrastructure, construction organisations are able to support changes by reusing the existing component of IT infrastructure every time new technology is introduced as it is designed to handle changes. Besides, ITIF provides capability of adjusting to wide variety of environments, and it has depth and scalability to apply to most construction organisational needs. On top of that, construction organisations save the cost from providing training to

their own staffs or clients because with ITIF, it allows the construction organisations to exert greater control over IT/IS operations within and beyond the organisation to ever-changing technologies, legislation, policies, regulations and constituent expectations (SAP, 2009; Sweeny, 1995).

Time saving

ITIF allows managers in construction organisations to make decision towards business-IT infrastructure alignment so that they can quickly adapt to environmental changes and explore new ideas of processes (Leana and Barry, 2000). As re-development of new IT infrastructure takes too long to implement, ITIF enables IT systems to support changes and it can be improved without having to start all over again (Butler Group, 2006a). As a result, ITIF can shorten product time cycle, increase design alternatives and produce higher quality products (Omar et al., 2010). In addition, ITIF implies building a system with capabilities to anticipate distinct requirements such as a broad range of products that offer suitability for each party involved as clients, contractors, and designer team. They will be communicating using IT systems and this saves time in term of communication (Hashim et al., 2010).

Improve communication

ITIF offers expansion plans to other geographical locations. Thus, ITIF improves connection between parties involved and the construction organisations will become more globalised. They can get real time data, and communicate with other parties at anytime from anywhere. Therefore ITIF promotes better integration and better business process.

Increase effectiveness and enhance competitive advantage

As many researchers have addressed the impact of ITIF towards IT effectiveness, they agree that ITIF is a significant factor towards the effective delivery of IT services and solutions and it provides a powerful and viable approach to delivering efficacious IT solutions and services to the business (Butler Group, 2006b; Chung et al., 2005; Chung, et al., 2003; Masrek and Jusoff, 2009; Ness, 2005; Sääksjärvi, 2000; Sriprasert and Dawood, 2002). Additionally, the combination of having both technical infrastructure and human infrastructure in IT is proven by few studies that it enhances competitive advantage with their importance is found to be positive to the organisations' flexibility (Byrd and Turner, 2001; Chung et al., 2005; Fink and Neumann, 2007). Hence, this paper can safely state that ITIF will improve effectiveness in construction organisations, as well as enhancing competitive advantage.

DIMENSIONS OF IT INFRASTRUCTURE FLEXIBILITY

The result of Duncan's study was a framework for IT infrastructure, and since then, other authors have investigated further on ITIF (Table 2). The definition of flexible IT infrastructure qualities through the dimensions of connectivity, compatibility, modularity and skilled IT personnel, and these dimensions appear to be consistent among the literature reviewed (Table 1). Even though many researchers included an extra variable for data transparency/integration/management, this is, however, is part of Duncan's original classification and falls into the categories of compatibility and modularity. In construction industry context, there are three dimensions suggested as very important measures to be used; namely technical infrastructure, human infrastructure and flexible information system (IS).

Technical infrastructure flexibility deals with hard issue. It consists of connectivity, modularity, and compatibility. Connectivity is the ability of any technology component to communicate with any of the other components intra or inter organizational environment (Duncan, 1995; Masrek and Jusoff, 2009) which helps to facilitate the ability to share of IT resources at the platform level (Tapscott and Caston, 1993). This means that, with ITIF the system is readily connected anytime and anywhere it is needed, with high speed and good telecommunication lines provided. As for one simple example, text messages can be shared, or at the other extreme, any document, process, service, video, image, text, audio, or a combination of these can be used, regardless of the manufacturer, make, or type. Compatibility is the ability to share any type of information across any technology component throughout the organization (Duncan, 1995) and across organizations (Masrek and Jusoff, 2009). It enables an organization to capture data, information and knowledge, as well as span organizational boundaries and empower employees at anytime (Tapscott and Caston, 1993). The ability to easily reconfigure any technology component with no major overall effect is known as modularity (Byrd and Turner, 2000; Duncan, 1995; Masrek and Jusoff, 2009; Schilling, 2000). It relates to the degree to which IT software, hardware, and data can be either effortlessly diffused into the infrastructure or easily supported by the infrastructure (Chung et al., 2005). Consequently, software application can be more manageable when routines are processed in separate modules.

Human IT infrastructure puts skilled IT personnel in this category. It refers to a person, or a professional team who has knowledge, skills and experiences required to manage IT resources within organisations and master in

Table 1. ITIF dimensions from research literature.

Authors (by years)	ITIF dimensions					
	Technical infrastructure				Human infrastructure	Information system
Keen (1991)	Reach	Range				
Gibson (1993)	Communication connectivity	Computer compatibility	Application functionality	Data transparency		
Duncan (1995)	Network connectivity	Platform compatibility	Modularity			
Broadbent, et al. (1996)	Communication management	Standards management	Application management	Data management	Human infrastructure	
Byrd and (2000) Byrd et al.(2004) Tallon and Kraemer (2003) Chung et al. (2003) Chung et al. (2005) Ness(2005)					Human IT infrastructure Skilled IT personnel	
Chanopas et al.(2006)	Connectivity	Compatibility	Modularity	Scalability, rapidity, facility, modernity	Human IT infrastructure	
Paschke et al., (2008) Masrek and Jusoff (2009)					Skilled IT personnel	Market, integrity and network

business knowledge as well (Byrd and Turner, 2000; Chanapos et al., 2006; Chung et al., 2003; Paschke et al., 2008; Tallon and Kraemer, 2003). The third dimension is flexibility of IS (Paschke, et al., 2008). The IS flexibility is the ability of IS to adapt to organization's environment changes. Parchke et al. (2008) suggest three elements fall under this dimension, which are as market flexibility, integrity flexibility, and network flexibility.

IMPLICATION TO MANAGEMENT OF CONSTRUCTION INDUSTRY

Few researchers have examined the importance of IT infrastructure being flexible, and they have agreed that ITIF brings positive implications to management (Chanapos et al., 2006; Chung et al., 2003; Davenport and Linder, 1994; Duncan, 1995; Ness, 2005; Tallon and Kraemer, 2003). In construction industry, IT systems have typically been architected either in a project-centric way, addressing a business issue at a point in time, or in the case of primary transactional systems; resulting inflexibility in design of individual applications or the supporting infrastructure. Whilst each system may be fit for purpose, it is difficult to modify that purpose as business needs change. To overcome this issue, construction organisations need to develop an approach to ITIF for the reason that ITIF enables organizations to build applications that more closely satisfy business objectives as proven by Chung et al. (2003).

In practice, there is a gap between business and IT, and both of the environments are rapidly changing conditions (Butler Group, 2006a; Robertson and Sribar, 2002). The dimensions of ITIF have positive impacts on strategic IT-business alignment (Chung et al., 2003; Tallon and Kraemer, 2003); therefore ITIF seems to benefit the construction managers in aligning the relationship between the business and IT infrastructure. For IT infrastructures to be able to facilitate organisational responses to dynamic environments, the IT strategy (technical and human infrastructure and information system) must be tightly aligned with the organisational strategy. Thus, ITIF increases levels of an organisation's

Table 2. Current ITIF research approach.

Study / Research	Approach	Focus	Developers	Comment
ITIF dimensions of evaluation.	Technical infrastructure.	Study of resource characteristics and their measure.	(Duncan, 1995)	Develop 3 dimensions of IT flexibility, namely; connectivity, compatibility, and modularity.
ITIF model.	Technical infrastructure and human infrastructure.	Exploratory analysis of a construct.	(Byrd and Turner, 2000)	Added IT personnel flexibility as an important dimension of ITIF while combining connectivity and compatibility into one dimension called integration.
Holistic view of flexibility on online business.	Managerial.	Role of flexibility in online business.	(Ozer, 2002)	Investigating how online business can achieve flexibility through the different functional aspects of their business; technology, human resources, operations, marketing, finance, and management.
The impact of ITIF on organizations.	Technical infrastructure and human infrastructure.	Relationships among ITIF and strategic alignment and application implementation.	(Chung et al., 2003)	Connectivity, modularity and IT personnel competency have positive impact on strategic alignment. Four components of ITIF (compatibility, connectivity, modularity, IT personnel competency) have positive impact on the extent of applications implementation.
Model on how ITIF and strategic flexibility interact with, and shape, strategic alignment.	Technical infrastructure, human infrastructure, and managerial.	Implications for IT business value.	(Tallon and Kraemer, 2003)	ITIF and strategic alignment complement each other. ITIF can have both direct and indirect effects on business value. ITIF is a determinant of strategic flexibility.
The impact of ITIF on business performance.	Technical infrastructure and human infrastructure.	Relationships among ITIF, mass customization, and business performance.	(Chung et al., 2005)	
The impact of ITIF on strategic alignment and IT effectiveness.	Technical infrastructure.	Exploring relationships between strategic alignment and IT effectiveness.	(Ness, 2005)	The relationships exist and ITIF have positive impact on strategic alignment and IT effectiveness.
The role of IT	Managerial, leadership.	Focusing at how to manage flexible IT strategy.	(Patten et al., 2005)	Proposes IT Flexible Framework (IFF) with three critical aspects that an organisation should consider in managing flexible IT/IS.

Table 2. Contd.

The mediating role of IT infrastructure capabilities on flexibility and IT personnel capabilities	Technical infrastructure and human infrastructure.		(Fink and Neumann 2007);	
Dimensions of ITIF	Technical infrastructure, human infrastructure, and flexible IS.	Exploring IS as one of the dimensions of ITIF.	(Paschke et al., 2008)	
Relationship between ITIF and IT responsiveness.	Technical infrastructure and human infrastructure.	Small-medium-enterprises' ITIF.	(Jie et al., 2009)	The impact of connectivity and compatibility on IT responsiveness is fully mediated by modularity and IT personnel competency, which in turn affect IT responsiveness directly.
The effect of ITIF on intranet effectiveness.	Technical infrastructure and human infrastructure.	Exploring relationships between ITIF and intranet effectiveness.	(Masrek and Jusoff, 2009)	Compatibility, connectivity and IT personnel competency are significantly related to intranet effectiveness.

effectiveness and efficiency. This fact has been examined by few researchers namely Ness (2005), Masrek and Jusoff (2009), Chung et al. (2003), and Chung et al. (2005).

The findings contribute to a more thorough understanding among top management in construction organisations of IT infrastructure flexibility. By knowing this, managers in construction organisations have freedom to take full advantage of an IT system because ITIF is able to accommodate and respond to new initiatives. Furthermore, managers can create an investment plan by looking at their weak points and make immediate changes to keep up with the competition.

DISCUSSION

Construction industry brings unique features that differ it from other industries. Hence the central focus of this paper is to identify the dimensions that can be proposed to measure ITIF in construction context. IT infrastructure developments in construction play a role in changing the service channels and upgrading processes to the faster and saver ways with significant efficiencies (Musara and Fatoki, 2010). Therefore, the element of technical infrastructure is the major factor that needs to be focused on in the first place. Without a good infrastructure with capability to adapt with rapid technology changes, IT development can be very costly and it could be a burden and a major hindrance to some construction organisations (Omar et al., 2010). Consequently, this element is critical thus technical infrastructures, which encompasses modularity, compatibility and connectivity, are identified as one of the dimensions to measure ITIF, and these dimensions have been proven by many researchers as discussed earlier.

In order to develop a flexible IT infrastructure, a team of IT experts must be carefully selected. Currently, there is a gap between business and IT environment among IT personnel in construction industry (Rettig, 2005). There is always a case where IT personnel who are in charge of IT development for construction organisations may be very knowledgeable in IT but they may not understand the nature of construction business. Vice versa, if they have a team of people from the construction background, these people may not be as knowledgeable in using IT and probably not catching up well with the IT technology advancement. In order to align between business and IT infrastructure, IT personnel who develop the IT systems must understand the nature of business that they are working on, and be an expert in using IT. At the same time, they must be aware of the changes in business needs, as well as in technology. For this reason, human infrastructure is the second crucial dimension to be considered in evaluating flexibility of IT in construction industry. This dimension can be assessed through IT knowledge and business knowledge.

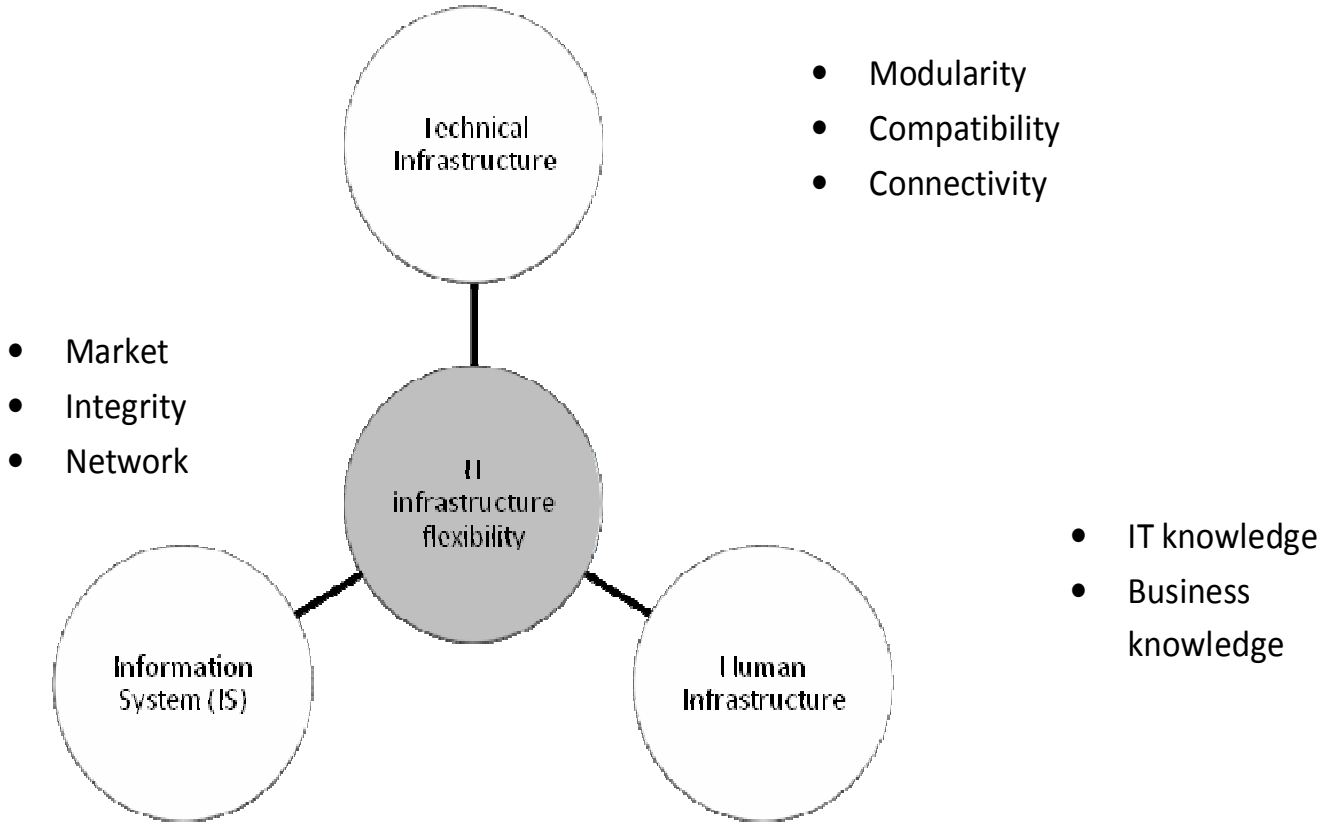

Figure 1. Proposed IT infrastructure flexibility dimensions for construction industry.

Flexible IS has been proposed as one of the important dimensions in ITIF from construction industry perspective. Even though Salleh (2007) pointed out that the distinction between IT and IS is almost impossible, this paper however, notes that there is a difference between IT and IS according to Paschke et al. (2008). IT processes, transmits and stores information using technological base which comprises the computers, communications, software, and networks which are brought in from the external environment (Cooper and Zmud, 1990; Weill and Olson, 1989). On the other hand, IS is a set of integrated software that uses IT that is embedded within organisations to support individual, group and business goals (Hsiao and Ormerod, 1998; Paschke et al., 2008). In a fragmental nature of construction industry (Figure 1), IS flexibility is measured in a separate element from technical infrastructure because in facing rapid changes of IT, IS has to be flexible enough to evolve with the changing construction business process.

SIGNIFICANCE OF THE STUDY

As many researchers and gigantic companies are moving towards having flexible IT infrastructure, there has been a lack of empirical study conducted in context of construction industry. Hence, the following are the reasons why this study is significant:

1. To establish the research gap in ITIF concerning IS projects within construction companies: This study is certainly important as that would further deepen our understanding on factors that contribute towards the success of the IT/IS implementation in construction industry considering that construction has several unique features which distinguish it from other industries; namely the fragmental nature, one-off projects, and multi-participants. Furthermore, IT/IS within construction companies involve end-users from many and different levels and backgrounds such as contractors, managers, suppliers, and construction workers as well. For that reason, to measure ITIF for IT/IS projects within construction companies is assumed to be different that measuring ITIF in other industries.

***2*. To provide potential information about each dimension in measuring ITIF:** This paper gathers dimensions to measure ITIF that have been introduced by many researchers (Table 1). However, the shortlisted dimensions then are proposed based on its suitability to construction industry. This information could be used as

critical factors in developing ITIF evaluation framework or ITIF matrix to assess and measure the flexibility of IT infrastructure.

3. As a checklist for IT managers in construction companies: This paper could be a guidance for IT managers to verify whether IT/IS projects in their construction companies have got the element of flexibility or not. The dimensions of ITIF proposed in this paper could help them in decision making of where to improve their IT infrastructure to become more flexible and at the same time enhancing competitive advantage (Figure 1).

4. For the abovementioned reasons, this paper therefore, will not contradict, but it complements others research.

FUTURE RESEARCH

This paper critically discusses about dimensions of ITIF that can be used to test ITIF from construction industry point of view. The authors' goal for future research is to develop an ITIF maturity model for IS projects dedicated to construction industry. The model will be a blended process from an extensive literature reviews and expert opinion and will further enhance through pilot study, case studies and large survey. The model will enable construction practitioners to benchmark the flexibility of their own IT. It will also be anticipated in evaluating construction organisation's strategies and opportunities to increase ITIF and resulting business value through increased IT effectiveness. Furthermore, as the business and IS agree on the need for growing flexibility towards increased value, then their efforts can certainly be supplemented and kept on track through strategic planning.

Conclusion

The world has witnessed the development of many technological advances in the construction industry. Despite the huge spending costs for IT/IS investment, the failure rate is also increasing. The industry has become bothered with the failing of IT/IS as many organizations are facing large quantities of unplanned system requirements due to changing and continual of customer demand and technology rapid changes. For this reason, construction industry definitely needs a new alternative by having a flexible IT infrastructure that will save huge long-term costs, save time, increase effectiveness and competitive advantage. However, even with growing studies upon ITIF, current research approaches are still facing limitations resulting to a need of proposing a maturity model.

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