ICRP
2018

PROCEEDING OF 3rd INTERNATIONAL CONFERENCE ON REBUILDING PLACE (ICRP) 2018

Towards Safe Cities & Resilient Communities

13 & 14 SEPTEMBER 2018
IMPIANA HOTEL, IPOH, PERAK

ORGANIZED BY :

UNIVERSITI TEKNOLOGI MARA

F|S|P|U
Fakulti Senibina, Perancangan & Ukur
Faculty of Architecture, Planning & Surveying

https://icrp2018.wixsite.com/icrp18

UNIVERSITI TEKNOLOGI MARA

USM UNIVERSITI SAINS MALAYSIA

APEX

京都工芸繊維大学
KYOTO INSTITUTE OF TECHNOLOGY

GRESAFE_CITIES
Green Safe Cities, Research Interest Group

Malaysian Institute of Planners

PROCEEDING OF

ICRP

2018

3rd INTERNATIONAL CONFERENCE ON REBUILDING PLACE (ICRP) 2018

Towards Safe Cities & Resilient Communities

13 & 14 SEPTEMBER 2018 | IMPIANA HOTEL, IPOH, PERAK

eISBN 978-967-5741-63-0

ORGANIZED BY

Faculty of Architecture Planning and Surveying
Universiti Teknologi MARA, Perak Branch
Seri Iskandar Campus,
32610, Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA

ICRP2018
3rd International Conference on Rebuilding Place

13-14 September 2018
ISBN 978-967-5741-62-3 eISBN 978-967-5741-63-0

BUILDING INFORMATION MODELLING (BIM) ADOPTION IN CONTRACTOR ORGANISATIONS

Wan Nur Syazwani Wan Mohammad[1*], Mohd Rofdzi Abdullah[2], Sallehan Ismail[3]
[1, 2, 3]Department of Building, Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, Seri Iskandar Campus, Seri Iskandar, 32610, Perak, Malaysia.
Email of corresponding author *: wannursyazwani@gmail.com

Abstract **-** The construction industryhas been facing various problems such as low investment rate, rising cost, additional risks, and wastein labour productivity whichled to a decline in the quality of life of the construction stakeholders. To date, Building Information Modelling (BIM) has been used to improve visualization and productivity;to better coordinate construction drawings and communication;to provide faster delivery; and to lower costs. However, the adoption of BIM among Malaysian contractors organisations has been low and stagnant.Hence, this research aims to gainan overview of BIM adoption among contractors organisations as well as to investigate the reasons for the low adoption among contractors organisations. A qualitative approach in the form of semi-structured interview was used in this study to explore BIM adoption among contractors organisations. The findings were subsequently analysed using content analysis. The findings indicated that contractors organisations in Malaysia have no framework or model. Hence, developing the BIM adoption framework or model is urgently needed to encourage the development of BIM in Malaysia.
Keywords **-** Building Information Modelling (BIM), Adoption, Contractors organisations

1 INTRODUCTION

The construction industry is an important sector that has made greatcontribution to the Malaysian economic growth. However, in December 2017Malaysia's Gross Domestic Productfrom Construction had declined to 5.9% from 6.2% of the preceding three months (Department of Statistics, Malaysia, 2018). For this year, Bank Negara has forecasted Malaysia's Gross Domestic Productto be between 5.5 % and 6.0% (https://tradingeconomics.com/malaysia/gdp-growth-annual). Hence, the construction industry needs to move out from the traditional method as it had led to various problemsdue toreworks, time delay, rising costs, lack of communication and coordination, and wastagesthat havecontinued to plague the industry for years(Yaakob et al., 2016). In view of this problem, adopting Building Information Modelling (BIM)in the construction industry is vital.

Over the years, the global rate of adoption of BIM among commercial contractors has shown improvement (Beveridge, 2012). As reported by McGraw Hill Construction(2012), the level of adoption in North America was 28% in 2007 but had tremendously increased to 71% in 2012. From the report,the adoption rate among the contractors (74%) wasalsoshownto be the highest compared to architects (70%) and engineers (64%). In the United Kingdom, 12% of contractors have usedBIM for 6 or more years, while 19% have used BIM for more than 10 years. Meanwhile, in South Korea, the BIM adoption rate among contractors was 65%(McGraw-Hill Construction, 2014). In contrast, in Malaysia, the adoption rate of BIM among contractors organisations from 2007 to 2013 had beenmerely 5.2% (Jusoh, 2017). In 2016, the adoption rate among contractors organisations showed an improvement of about 13% (Construction Industry Development Board of Malaysia, 2016) yet in comparison to other countries, the adoption rate in Malaysia is still considered low.

Hence, this study seeksto gain an overview of BIM adoption among contractors organisations as well as to investigate the reasons for the low adoption among contractors organisations.The contractors organisationsare the target of the studybecausecontractors are the key players in the construction industryandthey are the peopleresponsible fortransferring and interpretingmodels in 3-dimensional drawingtothe real situation(Eadie et al., 2013).

2 LITERATURE REVIEW

In this section, the introduction of BIM, BIM adoption, and the overview of BIM among contractors organisations will be further discussed.

2.1 Definition of BIM

In the literature, various definitions of BIM were given by various researchers. Understanding the concept of BIM is vital as it helps in the application of BIM in the contractors' organisations. Table 1 below shows the definition of BIM by previous researchers according to their different perspectives.

Table 1 BIM adoption definition from previous literatures

Authors	Definition of BIM
Erntrom et al.,(2006)	The development and use of a computer software model to simulate the construction and operation of a facility. Hence, Building Information Model produced is rich in information, object-oriented, intelligent and parametric digital representation in order to help user to make a decision.
Kymmell(2008)	Building information model is related to project simulation for the purpose of project components such as planning, design, construction, and operation by using a 3D model.
Young etal.,(2009)	A process of creating a digital model for design, construction, and operation of projects.
Taylor., (2009)	A parametric three-dimensional (3D) computer-aided design (CAD) technologies and processes in the architecture, engineering and construction (AEC) industry.
Smith.,(2012)	BIM is a process with intelligent planimetric 3D modelling through life cycle construction.
CIDB, (2014)	A modelling technology and associated set of process to produce, communicate and analyse digital information models for construction life cycle.
Shapiai, (2015)	A tool for AEC industries in parametric model in which digital information can be visualized and simulated in order to achieve a better coordination and integration among stakeholders
Autodesk (2016)	An intelligent 3D model-based process that equips architecture, engineering, and construction professionals with the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.

From the table above, it clearly explained that BIM is not merely a model created by using a suitable software but it is also used in making decision, storing information, and describing an activity in construction projects (Shapiai, 2015)

Hence, for this study Building Information Modelling (BIM) can be described as a process of creating digital information for architecture, engineering, and construction (AEC) in the form of 3-dimensional (3D) model for a better coordination.

2.2 Definition of Adoption

According to Rogers., (1995);G. Winch., (1998); Hosseini et al., (2016)and Monko et al., (2017); adoption is the decision to make full use of any technological innovation to obtain a realistic information/result. As clarified by Rogers (1995), adoption is the process of decision making based on technological innovation of the communication channel. Furthermore, the authors also added that adoption can happen in two ways: 1) accept the innovation or, 2) reject the innovations.

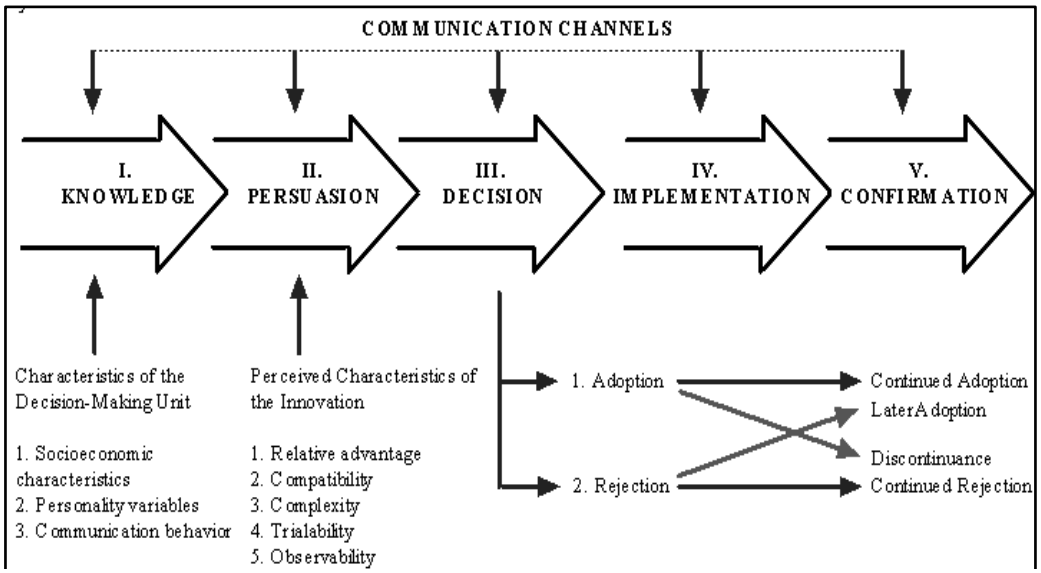

Figure 1 Innovation Decision Process (Roger, 1995)

2.3 Overview of BIM Adoption among Contractors Organisations

The world's first BIM adoption among contractors organisations was initiated by Mtai (2009). The author investigated BIM adoption factors among 400 biggest contractors in the United States. Mutai(2009) addressed the challenges in adopting BIM since BIM was still new in the industry by suggesting a clear adoption strategy that should be developed. As a result, a BIM adoption model was developed. Later, Division 15 Mechanical Ltd, (2013)as one of the specialist Mechanical contractors, took the initiative to develop a strategic implementation plan which consisted of a BIM adoption model for an organisation. A BIM adoption model was conceived to reduce the adoption rate of adopting new technology among SMEs contractors in order to remain in the industry. Similar study carried out by Poirier et al.,(2015)indicated that SMEs mechanical contractors in Canada were rather hesitant in adopting and implementing BIM. Meanwhile, Al Awad (2015)indicated that the use and adoption of BIM among SMEs contractors in Jordan had lagged behind. Thus, a BIM adoption framework was developed in order to assist SMEs contractors to adopt BIM in the organisations. A similar scenario was shown by Hong et al.(2016)in Australia where the BIM adoption among SMEs contractors was also limited.

In Malaysia, research on BIM adoption among contractors organisations is minimum. CIDB, (2014b)conducted a workshop regarding 'Contractor's Acceptance of Building Information Modelling (BIM) Towards Improvement of Project Performance and Profitability'. The study aimed to investigate the perception of individual contractors on BIM in performing their task; however, due to insufficient number of experienced contractors in the workshop, the workshop failed to achieve its goal. Similarly, Harris et al., (2014)conducted a workshop regarding 'The way forward for Building Information Modelling (BIM) for constructions in Malaysia'. The purpose of the study, which focused on barriers and adoption factors, was to promote BIM especially among the newcomers in the industry. Meanwhile, Bidin.,(2015) who investigated BIM adoption challenges among G7 contractors in Malaysia suggested in his report several success strategies in BIM adoption. A majority of previous researchers merely listed the success strategies or adoption factors without presenting the model or framework. This situation was also observed by Osman et al.,(2015)in her study on BIM adoption among quantity surveying firms in Malaysia which suggests that adoption factors in a structured manner are required.

3 METHODOLOGY

In this study, the literature review used to seek information regarding BIM adoption was gathered from various sources such as journal articles, conference papers, and reports from various agencies, among them CIDB. Meanwhile, in obtaining the primary data, a qualitative approach in the

form of semi-structured interviews was conducted. According to Saunders et al., (2008) qualitatitive research is associated with such concepts and are characterised by their richness and fullness based on the opportunity to explore a subject as realistically as possible.

Hence, information was collected from eight (8) respondents who represented five (5) large private contractors in Malaysia. The respondents were selected based on the contractors' experience using BIM for their entire projects in Malaysia. In addition, the Construction Industry Development Board (CIDB), an important body that enhances the development of BIM in Malaysia had provided sufficient data in connection with the organisations involved in BIM projects. Thus, in this study, the respondents were labelled accordingly as R1 to R8.

Meanwhile, the interview form was prepared to obtain the data from the respondents. The first section in the interview form filters the respondents based on their background and experience in BIM projects while section 2 explores the overview of BIM adoption among the contractors organisation. The following table presents two (2) sections of the interview form. The information gathered from the semi-structured interviews was subsequently recorded and analysed using ATLAS.*ti* in the form of content analysis. Content analysis was used to analyse unstructured data, such as the data from semi-structured interviews (Latiffi et al., 2016). According to Latiffi et al.,(2016), ATLAS.*ti* is a qualitative tool to analyse the visual and hierarchical modelling of concepts and theory. It also encompasses large number of documents and materials such as images, codes, video, audio, and geo data in order to retain the information.

Table 1 Questions from the Interview form

Section	Descriptions
Section 1: Respondents' Particular information	• To extract the respondents' background and experience in BIM projects
Section 2: Overview of BIM adoption among contractors organisations in Malaysia	• To understand the definition of BIM • To explore the current adoption of BIM among contractors organisations

4 FINDINGS AND DISCUSSION

The information gathered from the data collection was discussed in the following sections. As mentioned in 3.0, it consists of two sections.

4.1 Respondents' Particulars

The following table shows the respondents' particulars. From the table, four (4) respondents (R1, R2, R6 and R7) fall under Architect. Meanwhile, three (3) respondents (R3, R5 and R8) fall under Engineer. Only one (1) respondent is under Quantity Survey.In addition, this respondent had a minimum experience of6- 10 yearsin construction compared to other respondents.

In BIM experience, three respondents (R1, R2, and R5) had more than 5 yearsof experience while, four (4) respondents had 4-5 yearsof experience in BIM. Only one (1) respondent (R3) had minimum experience which is 2-3 years. The valuable information provided by these respondents are considered reliable as the respondents come from various backgroundand working experience in the construction industry and BIM-based projects.

Table 2 Respondents' Particular Information

Respondents	Occupations	Experience in Construction	Experience in BIM
R1	Architect	11-20 years	Above 5 years
R2	Architect	11-20 years	Above 5 years
R3	Engineer	11- 20 years	2-3 years
R4	Quantity Survey	6- 10 years	4-5 years
R5	Engineer	11-20 years	Above 5 years

R6	Architect	11-20 years	4-5 years
R7	Architect	11- 20 years	4-5 years
R8	Engineer	11-20 years	4-5 years

4.2 Overview of BIM Adoption among Contractor Organisations

In this section, the findings from semi-structured interview on BIM definition and current adoption of BIM among contractors organisations in Malaysia are discussed.

4.2.1 BIM definition

The findings suggested that the definition of BIM falls into two (2) categories, process and perceived benefits. Five respondents (R1, R2, R5, R6, and R7) agreed that BIM is a process which helps contractors organisations to be seamless in their projects. These findings were echoed by various researchers, for instance Young et al.,(2009); Taylor et al. (2009); and Smith (2012), CIDB, (2014) and Autodesk (2016).

"The process of managing information is more effective, easier and faster for their user" (R1,and R6)

"BIM is a process of developing a 3D model such as architectural, structural, and mechanical drawing using BIM software" (R2)

"BIM is a collaborative tool which consists of processing, creating, and managing information for the entire lifecycle"(R5, andR7)

Furthermore, all respondents (R1, R2, R3, R4, R5, R6, R7, and R8) agreed that BIM is defined as perceived benefits or advantages. This is consistent with Erntrom et al.,(2006); Kymmell (2008) and Shapiai.,(2015)who defined BIM as a tool that gives benefits and effects to the users.

"BIM provides an advantage as it can save our time and is easier"(R1,R2,and R6)

"Detecting clashes, improving visualization, and providing better coordination are the functions of BIM" (R3,R4, R5, R7, and R8)

4.2.2 Current adoption of BIM among contractors organisations

The next results show that the adoption of BIM is low because there is no framework or models, specifically for contractors organisations, that is available in the construction industry. This resonates with the findings made by Osman et al.,(2015) in the study of BIM adoption among quantity surveyors in Malaysia. Besides, it also discovered that so far no research on BIM adoption framework/ model that is relevant to contractors organisations has ever been conducted in Malaysia.

The following quotes are stated by the respondents:

"Since 2014, the adoption of BIM has become stagnant due to various challenges faced by the organisations. In addition, the lack of framework and model regarding BIM adoption is the biggest problem" (R1)

"The organisations face challenges and barriers in changing from the traditional method to BIM. Hence, the adoption of BIM only existsin the BIM department. Apart from that, there is no framework or models in the Malaysian construction industry" (R4,and R5)

"To date, there are no framework or adoption models suggested or available in the construction industry. Thus, it influences many organisations to create their own path and direction. Moreover, the adoption becomes more stagnant due to various challenges in the organisations" (R2, R3, R6, R7, and R8)

4.3 Summary of Findings

From the findings, it shows that Malaysia still lacks BIM adoption framework/models for contractors organisations. This statement is echoed by all the respondents (as per table below) which explains the limited number of BIM framework/models in the industry. Hence, the development of BIM adoption model for contractors organisation is vital in order to increase the rate of adoption. Nonetheless, various factors such as benefits, challenges or barriers in BIM adoption also need to be investigated in order to develop a comprehensive framework or models. This is because these are the factors (challenges or barriers, and benefits) mostly revealed by the respondents. The table below shows a summary of the findings.

Table 3 Summary of findings

Items	**Definition of BIM**		**Current adoption of BIM among contractors organisations**		
	Process	Perceived benefits	Very low/ stagnant	Challenges or barriers	No framework or BIM models
Respondents (n=8)					
R1	x	x	x	x	x
R2	x	x	x	x	x
R3		x	x	x	x
R4		x	x	x	x
R5	x	x	x	x	x
R6	x	x	x	x	x
R7	x	x	x	x	x
R8		x	x	x	x
Total	**5**	**8**	**8**	**8**	**8**

Noted: R is respondents. The highest score is from 5 to 8 respondents

5 CONCLUSIONS

The research confirmed the literature written by previous researchers in investigating the issues of BIM adoption. The results also revealed that no framework or models is available to facilitate BIM adoption by contractors organisations in Malaysia. As a consequence, the other variables (benefit and challenges or barriers) also must be included as part of the empirical data. The paper was presented with the aim of developing a framework of BIM adoption model for Malaysian Contractor Organisations. Thus, it is hoped that the research will encourage positive input from researchers and contractors in order to strengthen the development of BIM in Malaysia.

REFERENCES

Al Awad, O. (2015). The Uptake of Advanced IT with Specific Emphasis on BIM by SMEs in the Jordanian Construction Industry.

Beveridge, S. (2012). *Best Practices using BIM in Commercial Construction*. Brigham Young University.

Bidin, Z. A. (2015). *Malaysian Contractors' Perception Towards Building Information Modeling (BIM) Applications*. Universiti Teknologi MARA.

CIDB. (2014a). Building Information Modeling Roadmap for Malaysia's Construction Industry, Workshop Report (Series 2). *Construction Industry Development Board Malaysia (CIDB)*, (2), 1–21.

CIDB. (2014b). Contractor's Acceptance of Building Information Modelling (BIM) Towards Improvement of Project Performance and Profitability, (February), 1–27.

Construction Industry Development Board of Malaysia. (2016). BIM report 2016. Kuala Lumpur, Malaysia.

Division 15 Mechanical Ltd. (2013). Pilot Project III : BIM Adoption and Implementation Within a Specialty Contracting Firm, (March).

Eadie, R., Odeyinka Henry, Mike Browne, C. M., & Yohanis, M. (2013). An Analysis of the D Rivers for Adopting Building Information Modelling. *Journal of Information Technology in Construction ISSN1874-4753*, *18*(February), 338–352.

Erntrom, B., Handson, D., Hill, D., Jarboe, J., Kenig, M., Nies, D., … Webster, T. (2006). The Contractors' Guide to BIM - Edition 1. *AGC of America*, 48. Retrieved from http://www.agcnebuilders.com/documents/BIMGuide.pdf

Harris, M., Ani, A. I. C., Haron, A. T., & Husain, A. H. (2014). The way forward for Building Information Modelling (BIM) for constrctions in Malaysia. *Malaysian Construction Research Journal (Mcrj)*, *15*(2), 1–9.

Hong, Y., Sepasgozar, S. M. E., Ahmadian, A. F. F., & Akbarnezhad, A. (2016). Factors influencing BIM Adoption in Small and Medium Sized Construction Organizations. *33rd International Symposium on Automation and Robotics in Construction (ISARC 2016)*, (Isarc), 2016.

Hosseini, M. R., Banihashemi, S., Chileshe, N., & Namzadi, M. O. (2016). BIM adoption within Australian Small and Medium-sized Enterprises (SMEs): an innovation diffusion model. *Construction Economics and Building*, *16*(3), 71–86.

Jusoh, H. B. (2017). *Factors Influencing Clients' Behavioural Intention on BIM Adoption in Malaysia Construction Industry*. Universiti Teknologi MARA.

Kymmell, W. (2008). *Building Information Modeling Planning Planning and Managing Construction Projects with 4D CAD and Simulations*.

Latiffi, A. A., Brahim, J., & Fathi, M. S. (2016). Transformation of Malaysian Construction Industry with Building Information Modelling (BIM). In *IBCC* (Vol. 22).

McGraw Hill Construction. (2012). *The Business Value of BIM in North America. SmartMarket Report*.

McGraw-Hill Construction. (2014). *The Business Value of BIM in Australia and New Zealand: Smart Market Report*. Retrieved from http://www.consultaustralia.com.au/docs/default-source/bim/the-business-value-of-bim-in-australia-new-zealand.pdf

Monko, R. J., Berryman, C. W., & Friedland, C. J. (2017). Investigation of Factors and Sub-Factors Influencing Interorganizational Building Information Modeling Adoption, *6*(4), 160–167. http://doi.org/10.5923/j.ijcem.20170604.04

Mutai, A. (2009). Factors Influencing the Use of Building Informationmodeling (Bim) Within Leading Construction Firms in the United States of America, (August 2007).

Osman, J., Mazlina, S., Khuzzan, S., & Razaksapian, A. (2015). Building Information Modelling : Proposed Adoption Model For Quantity Surveying Firms. *Proceeding of IC-ITS 2015, International Conference on Information Technology & Society*, (June), 151–165.

Poirier, E., Staub-French, S., & Forgues, D. (2015). Embedded contexts of innovation. *Construction Innovation*, *15*(1), 42–65. http://doi.org/10.1108/CI-01-2014-0013

Rogers, E. M. (1995). *Diffusion of innovations. Macmillian Publishing Co.* http://doi.org/citeulike-article-id:126680

Saunders, M., Lewis, P., & Thornhill, A. (2008). *Research Methods for Business Students. Research methods for business students*.

Shapiai, M. F. (2015). *Minimizing Conflicts During Construction Stage By Using Building Information Modeling*. Universiti Teknologi Malaysia.

Smith, J. A. (2012). BIM – A Contractors Perspective 1, (June 2012), 1–5.

Taylor, J. E. (2009). Paradigm Trajectories of Building Information Modeling Practice in Project Networks Paradigm Trajectories of Building Information Modeling Practice in, *2*(April). http://doi.org/10.1061/(ASCE)0742-597X(2009)25

Winch, G. (1998). Zephyrs of creative destruction: understanding the management of innovation in construction. *Building Research & Information*, *26*(June 2013), 268–279. http://doi.org/10.1080/096132198369751

Yaakob, M., Athirah, W. N., Ali, W., Radzuan, K., Nur, W., & Ali, A. W. (2016). Identifying critical success factors (CSFs) of implementing building information modeling (BIM) in Malaysian

construction industry. *International Conference on Applied Science and Technology 2016 (ICAST)*, *19*(10), 20105–15095.

Young, N. W. . J., Jones, S. A., Bernstein, H. M., & Gudgel, J. E. (2009). SmartMarket Report. *McGraw Hill Construction - SmartMarket Report Construction*, 1–52. Retrieved from http://bim.construction.com/research/pdfs/2009_BIM_SmartMarket_Report.pdf