DEVELOPMENT OF BUILDING INFORMATION MODELING (BIM) IMPLEMENTATION FRAMEWORK IN MALAYSIAN CONSTRUCTION INDUSTRY

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UNIVERSITI SAINS MALAYSIA

2020

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by

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Thesis submitted in fulfilment of the requirements
for the degree of
Doctor of Philosophy

February 2020

ACKNOWLEDGEMENT

Alhamdulillah, my greatest gratitude to Allah SWT for giving me the strength to complete this PhD thesis.

I would like to express my sincere and utmost appreciation and gratefulness to my main supervisor, Dr. Sharifah Akmam Syed Zakaria for her guidance, facilitation, encouragement and all advices given during the process of conducting my research study.

My appreciation also goes to the Government of Malaysia, especially to the Ministry of Education (Higher Education) Malaysia and Universiti Malaysia Perlis (UniMAP) for giving me the opportunity to further my study and providing the scholarships. Special thanks to the Dean and staffs of the Faculty of Engineering Technology, UniMAP, particularly Mr. Norrazman Zaiha Zainol, the Programme Chairman of Department of Civil Engineering Technology, UniMAP for their co-operations and supports. Not to forget, the Dean and staffs of the School of Civil Engineering, Universiti Sains Malaysia (USM) for their assistance, guidance and supports throughout my study.

I also would like to extend my appreciation to the Construction Industry Development Board (CIDB) and the research participants, my saviour Ms. Aida Zunadiya Ahmad Zuki for her assistance during my data collection process in Johor and all my relatives, family members and friends who have supported me through thick and thin.

My heartfelt thanks go to my husband, Muhammad Faiq Abdullah and sons, Muhammad Zharif Muhammad Faiq and Muhammad Zharfan Muhammad Faiq for being there during all my hard times. They have shown endless supports, unfailing patience, always prepared to listen to my arguments and shared something positive which motivates me to keep going and complete my study.

I also would like to express my wholehearted gratitude to my father, Abdul Rahim Itam and my mother, Yurni Abdul Shukor, besides my sisters; Nur Addini Abdul Rahim and Nur Syuhada Abdul Rahim, and my younger brother, Muhammad Afiq Asyraf Abdul Rahim for their supports and prayers for my study. Last but not least, to my family-in-law, thank you for all the support and understandings. I am blessed and thankful to have had them during this journey. Thank you so much.

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ABSTRAK

Permodelan Maklumat Bangunan (BIM) dijangka akan dimandatkan bermula 2019 dan seterusnya bagi projek awam di Malaysia. Namun, pelaksanaan BIM masih lagi di peringkat awal. Oleh itu, terdapat keperluan segera untuk kerajaan memantau corak pembangunan BIM dalam industri pembinaan. Kajian ini bertujuan untuk menentukan dan menilai fasa pembangunan BIM dalam industri pembinaan dengan mengambilkira aspek kemampanan dan penawaran-permintaan berdasarkan dua perspektif, iaitu kontraktor (permintaan) dan institusi akademik, tertumpu kepada pelajar tahun akhir (penawaran). Penemuan dari kajian soal selidik menunjukkan bahawa 72% kontraktor masih di fasa kesedaran pembangunan BIM; manakala 22% di fasa adaptasi, 3% di fasa adopsi dan 3% di fasa penggunaan. Di samping itu, hasil kajian juga menunjukkan bahawa 73% kontraktor berpendapat bahawa tiada keperluan mendesak untuk graduan mahir BIM. Dari perspektif penawaran, hanya 19% bakal graduan mempunyai pengalaman BIM selama 1 hingga 5 tahun yang menonjolkan keperluan institusi akademik untuk menyediakan lebih banyak latihan (kemahiran) dan kemudahan berkaitan BIM pada masa akan datang. Selain itu, 68% kontraktor hanya menyedari sumbangan BIM ke arah kemampanan alam sekitar berbanding dengan kemampanan ekonomi (43%) dan sosial (11%). Dijangkakan kajian ini dapat membantu kerajaan dalam memantau pembangunan BIM dalam industri pembinaan serta menyumbang kepada kesusasteraan dan pengetahuan khususnya dalam bidang kejuruteraan awam dan pengurusan pembinaan.

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ABSTRACT

Building Information Modeling (BIM) is anticipated to be mandated starting 2019 onwards for public projects in Malaysia. However, the BIM implementation is still at a nascent stage. Therefore, there is urgency for the Government to monitor the trend of BIM development in the construction industry. This study aims to determine and evaluate the current phase of BIM development in the construction industry with the consideration of sustainability aspects and demand-supply based on two perspectives, namely contractors (demand) and academic institutions, focusing on final year students (supply). The findings from the questionnaire survey show that 72% of the contractors are still at the awareness phase of BIM development; whereas 22% at the adaptation phase, 3% at the adoption phase and 3% at the application phase. In addition, the results also indicate that 73% of the contractors perceive that there is no urgent demand on BIM skilled graduates. From the supply perspective, only 19% of the future graduates have 1 to 5 years of experience on BIM highlighting the needs for academic institutions to provide more BIM related-training (skills), facilities and networking in the future. Additionally, 68% of the contractors are only aware of BIM contribution towards environmental sustainability compared to economic (43%) and social (11%) sustainability. It is expected that this study can assist the government in monitoring the development of BIM in the construction industry as well as contributes to the literature and knowledge particularly in the civil engineering and construction management area.

CHAPTER 1

INTRODUCTION

1.1 Chapter Structure

Chapter 1 intends to outline the concepts of the study as an introduction to the research. This chapter provides a background to the topic (section 1.2), research and knowledge gap (section 1.3) and also highlights the research problem in section 1.4. The research aims and objectives are stated in section 1.5 and section 1.6 outlines the methodological approach of this research. The research process and related tasks are outlined in section 1.7 which also presents a flow chart linking the objectives to the thesis chapters. The justifications and scope of the research are highlighted in section 1.8 and 1.9 respectively. Meanwhile, section 1.10 provides further detail on the structure and content of each thesis chapter. Section 1.11 concludes Chapter 1.

Building Information Modeling (BIM) can be described as the latest technology in Malaysian construction industry and a process involving the combination of information to develop a virtual representation of a project. BIM is a revolutionary technology that transforms the way buildings are designed, planned, constructed and managed. “Built the project twice” is the simplest way to explain about BIM. BIM can change many industries dramatically including construction. This research is about evaluating the development of BIM in construction related organisations. Additionally, this research also determines various elements that are perceived as important which contributed to the development of BIM, with specific focus on Malaysian construction industry.

1.2 Background of Study

The construction industry can be described as one of the most challenging industries in various countries around the world including Malaysia. Cost and time overrun are the most common issues associated with the construction industry. According to Senouci et al. (2016), public projects in Qatar are facing the same issues where the constructed projects between years 2000 to 2013 experiencing 54% cost overrun and 72% time delay. Mostly, the construction projects in Malaysia also experiencing cost overruns (Shehu et al., 2014b; Ali, 2018) and project delay (Memon et al., 2012; Ramli et al., 2018). Poor planning and site management, lack of contractor's experience, high level of project's complexity and delay in payment are some of the factors contributing to cost overrun and project delay (Shah, 2016). Dao et al. (2016) defined project complexity as *"the degree of differentiation of project elements, interrelatedness between project elements and consequential impact on project decisions"*. Thus, if the project complexity increased in a project, the cost performance would be adversely affected (M et al., 2016; Luo et al., 2016).

In addition, massive waste production created by the construction industry also becoming one of the major issues emphasized in previous research (Mah and Fujiwara, 2016). This issue occurs due to the mistakes during construction (e.g. miscalculation or miscommunication between parties), purchasing error, inappropriate material storage and rework (Ikau et al., 2016). The occurrence of each issue in construction industry is usually interrelated and affects one another. For example, any rework in a construction project will generate construction waste (Yap et al., 2017) and may lead to addition construction time (delay). Subsequently, delays in construction project will incur additional construction costs (Hamzah et al., 2012).

Therefore, leverage on information and communication technology (ICT) tools is considered as one of the available technology-based alternative to encounter issues related to the construction industry such as cost overrun, project delay and massive waste production.

Over the last few decades, ICT plays an important role in enhancing the communication and efficiency of construction process (Lu et al., 2014). Currently, majority of the construction industry players are using ICT tools such as 2D AutoCAD to enhance the performance of its delivered products and most of the players are already exposed to 3D modeling. Recently, the latest ICT tools known as building information modeling (BIM) is getting more attention in the architectural, engineering and construction (AEC) industry around the globe (Dutta et al., 2016). In order to understand further on various benefits that BIM could offer and its development in the construction industry, exploring and assessing on BIM are necessary due to the lack of research on BIM particularly in Malaysian industry context (Badrinath et al., 2016; Olawumi et al., 2017).

As describe in numerous research, BIM is one of the new emerging technologies (Anuar and Abidin, 2015) in the construction and project management area (Aziz et al., 2016; Azmi et al., 2018) and has been widely used by many countries as the principal communicating tools in the construction process which will increase the needs for closer collaboration and more effective communication (Bryde et al., 2013). BIM represents the process of development and use of computer generated model to simulate the planning, design, construction and operation of a facility (Azhar et al., 2008). It helps architects, engineers and constructors to visualise what

is to be built in digital platform and to identify potential design, construction and operational problems earlier, prior to the construction process.

In Malaysia, BIM concept was first introduced to the Public Work Department (PWD) in 2007 (Ashhar, 2017) and subsequently, the government started to encourage the Malaysian construction industry to implement BIM in construction projects through the Infrastructure & Construction Asia's Building Information Modeling & Sustainable Architecture Conference in 2009 (BuildingSMART, 2015; Harun et al., 2016). In 2010, the government has officially announced the first government's project that would be utilising BIM is the National Cancer Institute (NCI) in Sepang, Putrajaya (BuildingSMART, 2015). With the implementation of BIM, the NCI project has been completed two (2) weeks ahead of schedule and able to save the construction costs through the minimization of waste from clash detection function (Latiffi et al., 2015b). Implementation of BIM has allowed the construction industry to achieve remarkable gains especially in terms of productivity, efficiency and construction work quality.

BIM is currently growing and expected to continue in the coming years. In the North America, the implementation of BIM expanded from 28% in 2007 to 71% in 2012 (McGraw-Hill Construction, 2014). A similar dramatic expansion in the United Kingdom (UK) with the current rate of implementation is 62% (2017) compared to 13% in 2011 (Malleson, 2017). Besides the successful implementation, some of the countries are still experiencing the slow uptake of BIM implementation. In Malaysia, BIM is still considered at the nascent stage where its development is very low and slow (Ya'acob et al., 2018), and this has prevents the actual benefits of BIM being

utilised by all construction industry practitioners. Conclusively, the implementation of BIM has been increasing from time to time due to the rapid growth of the construction industry.

The Ministry of Works Malaysia in collaboration with the Construction Industry Development Board (CIDB) of Malaysia has developed the Construction Industry Transformation Programme (CITP) focusing on the five-year plan (2016-2020) for the industry to improve and transform the future direction of the Malaysian construction industry. CITP comprises 18 initiatives under four strategic thrusts and one of the initiatives is to roll out technology advantage across project life-cycle where the main focus is to improve BIM adoption in Malaysia (CIDB, 2015a). This shows that the Government policy supports the development of BIM in Malaysia.

Despite the positive records on implementing BIM from other countries, the construction industry practitioners in Malaysia are still considering to change from the current practices to BIM and creating the implementation rate of BIM around 17% in 2016 (Hamid et al., 2017). The low implementation rate was particularly due to the lack of BIM skilled personnel (Gardezi et al., 2014), high upfront investment cost (Ahmad Latiffi et al., 2015), lack of awareness (Memon et al., 2014c) and reluctant to change (CREAM, 2014; Salleh and Phui Fung, 2014; Zakaria et al., 2013a; Zakaria et al., 2013b). Thus, the development of BIM in building projects needs to be improved in accordance to the CITP (2016 – 2020).

While BIM is rapidly expanding and attracts construction practitioners around the globe, academic institutions need to play their roles in educating future engineers to

cater the current demand of BIM implementation. Several initiatives and programmes such as BIM road shows, seminars, workshops, and affordable BIM training programme have been planned and organised for the industry players as well as academic institutions to assist in improving the percentage of BIM development in Malaysia (CREAM, 2014). The government, CIDB and professional bodies are responsible to educate and create awareness to the industry practitioners on BIM especially in terms of its benefits towards sustainability aspects. Meanwhile, academic institutions need to work and collaborate with the industry players in performing research and producing experts to support the current development of BIM.

Furthermore, in line with the implementation of the CITP, CIDB has launched the country's first one-stop "MyBIM Centre" to serve as a resource centre to promote and increase the use of BIM system amongst construction industry players in Malaysia (Construction Industry Development Board Malaysia (CIDB), 2018). The Centre enables construction industry players to model and visualise building projects in a simulated environment using BIM. It also provide the BIM Training which is called as Affordable BIM Training (ABT) for industry players to learn the process of implementing BIM process including the usage of tools and managing the construction site by using the knowledge of BIM (E-Construct CIDB, 2019). Therefore, creating and improving collaboration between construction industry practitioners and related agencies or parties including academic institutions for BIM development can lead to a higher possibility to achieve a more successful level of BIM implementation in the future.