ISSUES AND CHALLENGES TO IIMPLEMENT BIM FOR SMEs IN THE CONSTRUCTION INDUSTRY

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DEDICATION

With lots of love to my husband, Nasri bin Hj Marob,

Daughters, Nursyuhadak, Nursyahidah and

Nurhasyireen, Sons, Nazirul Mubin, Nafizudin and

Muhammad Raziq and my late parent,

mother, Zainon binti Ayob

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ABSTRACT

In Malaysia, the strategic changes towards the promotion of the concept of Building Information Modeling (BIM) started in 2007 and the idea to implement BIM in Malaysia was introduced by the Director of Public Works Department (PWD). The government of Malaysia has set to implement BIM for their projects by the year 2016. It is foreseen that the industry players are required to understand and able to use BIM and thus to drive the industry towards sustainable construction which underlines long term affordability, quality and efficiency. A literature review was done to explore previous BIM studies on definitions and history of BIM, construction issues, application of BIM and BIM tools in construction projects as well as benefits of BIM. It is envisaged that the benefits of using BIM will have a positive impact and will facilitate many processes in a construction project planning. But there are still many construction companies in Malaysia especially Small Medium Enterprise contractors struggle to execute a project using the BIM concept. The aim of this paper is to identify the readiness of BIM implementation in Malaysian construction industry. Therefore, this study focusses on the identification of the list of constraint factor on BIM by Small Medium Enterprise construction industry. From this study, there are four main factors that impinge on the implementation of BIM. 35 respondents from construction players have participated in this study. 22 completed surveys were returned with a return rate of 62.9%. (adequate for further analysis). Based on the statistical analysis result, distributed survey reliability level is found acceptable. By using descriptive analysis, the analysis was implemented to prioritize the constraints factor based on ranking which gave the result of mean value and standard deviation of information, time, knowledge and cost factor. Correlation analysis results show that there is a significant relationship between the factor constraint in terms of collaboration where the highest result of Pearson correlation based on ranking were factor of time, knowledge, information and cost. The results of the study for second and third objectives were found to have a distinct similarity in priorities as stated above. .

ABSTRAK

Di Malaysia, perubahan strategik mempromosikan konsep membina pemodelan maklumat (BIM) telah bermula pada tahun 2007 dan idea untuk melaksanakan BIM di Malaysia telah diperkenalkan oleh Pengarah Jabatan Kerja Raya (JKR). Kerajaan Malaysia telah membuat ketetapan untuk melaksanakan BIM bagi sesuatu projek menjelang tahun 2016. Adalah dijangka bahawa industri perlu memahami dan berkeupayaan menggunakan *BIM* dan dengan itu dapat memacu industri pembinaan yang mampan mengikut kemampuan jangka panjang, kualiti dan kecekapan. Satu kajian literatur telah dilakukan untuk mengkaji berkaitan dengan BIM terdahulu iaitu definisi dan sejarah BIM, terbitan pembinaan, aplikasi *BIM* dan *BIM Tools* dalam projek pembinaan serta faedah *BIM*. Ia dijangkakan bahawa faedah menggunakan *BIM* akan memberi kesan yang positif dan memudahkan proses di dalam perancangan projek pembinaan. Namun masih banyak lagi syarikat pembinaan kecil kontraktor di Malaysia mempunyai perusahaan sederhana adalah sukar untuk melaksanakan projek pembinaan menggunakan konsep BIM. Matlamat kajian ini adalah untuk meneroka pelaksanaan BIM dalam industri pembinaan Malaysia. Oleh itu, kajian ini lebih memberi tumpuan kepada mengenalpasti beberapa faktor kekangan terhadap pelaksanaan BIM oleh industri pembinaan perusahaan kecil sederhana. Daripada hasil dapatan kajian, didapati terdapat 4 faktor kekangan utama terhadap pelaksanaan BIM. 35 responden dari industri pembinaan adalah dijangka untuk mengambil bahagian dalam kajian, 22 bilangan kaji selidik yang telah dilengkapkan telah dikembalikan dengan kadar pulangan 62.9%. (Mencukupi untuk analisis seterusnya) Berdasarkan kepada keputusan analisis statistik, tahap kebolehpercayaan tinjauan teragih adalah diterima. Dengan menggunakan analisis deskriptif, analisis dijalankan untuk mendapatkan faktor kekangan mengikut keutamaan yang berdasarkan keputusan nilai min dan sisihan piawai ke atas faktor maklumat, masa, pengetahuan dan kos. Dengan menggunakan analisis korelasi bagi mencapai objektif ketiga, keputusan menunjukkan bahawa terdapat hubungan yang signifikan di antara faktor kekangan dari segi kerjasama di mana hasil tertinggi daripada korelasi Pearson berdasarkan kedudukan adalah faktor masa, pengetahuan, maklumat dan kos. Keputusan kajian bagi objektif kedua dan ketiga telah didapati mempunyai persamaan mengikut keutamaan seperti yang dinyatakan di atas.

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LIST OF ABBREVIATIONS

BIM	-	Building Information Modelling
MEP	-	Mechanical Electrical Programming
AEC	-	Architecture, Electrical, Construction
SME	-	Small-Medium Enterprises
IBS	-	Industrialized Building System
3D	-	3 Dimensional
4D	-	4 Dimensional
5D	-	5 Dimensional
DBB	-	Design-Bid-Build
CO	-	Change Order
RFI	-	Request For Information
SPSS	-	Statistical Package Science Software
CIDB	-	Construction Industry Development Board
PWD	-	Public Work Department
ANOVA	-	Analyze of Variance

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CHAPTER 1

INTRODUCTION

1.1 Background of the study

Building Information Modelling (BIM) is a series of digital tools which can control the efficiency of building projects. BIM was used by the Malaysia's architecture, engineering and construction (AEC) industries. In 2007, the idea of implementing BIM in Malaysia was introduced by the Director of Public Works (PWD). The government of Malaysia promotes site workers to use BIM to build projects because it can be overcome the problems for the projects for example delays and disputes over the design for various professionals and overrun the construction costs. BIM can also help increase the efficiency and effectiveness of construction projects and be introduced to improve communication and cooperation among construction stakeholders such as customers, contractors and consultants. Due to the government's efforts in promoting BIM, adoption technology of BIM is projected becoming more common in the construction industry in Malaysia.

One of the new emerging for architecture, construction and facility management technologies to be developed is from Building Information Modelling. It can also promote the sharing and interoperability of information in digital format. BIM has a digital representation for the construction of the building and the most advanced countries must ensure that the use of BIM as the main communication techniques in the construction workflow is embraced by their industry leader.

The processes of design, construction and operation can be enhanced the performance of the project by BIM implementation. Initially, BIM's implementation is aimed at addressing the common practice of sharing and exchange of knowledge. The delivery process is dependent on paper-based communication, according to

Eastman et.al (2008). Mistakes and omissions occur in paper documents lead to unforeseen costs, possible lawsuits which is delay in a project team between different parties. We also established that the most familiar issues similar to paper-based contact during design phase is significant estimation of expenses and time analysis of energy-use, structural data, etc. Such analyzes are usually conducted last when important changes are already too late.

Building Information Modeling (BIM) is a relatively new methodology developed and implemented in engineering field. It is a data model that incorporates all relevant information with three-dimensional digital technologies for engineering projects. BIM is used primarily in the design, construction and operation stage. Using BIM improves design efficiency dramatically and reduces risk throughout the engineering and construction process. Figure 1 demonstrates a conventional cost estimate of quantification based on take-off and BIM.

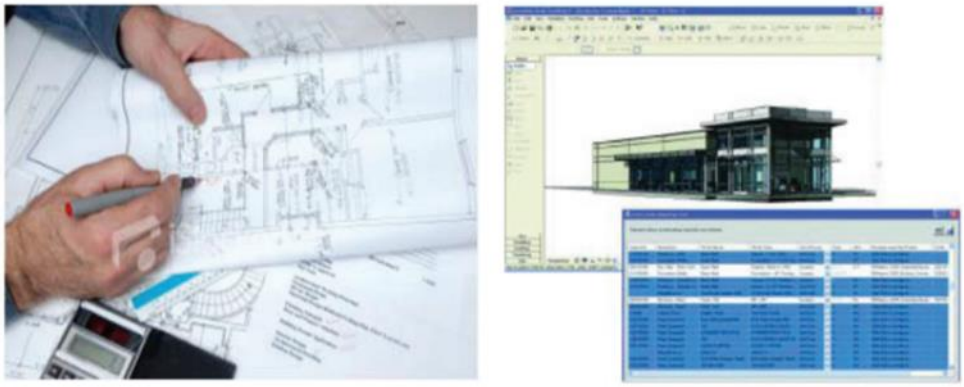

Figure 1.1 BIM-based quantification vs Traditional cost estimating take-off

Because of changing customer demands and their search for innovation, Small to Medium Enterprise (SME) construction companies are increasingly using design-build delivery approaches to build infrastructure. Disruptive technologies enable small and medium-sized enterprises to upgrade their work process, increase productivity and quality growth. Building Information Modeling (BIM) has been described in the Malaysian construction industry as a pioneering inovations that can lead to improved efficiency and performance throughout the life cycle of an asset. Although BIM is beginning to be adopted within the construction industry in

Malaysia, particularly by the public sector for large-scale projects and implementation standards are evolving, limited attention has been given to how SMEs can effectively use this technological solution.

Building Information Modelling could be based on a 5D modeling environment that include construction geometry (3D), expense (4D) and construction schedule (5D). BIM covers all planning, research, development, service and data management phases of construction. BIM technology provides an efficient communication platform for each key player before construction begins. BIM could also be built up to 6D and 7D, offering protection which control the facilities and properties. BIM and consistency results, visualization of design, efficient teamwork, multi-user cooperation, improved productivity, connectivity and quality, and the efficiency of energy and sustainability have some specific advantages.

The role of IT in construction is increasingly evolving as an industry becomes more complicated. At the early stage with the conventional use of paper, nowadays the technology has developed into the first generation of Vector CAD; then the CAD object, which is a ‘professional' object with added properties and finally BIM. Figure 1.2 demonstrates the progression of BIM.

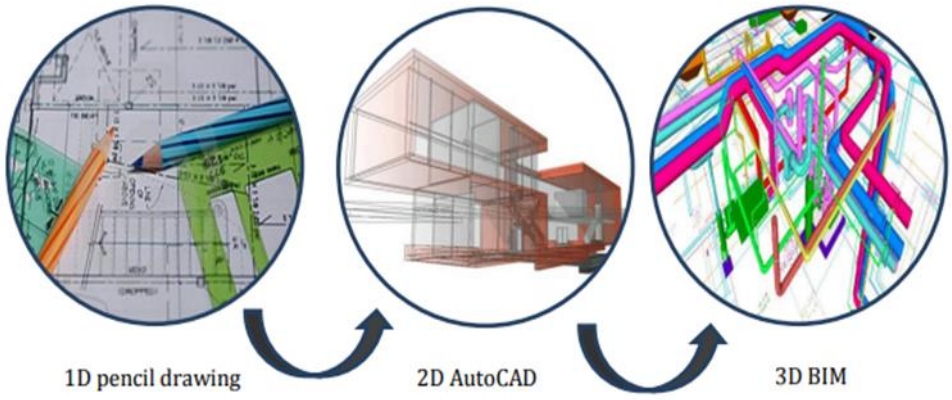

Figure 1.2 BIM and the evolution

According to Stewart and Mohamed (2003) reported that the construction industry is still slow in terms of IT implementation due to the service or product features offered by the company. Froese et. Al. (1997) claimed that the key contributing factor to the restructuring of the industry was the amount of information provided by many outlets and at many rates, and the implications of this scenario included issues such as low productivity, cost and time overruns, and disagreements and disputes resulting in litigation and time-consuming litigation. Various scholars, such as Mohamed (2003) and Alshawi and Faraj (2002), believed that to minimize delays, rework and communication breakdowns, coordination and teamwork are critical to enabling up-to-date information to be exchanged among the construction project stakeholders. Therefore, as mentioned by Rashid (2009); Haron, BIM is recommended for the integration and collaboration of parties in the construction of Malaysian IBS industry. (2013);

1.2 Problem statement

BIM has been scheduled to be introduced by the government of Malaysia for their ventures by 2016 as they are the biggest property holder considered by BIM as an important tool for future property management for them. The industry's players are expected to know and have the ability to use BIM, but the industry still does not use BIM's technology in its construction management until today.

Building Information Modelling (BIM) has been widely recognized as a shift in technology and procedures in the architecture, engineering and construction (AEC) industries. It is also technique for managing the design of the building and data of the project in digital form during a building life cycle. To achieve the project performance, the processes of design, construction and operation can be simplified with the introduction of BIM. Governments around the world, including Malaysia, are now calling for BIM because of its far-reaching benefits. Nevertheless, a substantial lack of understanding of BIM, program requirement (IT), expense and business readiness to adapt has been described as a major hindrance; thus, the

construction industry is increasingly demanding to integrate BIM into its management.

The Construction Industry Development Board (CIDB) Malaysia is one of the government agencies responsible for identifying issues and challenges faced by small and medium-sized enterprises when adopting BIM. The advantages of using BIM for sustainable building in the construction, which stresses sustainability, quality and efficiency in the long term. The government must therefore increase awareness and excitement among consultants and large construction firms regarding BIM's implementation. Nonetheless, the role of small, medium-sized business contractors (SMEs) in the implementation of BIM continues to face problems and require government intervention. Until implementation, the road to implementing BIM must be prepared thoroughly. It is necessary to identify, fix and resolve the issues and challenges faced by the sector of SMEs.

1.3 Objectives of the study

The aims of this analysis are as follow

i. Identify the constraints on Building Information Modelling (BIM) by practitioners in the SMEs construction industry.
ii. Priorities constraint factors based on ranking.
iii. Identify the relationship at the level of acceptance with the ranked factor constraint.

1.4 Scope of the study

The aim of the study is to address the issues and challenges of implementing BIM in the Malaysian's construction sector. This study focuses on small-medium-enterprise (SME) in Melaka, Johor and Kuala Lumpur who have not yet practice Building Information Modelling (BIM) but currently practicing Industrialized Building System (IBS) in the Malaysian construction project. A construction players involved in this analysis are primarily customers, contractors and advisors from BIM. The client was chosen because they are the project owner and they have the project details.

The contractor was chosen because they understand the most construction work on the construction site and the contractor will also learn more about safety and health management in the construction industry in Malaysia. As well educated and informed about BIM design and use of BIM, BIM consultants were selected. You also have the opportunity through the application of BIM to identify the advantages and issues.

The research also focuses on a case study of an actual construction project that will be performed by a SME residential contractor for an extended period of time to obtain a reasonable understanding of the cases that impede the application of BIM and to show the successful used in daily practical of construction in residential. This report also addresses problems and challenges faced by small and medium-sized businesses when embracing and implementing BIM.

1.5 Significant of Study

The use of BIM is rising and is projected to have a significant impact on the standard of procedure of the construction sector. Therefore, on the side of business, the SME must remain competitive which they will use BIM for their project execution.

The research discusses the application of 4D BIM as a possible framework for involving customers, contractors and consultants to expand the use of construction design. The model of fully formed 4D is linked to help the data of the building by providing users with opportunity to use the structure knowledge downstream beyond the initial participants in the construction sector (Smith 2007).

While the purpose of this study examines existing potential for future improvement by collaboration between scheduling and design that can be enhanced to streamline the adoption of BIM by small medium enterprise, it is envisaged that the final product can be extend in the future to help apply BIM to Malaysian IBS construction such as cost-related ones.

REFERENCES

Ahmad Latiffi, A., Mohd, S., Kasim, N., Fathi, M.S.: *Building Information Modelling (BIM) application in Malaysian Construction Industry*. Int. J. Constr. Eng. Manage. 2(A), 1-6 (2013)

Ali A Taher. *BIM Software Capability and Interoperability Analysis.* Civil and Architectural Engineering Kungliga Tekniska Hogskolan. March 2016.

Andy K.D., Wong, Francis K.W. et al.; *Government Roles in implementing Building Information Modelling Systems.* Retrieved 10 July 2009, Accepted 15 February 2010.

Aryani, Suzila., Umol Syamsul.: *Potential Improvement of Building Information Modeling (BIM) Implementation in Malaysian Construction Projects.*

Azarikasmaee, Y. Journal on *Adoption of Building Information Modelling In Construction*: *The Case of a Small – to Medium-sized Enterprise*. December 2017

Azhar, S., Khalfan, M., Maqsood, T.:*Building Information Modeling: now and beyond.* Australas, J. Constr. Econ. Build. 12(4), 15-28(2012)

CIDB (2000). *Malaysian Construction Industry Technology Foresight Report, Malaysia*: CIDB Malaysia.

CIDB, (2013), *BIM in Malaysia*. *Construction Industry Development Board Malaysia Kuala Lumpur, Malaysia*

Construction Research Institute of Malaysia (CREAM). Final BIM Report SME. *Issues and Challenges in Implementing Building Information Modelling (BIM) for SME's in The Construction Industry.* Makmal Kerja Raya Malaysia, 2009.

Construction Research Institute of Malaysia (CREAM).: *Issues and Challenges in Implementing BIM for SME's in the Construction Industry*. Malaysia. Construction Research Institute of Malaysia (CREAM) (2014)

Hooper M. and Ekholm A. (2010). A pilot study. *Towards BIM integration – an analysis of design information exchange & coordination*. Proceedings of the CIB W78 2010. 27th International Conference –Cairo, Egypt, 16-18

November, 2010, Retrieved March18, 2014, from http://lup.lup.lu.se/record/1766917/file/1766923.pdf

Mohd Nawi, M.N, Abd Hamid, Z. *Improving Integrated Practice Through Building Information Modelling – Integrated Project Delivery (BIM-IPD) for Malaysian Industrialised Building System (IBS) Construction Projects.* December 2014

Rogers, JP 2013. *The Strategic Adoption of Building Information Modelling by Malaysian Engineering Consulting Services Firms*. DBA Thesis, Southern Cross University, Listmore, NSW.

Valladares, CM. *Construction Industry Attitude Towards the Building Information Modelling Process*. DBA Thesis, University of Florida; 2011.

Wan Ghazali, W.A.I. Journal on *Potential of Building Information Modelling (BIM) In Improving Safety Management in The Malaysian Construction Industry; February* 2009.

Wen Wang, Rui Han. *A Review of Building Information Modelling*. School of Civil and Hydraulic Engineering, Shandong University, Jinan 25061, China.

Wong, A.K.D., Wong F.K.W., Nadeem, A.: *A government roles in implementing Building Information Modelling Systems.* Constr. Innov. 1(1), 61-67 (2009)

Yan, H., & Demian, P., (2008). *Benefits and barriers of building information modelling, Proc., 12th Int. Conf. on Computing in Civil and Building Engineering 2008*, Tsinghua University, Beijing: China

Zawawi, M. Journal on *Effectiveness of Industrialized Building System (IBS) Implementation for Malaysian Construction Industry*. November 2009.