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Critical Success Factors to Implementing Building Information Modeling in Malaysia Construction Industry

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ABSTRACT

Building information modeling (BIM) known as the features existing the earliest concept to demolition and it involves creating and using an intelligent three-dimensional model to inform and communicate to make a decision on the project. The potential of BIM will be improve overall in the construction performance in term of cost effectiveness, increase quality of project and reduce time to develop the project. Besides that, the advantages of BIM in constructions industrialized is far beneficial to the majority of stakeholders to implementing BIM in the projects. The limited take up is also associated with readiness issues, lack of previous experience in BIM, lack of knowledge about BIM and lack of market demand BIM. Thus, the paper reviews literatures to identify the critical success factors for construction projects in implementing BIM.

Keywords: Construction Industry, Building Information Modeling, Critical Success Factors
JEL Classifications: M00, O22

1. INTRODUCTION

Nowadays, the implementation of information and communication technology (ICT) tool is significant in numerous of industry including construction. For example, in construction domain, it has been proven the existence of ICT tool such as two-dimensional AutoCAD has increasing the effectiveness of project life cycle (PLC) management particularly in design phase. Recently, construction industry has been introduced to latest ICT tool which is called building information modeling (BIM). The successful implementation of BIM at stage of the project needs meticulous planning by client and all the project participants (project managers, architects, engineers, contractors and subcontractors) to achieve the changing smoothly from traditional approach to conventional for integrate a new technology BIM appear into the flow project. The research has shown the tremendous evidences on effectiveness of BIM towards enhancing construction around the project management. However utilization of BIM have growing rapidly and BIM has been adopted the successfully such as several countries, including Finland, Denmark, and United States contractors and architectural firms request for the submit BIM in public construction projects (Won and Lee, 2010).

The first idea of BIM has been presented by Professor Charles M. Eastman in year 1970 but BIM only been introduced in Malaysia since 2007 by Director of Public Works Department (PWD). They was choosing the BIM platform to ensure interoperability project management going smoothly (Latiffi et al., 2014). This step taken with the choice on the government's consciousness of the potential of BIM get to evade design problems in planning phase and decrease construction cost. In addition, the BIM practice has improving communication and collaboration between contestants project through larger interoperability of data. In this way, the implementation of BIM it is a noticeable reshaping the way construction participant work project can closely together to increase productivity and improve in the project outcome. However, the appearance of BIM is still quite new among the construction players (Latiffi et al., 2014).

Meanwhile, the many investigators mention BIM there are many benefits are worth when the using BIM. Although the beneficial

of BIM has been proven, yet the implementation of BIM in construction project in Malaysia is still far from mature. This is due to the several problems such as limited skills and knowledge in BIM, reluctance to changes and communication problem. Thus, the identification of critical success factors (CSFs) is significant to deal with this problem and guide Malaysia construction industry toward the implementation of BIM.

2. METHODOLOGY

The research method in this study is focuses on literature review from past research, expert interviews, and qualitative analysis of the collected data. Sources such as journal articles, books, international conference papers, and materials available on the Internet have been used as literature review in this study. Literatures review is significant for investigation of BIM definition, BIM implementation, benefits of BIM, barriers in BIM and, etc. After an intensive literature review, a semi-structured interview will be conducted among construction experts (engineers, contractors, consultant, policy makers, and developers) in Malaysian construction industry. The selection of expert is based on their involvement and experience of BIM project in Malaysia. The questionnaires for semi structured interview consist of 20 questions. During the semi structured interview, respondents will be encouraged to give their opinions. Next, result from the interview will record and transcribes. All the information and data gather will be analyzed through content analysis in qualitative nature.

3. RELATED OF RESEARCH STUDY

3.1. BIM Applications Areas

3.1.1. Clash/error detection

Clash detection is one of the significant features in BIM. Through BIM, clash detection can be performed in three-dimensional (3D) built-in model of the actual construction project such as building. Each of components used in project will be illustrate precisely through virtual model in BIM software. Any clash between piping, wall, and steel beams can be detected in early design phase of construction project. Clash detection is an integral part of the BIM modeling process to create a multidiscipline modeling. Mostly Autodesk Navisworks has used for this purpose as well as for scheduling features. These features through 3D model will also increase the understanding of each project stakeholder and simultaneously will increase their collaboration.

3.1.2. Construction sequencing/four-dimensional (4D) scheduling

A 4D BIM Schedule is a derivation of the 3D BIM geometry and an optimization of the resources. 4D features in BIM came with some advance features such as BIM model information, provisional components, restructuring, animation, analysis, output and automatic interconnection processes. The development and presentation project of 4D features precisely with all project detail will increase the understanding of project stakeholders towards project.

3.1.3. Cost estimating

Five-dimensional (5D) model is the integrated from 4D model. A 5D estimate is a BIM linked to construction cost estimation through material quantities that are automatically produced from the data within the model which is brought into the virtual building life cycle. However, 5D estimation can improves budgeting, provides cost-loaded schedules, and featuring a variety of interactive forecasts to make agile comparisons. For example, a changing in design or material use in virtual model, the calculation of project cost wills also automatically changing. The model parametric BIM provides the preliminary cost estimating during early design to construction phase. Nevertheless, the pursuant Enegbuma and Ali (2011), the cost estimating enables generation using with count and measurement directly with using BIM software Innovaya and Vico.

3.1.4. Facility management (FM)

The researchers has begin more provide attentions to be used BIM during the operation and maintenance phases. According to Brewer (2006), the obstacles to implement BIM in FM are as below:

i. The total of work that needs to do;
ii. Unclear and invalid benefits of BIM in FM practices;
iii. Lack of interoperability;
iv. Unclear about responsibility;
v. Lack of effective FM equipment process;
vi. Limited knowledge about BIM for internal staff.

3.2. CSFs Implementation of BIM

Research has highly suggested technical and organization factor as pillar factor in evaluation of BIM. A number of obstacles in implementation of BIM has been reported which related with technology, organization, process and legal Gu and London (2010), Alfred (2011) stated that BIM required a new set of legal instruments to achieve its promise. CSFs of BIM implementation are shown in Figure 1. Meanwhile, Table 1 shows the CSFs based on the literature. There are four categories of CSFs known as technology, organization, process and legal of adoption of BIM. The details of these CSFs described as below.

3.2.1. Technology

Due to the effectiveness of BIM in increasing project performance, numerous of BIM tools have been developed and available on market. Research has proven there is no single software can fulfill all the project need, thus an integration of BIM software is a must. The variety of BIM software from different software vendors has led to interoperability issues. In order to deal with this problem, interoperability and compatibility effort has been taken to standardize data exchange for all the available BIM software. Interoperability is a major drawback in implementation of BIM. Others issues such as security of confidential information on project data also frequently rise by construction players Alfred (2011). Lesser in security led to ineffective communication, information sharing, and cause trust issues among project stakeholders. Perceive to use of BIM is also been highlighted by construction players. User interface of BIM software should be easy to use that will an enhance user participation and compatibility (Singh et al., 2011).

Figure 1: Critical success factors of building information modeling implementation

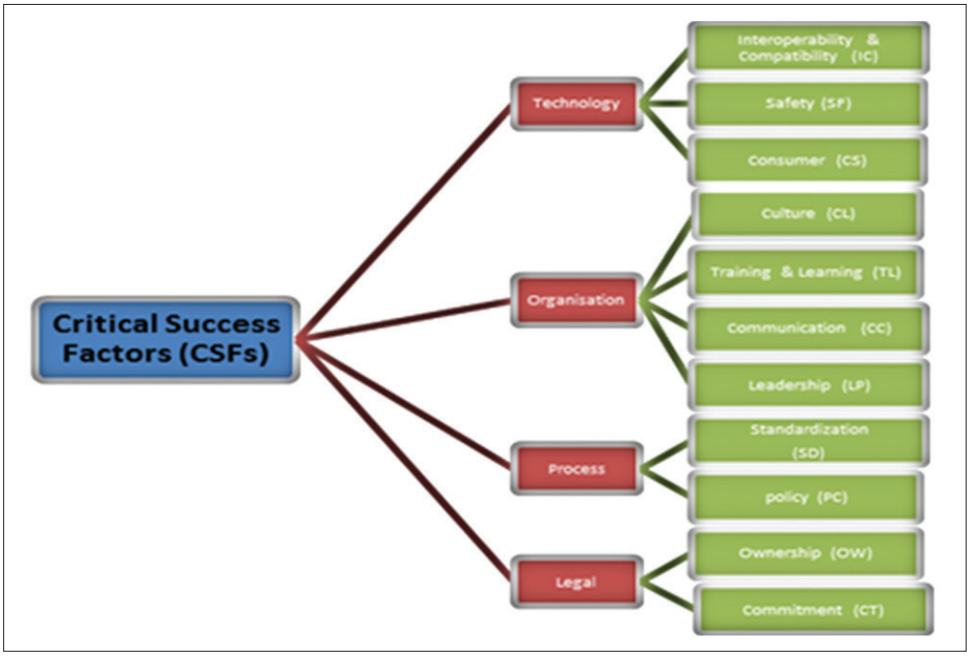


Table 1: CSFS sele cted from literature review

Authors	CSFs of BIM										
	Technology			Organization			Process			Legal	
	IC	SF	CS	CL	TL	CC	LP	SD	PC	OW	CT
Nitithamyong and Skibniewski		✓	✓							✓	✓
Gu and London	✓	✓			✓			✓			
Singh et al.		✓	✓	✓	✓	✓					
Jung and Joo	✓							✓			
Azhar					✓					✓	✓
Enegbuma and Ali [6]								✓		✓	✓
Hwang and Lim											✓
Latif et al.					✓	✓				✓	
Zin		✓									✓
Morhlhan et al.								✓			

CSFs: Critical success factors, BIM: Building information modeling

3.2.2. Organization

There is a limited collaboration among the construction players due to the differences of their background and culture. Most of the organization has been domination by traditional practice in construction project. This has been considered as a barrier toward implementation of BIM that required high collaboration. For example, construction players tend to used or viewed project design through hardcopy compare to softcopy. Considered BIM as a new technology that required specific skill to use it, training and learning program for the construction players such as architect is a must (Latiffi et al., 2014). Furthermore, the program has to be available for each of project stakeholders and in line with global requirement (Singh et al., 2011). BIM has proven capable of enhance communication and collaboration in organization such as construction company, yet in reality the effectiveness of BIM is depend on user its self. For example, the ability of project leaders towards other project stakeholders.

3.2.3. Process

Currently, there is limited of guidance of BIM particularly on integration of BIM with current practice in construction industry (Brewer, 2006). As a result, most of the construction players tent to implement BIM with their own term which is led to low efficiency of project management. Therefore, there is a need for standardize of BIM process and guidelines for adoption of BIM in Malaysia (Azhar, 2011). Is has been mentioned that each of BIM software has their own features and function based on the purposed of used in PLC. Yet, there is limited expertise available to used BIM software. Thus, people factor has been considered fall as one of the CSFs (Singh et al., 2011). One of the BIM features is enable user to create, review and edit schedule through virtual model namely as 4D schedule modeling. Therefore, there is a need of technical and nontechnical to enhance the sequencing process.

3.2.4. Legal

The implementation of BIM in construction project required utilization of copyright law and legal channel in order to unsure data security and owner benefits. However, the existence of this regulation has negative impact on designer's tent to transfer risk such as design error towards owner's responsibility (Alfred, 2011). The combination of ownership with security system led to limited

user access and barrier in communication among other project stakeholders. In addition, user who has an overall control of data in model will be fully responsible of any inaccuracies. This is challenging due to the differences in objective and culture among the project stakeholders. Thus, in order to successfully implement BIM this issue need to be highlighted for development of contract document, case law, regulation and status.

3.3. Pull and Push to Implementation of BIM

Several in review exploring the pull and push factor in BIM implementation (Nitithamyong and Skibniewski, 2006). The full factors the encouraged the use of BIM are improved design quality and constructability, shorter construction period, simulation of construction process, save the cost of design, decreasing construction cost and reduction of rework in construction. On the other hand, the push factors that encourage the adoption of BIM are government's initiatives given by PWD, CIDB, MSC and CREAM demonstrated their effort to expand BIM (Latiffi et al., 2013). The governments initiatives such as provide training programmes, certification and accreditation/licenses, awareness and motivation programme implementation of BIM and preparing for a BIM standard/guideline.

3.4. CSFs Definition

The first investigation of CSFs has been conducted in 1980s which is related with organization performance. CSFs have been defined as foundation that determined the successful performance of individual, department or organization (Bullen and Rockhart, 1981). The identification of CSFs is a need in enhancing project performance towards organization performance. The approach for identification of CSFs and measuring organization performance has been proposed by Bullen and Rockhart (1981) and Forster and Rockart (1989). CSFs are intended in this study was to highlight key areas towards the effective implementation of BIM in Malaysia from the literatures study and validation of previous preliminary findings the industry top management. However, this study will assist industry stakeholders to understand intricacies about BIM. The develop a benchmark to measure the industries readiness of professionals and strategic policies for the revolutionary change coming soon such as proposed by Camp (1989) and others scientists, the CSFs utilized as criteria for a benchmarks study.

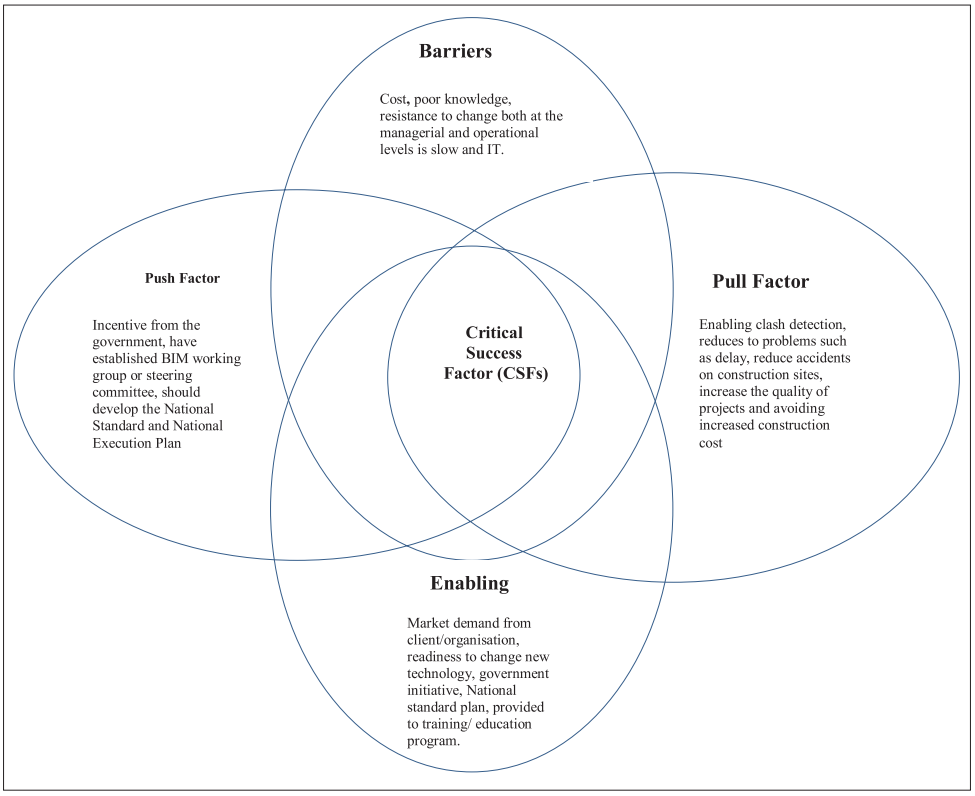
3.5. BIM Barriers and Empowerment Factors

Despite the conceivable points of interest, BIM implementation had to face inadequacies as highlighted by recent literatures and reports Nitithamyong and Skibniewski (2006), Memon et al. (2014), Yan and Damian (2008), Chan (2014) and Liu et al. (2015). The hindrances for the adoption are cost issues, lack knowledge, unawareness to change of the new technology, shortage of training/ education and lack of qualified internal staff. Nevertheless, several allow factors has been identified to enhance the reception primarily come from government initiatives. The enabling factors are the government promotion and incentives Liu et al. (2015) and Zahrizan et al. (2014). According to Aryani (2014) the Malaysian government has taken a few initiatives to encourage and promote BIM to construction players for implementing it in their projects. Figure 2 represent an overview of BIM implementation in the perspective of construction.

4. CONCLUSION

The identification of CSFs has been considered important particularly in adoption of new ICT technology. According to

Figure 2: Building information modeling implementation in the perspective of construction



Liu et al. (2015), the adoption of BIM software has proven to be beneficial to the construction organization in terms of design, analysis, construction, operation and data management. Thus, this paper has discussed a significant of identification CSFs in implementation of BIM. From literature, its shows that a well set of CSFs in adoption of BIM has been considered as foundation to successful of project. In this paper, several categories of CSFs in BIM have been identified from several of past research. In order to investigate CSFs of implementation of BIM in Malaysia, a semi-structured interview will be deployed among the construction players.

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