Development of E-BIM Readiness Assessment Application for Construction Organizations: A Proposal

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Abstract: ***The construction industry has endured fragmentation for quite some time and the utilization of information and communication technology (ICT) able to reduce the negative impacts of fragmentation. However, the construction industry in Malaysia is lagging behind in adopting information technology (IT) compared to the other industries. This situation contributed by many factors including lack of readiness model development. Even though the advance of BIM in Malaysia was predominantly driven by private sectors since 2009, the Building Information Modelling (BIM) adoption rate is extremely low. The readiness framework for BIM implementation was developed for design consultants in Malaysia however, it has not been assessed. The organizational readiness for the adoption of new technologies leads to the development of e-readiness models or e-readiness assessment. Therefore, this study proposes the development of e-BIM readiness assessment application for design consultants. It underpins the need for the design consultants to evaluate their e-BIM readiness level and achieve total readiness that leads to the successful adoption of BIM.***

Keywords: Building Information Modelling (BIM), Readiness Assessment, Information Technology (IT), Construction Organization, Construction Industry

I. INTRODUCTION

The design and construction industries were precisely describes as fragmented, inefficient and adversarial by the professional experts [1]. The construction industry has endured fragmentation for quite some time, along the stages of construction life cycle and fragmentation has been viewed as the basic factor that resulted to poor execution, low profitability and uncompetitive [2]. Fragmentation has negative influence on construction projects and the major impacts such as project performance, productivity, learning, knowledge sharing and production, and innovative solutions implementation were emphasized [3]. Even though the economy of any country was contributed mainly by construction industry, this industry confronted not only high fragmentation and low productivity, but also instability, poor quality and lack of standards [4]. The separation of design and construction phases in construction work process and construction of the structure itself were highlighted as two areas that led to the fragmentation within the construction industry [5]. The separation of experts, lack of correlation between design and construction and the work process conducted in a serial manner had been discovered as problems associated with fragmentation [5]. The fragmentation process led to the obstruction of construction knowledge integration between contractors, reducing their chances to influence design decisions and the failure of design professionals to take into account the ability of a contractor to construct the designed project resulted to schedule problems, delays, and disagreement during the construction process [5].

The collaborative work through integrated practices, integrated teams or integrated design process could be the solution to problems related to fragmentation [6]. Through collaboration the common goals and commitment among the parties could be defined and the relationship was fostered by information and communication technology (ICT) as it capable to support communication, graphical representations and project developments [7]. The implementation of ICT tools in construction projects encouraged an effective communication, an efficient information transfer and allowed the organizations to use an updated business practices and construction methods [8]. Therefore, the utilization of information and communication technology (ICT) was highlighted as one of the ways to reduce the negative impacts of fragmentation [9]. However, the construction industry was not keeping up in information and communication technologies (ICTs) area due to various reasons included the fragmented structure itself and this failure was considered as a main problem that affected its performance [10].

The empowerment and reinforcement of construction industry in Malaysia have been embraced in the thrusts of the Eleventh Malaysia Plan (RMK11), therefore the Construction Transformation Programme (CITP) 2016-2020 was developed by Ministry of Work (MOW) through Construction Industry Development Board (CIDB) [11]. This industry would be transformed and developed continuously guided by four strategic thrusts; (1) quality, safety and professionalism, (2) environmental sustainability, (3) productivity and (4) internationalization [11]. Under the strategic thrust of productivity, CITP aimed to roll out the advantage of technology across project life-cycle due to the limited adoption of information technology such as Building Information Modeling (BIM) [11].

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This was aligned with RMK11 that urged productivity through increment of technology adoption and modernizing construction methods [12].

The BIM was significant towards connecting the fragmentation among building delivery professionals during building delivery process as the knowledge obtained from all the information generated by professionals will be managed in a repository [13]. The knowledge management provided a holistic understanding on the effect of decision making on one building system and performance mandates towards another or more building systems and performance mandates the affect [13]. The BIM allowed the project participants to work together and heeded the unique goals started from the conceptualization stage and continuously until the completion of the project, therefore, this approach provided an interdisciplinary working environment for creating and achieved successful project outcomes [14].

While developed countries steadily imposed BIM in many of their construction projects, the cultivation of the technology in developing countries was falling behind [15]. The benefits of BIM utilization were admitted even though developing countries in Asia emphasized their low level of BIM implementation in particular districts, and one of the main thrusts that motivated the construction industry players to engage BIM into practices was government mandates [15].

In August 2009, Dato' Sri Prof. Ir. Dr. Judin bin Abdul Karim, the Director General of Public Works Department, urged the construction companies to embrace ICT in their deliverables during the Infrastructure & Construction Asia's Building Information Modeling & Sustainable Architecture Conference and emphasized on the significant of integrated software system due to the different kinds of software used by professionals and to obtain effective workflow for the project development and implementation through standardization [16]. Therefore, the advance of BIM in Malaysia was predominantly driven by private sectors since 2009 and followed by the National Cancer Institute, the first government project proclaimed using the methodology of BIM in 2010 [17].

Problem Statement

The construction industry in Malaysia basically was lagging behind compared to other industries in embracing ICT [18]. The low usage of technology was one of the factors contributed to low productivity in construction industry [19]. Even though professionals able to incorporated computerization quickly into their construction processes, the adoption of ICT by contractors and builders was still far, as the most common ICT tools used in the industry practice were Microsoft Excel and Microsoft Project [18]. The managers in construction firms scored a median value of 3.18 for Technology Readiness Index (TRI) indicated they were moderate in terms of their readiness to embrace and use technologies [20].The transformation of ICT implementation in Industrialised Building System (IBS) management processes also indicated an average level of acceptance [21]. The Microsoft Office, Microsoft Project and AutoCAD were the ICT tools that usually used in IBS [21], [22].

The insufficient experience of strategic ICT adoption resulted to slow adoption decision as the construction companies uncertain how to start the process, continuous problems related to organizational and individual aspects, and inappropriate adoption resulted to a negative perception among expected users towards the use of ICT and led them to resist the adoption [23]. The poor ICT infrastructure in offices and construction sites, and unwillingness of employers to allow their staff for training due to high cost and time taken out of working hours had reduced the confidence level of construction stakeholders confidence level to invest in ICT for their projects [24].

In November 2016, the Chief Executive Officer of CIDB, Datuk Ahmad Asri Abdul Hamid stated that by 2020 the Malaysian construction industry players were required to use BIM [25]. However, the limited adoption of information technology (IT) such as BIM has been addressed as one of the productivity-related issues in the construction industry [11]. Based on the survey conducted by CIDB in 2016 found that only 45% of the respondents in Malaysia had knowledge on BIM and from that percentage only 17% had experience using BIM which considered as extremely low adoption rate [26].

The limited number of readiness model development in construction industry was one of the factors that caused the industry not keeping pace with implementation of IT [27]. There were several readiness model or framework had been developed for BIM implementation [28], [29]. Other readiness models related to IT and specifically developed for construction industry were also found; concurrent engineering [30], e-commerce [31], [32], e-procurement [33], IT project [34] and e-tendering [35].

The readiness model or framework for BIM implementation had been developed aimed for specific purposes with different criteria to obtain intended results. The readiness framework for BIM implementation was developed for design consultants in Malaysia however, it has not been assessed. Hence, this study will evaluate the readiness level of design consultants prior to the BIM implementation. Recently, the organizational readiness for the adoption of new technologies leads to the development of e-readiness models or e-readiness assessment. It is observed that research to date, the e-readiness assessment for BIM implementation has not been developed. Therefore, this study will also develop the e-BIM readiness assessment application for design consultants.

Research Objectives

The primary aim of this research is to develop the e-BIM readiness assessment prototype application for design consultants. In order to achieve the aim, the following research objectives are established:

(i) To evaluate the readiness level of BIM implementation
(ii) To determine the level of importance of each readiness criteria
(iii) To explore the strategies to achieve total readiness of BIM implementation

(iv) To classify the strategies to achieve total readiness of BIM implementation
(v) To develop the e-BIM readiness assessment application

Significance of Research

This research is expected to contribute knowledge in theoretical context as it has broadened the area of e-readiness research in construction industry by exploring the strategies to achieve total readiness for BIM implementation and development of e-BIM readiness assessment. This research is also important in practical context as it underpins the need for the design consultants to evaluate their e-BIM readiness level and achieve total readiness that leads to the successful adoption of BIM. The criteria of e-BIM readiness assessment can also be used as the baseline to further the research on other construction industry players.

Scope of Research

In this research, the context of BIM in Malaysia was selected due to several reasons. First, the adoption rate of BIM in Malaysia was low. Second, BIM is novel technology especially to the construction industry players and it has been extensively promoted due to its potential to transform the construction industry. Third, BIM is relevant and important due to the involvement of government and the actual adoption significantly affects the construction industry and economic growth. Fourth, based on the literature the interest in BIM topic is increasing in both, developed and developing countries. These reasons make BIM as the best context for development of e-readiness assessment.

This research is limited to evaluate the e-BIM readiness level by focusing on the design consultants. However, refinement can be done to the e-BIM readiness assessment if it is going to be applied to other developing countries, so it will be suited with the current adoption level of the respective country.

II. CONCLUSIONS

The novelty of this research lies on development of e-BIM readiness assessment application at organizational. Even though it is limited in the context of Malaysia and focusing on the design consultants, this research contribute to the theoretical and practical contexts. It can assist the government, policy makers and construction industry players in achieving a successful BIM implementation thus, increase the productivity of construction industry.

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