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Comparative Study on the Perspective towards the Benefits and Hindrances of Implementing Building Information Modelling (BIM)

Peniel Ang Soon Ern[1*], Yong Yee Ooi[1], Yasser Yahya Al-Ashmori[2]

[1]Department of Civil Engineering Technology, Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia (UTHM), Pagoh, Johor, MALAYSIA

[2]Department of Civil and Environmental Engineering, Faculty of Engineering, Universiti Teknologi PETRONAS, Seri Iskandar, Bota Perak, MALAYSIA

*Corresponding Author

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Abstract: Building Information Modelling (BIM) is considered one of the most effective technologies to improve the productivity of the building process. BIM has proven its advantages throughout the building project life cycle. However, the lack of awareness towards BIM is due to the persistent practice of obsolete technology in construction. Thus, the aim of this study is to explore the industrial practitioners' perspectives on the benefits and hindrances of BIM implementation in order to understand their level of awareness. A questionnaire survey was distributed to 120 consultant companies in Kuala Lumpur where 52 responded. The data were analysed using frequency analysis and test for correlation was performed. Results revealed that respondents have a positive awareness of the benefits and hindrances towards the implementation of BIM. Both BIM and non-BIM users achieve a significant agreement on the benefits of BIM to control delay, cost, and improves management. On the other hand, all participants criticised that High Cost Allocation, Time Consuming, Lack of Information are hindering the implementation of BIM. In addition, there was a weak relationship between the BIM as a tool in company and the predictor variables which are level of understanding, time saving, cost saving, better management, cost allocation, time consumption and lack of awareness. The correlation coefficient values obtained were 0.419, 0.403, 0.376, 0.446, 0.324, 0.407 and 0.274 respectively. The outcomes indicate that construction industry experience constraint on implementing BIM mainly due to the BIM enforcement by the government industry. Thus, this paper is significant in contributing knowledge of awareness between BIM and non-BIM users on benefits and hindrances of BIM implementation. It also acts as a benchmark for the government to address the relevant issues provide a channel to drive the industry towards BIM level 2.

Keywords: Construction, Building Information Modelling (BIM), Malaysia, benefits, hindrances

1. Introduction

The development of Information Technology (IT) and implementation of Building Information Modelling (BIM) have benefited the construction industry to tend from its conventional methods to a more sustainable and technical construction method (Haron, Marshall-Ponting, & Aouad, 2009). The revolution of Engineering Technology by

*Corresponding author: peniel@uthm.edu.my

implementing Information Technology (IT) takes the most important step to manage the information in a systematic manner. Building Information Modelling (BIM) is considered a leading edge technology in the IT field which proves its suitability as a tool to improve Computer-Aided Drawing (CAD) in the construction industry (Yan & Damian, 2008). BIM has proven its ability not only to overcome several problems in construction industry such as delay and cost escalation, but also to improve effective communication, and solve clashes. One of BIM's distinct features is to merge construction players, design team, consultant engineer's team, and the construction contractor. This greatly solve a lot of communication problems and predict clashes before execution (Crotty, 2006). Moreover, the implementation of BIM enhances quality and reduce reworks and the associated cost. BIM has been implemented globally by many countries throughout the decades. For instance, Singapore, being the nearest developing region, has achieved 92% of projects adopted BIM while 65% of contractor implement BIM as in year 2018 (Enegbuma, Aliagha, & Ali, 2015).

However, the readiness of BIM among Malaysian construction players are still low, survey done by CIDB in 2016 indicating 64% of the organisation failed to failed to invest in BIM training and 67% failed to invest in BIM hardware and software (Latiffi et al., 2013). Despite the potentials mentioned above, previous studies have shown that Malaysia lacks some drivers that could fasten the pace of implementing BIM in construction industry. It is believed that the drawback of implementing new IT in construction industry happens due to the lack of technical expertise, the complexity of the system and the people's behaviour that rejects new technology (Haron, Marshall-Ponting, & Aouad, 2009; Ruikar, Anumba, & Carrillo, 2005; Zakaria et al., 2013). Therefore, this study was conducted to:

i. Determine the awareness of BIM and non-BIM users towards the benefits of BIM implementation in the construction industry.
ii. Evaluate BIM and non-BIM users' perspectives on the hindrances of BIM implementation in the construction industry.
iii. Test the correlation coefficient between BIM the presence of BIM, benefits and hindrances of implementing BIM in Malaysia.

This study is significant in contributing knowledge of awareness between BIM and non-BIM users on benefits and hindrances of BIM implementation.

2. Research Background

2.1 Benefits of BIM Adoption

BIM is one of Information and Communication Technology (ICT) that provides a range of solutions in delivering projects, therefore, it has been suggested that construction projects will be more effective and productive with ICT applications (Aigbavboa, Oke, & Kekana, 2017; Bui, Merschbrock, & Munkvold, 2016; Ang et al., 2017; Ang, Kasim, & Goh, 2016; Ang et al., 2012).

BIM is a leading edge technology that has improved the ways where building structures are designed and built (Haron, Marshall-Ponting, & Aouad, 2009). It is a process that utilizes shared knowledge resource to analyse and predict the outcomes through virtual design and construction along the phases of the building life cycle (Reddy, 2012; Hergunsel, 2011). It is generally defined as a three dimensional representation of a building and its behaviour or characteristics in practice (Hergunsel, 2011). BIM has proven its ability to improve construction industry in several aspects such as;

i. Visualisation: BIM provides specifications in every individual object that involves in the design (Kymmell, 2008). It also provides the feature to identify activity that could possibly cause delay to the progress of project (Haron, Marshall-Ponting, & Aouad, 2009). In addition, BIM can also provide graphic simulation that enables construction players to gain insight on the progress of the building constructed day by day. BIM allows the client to have a clear images of the proposed building which would be in the sense that he can actually walk around the virtual building and see from any angle inside out (Crotty, 2006; Azhar, 2011). This would improve communication, build trust among stakeholders, and enhance faster decision making. By having these simulations, sources of problems are predicted and improvements can be organised for further considerations (Eastman et al., 2011).
ii. Communication: BIM enables less documentation, and provide well organised documentation process (Wang & Chong, 2015). This can eliminate errors and improve communication. Unlike 2D the built-in intelligence extracted from BIM Model allows automated extraction of 2D drawings, documentation and other building information (Singh, Gu, & Wang, 2011). BIM as highlighted by (Bui, Merschbrock, & Munkvold, 2016) enable practitioners to collaborate, visualize and manage construction works. The integration of BIM with other technologies will also create an innovative working practice that is able to streamline communication - from the drawings/designs etc.- with the actual onsite processes (Wang & Chong, 2015). Designer at any time will have the ability to respond to any issue directly, and this will enhance communication among parties on the construction site (Wang & Chong, 2015).
iii. Multi-disciplinary Coordination: BIM is an inhabit factor for industry where most projects are handled in multidisciplinary and multi-organisational teams. It can clarify roles, responsibilities, and distribution of benefits (Gu & London, 2010). BIM enables multi-discipline from architectural, design, and construction

coordination to be made by incorporating and testing them in a shared BIM model. Knowledge on BIM varies across different disciplines within the AEC industry, reflects the fact that BIM is able to eliminate visual ambiguity among the different disciplines teams (Gu & London, 2010). BIM can also support the fully coordinated system to provide surveyor with a function that can translate XYZ coordinates to North, East and Elevation points. This can be directly transferred to the surveyor's equipment (Memon et al., 2014).

iv. Clear Information: BIM is a new approach that describes and displays all the information concerned with construction from inception to demolition (Aigbavboa, Oke, & Kekana, 2017). When BIM is implemented, information is well distributed and organized in a presentable and digital format. BIM can be effectively used to coordinate material ordering, fabrication, and delivery schedules for all building components as it provides a clear information of the building aspects (Azhar, 2011). Furthermore, it enables early decisions to be made in the earlier stage and the clear communication made with client, designer can be released to the contractor to commence work. Thus, contractor can follow schedule and achieve completion date (Crotty, 2006). BIM provides clearer direct information regarding the cost implications of a project with real time which will be provided to users (Memon et al., 2014).

v. Clash Detection: Overlapping between components in the same space often happens in 2D drawings. Using BIM however, clash detection can be easily identified with the usage of a single integrated database (Memon et al., 2014). This system is able to identify any errors in the construction related prior to the construction phase. Unproductive activity that could possibly cause delay to the progress of project can be identified by designing a construction schedule with BIM (Haron, Marshall-Ponting, & Aouad, 2009).

2.2 Hindrances of BIM Adoption

Construction projects are becoming more challenging to successfully plan and manage because of the advancement of technology, the innovative practices in other sectors and the enhancement of information across all disciplines. Several challenges that hinder BIM adoption in Malaysia are high cost of technology, high training cost, lack of BIM knowledge, high cost of software and insufficient BIM trainings software (Latiffi et al., 2013).

Incorrect visualization of project information is the largest problem in either planning or construction execution (Kymmell, 2008). Poor quality information leads to a visualization failure. This will lead to necessity for rectifying the design and update the plane manually, which cause project additional time, cost, and low quality.

Communication breakdown is one of the most significant problems in construction industry. Some of the problems are originated from the difference in the intended message with the received message (Dadi, 2014). Furthermore, the use of annotations and symbols were only recognized by the particular designer. In other words, it is a discipline-specific language of technical drawings (Crotty, 2006).

Even though BIM has proven its benefits in improving construction industry, several hindrances faced practitioners while implementing this technology. BIM productivity and economic benefits have been acknowledged globally but adoption has been slower than anticipated (Bernstein & Pittman, 2004). In Malaysia, BIM is considered a new technology and it is very certain that the people are reluctant to accept this technology due to the fear of change. Several researches study the barriers or obstructs faced by practitioners, and some of those hindrances could be highlighted as follow:

vi. Cost: Cost here indicated the initial stage of the investment which covers several areas such as updating the new software, hardware and the training of staff (Memon et al., 2014). Only large organisations can afford to own BIM technology due to its high initial cost of hardware, also hiring new staff who have the skills and knowledge of BIM requires allocation of cost for the construction industry as well as providing training for them (Latiffi, Mohd, & Brahim, 2015). Although majority of organisations are aware of BIM, the adaption and usage is very low because of the high cost of the program (Aigbavboa, Oke, & Kekana, 2017). In addition, the cost of copy right and training is one of the drawbacks of implementing BIM (Yan & Damian, 2008).

i. Lack of Training: Technology has transformed the industry, and whoever cannot keep up will be left behind. Therefore, the lack of training hinders the implementation of BIM to achieve its satisfactory level. Therefore, training is vital for the success in implementing new technology and BIM has no exception as a new technology introduced to construction industry to enhance construction performance (Zakaria et al., 2013). Without proper training BIM cannot be fully utilised to its extent even if that particular organization did have the technology.

ii. Lack in Guidelines: With the absence of a national BIM implementation guideline, users develop their own guidelines without consulting BIM experts. As a result, all of these versions will lead to the confusion among construction players.

iii. People's Mind-set: Moving in to a new and unknown environment is challenging to the people within an organisation (Zakaria et al., 2013). People think that implementing BIM needs an expert to apply the technology and software in the company (Aziz, Nawawi, & Ariff, 2016). Companies are more comfortable with their traditional method and this mind set is one of the barriers to BIM implementation.

iv. Ownership: Ownership is meant to provide client with proprietary design elements. This becomes the problem when parties in the team involve in the construction with the client by using the single data base. Project team

that has privilege over certain information in the model concerned to create questions regarding the ownership of BIM (Memon et al., 2015).

2.3 Construction of References

Researches have evaluated the benefits and barriers of using BIM in the UK and US and found that BIM has an impact which cause change of the process of how building is being executed if compared with traditional construction (Yan & Damian, 2008). However, result revealed that BIM drives to better decision making throughout the project lifecycle, reduce time and cost, and increased incorporation of multiple disciplines. BIM also integrates plans, sections, details, graphics, and data in ways not possible in 2D which reduce the clashed between different disciplines. Moreover, it has benefits during the operation phase as BIM can reduce human resources during the entire operation phase. From the other side, studies show that cost of technology, lack of training, unsuitability of technology in some projects, and unavailability of clear evidence of the success of the technology are some of the barriers of BIM implementation. Five barriers which hinder BIM implementation namely: not client demand, not always relevant to projects worked on, cost, projects worked on perceived is too small, and lack of in-house expertise (Ang et al., 2017).

3. Research Methodology

Fig. 1 shows the summary of the methodology for the study. As this study's methodology is based on quantitative method, the data collection came from sampling of a selected population. This study applies the method of purposive sampling, where the samples are selected based on the knowledge of a population and the purpose of the study.

Questionnaires were used as a medium to obtain the required data from a large group of people, in this case, BIM and non-BIM users. In this study, questionnaires were distributed to the population of 120 respondents via email. Total of 52 responses were collected and went through the analysis. This study focused on the C&S consultant engineers who are from the big cities in Malaysia such as Kuala Lumpur. Consultant engineers are individuals that play an important role in designing phase and this promotes a bigger chance and opportunity to involve in BIM as a result.

The questionnaire from this study was designed by reviewing previous studies to suit the current condition of Malaysia. The level of importance was based on the respondent's professional judgment on a given five point Likert-scale from 1 to 5 (where 1 is very insignificant and 5 is very significant). The questionnaire contains 4 parts namely demographics, the level of general understanding of BIM, benefits of BIM and hindrances towards BIM implementation.

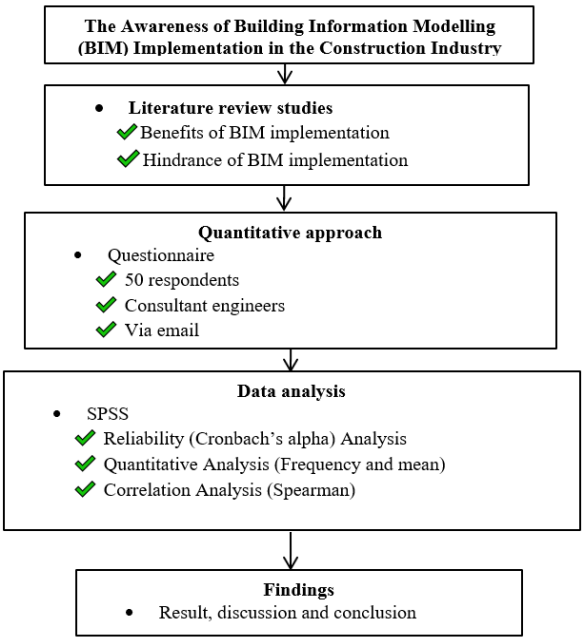

Fig. 1 - Research Methodology Flowchart

Frequency and correlation analysis were conducted from the questionnaire findings with the aid of Statistical Package for Social Science (SPSS). Spearman correlation analysis is employed for this parametric procedure, examining the association and linear relationship between the presence of BIM, benefits and hindrances of implementing BIM in Malaysia.

4. Results and Discussion

Based on the results of questionnaire and the literature review, this section discusses four parts; demographic information, level of understanding, benefits/barriers to adopt this technology and the correlation between BIM as a tool in company and the predictor variables.

Respondents to the questionnaire were from different range of age which reflects the experience of participant. As shown in Fig. 2, the respondents from the age of 20 to 30 years old got the highest percentage of 46.2%, equivalent to a number of 24 persons. The lowest percentage was 25% equivalent to 13 respondents and it was on the category of 41 years old and above.

Based on the result, the current presence of BIM implementation in the respondents' company is illustrated in Fig. 3. It is clearly shown that more companies still did not use this technology in their firm up to the time where this study was conducted. The percentage for companies that are currently implementing BIM is 46.2% (BIM users) whereas the percentage for companies that are currently not implementing BIM is 53.8% (non-BIM users). Results reveal that consultant companies are depending more on the traditional method of designing and managing project. Backward of implementing new technology could be due to the lack of knowledge or barriers which restricts firms to adopt new technology.

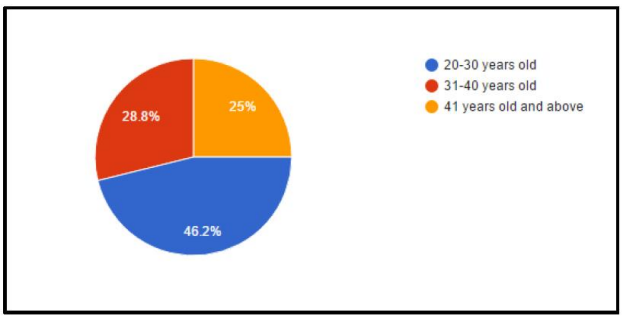

Fig. 2 - Percentage of the respondents' age.

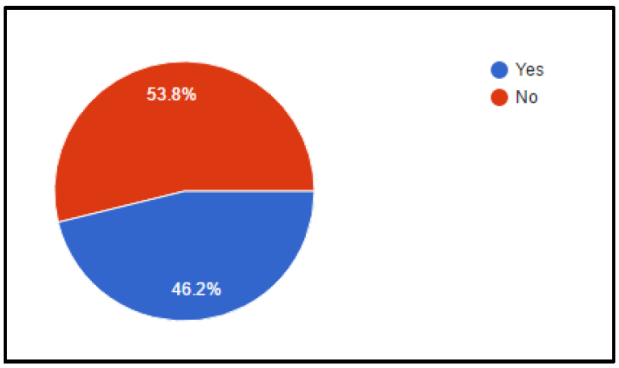

Fig. 3 - The percentage of BIM as a tool in company.

4.1 Level of understanding BIM technology

This level of understanding aims to evaluate the awareness of the respondents to the new technology. Result will give a clear anticipate of professionals' tendency to new technology. Descriptive statistics was employed to show the frequency and percentages of the level of understanding regarding BIM. In this study the technique that was being chosen is measures of dispersion. This technique gives us an idea about the amount of dispersion or spread in a set of data.

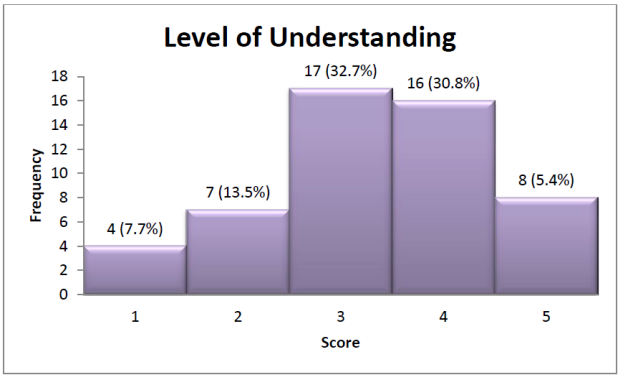

Fig. 4 - Frequency and percentage of level of understanding regarding BIM and its application in the construction industry.

The results of the level of understanding according to every item in the questionnaire are shown in Figure 4, where it illustrates the respondents' level of understanding to BIM and its implementation in the construction industry. The percentages from very low understanding to very high understanding are 7.7%, 13.5%, 32.7%, 30.8% and 15.4% respectively. Result reveals that majority of respondents understand the concept of BIM in construction. This could encourage the companies which did not implement BIM in their work to be updated with new technology and achieve an acceptable level of understanding.

Level of understanding consists of 4 sections namely: BIM differs from 3D design, BIM as a key to sustainable development, BIM provides benefits over project life cycle, and BIM features that can improve the construction industry. The level of understanding context was developed based on past research reviews and suited to the current construction industry. Table 1 summarized the general understanding of BIM among professional participants. It shows the frequency, percentage and mean score. Respondents found to be aware to BIM technology in all perspective presented and the highest mean value obtained was 3.90 which was about the BIM features that can improve the construction industry.

Table 1 - The summary on general understanding on BIM.

No.	General understanding on BIM	1	2	3	4	5	Mean
1	BIM differs from 3D design	4	3	15	18	12	3.60
	Percentage (%)	7.7	5.8	28.8	34.6	23.1	
2	BIM as a key to sustainable development.	2	0	17	23	10	3.75
	Percentage (%)	3.8	0	32.7	44.2	19.2	
3	BIM provides benefits over the life cycle of a project.	1	3	14	20	14	3.83
	Percentage (%)	1.9	5.77	26.9	38.5	26.9	
4	BIM features can improve the construction industry.	1	1	13	25	12	3.90
	Percentage (%)	1.9	1.9	25.0	48.1	23.1	
		Overall mean					**3.77**

4.2 Benefits of BIM implementation in the construction industry

This section discusses the respondents' level of agreement towards the benefits of implementing BIM in the construction projects. There was a total of 3 sections namely: BIM saves time, BIM saves cost and BIM provides a better management of a project. Each category included five factors.

Table 2 shows BIM benefit categories with relevant factors, it also illustrates the summarized results from the analyzed questionnaire on benefits of implementing BIM. Participants were found to have the sufficient awareness towards the benefits of BIM. Results demonstrates that BIM users are more aware to the benefit of the technology than those Non-BIM users.

Table 2 - The summary of the result from the questionnaire analysis on benefits of implementing BIM.

Benefits of BIM	*Factor*	*Mean*	
		BIM User	**Non-BIM User**
Time Saving	1. BIM saves time during the planning and design phase.	4.38	3.89
	2. BIM saves time as it provides more accurate design visualization of project for users.	4.50	3.79
	3. BIM saves time with the extracted information to prefabricate building components.	4.08	3.64
	4. BIM saves time by identifying clashes in a short time with its clash detector.	4.33	3.79
	5. BIM saves time when changes have to be made in the model.	4.21	3.71
	Overall Mean	**4.30**	**3.76**
Cost Saving	1. BIM saves cost as it provides sustainable building design.	4.25	3.75
	2. BIM saves cost as it helps to reduce wastage of construction materials.	4.25	3.68
	3. BIM saves cost as it improves cost estimating at every stage of a project.	4.38	3.75
	4. BIM saves cost as it reduces the cost of hiring extensive labors for drawing and documenting manually.	4.08	3.71
	4. BIM saves cost as it utilizes prefabrication which reduces the on-site labor cost.	4.04	3.50
	Overall Mean	**4.20**	**3.69**
Better Management	1. By enabling users to keep track on a project's progression.	4.38	3.86
	2. By providing details for every individual component in the design model.	4.42	3.75
	3. By developing a construction schedule for the construction project.	4.25	3.75
	4. By providing a better communication platform for construction players.	4.38	3.68
	5. By enabling multi-disciplinary design coordination (eliminates doubts between design team).	4.25	3.54
	Overall Mean	**4.34**	**3.72**

Results are discussed as follow:

i. BIM is Time Saving: All respondents from industry show their acknowledgement to the BIM benefits to save time. Both respondents with experience implementing BIM in their firm and others have agreed that BIM could save time in different forms. Result shows that the highest mean score for BIM users was 4.50 as BIM could save time by providing a more accurate design visualization of project for users. Whereas, the highest mean value for non-BIM users was 3.89 as BIM saves time during the planning and design phase.
   The overall mean for BIM users and non-BIM users was 4.30 and 3.76 respectively. From the response of BIM user and non-BIM user, it can be seen that there was difference in their perspective towards the benefits that BIM provides. However, both categories of respondents had a considerably high awareness with their mean scores and overall mean scores on this topic. BIM user had a much higher score than non-BIM user which indicated that BIM users were more aware of the benefits on this section.

ii. BIM is Cost Saving: Similarly, result reveals that respondents also admit BIM benefits to save cost. Even though, respondents whom already have implemented the technology seem to be more aware of the BIM benefit to cost, others are also found to be knowledgeable with the benefits. Result shows that the highest mean score for BIM users was 4.38 which was BIM saves cost as it provides sustainable building design. Whereas, the highest mean value for non-BIM users was 3.75 as it provides sustainable building design and it improves cost estimating at every stage of project. This was supported by (Levy, 2012) that BIM will eventually lead to sustainable design of building due to its features that reduce wastage of material by estimating the materials needed to complete the project. Cost estimation was also brought in in his book which

was the direct relationship with materials estimation. This was also agreed by the BIM users which agreed on BIM save cost by improving cost estimation.

The overall mean for BIM users and non-BIM users was 4.20 and 3.69 respectively. However, the overall mean showed that BIM users were more aware of the benefits of this section. It can be seen that BIM users and non-BIM users agreed most on the same topic which was cost estimating. However, the mean score of BIM users were higher than that of non-BIM users. This indicated that BIM users were more aware of the benefits discussed in this topic.

1. BIM Provides a Better Management of Project: BIM also has proven its benefits to provide a better management of project. It ~~is~~ shows that all respondents declare that BIM could enhance project management system. The highest mean value for BIM users was 4.42 and it fell under the topic BIM provides details for every individual component in the design model whereas the highest mean score for non-BIM users was 3.86 which was on the topic BIM enables users to keep track on a project's progression. Studies have supported that BIM could improve the management of a project by providing details for every individual component in the project (Hergunsel, 2011).

The overall mean for BIM users and non-BIM users was 4.34 and 3.72 respectively. It was also seen that both categories of respondents agreed most on different benefits in this section. However, both BIM users and non-BIM users were aware of the benefits but BIM users were more aware as proved by the mean score.

4.3 Hindrances towards BIM implementation construction industry

This section discussed the respondents' level of agreement towards the hindrances BIM implementation in construction industry. There was a total of 3 sections namely BIM requires cost allocation, BIM implementation is time consuming and BIM implementation lacks of awareness. Each category included five factors. Table 3 shows BIM hindrance categories with relevant factors, it also illustrates the summarized result from the analyzed questionnaire on barriers of implementing BIM. Participants were found to be familiar with all barriers that constrained BIM to be employed widely in all construction projects.

Table 3 - The summary of the result from the questionnaire analysis on hindrance of implementing BIM.

Hindrances of BIM	Factor	Mean	
		BIM User	Non-BIM User
High cost allocation	1. BIM supported software and updates.	4.50	4.14
	2. Employment of additional staffs.	3.92	3.64
	3. Hiring professionals to provide knowledge for pioneers.	4.08	3.75
	4. Attending training programs for existing staffs.	4.33	3.68
	5. The startup of a BIM department.	4.25	3.79
	Overall Mean	**4.22**	**3.80**
Time consuming	1. Producing the model.	4.08	3.43
	2. The initial adoption of the model.	4.21	3.71
	3. The training of the existing staffs.	4.08	3.89
	4. Collaboration among the involving parties in the same model.	4.00	3.46
	5. Hiring suitable professionals with adequate skills to deliver to staffs	4.04	3.75
	Overall Mean	**4.08**	**3.65**

Table 3 - The summary of the result from the questionnaire analysis on hindrance of implementing BIM (Cont.)

Hindrances of BIM	Factor	Mean	
		BIM User	Non-BIM User
Lack of awareness	1. The lack of national BIM guidelines hinders the implementation and senior management support	3.83	3.54
	2. Lack of experience and senior management support.	3.88	3.75
	3. Uncertainties regarding ownership of data.	3.83	3.32
	4 .Culture change towards full collaborative working.	3.63	3.39
	5. Restructuring of organization to accommodate BIM.	3.83	3.54
	Overall Mean	**3.78**	**3.50**

Results are discussed as follow:

i. BIM Implementation Requires High Cost Allocation
The most hindrance category was the cost associated with implementing BIM as a new technology. Result shows that consultants are agreed that applying this technology requires more investments on providing the technology, and to employee expert personnel or to train existing staff. The highest mean value according to all respondents is that BIM cost more money to offer supported software and updates. The overall mean of the cost allocation for BIM users and non-BIM users was 4.22 and 3.80 respectively.

ii. BIM Implementation is Time Consuming
Even though BIM has proven its success to save time, it is still found to be one of the barriers that restrain BIM implementation. As illustrated in the result, BIM requires more time at the initial stage as for producing the model, adopting the technology, and to train the existing staff. The highest score for BIM users' perspective was 4.21 as BIM requires additional time for the initial adoption of the model. Whereas, the highest score for non-BIM users' perspective was 3.89 which consumes time to train the existing staffs. Generally, the overall mean for BIM users and non-BIM users regarding this category of barrier was 4.08 and 3.65 respectively.

iii. Lack of Awareness on BIM
Respondents have acknowledged their awareness and knowledge about BIM, but they still face a challenging to get sufficient information. As result shows that there is a lack of guidelines, expertise, and/or uncertainties regarding ownership of data. This hinders the participants to employ the technology widely. The lack of experience and senior management support found to be the highest hindrance from respondents' perspective. The overall mean regarding lack of information from BIM users' and non-BIM users' perspective was 3.78 and 3.50 respectively.

4.4 Correlation analysis

Table 4 shows the correlation between BIM as a tool in company with its predictor variables. Correlation coefficients can range from -1.00 to +1.00. The value of -1.00 represents a perfect negative correlation, which means that as the value of one variable increases, the other decreases. While a value of +1.00 represents a perfect positive relationship, meaning that as one variable increases in value, so the other does. A value of 0.00 means that there is no relationship between the variables being tested.

The predictor variables in this study included level of understanding, benefits of BIM implementation (time saving, cost saving, and better management), and hindrances of BIM implementation (cost allocation, time consumption and lack of awareness). From the results, the correlation coefficient values were considerably low as all of the predictor variables correlate to BIM implementation are less than 0.5, which marked a weaker positive relationship. The low correlation coefficient values and a weak relationship were obtained due to the number of respondents that implemented BIM in their company was low as compared to those who implemented. The amount of respondents that were currently implementing BIM is only 46.2% out of the 100%.

Spearman correlation between BIM as a tool in a company with level of understanding was 0.42, this represents that the application of BIM improves the level of understanding to professionals and increases their awareness towards the implementation of BIM and its benefits.

In addition, the presence of BIM in company correlates positively to achieve its benefit. The result revealed that the correlations between BIM implementation with time saving, cost saving, and better management were 0.40, 0.38, and 0.45 respectively, this indicates that the more the company implements BIM more benefits could be achieved.

Lastly, correlation results prove that implementing BIM will positively increase cost allocation, require more time to acquire the technology, and enhance the awareness. The lowest correlation coefficient value fell between BIM as a tool for company and the lack of awareness which was 0.27.

Table 4 - Spearman correlation matrix.

Predictor Variables	Presence of BIM implementation in company
Presence of BIM implementation in company	1.00
Level of understanding	0.42
Benefits of BIM Implementation	
Time saving	0.40
Cost saving	0.38
Better management	0.45
Hindrances towards BIM implementation	
Cost allocation	0.32
Time consumption	0.41
Lack of awareness	0.27

5. Summary

This paper discussed BIM implementation in construction industry as one of ICT technology which improves construction performance and enhances project delivery. It helps construction project to tackle several of its problems such as; delay, cost overrun, quality, and better management, etc. many companies nowadays are implementing this technology in their projects or intending to implement it. In Malaysia, practitioners from consultant achieve a satisfactory level of understanding BIM. Even though many companies have yet to implement BIM in their work, but professionals still record good level of understanding of BIM.

Results of this research reveal that all participants acknowledge the benefits of implementing BIM in construction industry. Both BIM and non-BIM users achieve a significant agreement on the benefits of BIM to control delay, cost, and improves management. On the other hand, all participants criticised that High Cost Allocation, Time Consuming, Lack of Information are hindering the implementation of BIM.

All factors achieve significant level that effect implementation of BIM as new technology. Users are concerned about the BIM supported software and updates cost. Although, respondents agree BIM has succeeded to reduce cost, its implementation cost still high which hinders the spread of BIM. Similarly, BIM benefits construction project time, but initial adoption of the model, and time need to train existing staff, consider the most hinders of BIM. The barriers concern was due to lack of information, lack of experience and senior management support. Last but not least, study reveals a low correlation between BIM as a tool for company and predictor variables (level of understanding, time saving, cost saving, management, cost allocation, time consumption and lack of awareness).

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