Breaking the Barriers: BIM Adoption Challenges in Quantity Surveying Firms of Northern Malaysia

Nur Muhammad Haziq Shamsul Anwar[1], Wan Faida Wan Mohd Azmi[2*] and Lilawati Ab Wahab[2]

[1]Godeco Services Sdn Bhd

[2]Department of Quantity Surveying, College of Built Environment and Technology

***Corresponding Author**

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ABSTRACT

The Malaysian construction industry plays a crucial role in generating national wealth. To realize the vision of Malaysia as a well-developed nation, adopting technologies and innovations is critical for the industry, particularly as the country advances towards the Fourth Industrial Revolution (IR 4.0). Building Information Modelling (BIM) is one such process, supported by various tools, that significantly enhances construction project efficiency while easing the workload of industry professionals. As integral construction team members, quantity surveyors are poised to benefit from BIM in improving their cost estimation and planning processes. However, various challenges and barriers have hindered the full implementation of this innovation. The focus of this paper is to identify the barriers to BIM implementation within the northern region of Malaysia, a topic that has become increasingly relevant as Malaysia moves towards the Fourth Industrial Revolution (IR 4.0). Data collected from a survey of 22 QS firms revealed that the top two barriers are the high cost of operating BIM software and the high cost of training. Based on these findings, it is recommended that the government provide incentives to encourage QS consultants to invest in BIM technology.

Keywords: Building Information Modelling, Quantity Surveyor, Challenges Northern Malaysia

INTRODUCTION

Adopting new technologies and strategies is necessary to make every work on the construction site much more accessible. As technology adoption continues to ramp up in our construction industry, the one thing that construction firms are not globally aware of is the implementation of Building Information Modelling (BIM). BIM is an intuitive 3D model-based process that eases the work for architects, engineers, and construction professionals to create an efficient plan and design projects. Building Information Modelling ought to have an innovative reception view as it is as much about people and processes as all things considered about innovation. However, many challenges were faced during the implementation of BIM in the industry.

The Construction Industry Development Board (CIDB) suggests compulsory employment of BIM in particular private area ventures by 2020. The move was to motivate and inspire industry players to adopt digital software while Malaysia readily set the fourth industrial revolution 4.0 in motion. Also, starting in 2019, any public sector that handles a RM 100 million or more project was compelled to implement the BIM system in the project's construction (CIDB, 2020). By using BIM, developing a structure or a framework can be done digitally without wasting too much paper. Any dispute arising from the project can be solved using the software. It will not be costly as the problem can be detected at the planning and designing stage and solved immediately before continuing with the project. Technology adoption, such as BIM in the development business, can help to abbreviate the building and planning approval time. Research into the technology acquisition of BIM can help open the eyes of development firms to see the future of Building Information Modelling software.

Problem Statement

One of the solutions for producing the most excellent construction industry products is considered to be BIM. According to Zahrizan et al. (2013), many construction industry players believe that using Building Information Modelling (BIM) software is latent in promoting synergistic activities in the Malaysian development industry. Because of this, customers in the development business expected the utilization of BIM in the projects to enhance the quality of the project, which caused various construction companies to start investing in BIM technology to meet the client's satisfaction (Zahrizan et al., 2013). Quantity surveyors are one of the construction companies moving toward implementing BIM in their working environment. This issue also included Quantity Surveyors applying the studies of BIM to their old estimating service to gradually increase the roles in cost estimating and cost planning games. However, specific barriers and challenges prevent the success of BIM implementation in quantity surveying firms.

According to Zainon et al. (2016), to effectively apply BIM in firms, every firm has to upgrade its hardware to the latest version. Moreover, they also have to obtain mandatory software, and the employees must go through a BIM training module to get used to the new environment. This will extend the company's time to use the BIM as it uses the latest version; it will also have to upgrade its computer to ensure the software's performance is at its best. Much money is also needed to pay for the BIM training fees for the employees. Moreover, Zainon et al. (2016) said the firm needs to know and gain proficiency with everything about the arrangement for the execution cautiously before BIM change can occur.

With the presence of BIM, a new, modern, and faster way to create the best quality product can be achieved. However, because of the barriers and challenges stated above, the maximum first-rate product from the construction industry will be hard to achieve. Without the implementation of BIM, the project’s cost will be higher, and the saving of resources will be hard to achieve. According to Al-Ashmori et al. (2020), the absence of a BIM system can lead to the existence of mass documents and the disintegrated information shared among the teams, which can highly likely lead to significant misunderstanding problems. Thus, some conflicts will arise among them. In the end, the productivity of the client's project will be affected because of the poor management of time, cost, and quality.

Building Information Modelling

BIM is a working technique that includes mechanising the whole task group utilising a 4D model that can do many of the conventional elements of a Quantity Surveyor. According to Bui et al. (2016), Building Information Modelling (BIM) is perceived to be specific, like a bracer for development and efficiency in the development business. Memon et al. (2014) said that Building Information Modelling (BIM) is another method of the development plan. It can encourage the digital portrayal of plans and gives all the fundamental data to any extent before it is built. Liu et al. (2015) contends that BIM is an agreement to sort the right people and data together viably and efficiently by supplying them with some processes and innovation help.

It is said that BIM is used to create and oversee construction information during the structure's life cycle (Enegbuma & Ali, 2013). Moreover, BIM can be viewed as a combination of cycle and advancement that offers a phase for a planned exertion between different parties in the construction industry by utilising the occupations of Information Technology (IT) (Zahrizan et al., 2013). According to Thurairajah & Goucher (2013) BIM addresses the course of action of advanced models for use during the organising, plan, advancement, and movement periods of the product's life.

Building Information Modelling (BIM) has brought major benefits to the construction industry, but it has also had a substantial impact on present practices, contractual policies, and business models. Numerous governments and consulting firms have proposed for the BIM adoption in the construction industry to encourage more collaboration and cooperation among involved parties while making sure construction standard and affordability (Olawumi and Chan, 2018). According to Smith (2014), one of the most significant factors in promoting BIM implementation is leadership. Although the government should take the lead in BIM implementation, it is insufficient. Government should work with and support other parties who have an impact on the development, such as private sector experts, contractors, and other professionals (Smith, 2014).

Kori and Kiviniemi (2015) observed some significant benefits of efficient construction delivery in many countries such as the Australia, United Kingdom, the United States, the Netherlands, Hong Kong and Singapore. Despite potential advantages of employing BIM in the construction industry, both developed and emerging countries are still slow to adopt the new technology. (Azhar et al., 2008; Enshassi et al., 2009; Gu and London, 2010; Sebastian, 2011; Both and Kindsvater, 2012). In New Zealand, BIM adoption is still in its beginning phases, with modest adoption (Miller et al., 2013). A lack of interest from researchers, resulting in a small number of BIM publications (Amor et al., 2007). BIM adoption by AEC firms in Gaza is also still in its early stages (Enshassi et al., 2007). In Indonesia as well, BIM did not reach everyone as much as 47% of the respondent still have no idea what BIM is, indicating that BIM is still unpopular among Indonesian construction professionals. Dare-Abel, Igwe, and Ayo (2014) conducted a study in Nigeria that identified the availability of BIM literate staff in architectural firms. However, studies on the adoption of BIM by architectural firms in Nigeria are very limited. Thirteen years ago, Tse et al. (2005) conducted the first research on implementation of BIM in Hong Kong, which found that BIM adoption in Hong Kong is very low due to a lack of customer demand.

In Malaysia, building information Modelling (BIM) is proving to be challenging to apply in the Malaysian building industry. Despite the government's strong support for BIM adoption, BIM adoption is currently at a relatively low level (Al-Ashmori et al., 2019). However, an open-ended interview by Enegbuma and Ali (2011) has revealed the current level of BIM implementation in the Malaysian construction industry, with the aim of growing the adoption and increasing the productivity of BIM.

Construction industry has recently become more interested in designing and building ecologically responsible buildings as well as sustainable buildings that can provide superior efficiency while also saving money (Jrade and Jalaei, 2013). This is needed in this polluted world with growing population noted Wong and Fan (2013). Due to the release of greenhouse gases such as carbon dioxide, construction industry has substantial impact on the environment and climate change (Khahro et al., 2021). Worldwide, buildings are responsible for 25% of global greenhouse gas emissions and consume 32% of total energy (Lucon et al., 2014). Future buildings should consume less energy, more efficient usage, and take advantage of local renewable resources to achieve the European Union's goals (Schlueter and Geyer, 2018).

Buildings are well known for their high energy consumption, so owners, architects, and engineers should be more concerned about sustainability and energy performance of proposed construction projects. Designers have been using energy analysis techniques to develop energy efficient buildings for years. (Jalaei and Jrade, 2014). Those include awareness of the impact of construction on environmental degradation, which has resulted in significant initiatives including building legislation and assessment, as well as a number of national and regional drivers and targets (Schlueter and Thesseling, 2009).

In general, sustainability can be defined as three main components: (1) environmental, (2) economic, and (3) social. Sustainable design requires architects, engineers and other designers to identify related materials and systems based on any chosen certification (rating) system to incorporate these components at the conceptual stage (Jrade and Jalae, 2013). However, research has revealed that majority of developing countries indicated low level of sustainability (Banihashemi et al., 2017).

Manzoor et al. (2021) noted that building information modelling (BIM) can serve as a central database for managing the entire building life cycle by making digital representations of the physical and functional information of sustainable projects available to all parties involved. Building Information Modeling (BIM) furthermore, is effective not only in sustainability analyses and management, but also in the procedure, maintenance, and demolition of structures (Yang et al., 2018).

BIM tools are useful for selecting optimum orientation and moderating other building components, resulting in lower energy costs and better building envelope optimization. BIM can also be used in the design stage to integrate techniques like water harvesting to reduce water usage in the building (Khahro et al., 2021). BIM tools, according to Steel et al. (2010), are beneficial not just for design but also for information transmission amongst building stakeholders. The inability to collect life cycle data, track projects, and execute real-time data analysis to share with project participants is the most difficult job for sustainable buildings (Chastas et al., 2016). However, despite these restrictions, Motuziene et al. (2016) stated that significant progress has been made in the

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usage of BIM technology, and sustainable building projects can achieve excellent outcomes by implementing these new features.

BIM allows for better project quality, more accurate scheduling, and lower total project costs (Succar and Kassem, 2015). Its main goal is to maximize the project's environmental versus cost advantages by making informed decisions based on timely feedback about building materials and construction specifications, energy consumption and generation, CO2 emissions, water use and harvesting, waste and pollution management, and so on (Ceranic et al., 2015)

Barriers to Implementing Bim

BIM is known for its many benefits to the project's future. However, the Malaysian construction industry must control the various difficulties for fruitful BIM usage. Many factors can cause a low level of BIM implementation in the construction industry.

Lack Of Professionals

Liu et al. (2015) studies found that one of the significant barriers to implementing BIM in the construction industry is the lack of professionals in handling BIM. Moreover, Bui et al. (2016) also discovered that the primary barrier to implementing BIM is the absence of skilful staff to work on the product, ignorance of the innovation, and non-accessibility of the parametric library. Gardezi et al. (2014) added that the absence of skilled professionals is among the top five barriers to BIM implementation in the Malaysian construction industry. This statement is also supported by Haron et al. (2017) who said that the second major problem in implementing BIM in Malaysia is the non-availability of national standards and the shortfall of skilled personnel in handling BIM (Wong & Gray, 2019). Moreover, Zhen Zhi et al. (2022) contend that the lack of assets and expertise in the Malaysian development industry is another obstacle to BIM implementation inside the Malaysian development industry. Moreover, Ahmad Jamal et al. (2019) study indicates that the absence of a talented and experienced BIM workforce ranks number one among the other barriers.

Reluctance to change to BIM software.

The next problem in implementing BIM is the notable individuals in the firm. As Zainon et al. (2016) said, seniors in firms tend to resist technology as they are used to the old traditional ways, which makes it a lot harder to change their behaviour into enjoying and tolerating them. Their hesitance to gain helpful knowledge or attempt new technology and software will be the most challenging barrier the top administration should overcome for BIM to operate successfully (Zainon et al., 2016). According to Memon et al. (2014), employees are not ready to change their software to BIM software as they prefer and are more comfortable with the old way. Moreover, the Gardezi et al. (2014) study, it was stated that one of the barriers discovered in implementing BIM is the reluctance of the industry player resistance to process change in the company. Next, in the survey questions by Wong & Gray (2019), where they asked the respondents about other barriers to implementing BIM, most of them answered that the way of life of the Malaysian Construction industry is reluctant to change to a newly introduced software.

Mohammad et al. (2018) found that, out of all the obstacles to BIM implementation, staff resistance occurred most frequently. Similarly, Mat Ya'Acob et al. (2018) found that one significant challenge in adopting BIM software is management risk, particularly resistance to shifting from traditional methods. Gamil and Rahman (2019) noted that similar barriers exist in countries beyond Malaysia, such as Yemen. Ahmad Jamal et al. (2019) and Babatunde et al. (2020) also highlighted that staff reluctance to transition to BIM ranked among the top 20 barriers to its adoption. Mamter et al. (2017) further emphasized that employees' unwillingness to share information has been a key factor contributing to the slow adoption of BIM in Malaysia. One respondent in Babatunde et al.'s (2020) study remarked, “Construction professionals in Malaysia are reluctant to adopt BIM because they are resistant to change. It becomes challenging to teach those over 40." Babatunde et al. (2020) confirmed that staff resistance to adopting new software remains one of the top barriers in the Architecture, Engineering, and Construction (AEC) industry.

Absence of BIM Legislation/Policy

According to Gardezi et al. (2014), one of the barriers to BIM implementation is the deficiency of BIM standard modelling policy to ease the implementation. The lack of standard policymakers for BIM also contributed to a small percentage of BIM implementation barriers (Mohammad et al., 2018). Mat Ya'Acob et al. (2018), their study stated that the absence of a BIM license policy, which is included in the technology risk type, is one of the barriers to implementing BIM in the company. Moreover, the lack of governmental legislation contributed to the barriers to BIM implementation, as stated by Gamil & Rahman (2019) study. Next, among the top ten ranks for BIM implementation barriers is the absence of BIM contractual agreements to be used in the construction industry (Ahmad Jamal et al., 2019). Mamter et al. (2017) study indicates that the truancy of BIM policy is one of the leading causes of the low implementation of BIM.

Low Awareness of BIM

Haron et al. (2017), referencing CIDB (2014), reported that insufficient knowledge and information about BIM account for 11.5% of the barriers to its implementation in Malaysia. Similarly, Memon et al. (2014) identified a lack of awareness of BIM technology as the second most significant barrier within the construction industry. Abd Hamid et al. (2018) also highlighted that many construction companies continue using outdated software and equipment, which are not updated with current advancements. As a result, their knowledge is limited, and they lack the capability to improve their skills and adopt new technologies.

In the survey conducted by Wong and Gray (2019), respondents identified the lack of current information on BIM as one of the main barriers to its implementation. Similarly, Mohammad et al. (2018) ranked the lack of awareness and knowledge of BIM among the top three barriers. Mat Ya'Acob et al. (2018) also highlighted that insufficient knowledge of BIM, classified as a management risk, is a key obstacle to its adoption within companies. Gamil and Rahman (2019) reinforced this finding, noting that the lack of familiarity with BIM software contributes to the challenges of implementation. Additionally, Oraee et al. (2019) pointed out that inadequate training in BIM and collaboration leaves graduates with insufficient knowledge in these areas. According to Babatunde and Udeaja (2020), the top barrier to BIM implementation is the limited knowledge and awareness of how to operate the software.

High Cost to Operate Software

Haron et al. (2017), referencing CIDB (2014), highlighted that the cost of BIM software is the leading barrier to its adoption in Malaysia, with a significant 26.2%. Construction industry clients have similarly ranked the high cost of BIM software as a primary challenge in implementing BIM applications. Abd Hamid et al. (2018) found that many construction companies are hesitant to adopt BIM due to the substantial costs involved, including the need to upgrade software and equipment to ensure smooth project and documentation processes. Gardezi et al. (2014) also reported that the high initial cost of BIM software and hardware ranks among the top five barriers to BIM implementation in the Malaysian construction industry.

The cost of the BIM implementation is also included in the top five barriers to implementing BIM (Mohammad et al., 2018). According to Mat Ya'Acob et al. (2018), their study stated that financial risk, such as lack of funds to invest in new software and hardware, is one of the barriers to implementing BIM in the company. Moreover, the expensive cost of BIM software when implemented also contributed to the barriers of BIM implementation as stated by Gamil & Rahman (2019) study. Next, among the top three ranks for BIM implementation barriers are the expensive cost of software and hardware and the operation of BIM to be used in the construction industry (Ahmad Jamal et al., 2019).

Lack of Client Demand

Zahrizan et al. (2013) and Memon et al. (2014) identified the lack of client demand as one of the key challenges hindering the adoption of BIM software in the construction industry. Gardezi et al. (2014) further emphasized that the absence of demand for BIM implementation ranks among the top five barriers in Malaysia's construction sector. Limited usage of BIM remains prevalent in the industry, with Mohammad et al. (2018) also noting that

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client indifference contributes to this obstacle. Similarly, Gamil and Rahman (2019) pointed out that a lack of interest from clients adds to the barriers against BIM adoption. Ahmad Jamal et al. (2019) highlighted that clients rarely enforce the use of BIM in their projects, ranking this issue among the top ten barriers to BIM implementation.

High Cost for BIM Training

Abd Hamid et al. (2018) noted that some construction companies are hesitant to adopt BIM due to the high cost of implementation, particularly when it comes to sponsoring BIM training for employees. A shortage of skilled BIM trainers has further contributed to the low uptake of BIM in Malaysia's construction industry. Zahrizan et al. (2013) emphasized that funds are necessary to cover the costs of BIM training. Wong and Gray (2019) found that the most significant barrier was the lack of education and training about BIM software, which has led to a genuine deficiency in BIM training within Malaysian construction firms. Similarly, Mohammad et al. (2018) and Gamil and Rahman (2019) identified the unavailability of BIM training as a key barrier to BIM implementation. Chan (2014) also underscored the importance of training, highlighting it as a major obstacle to BIM adoption. Ahmad Jamal et al. (2019) ranked the lack of training among the top twenty barriers to spreading BIM awareness in the construction industry. Babatunde and Udeaja (2020) pointed out that the high cost of BIM training makes companies resistant to adopting the software, while Marefat et al. (2020) concluded that the absence of BIM education and training is one of the most critical barriers to its implementation.

METHODOLOGY

This study employed a quantitative research method, with respondents selected through purposive sampling. A questionnaire was distributed to 29 Quantity Surveyor (QS) consultant firms located in Malaysia's northern region, covering firms in Perak, Penang, Kedah, and Perlis. The selection was based on data from the Board of Quantity Surveying Malaysia (BQSM) website. According to the Construction Industry Development Board (CIDB) Report (2016), the northern region had the lowest percentage of BIM adoption in Malaysia, accounting for just 2%, which is significantly lower compared to other regions (Refer to Figure 1.0).

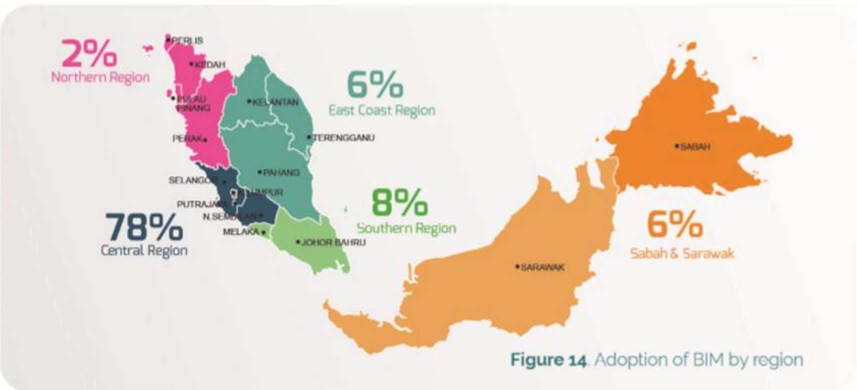

Figure 1 Level of BIM Adoption by Region in Malaysia Source: CIDB (Report, 2016)

For this research, 29 questionnaires were distributed. However, only 22 questionnaires were returned, which is equal to a 76 percent response rate. Fincham (2008) stated that a 60% response rate is acceptable. Data gathered is analysed using descriptive analysis via SPSS version 26.

Table 1 Summary of respondent rate

Description	Sample
Quantity of distributed questionnaires	29
Quantity of returned questionnaires	22
Percentage	76

The questionnaire used in this research is based on a four-point Likert scale, which is a constrained version of the traditional Likert scale. Unlike a typical scale, it does not include a neutral option, forcing respondents to provide either a positive or negative assessment (Hassanain et al., 2012). This approach ensures that participants commit to a definitive opinion, eliminating the possibility of selecting a neutral stance.

Table 2 Interpretation of the Likert Scale

Scale	Interpretation
Strongly Disagree	Totally disagreed with the term of the question
Disagree	Disagreed with the terms of the question
Agree	Totally agreed with the term of the question
Strongly Agree	Agreed with the term of the question

Descriptive statistics are methods used to calculate, summarize, and present research data in a logical and efficient manner (Vetter, 2017). This study utilizes the mean for data analysis, which represents the arithmetic average of the values. Additionally, ranking data were analyzed to determine the relative importance of variables based on respondents' preferences, with higher means and top rankings indicating stronger agreement or preference. The descriptive statistics, including frequency, mean, and ranking data analysis, were conducted using SPSS version 26.

ANALYSIS AND FINDINGS

The data was analysed using descriptive analysis for the Likert scale questions, respectively. The data was ranked accordingly based on percentage and mean using SPSS version 26. The results are shown in Table 3 below.

Table 3 Barriers to BIM Implementation in the Construction Industry

Rank	Descriptions	Mean
1	High cost to operate software	3.55
2	High cost of BIM training	3.36
3	Absence of BIM Legislation/Policy	3.27
4	Lack of professionals	3.23
5	Lack of client demand	3.23
6	Low awareness of BIM	3.18
7	Reluctant to change to BIM	2.95

Table 3 presents several key barriers hindering the full implementation of BIM in the construction industry. The top-ranked barrier, with a mean score of 3.55, is the high cost of operating BIM software, with most respondents strongly agreeing. This finding aligns with Haron et al. (2017), referencing CIDB (2014), which identified software cost as a major barrier, accounting for 26.2% of the challenges to BIM adoption. Similarly, Gardezi et al. (2014) also highlighted this as one of the top five barriers to BIM implementation in Malaysia. The second-ranked barrier, with a mean score of 3.36, is the high cost and unavailability of BIM training. Wong & Gray (2019) reported similar findings, emphasizing the lack of education and training as a significant barrier.

The third barrier, with a mean score of 3.27, is the absence of BIM legislation or policy, differing from Ahmad Jamal et al. (2019) and Babatunde et al. (2020), where this issue was ranked among the top 10 rather than the top 3. Ranked fourth and fifth, both with a mean of 3.23, are the lack of professionals to manage BIM and the lack of client demand for its implementation. The sixth barrier, with a mean score of 3.18, is low awareness of BIM. Lastly, the reluctance of senior professionals to adopt BIM, with a mean score of 2.95, ranked lowest. This barrier reflects cultural resistance to change within the Malaysian construction industry, as also noted by Wong & Gray (2019).

CONCLUSION

In conclusion, Building Information Modelling is rapidly being implemented in most developing countries around the world, including Malaysia. Especially from the view of quantity surveyors, it moreover leads the quantity surveyors to understand BIM advantages, which can maximise their records and expertise of the undertaking operation and deal with to assist quantity surveyors in organising extra reliable fee estimates. However, in order to reach a successful BIM implementation, challenges and obstacles are being overcome. From the frequencies, percentage, and mean score for the answers responded to by the respondents, there are numerous obstacles to BIM implementation inside the construction industry. Based on the data analysed, the top three barriers ranked by the respondents are the high cost to operate the software, the high cost of BIM training and the absence of BIM legislation. All of these barriers might be handled or reduced with the involvement and cooperation of the government, for example, by giving incentives or tax exemptions to companies that implement BIM in construction projects. As a recommendation, the study can be conducted in other regions in Malaysia, such as the East Region, Southern Region, West Region and Sabah and Sarawak, to identify barriers to implementing BIM in their firm in Malaysia. The scope of the study can also be broadened to other consultant's teams, like Architects and Engineer consultants' firms, as they also implement BIM in their construction projects as well.

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