BUILDING INFORMATION MODELLING FRAMEWORK IN FACILITIES MANAGEMENT FOR BUILDING REFRUBISHMENT

ALHAMZA YASSIN FLAIH MAENI

A project report submitted in partial fulfilment of the
Requirements for the award of the degree of
Master of Engineering (Construction Management)

School of Civil Engineering
Faculty of Engineering
Universiti Teknologi Malaysia

JUNARUY 2020

DEDICATION

This project report is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time.

ACKNOWLEDGEMENT

Alhamdulillah, all praises be to Allah S.W.T, The Al Mighty, The Most Gracious and The Most Merciful. First of all, I would also like to acknowledge the effort and assistance of my supervisor **Dr.EEYDZAH BINTI AMINUDIN** for the encouragement, advice and guidance which helped me in preparing and completing this project report.

I would like also to extend my gratitude to all my family and friends for their contributions in one way or the other for making this study a successful, thank you and May God bless you abundantly Amen.

ABSTRACT

Building Information Modelling (BIM) is a synergistic mechanism utilized for Architectural, Engineering and Construction (AEC) sectors on the basis of several software solutions. Today, Malaysia construction industry is facing a serious issue from the society to improve efficiency, value, and quality. Loading of the cycle of construction project operation and maintenance seem to be around as most of costing to be during the phases. The aim (of this study is to propose to develop a Building Information Modelling framework in facilitating management for Building Refurbishment) By adopting BIM in facilities management (FM) will be able to overcome this issue. Hence, the objectives are (1) To study the challenges of factors affecting BIM adoption in ecosystem maintenance and refurbishment. (2) To identify the factors influencing BIM acceptance in facilities management (FM) for building refurbishment.(3) To determine the relationship of BIM for factors that influencing the faciliting management for building refurbishmen. Hence, (4) set of structured survey questionnaire from random construction sites managed by various contractors in Malaysia. The collected data was then analyzed using frequency distribution analysis and the Average Index also Smart PLS software to test the internal consistency method. The results are categorized according to the level of disagreeing or agree and presented in the tables and figures for easy interpretation. The findings showed that the factors reduce human resource during operation phase and improve Maintenance planning schedules were in the category of agreeing to important according to the analysis and ranking of the average index. Furthermore, the most important factors that were noticed from BIM can enhance operations & maintenance of facility management. Also, the results showed that management and maintenance were mostly classified as, which indicate that BIM can reduce in operation maintenance cost and data support in facilities management.

ABSTRAK

Pemodelan Maklumat Bangunan (BIM) adalah mekanisme sinergi yang digunakan untuk sektor Senibina, Kejuruteraan dan Pembinaan (AEC) berasaskan beberapa penyelesaian perisian. Hari ini, industri pembinaan Malaysia menghadapi masalah serius dari masyarakat untuk meningkatkan kecekapan, nilai dan kualiti. Lambakkan kitaran operasi dan penyelenggaraan projek pembinaan seolah-olah meninggikan kos operasi ketika berada dalam fasa. Tujuan (kajian ini adalah untuk mencadangkan untuk membangunkan rangka kerja Pemodelan Maklumat Bangunan dalam memudahkan pengurusan Pembaharuan Bangunan) dengan menggunakan BIM dalam pengurusan kemudahan (FM) dapat mengatasi masalah ini. Oleh itu, objektifnya adalah (1) Untuk mengkaji cabaran dan faktor yang mempengaruhi penerimaan BIM dalam penyelenggaraan dan pemulihan ekosistem. (2) Untuk mengenal pasti faktor-faktor yang mempengaruhi penerimaan BIM dalam pengurusan kemudahan (FM) untuk membina penambahbaikan. (3) Untuk menentukan hubungkait BIM dan faktor-faktor yang mempengaruhi pengurusan kemudahan untuk membina pengubahsuaian. Oleh itu, (4) set soal selidik kaji selidik berstruktur dari tapak pembinaan rawak yang diuruskan oleh pelbagai kontraktor di Malaysia. Data yang dikumpul kemudian dianalisis menggunakan analisis pengedaran frekuensi dan Indeks Purata juga perisian Smart PLS untuk menguji kaedah konsistensi dalaman. Hasilnya dikategorikan mengikut tahap tidak setuju atau bersetuju dan disediakan dalam jadual dan angka untuk tafsiran mudah. Hasil kajian menunjukkan bahawa faktor-faktor yang mengurangkan sumber manusia semasa fasa operasi dan meningkatkan jadual perancangan Penyelenggaraan berada dalam kategori bersetuju berdasarkan analisis dan ranking indeks purata. Selain itu, faktor yang paling penting yang dilihat dari BIM ialah ia dapat meningkatkan operasi & penyelenggaraan pengurusan kemudahan. Tangga keputusan kajian pengurusan dan penyelenggaraan ini boleh diklasifikasikan sebagai penanda aras yang menunjukkan bahawa BIM dapat mengurangkan kos penyelenggaraan operasi dan sokongan data dalam pengurusan kemudahan.

.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BIM	-	Building Information Modelling
AEC	-	Architecture Engineering, Construction
CIDB	-	Construction Industry Development Board
CRC	-	Construction Research Centre
CRIEM	-	Construction Research Institute of Malaysia
PWD	-	Public Works Department
SME	-	Small Medium Enterprises
IBS	-	Industrialized Building System
BM	-	Building Maintenance
DI	-	Defect Identification
FM	-	Facilities Management
CMMS	-	Computerized maintenance management system
RFIS	-	Request for Information System
BIFM		British Institute of Facilities Management

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Overview

Building Information Modelling (BIM), is a synergistic tool utilised for engineering, architectural and construction (AEC) sectors about several software solutions (Robinson, C. (2007). itself technology and a method for managing construction Projects (Azhar, S. et al. 2013). In Malaysia (BIM), is primarily utilised by the private industry (CIDB, 2013). The word BIM was initially applied during a two-day infrastructure and construction Asia's Building Information Modelling and Sustainable Architecture Conference in 2009 in Malaysia.

In 2014, the Malaysian Build SMART international was formally listed for supporting open BIM program and policy push for BIM (Ismail, 2014). Remarkably BIM successes are evident in all aspects of the construction phase, for example, disclosing faults and lapses in design papers (Campbell, 2007), on-site verification support and pursuing of building actions (Memon, 2014) and growing the speed and usefulness of activities by enhancing the quality of schedule and cost information throughout project lifecycle (Fallon, 2007) visualisation to reduce the chances of misinterpretation from any participant involved in the project(Salazar, 2006). combination of information from many officials making an improved representation of the project (CRC, 2005),for Building Novelty.

1.2 Research background

BIM is comparatively a fresh idea in the Malaysian construction sector (Zakaria, 2013) and promises to edge Malaysia into the excellent construction business, pioneering and well-informed about worldwide solutions (Latiffi, 2014). Construction stakeholders regard BIM as a prospective solution for present problems affecting budgets, worth, and time of accomplishment (CREAM 2014).

Despite efforts such as public works department (PWD), BIM working group, practising BIM, BIM standard handbook and procedures, BIM roadmap and trial projects, construction industry development board (CIDB), BIM portal, BIM steering commission, conferences and discussions, multimedia super corridor (MSC), construction research institute of Malaysia (CREAM), the adoption of BIM remains at a slow pace (Haron, 2014).

The application of BIM in Malaysia, when compared to different developing nations, is far behind in adoption and level of use (Zakaria, 2013). Malaysia faces struggles in accepting BIM which at present focuses on moving from 2D to 3D working environment (Latiffi, 2014).The Malaysian government decided to dictate the usage of BIM for its tasks beginning from 2016 against the backdrop of slow uptake in the use of BIM both within companies and to support collaboration within the Malaysian industry (Ismail et al., 2015).

1.3 Problem statement

Today, Malaysia construction business is facing a large trial from the societies to improve their effectiveness, value, and quality. Therefore, the building sector has been

understood as the best case in Malaysia industry. Such as delay overrun cost, and the adoption rate is still slow, the construction of the lower product quality the serious worker still using low-class technology. This is happening because, in dealing with the complex project and involves many parties that should drive the development and implementation of building info, modelling (BIM), in order to address this low productivity rate. Then, in the construction industry involved much exchange among them.

The absence of procedures for informing the designed model with as-built information is measured between the top issues for BIM in FM (London 2010). Responsibilities and duties for facilitation the data and preserving the model are not clearly identified (Davtalab 2013). Facility supervisors have usually been involved in the building lifespan in a very restricted method and at the late stage of facility delivery to customers. Moreover, design conclusions are not generally challenged for their influence on working or preservation cost (BIFM 2012).

Because of these issues, BIM data for FM is either missing or insufficient. The FM field depend on receiving practical data from a BIM to do everything significant with it. Frequently, this data is not there or is wrong. The traditional method to adopt new procedures and tools in the FM industry is also measured a key issue. The FM is very inflexible in its method to new skill, and except BIM for FM benefits are noticeably confirmed (Becerik-Gerber 2011). It is also measured as a hindrance for implementing BIM in FM applications. This alteration of participants with FM service provider frequently involves disgracefully poor laid down data among the contractors-clients, carrying out further analysis expenses being included to the fee. Propose that current facility management (maintenance & operation) once for the construction worker to complete the papers at the completion of construction and over again for the maintenance and the start of every.

This procedure is characteristically ineffectual as it primes to a repetition of information. It could be recommended that there requires to be enhancement done to

the workflow of transfer data and the maintenance of that data using the life of the building refurbishment. There is a deficiency of request by clients for BIM in FM which is intensified by a overall shortage of teamwork among project stakeholders for modelling and model utilisation (Australian Institute of Architects 2010). The deficiency of responsiveness by customers is intensified by a lack of BIM services and accepting by FM experts (Task 2013). Thus, these two causes are making a malicious circle constraining BIM acceptance in FM utilizations. Certainly, this is a challenge as a BIM for FM usages needs nonstop maintenance to continue useful to the building himself and his landlords (Et 2013).

Interoperability among BIM and existing FM skills is still a problem in the delivery of data to the operation stage (Akcamete 2013). In current resources, FM legacy systems are typically used for less than couple of decades and except the handover of BIM information to these legacy systems is united with or advances current means of process, and the value of BIM is confirmed.

Besides, one of the big issues faced in building a digital model of the oldest structure is the absence of documented material for the systems that have been changing and materials used during the of the construction phase. The selected of diagnosis tools or assessment on industrialised building system (IBS), building maintenance (BM), already important to impact to lifespan implementation to the understanding level of contractor or designer to indicate the suitable technologies and in ideas building repairs.

Hence, the lack of existing defect diagnostic methods and continuation methodologies construction and design features of collaboration between parties make a supplementary value to reshape the project when determining the maintenance delivery in building IBS (Chen, 2010).

The overhauling process in preservation by traditional printed reports, unsystematic database restricts manufacturers and workers from being participated in the information exchange in developing project performance appraisal stage which frequently results from design has changes identical.

The control level in Malaysia defect identification (DI), method fixing procedure and practice expertise in building DI of IBS constructions are behind nearly too advanced nations. Comparative with the large level of IBS construction in the Japan and USA, the technology supporting and high-scale production operations, for instance supervision on the framework, and close to technologies construction, are used to improving the maintainability of elements could analyse the maintenance cases using safety oversight procedure included anticipation of discrepancy including the parties in the construction; such as the contractor and designer, unwanted of occurring (Zhang, 2014).

Less to understand of building defect level and restricted support technical for example tools in building defect identification to support correspond the fault issues of BM, components as building maintenance system may source excessive economic damages and own casualty cases because of the disaster building defects such as a concrete roof.

1.4 Aim and objective of the study

The aim of this study is to propose to develop a Building Information Modelling framework in facilitating management for Building Refurbishment, To reduce cost and make the decision for the operation maintenance in Malaysian construction industry. Thus, to achieve this aim three objectives were adapted. The The objectives of the research are:

1. To study the challenges of factors affecting BIM adoption in ecosystem maintenance and refurbishment.
2. To identify the factors influencing BIM acceptance in facilities management (FM) for building refurbishment.
3. To determine the relationship of BIM for factors that influencing the faciliting management for building refurbishmen.

1.6 Scope of the study

This research has challenges and assessed phase to BIM, in Malaysian construction. Also, investigate software to make easier BIM, influence application challenges date collect for this research was used questionnaires with construction practices.

Finding analysis that stage of BIM in FM challenges in Malaysian construction is the lowest Normal index system employed to assess the effectiveness of software packages various of BIM. Main challenges to BIM.in FM Execution is requiring improved collaboration, include designer work, interoperability and wants to become collaboration. To increase the level of the construction industry in Malaysian, recommended a flexible training program of BIM with all practitioner's necessity to be built.

1.7 Significance of stdy

The motive of this essay to existing the strategic overall for the literature current on Buildings information modelling (BIM). Building Maintenance (BM), Facilites management (FM), to uncover the elements back to the proportional without the redeveloped discipline to make a contribution improvement of a greater cumulative knowledge base with the aid of providing current fame and suggesting directions future for research. Which skill-constructing region wants to significantly improve working practices. However, no technology barriers bog down the achievement of supply. The frequency development industry, the massive quantity of companies, quality reduction standards-compliant. Guidelines and Inspection protocols restrict the ordinary impact of high-scale strength effectivity placement to advantageous integration of renewable building facilities.

Lack of holistic restoration actions cannot only be based on restricted budgets and challenging institutional framework conditions; however, within the lack of awareness of benefits. Which will be tailored to numerous buildings varieties, therefore an even methodology to develop such ideas is helpful. Most of the solutions technological utilised for the renovation of buildings have the highest impact on the important estate design that ought to be saved by the renovation of the building.

1.8 Summary

The chapter introduced the research background on the current trend in BIM research and outlined the justification for adequate research into methods of improving BIM implementation towards maintenance. The research objectives, methodology and thesis outline, were delineated to depict the research procedures from start to a logical conclusion.

REFERENCES

Akcamete. (2013). BIM in facilities management applications: A case study of a large university. *Built Environment Project and Asset Management*, *5*(3), 261–277. https://doi.org/10.1108/BEPAM-02-2014-0011

Azhar. (2008). Study on benefits of implementing Building Information Modelling (BIM) in Malaysian construction industry. *Operations Management*, *2008*(JUL), 2842–2848.

Baba. (2010). Study on benefits and barriers of implementing Building Information Modelling (BIM) in Malaysian construction industry. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *2014*(JUL), 2842–2848.

CDA. (2012). Study on benefits and barriers of implementing Building Information Modelling (BIM) in Malaysian construction industry. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, *2014*(JUL), 2843–2844.

Chang, C., Tsai, M. (2013). (2016). *International Journal of Economics and Financial Issues A Case Study of Maintenance Management Systems in Malaysian Complex and High-rise Industrialized Building System Buildings*. *(Zhang et al., 2014)* (Vol. 6). Retrieved from http:%5Cnwww.econjournals.com

Chin, W. W. (1998). The Partial Least Squares Approach to Structural Equation Modeling. *Modern Methods for Business Research*, *295*, 295–336.

Nunnally, J. C., & Bernstein, I. H. (1967). *Psychometric theory* (3rd Editio). New York: McGraw-Hill.

Davtalab, D. (2013). N– *A Case Study Approach*. Retrieved from http://ecodomus.com/wp-content/uploads/2015/05/isarc2014_submission_122_davtalab.pd

Davtalab. (2013). Benefits of BIM for Construction Projects –Approach. *Benefits of BIM for Construction Projects – A Case Study Approach*. Retrieved from http://ecodomus.com/wp-content/uploads/2015/05/isarc2014_submission_122_davtalab.pdf

Eastman. (2011). The role of geotechnical data in Building Information Modelling. *Australian – New Zealand Conference on Geomechanics (ANZ 2012). 15th – 18th July 2012*, (44), 511–516. Retrieved from http://www.keynetix.com/white-papers/the-role-of-geotechnical-data-in-building-information-modelling/

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, *18*(1), 39. https://doi.org/10.2307/3151312

Huber. (2011). Project time and cost control using building information modeling. *ICCREM 2013: Construction and Operation in the Context of Sustainability - Proceedings of the 2013 International Conference on Construction and Real Estate Management*, (November), 545–554. https://doi.org/10.1061/9780784413135.052

Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed A silver Bullet". *Journal of Marketting Theory and Practice*, *19*(2), 139–150. https://doi.org/10.2753/MTP1069-6679190202

Hulland, J. (1999). Use of Partial Least Squares (PLS) in Strategic Management Research : a Review of Four Recent Studies. *Strate*, *20*(2), 195–204. https://doi.org/10.2307/3094025

Hamid et al. (2010). *Building Information Modelling*. (Vol. 29). malaysia.

Khemlani. (2010). BIM in facilities management applications: A case study of a large university complex. *Built Environment Project and Asset Management*, *5*(3), 261–277. https://doi.org/10.1108/BEPAM-02-2014-0011

L. Ding, R. D. (2009). *BIM-based framework for automatic scheduling of facility maintenance work orders*. *Automation in Construction* (Vol. 91). Elsevier. https://doi.org/10.1016/j.autcon.2018.03.007

MSC Malaysia, (2013). Building Information Modeling (BIM) Application in Malaysian Construction Industry Project management reference model View project Suzila Mohd UNIVERSITI TEKNOLOGI MALAYSIA Building Information Modeling (BIM) Application in Malaysian Construction Industry. *International Journal of Construction Engineering and M Anagement*, (4A), 1–6. https://doi.org/10.5923/s.ijcem.201309.01

Mcauley, B., & Mcauley, B. (2016). Identification of Key Performance Tasks to Demonstrate the Bene # t of Introducing the Facilities Manager at an Early Stage in the Building Information Modelling process on Public Sector Projects in Ireland . by. https://doi.org/10.21427/D7DK62

Motamedi, (2014). BIM in facilities management applications: A complex. *Built Environment Project and Asset Management*, *5*(4), 261–267. https://doi.org/10.1108/BEPAM-02-2014-0011

Motawa, I. & A. (2013). Building information modelling in operations of maintenance at the university of alicante. *International Journal of Sustainable Development and Planning*, *13*(1), 1–11. https://doi.org/10.2495/SDP-V13-N1-1-11

Niehaus, M. &. (2009). FORUM : QUALITATIVE SOCIAL RESEARCH SOZIALFORSCHUNG Review : 1 . General Information. *Forum Qualitative Sozialforschung*, (2009).

Prasetya, W. Y. S., Shihab, M. R., & Sandhyaduhita, P. I. (2015). Exploring the Roles of Personality Factors on Knowledge Management System Acceptance, 107–112.

Source. (2004). *BIM-based framework for automatic scheduling of facility maintenance work orders*. *Automation in Construction* (Vol. 91). Elsevier. https://doi.org/10.1016/j.autcon.2018.03.007

Shih, Y.-Y., Lu, Y.-H., Liu, T.-Y., & Wu, M.-F. (2017). THE STAFFS ' ADOPTION INTENTION OF KNOWLEDGE MAN- AGEMENT SYSTEM IN GREEN HOSPITAL — THE THEORY OF. *The International Journal of Organizational Innovation*, *9*(3), 27–36.

Teicholz. (2013). BIM and Future Quantity Surveyor's Practice in Sri Lankan Construction Industry. *The Second World Construction Symposium 2013: Socio-Economic Sustainability in Construction*, (June), 81–92. Retrieved from http://www.suranga.net/publications/2013_bm_future_qs.pdf

Vitiello, U., Ciotta, V., Salzano, A., Asprone, D., Manfredi, G., & Cosenza, E. (2019). BIM-based approach for the cost-optimization of seismic retrofit strategies on existing buildings. *Automation in Construction*, *98*(October 2018), 90–101. https://doi.org/10.1016/j.autcon.2018.10.023

Zhang. (2014). Benefits of 6D BIM for Facilities Management Departments for Construction Projects – A Case Study Approach. *Benefits of 6D BIM for Facilities Management Departments for Construction Projects – A Case Study Approach*. Retrieved from http://ecodomus.com/wp-content/uploads/2015/05/isarc2014_submission_122_davtalab.pdf

.