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The Emerging Challenges of Adopting BIM in the Construction Industry: Evidence from Sabah, Malaysia

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Abstract

Building Information Modelling (BIM) is the cornerstone of digital transformation in the architecture, engineering, and construction (AEC) industry. Building Information Modelling (BIM) is critical in boosting the productivity and quality of a building not only during design and construction stages but also includes post completion's maintenance period. However, the majority of project stakeholders are still having difficulties in adopting BIM into practice, especially in the Sabah Construction Industry. In addressing the issues, the research aim is hence will analyze the challenges of adopting BIM and examine the Sabah state governments' strategies that have been implemented to address the issues. The list of fourteen (14) BIM challenges that cover cost, process, people, technology were derived from a comprehensive literature review and further investigated through the use of 212 questionnaires distributed using online platform. The respondents were architects, engineers, and quantity surveyors. It was revealed that among the top challenges highlighted are: people being comfortable with the conventional process, high software cost, as well as incompetent staff to operate the software. The Sabah state government has assisted with the implementation of BIM by offering standard guidelines and continuous financial support; however, the strategies provided by them were still not enough. The result of this study showed that the implementation of BIM in the construction project in Sabah is still below expectations. The awareness among construction players on how beneficial BIM is in assisting their daily project tasks should be further enhanced for better BIM implementation in the region. The outcomes of this study will hopefully provide some directions towards developing managerial strategies for the government to aggressively promote BIM practices among project stakeholders.

Keywords

Building Information Modelling (BIM); Architecture, Engineering and Construction (AEC); Challenges; Sabah; Strategies

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1 Introduction

The outbreak of coronavirus disease (COVID-19) hampered the ongoing construction project in Malaysia thus badly affecting the economy. Undoubtedly, COVID-19 will leave a lasting impact on the construction industry. Quality of the construction project has become vital since the construction industry is one of the major contributors to the nation's economic growth hence, indirectly it enhances the citizen's quality of life[1]. Therefore, the quality of construction projects should be continuously improved from time to time. Due to the COVID-19 pandemic, construction project stakeholders are growing accustomed to working remotely and cooperatively managing the projects. This new norm has greatly changed various aspects of our lives than ever before.

This calls for Malaysian practitioners to adopt BIM into construction projects as implementing BIM may potentially aid in improving collaboration among project stakeholders and their business performance even in the remotely working situation[2]. Multiple benefits are gained by adopting BIM, including resolving common construction issues such as time and cost overruns, improving coordination and communication, and reducing design misconception among project stakeholders[3,4]. Simultaneously, implementing a BIM-led coordination strategy can effectively break the business and development dilemma caused by the pandemic[5]. Although the implementation of BIM in many developed countries showed costs reductions, it may not be so in developing countries like Malaysia since high upfront costs are considered as an initial barrier[6]. Notably, implementing BIM is complicated and requires strategies from both the government and the private sectors[7]. This is not the government's sole responsibility as many of the construction players criticize the lacking strategies from the government[8]. Thus, there is a need to further study the perceived issues in detail.

This study focuses on BIM implementation in the Sabah construction industry as this state is among the top six states with the highest contribution to the Nation's GDP with 6.8%[9]. It plays a critical role in developing social, economic, and physical infrastructure, as well as an income generator for the state. Several mega infrastructures and building projects are now being planned and implemented in Sabah[10]. Thus, the adoption of BIM to keep abreast with the latest technology in building design is highly needed[11]. Unfortunately, low BIM implementation in Sabah indicates that both the government and private sectors must put in a lot more strategies to successfully adopt BIM. In 2019, it was found that only 4% of construction projects adopted BIM in Sabah, Sarawak, and Labuan (Figure 1). There is an urgency to adopt BIM as part of a valuable technique to help the industry practitioners minimize the uncertainties and effectively complete their construction projects. Even many previous studies being highlighted the challenges of adopting BIM in Malaysia, but they are lacking in detail identification challenges facing by the AEC firms in Sabah. Thus, the objectives of this study are to investigate the challenges in adopting Building Information Modelling (BIM) for construction projects in Sabah and to identify the Sabah state government's strategies towards technology implementation in the region. The findings could provide a basis for developing the corresponding strategies that can be applied in obtaining a further understanding of BIM in the Sabah construction industry.

2 Literature Review

2.1 BIM adoption in Malaysia

The idea to implement BIM in Malaysia was introduced by the Director of Public Works Department (PWD) in 2007. The government resorted to this initiative after recognizing BIM's ability to decrease construction costs and reduce design difficulties during the planning phase. BIM is a collaborative tool used in the Architecture, Engineering, and Construction (AEC) industry to improve visualization and constructability of design, to avoid project delay, cost overrun, and conflict among construction players[12].

Figure 1. BIM adoption according to the region[27].

Rogers et al.[13] stated that most of the construction firms in Malaysia have an insight into the BIM idea, but lack of guidance, government support, and well-trained workers, have caused the slow pace of technology adoption. However, it was reported that the BIM adoption rate in architect firms was 20 percent[14], and only 10 percent of quantity surveying firms engaging in BIM adoption since BIM was introduced 10 years ago[15]. As architectural, engineering, and surveying practices are the key players in the BIM working environment, this can be a significant indicator of the slow adoption of BIM in the Malaysian construction industry as a whole. The chronology of BIM development in Malaysia is shown in Figure 2.

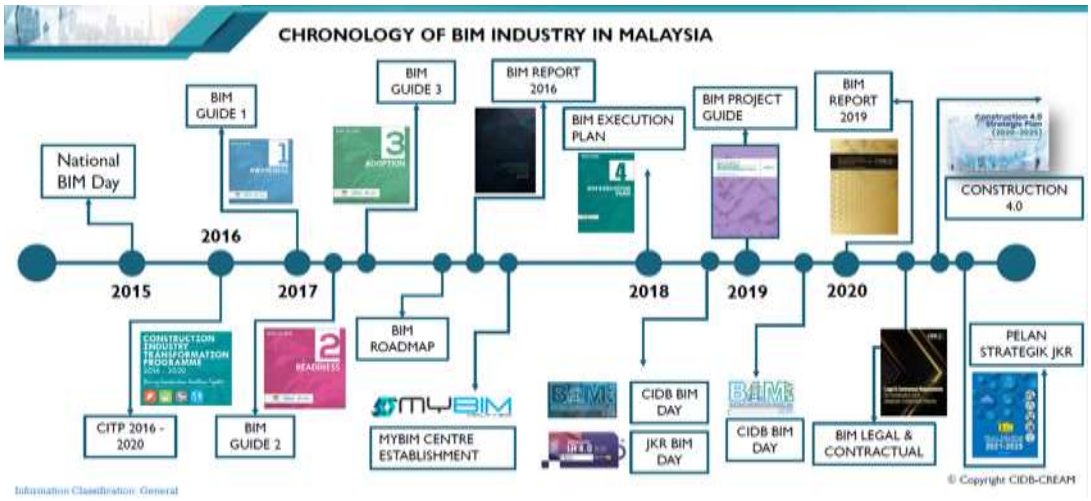

Figure 2. Chronology of BIM industry in Malaysia[27].

In line with the 12th Malaysia plan, the government predicted that the majority of the construction projects in Malaysia would be implementing BIM within the next five years[16]. This government initiative helps the authorities involved in the construction industry in providing sufficient information and guidance to assist the construction players in implementing BIM. Over the years, several seminars have been organized by CIDB around Malaysia, including Sabah to foster the understanding

and enthusiasm of the Malaysian construction players towards BIM. It focused on the introduction of BIM and the application of BIM to local authorities, developers, consultants, and contractors, as well as cost-effective adaptation methods.

Unfortunately, there arose some issues such as limited availability of usage guidelines and lack of clear guidance from the authority, would lead construction organizations to develop their version of the BIM Guideline; causing confusion among construction players and making them feel compelled to implement BIM[7]. The lack of encouragement and BIM knowledge in the educational institutions are still the major contributing factor to lack of awareness and knowledge on how to successfully integrate BIM in the construction industry[6]. To equip the project stakeholders in implementing BIM, the government should provide encouragement and motivation services, such as seminars and workshops for various levels of management in the construction industry.

Aside from seminars, there are also courses conducted in Sabah by Akademi Binaan Malaysia (ABM) which is the subsidiary of Construction Industry Development Board (CIDB) Malaysia. In line with the implementation of the Construction Industry Transformation Plan (CITP), CIDB collaborates with MyBIM Centre to initiate the BIM training called Affordable BIM Training (ABT). This program is primarily targeted for construction players to learn about the method of BIM process application, including the use of the equipment and managing the construction site, and educating on how to operate BIM. Unfortunately, it was reported that many of the project stakeholders in Sabah were unaware of these seminars and training courses due to a lack of promotions by the authorities[7]. Thus, to gain a better understanding of the challenges of adopting BIM in Sabah's construction industry, it is crucial to analyze the major challenges and then, evaluate the potential strategies to overcome the issues.

2.2 BIM Challenges in the Construction Industry

Despite the benefits of BIM, its implementation in the architecture, engineering and construction (AEC) industry is a very challenging task and requires the management of certain barriers before it can be successfully implemented in the AEC regions[17]. Based on the literature findings, the challenges can be incorporated into four categories of challenges in terms of cost, process, people, and technology. Table 1 presents the challenges of adopting BIM practices in several developed and developing countries.

2.3 Challenges in Terms of Cost

Since BIM is an advanced technology that allows users to cooperate in terms of design, planning, managing, and other benefits, the software is hence costly. BIM typically necessitates the purchase of new software and regularly requires new or upgraded hardware to run the processing-intensive software[18]. Many organizations undoubtedly hesitate to adopt BIM because the adoption of new technologies is costly in terms of workflow and work processes improvements[19]. Besides, lacking government subsidies may lead to the inability of top management to send their workers to attend BIM training[20]. A skillful worker is required to administer the software. Since the government was the first to adopt and encourage the use of BIM by construction stakeholders, the government should be offering as much help as possible, particularly in terms of funding.

Table 1: Challenges of adopting BIM practices among developed and developing countries.

No.	Challenges of adopting BIM practices	Categories	Author (s)							
			1	2	3	4	5	6	7	8
1	Increased upfront cost in terms of; cost of purchasing software, training, hardware	Cost	/	/	/	/				
2	Lack of government fund assistance					/				
3	Absences of guidance in BIM requirement/mandate exists in the industry	Process			/		/	/		
4	The assumption that conventional methods are better than new processes			/				/		/
5	Inadequate familiarity with the use of BIM								/	
6	Lack of time to implement				/		/			
7	Lack of references to assist in implementing BIM				/					
8	Lack of awareness on BIM benefits			/						
9	Lack of technical qualifications among team members in using BIM				/		/	/		/
10	Reluctance to initiate new workflows for the implementation of BIM		/		/			/		
11	Resistance to change for new technology				/			/	/	
12	Existing hardware incapable of running basic BIM software	Technology	/	/						/
13	BIM software is complicated to use			/						/
14	Lack of knowledge and training to operate the BIM practices			/	/	/			/	

Notes: Authors: 1 = Ayinla & Adamu[24], 2 = Ahmad Jamal et al.[18], 3 = Farooq et al.[19], 4 = Liao et al.[20], 5 = Pavón et al.[21], 6 =Rogers et al.[13], 7 = Memon et al.[22], 8 = Tulenheimo[23]

2.4 Challenges in Terms of Process

Several organizations are engaged in the BIM process, and they generally use various types of software. However, compatibility across other applications is not assured because some BIM vendors only handle interoperability between their authorized items[21]. In addition, Farooq et al.[19] stated that the inadequacy of a clear consensus on how to implement or use BIM is one of the challenges in implementing BIM. There was no legal mandating the use of BIM at a specific project scale, making BIM rarely adopted[11]. This is further consistent with findings by Manzoor et al.[16], when they perceived that in Malaysia, many construction companies in Malaysia have an insight into the BIM model, but the adoption has been delayed from the lack of guidance, government support, and well-trained staff. This will lead to inadequate familiarity with the use of BIM and a lack of references to assist in implementing BIM.

2.5 Challenges in Terms of People

Manzoor et al.[16] and Sinoh et al.[11] stated that BIM adoption requires a significant transformation in an organization's structure, as well as changes in human resource skills. People are the main harbinger in achieving the successful BIM implementation goal. The issue arises when humans resist any changes even though it leads towards betterment, simply because it requires an expert in the technology to apply BIM in their organizations[22]. Most of the construction companies still do not implement BIM because they are too comfortable using the conventional process. This is due to the perception that BIM is difficult to use, costly, and requires training[20]. As a skilled worker is needed to operate the software, the lack of expertise to operate the software is also one of the challenges. Reluctant to initiate new workflows for the implementation is another challenge because the process can be time-consuming especially for the new beginner to familiarise with the new workflow when incorporating

BIM technology, thus the reluctance in venturing into new processes of the implementation can be a hurdle.

2.6 Challenges in Terms of Technology

BIM naturally allows and expects new technologies to be incorporated. Prior to that, it is important to understand the current technology itself to produce appropriate BIM models, manage the process and satisfy ever-rising demands[23]. The strong relationship between BIM and information communication technologies means that the problems with conventional ICT implementations are intimately linked to BIM technology deployment. Another feature of BIM is its close relation to information and communication technologies, thus issues with conventional ICT implementations are closely connected to digital technology such as BIM implementation[19]. In addition, the lack of technology alignment may also lead to a digital divide between the design and other stages[24]. Therefore, it is critical to find a balance between the project lifecycle and the BIM software options available. This might be because there are yet no standard BIM protocols that allow data exchange among software[18].

This study will address the gap by identifying the major challenges of BIM adoption in the Sabah construction industry, and the influence mechanisms among these hindrances, as well as extending the relevant literature.

3 Research Methodology

A total of 212 questionnaires were sent out to the AEC - related firms in Sabah that including architect, engineer, and quantity surveyor firms. The targeted respondents were the project stakeholders holding a middle management position. The reason of targeted respondents is from AEC firms because it was identified that the only limited percent AEC firms (25%-30%) have adopted BIM even they are the parties most involved in construction activities[11,25]. Thus, the reason what are the main challenges that they face need to be investigated to overcome the slow pace of adoption BIM in the construction projects.

The sampling population for the respondents were based on the current registrants of the Board of Architects Malaysia (BAM), Board of Engineers Malaysia (BEM) and Board of Quantity Surveyors Malaysia (BQSM). The stage starts with defining the target population followed by selecting the sampling frame, choosing sampling techniques, and determining sample size. The targeted sampling size for the survey was 212 respondents. The cluster sampling technique was chosen to eliminate bias in the population and ensure all members had an equal opportunity of being included in the sample[26].

The survey was conducted online and distributed using a google form to the respondents. The respondents will receive an email with a link to the survey questionnaire hosted on Google Forms and linked straight to the spreadsheet. Other platforms were used to distribute the google form such as through WhatsApp, Facebook and Instagram. The reminders are also being sent to those who have not previously responded which could significantly improve the response rates.

The questionnaire was designed based on the review from the secondary data. The questionnaire's format consists of three (3) sections comprising mostly closed-ended questions. The first section A is to identify the respondents' demographic, section B is to examine challenges related to BIM adoption for construction projects in Sabah, and section C is to identify the authority's strategies towards BIM implementation for the construction projects in the region.

Out of 212 emails sent out, only 110 responses (52%) were received. Data were analyzed using Statistical Package for the Social Sciences (SPSS, V27) and generated in the form of a table. Then, the findings were discussed based on the research objectives. The data were analyzed using the Average Index calculation for each of the indicators and ranked accordingly. Figure 3 illustrates the research methodology conducted for this study.

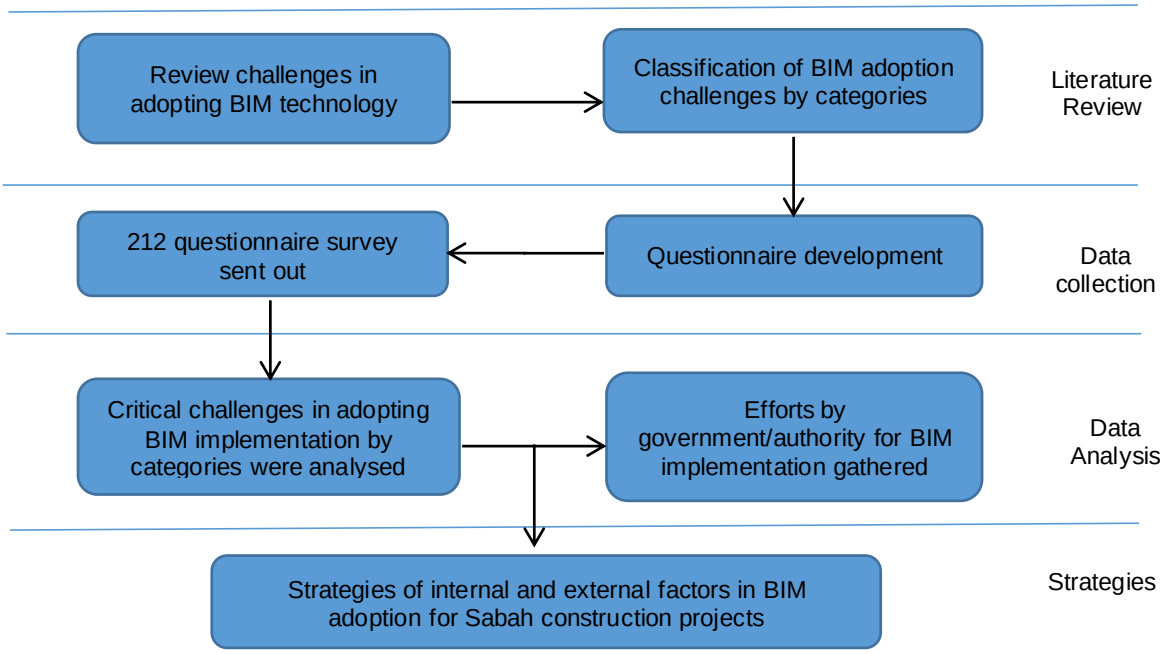

Figure 3. Research methodology.

4 Results and Discussions

4.1 Demographic Profile of the Respondents

Table 2 presents the profile of the respondents. From the 110 responses, respondents were Architects (40%), Civil Engineers (32%), and followed by Quantity Surveyors (28%). All role groups indicate a high level of confidence as they are actively involved in designing projects thus are qualified to answer the survey based on their experiences.

The majority of respondents (36%) have no experience handling BIM projects, then followed by 1 to more than 5 years (31%). The rest had experience of 6 to 10 years (18%), more than 15 years (9%), and 11 to 15 years (6%). This shows that although a large portion of the respondents had used BIM in their work, the majority of project stakeholders in Sabah still lack knowledge and experience in adopting BIM in their projects. Apart from that, 79% of private projects adopted BIM in the project, whereas only 11% percent adopted BIM in public projects. It was found that the highest projects that adopted BIM are located at the city centre such as Kota Kinabalu compared to the other locations. This proves that most construction projects in Sabah are developed around the city centre compared to the rural areas. In terms of BIM knowledge, the highest percentage is contributed by the respondents with neutral knowledge on BIM (29%) followed by knowledgeable respondents (28%). While the lowest number belongs to very knowledgeable respondents (7%). This implies that the majority of the respondents have a certain degree of knowledge of BIM although they are not experts in BIM technology.

Table 2: Profile of respondents.

Role of respondents	Frequency	Percentage	Years of experience using BIM	Frequency	Percentage
Architects	44	40%	No experience at all	39	36%
Civil engineer	35	32%	1 to 5 years	34	31%
Quantity surveyor	31	28%	6 to 10 years	20	18%
			More than 15 years	10	9%
			11 to 15 years	7	6%
Type of project involved in BIM	Frequency	Percentage	Knowledge of BIM technology	Frequency	Percentage
Private	87	79%	Neutral	32	29%
Public	23	11%	Knowledgeable	31	28%
			Little knowledge	23	21%
			No knowledge at all	16	15%
			Very knowledgeable	8	7%
Location of project	Frequency	Percentage			
Kota Kinabalu	85	77%			
Around Sabah	10	9%			
Tawau	9	8%			
Sandakan	4	4%			
Beaufort	1	1%			
Ranau	1	1%			

4.2 Investigation Challenges of BIM Adoption by the Construction Industry Players in Sabah

Respondents were required to identify the most prominent BIM challenges by selecting within the scale of agreement '1' as most disagreed and '5' as most agreed challenges. A total of fourteen (14) variables are classified into four categories of BIM challenges (People, Technology, Process, and Cost).

Table 3 presents the findings of challenges of BIM adoption in Sabah from three perspectives; architect, engineer, and quantity surveyor. The majority of the respondents are in consensus that the most prominent challenge of BIM adoption is coming from the categories of people. It was identified the most critical challenge in adopting BIM is the construction players are too comfortable with the conventional process with the mean value at 4.45 (SD = 0.778). They are reluctant to accept new things as they lack confidence in how BIM may enhance their profit. The second factor contributing to the challenges of BIM adoption is the high cost of providing the software with the mean value of 4.41 (SD = 0.792). Although there are many BIM benefits offered such as enabling the user to collaborate in terms of design, planning, and managing the software, however, it is expensive. Many construction companies especially SMEs in Sabah are unable to implement BIM in their projects for this reason. However, it contradicts with the findings from engineer and quantity surveyors' perspectives, when they ranked the high cost of training as the main challenges from categories of cost with the mean of 4.35 (SD = 0.790) and 4.40 (SD = 0.787). This finding is consistent with Sinoh et al.[11] as the high cost of training may trigger the inadequate of competent staff in operating the software, lack of knowledge, and lack of competent project managers to manage BIM projects.

From the quantity surveyor perspective, insufficient software interoperability due to different software used by construction players with the mean value at 4.11 (SD = 0.915) ranked as the main challenges in the process group. This is quite a challenge since not all BIM software is compatible with each other. While adopting BIM technology, the ability to convey data and information of each application used in a project is important[18]. Otherwise, engineers rank lack of standardized

procedures and guidelines for the implementation of BIM in the construction industry with the mean of 4.10 (SD = 1.15) leads to this problem since there is no guideline to refer to and follow. This finding is parallel with Farooq et al.[19] who pointed out the absence of clear consensus on how to implement or use BIM as one of the hurdles. There should be a mandatory requirement to standardize the BIM process and guidelines for its implementation.

Table 3: Challenges of BIM adoption in Sabah.

Challenges	Architect		Engineer		Quantity Surveyor	
	Mean	SD	Mean	SD	Mean	SD
People						
Too comfortable with the conventional process.	4.45	0.778	4.11	1.010	4.03	0.900
Lack of competent staff to operate the software	4.33	0.793	4.08	0.988	4.01	1.024
Reluctant to initiate new workflows for the implementation of BIM	3.95	1.12	3.95	1.12	3.98	0.974
Lack of knowledge and skill of BIM	3.83	1.15	3.91	1.03	3.95	0.946
Cost						
High cost of software	4.41	0.792	4.09	0,945	4.32	0.813
High cost of training	3.89	1.19	4.35	0.790	4.40	0.787
Inadequate financial fund from the government	4.08	0.988	3.79	1.28	4.10	0.935
Process						
Lack of software interoperability due to different software used by construction players in a project	3.82	1.199	4.01	0.991	4.11	0.915
Lack of standardised process and guidelines for implementing BIM in the construction industry	3.83	1.120	4.10	1.15	3.69	1.32
Lack of standard BIM protocols on how to exchange data between software	4.07	0.861	4.05	0.935	3.96	1.10
Technology						
High cost of hardware	3.61	0.827	4.23	0.860	3.83	1.15
BIM software is complicated to use	3.60	1.199	4.13	0.836	4.14	0.872
Lack of time to implement BIM	3.60	0.93	4.07	0.980	4.10	0.935
Existing hardware incapable of running BIM software	3.44	0.924	4.02	0.996	3.97	1.06

From the group of technology, the majority of the respondents ranked top to the high cost of hardware and complicated BIM software to use as the main challenges of adopting BIM with the mean of 4.23 (SD = 0.860) and 4.13 (SD = 0.836).

Further to this, they are reluctant to initiate new workflows for BIM adoption which leads to a lack of standard BIM protocols on how to exchange data between software which indicates the mean value at 3.63 (SD = 0.885).

Overall, it can be said that the human nature that resists accepting a new thing and lacking funds by the government to provide sufficient training and workshop on BIM leads to all of these problems. As result, our construction industry is unable to generate qualified personnel to operate the BIM technology, such as integrating data from all project stakeholders and consolidating data amongst various types of software utilized by ACE firms in Sabah, due to inadequate BIM training. This fact shows how BIM adoption becomes a major financial investment.

4.3 Identification of Sabah State Government Strategies in Adopting BIM

Table 4 summarizes the identification by Sabah State Government/Authority's strategies in adopting BIM technology. Rating percentages indicator ranged from the highest (very good) to the lowest (very poor) scales. The majority of the respondents (27%) agreed that adopting BIM Seminars and workshops may enhance awareness and readiness of BIM among construction stakeholders. This endeavor should be complemented by financial assistance in the form of a subsidy for the firms to send their staff to the MyBIM centre for training. Moreover, the training related to the BIM software/tools (24%) used by the practitioners is also being identified as their strategies to acquire more expertise in technical skills in handling the BIM software. For the financial support, 24% of respondents indicated that they are aware of the authorities' support in terms of discounted training offered at the MyBIM centre. While 18.4% are aware of the provision of subsidies for companies to train their employees or to purchase BIM software. However, only 15% of the respondents were aware that the Sabah government also provides standard manuals and guidelines to implement BIM in the projects. This was proven by CREAM[27], which highly recommends all the project details should include the level of BIM implementation based on the project. Surprisingly, only 14% of respondents were aware of the existence of the BIM Portal that provides sufficient information related to BIM despite the portal being launched a year ago. The findings from this solution are in line with several past studies whereas the enforcement of BIM by the government can help to increase BIM practices in construction projects[18-20].

Amongst several BIM training courses organized at MyBIM Satellite in Sabah are BIM Concept and Theory, Fundamental Modelling of Architecture, and BIM Manager. The facilities to use BIM software on a pay-per-use basis have also been offered at the CIDB MyBIM Centre. It can be concluded that the strategies done by the Sabah State government and authority are still inadequate as more than half of the respondents chose between neutral to very poor. As for the Sabah State Government and authority's strategies to implement BIM in Sabah, each strategy listed in the question is acknowledged by the respondents despite the high percentage of respondents who do not recognize any of the strategies at all. This reveals that the strategies of the authority are not widely publicized among the construction players in Sabah.

After analyzing and synthesizing the critical challenges in line with the government/authority's strategies, the appropriate measures for successfully adopting BIM can be grouped into internal and external factors. Table 5 presents the internal and external factors derived from both findings that need to be considered to mitigate the challenges. The internal factors include the inner strengths and weaknesses inside their organizations; meanwhile, external factors are beyond organizational control[28]. These strategies are suggested to possibly clarify the root challenges of BIM adoption in the Sabah construction industry.

Table 4: Sabah state government/authority's strategies for BIM implementation in Sabah.

Strategies to implement BIM	Frequency	Percentage
BIM Seminars and workshop on awareness/ readiness	53	27%
Training related to BIM software/tools	46	24%
I am not aware of any of above	38	20%
Standard Manual and Guidelines to implement BIM in projects	30	15%
BIM Portal that provides information related to BIM	28	14%
Financial support	Frequency	Percentage
I am not aware of any of above	64	42%
Subsidized training offered at the MyBIM centre	36	24%
Provision of subsidies for companies to train their employees or purchase BIM software	28	18%
Facilities to use BIM software on a pay per-use basis at the CIDB MyBIM Centre	24	16%
BIM Course Training at MyBIM Satellite in Sabah	Frequency	Percentage
BIM Concept and Theory	24	18%
Fundamental Modelling of Architecture	14	10%
BIM Manager	8	6%
Facilities to use BIM software on a pay-per-use basis at the CIDB MyBIM Centre	4	3%
None	86	63%

Within the internal factors, all respondents agreed that the first factor is that humans resist change and are too comfortable with the conventional process. It is not an easy task to transform from conventional to digital technology, especially for the non-tech-savvy people. However, due to the new norm in the construction industry, they should gradually adopt those changes. Lack of knowledge and skills to operate BIM platforms also hinder the adoption of BIM technology. The strategies that need to be implemented by the government are by organizing various seminars and workshops on enhancing the construction industry players' awareness and readiness. Not only that, subsidies should also be granted for sending staff to attend related training at the MyBIM centre. Constantly exposing staff to valuable training may increase competency and simultaneously improve productivity.

Apart from that, it is important to recognize potential opportunities and threats outside company operations. Some factors are beyond the organization's control such as dealing with the high cost of BIM software and its hardware. This is the major constraint for SMEs in Sabah to adopt BIM in their projects. They need to allocate funds as upfront costs, and it may affect their cash flow. Besides, they are also complaining about lacking standardized processes and guidelines for BIM implementation in the construction industry. It includes a lack of standardized BIM protocols on how to exchange data between software. Further to this, it is the government's responsibility to improve and standardize the Standard Manual and Guidelines for implementing BIM in projects, as well as mandating specific regulations to resolve BIM disputes. Moreover, CREAM[27] also pointed out that it becomes mandatory that all data from government and private projects must be integrated through big data analytics to ensure that all data are accurate and readily available for reference purposes. The findings from this solution are consistent with several past studies whereas the enforcement of BIM by the government can help to increase BIM practices in construction projects[12].

Table 5: Strategies of internal and external factors to mitigate the issues.

Internal Factors	
Challenges	Suggestions
Too comfortable with conventional process	▪ Conducting various BIM Seminars and workshops to enhance their awareness/readiness
Lack of knowledge and skill of BIM	▪ Early introduction on the university syllabus
Lack of competent staff to operate the software	▪ Provision of government subsidies for companies to train their employees ▪ Training related to BIM software/tools
Reluctant to initiate new workflows for the implementation of BIM	▪ Improvise the Standard Manual and Guidelines to adopt BIM in the projects
Lack of time to implement BIM	▪ Conducting various BIM Seminars and workshops to enhance their awareness/readiness
External Factors	
Challenges	Suggestions
High cost of software and hardware	▪ Provision of government subsidies for companies purchase BIM software
High cost of training	▪ Subsidized training offered at the MyBIM centre
Lack of software interoperability due to different software used by construction players in a project	▪ Improvise the Standard Manual and Guidelines to implement BIM in projects
Inadequate financial fund from the government	▪ Subsidized training offered at the MyBIM centre and to train their employees or purchase BIM software.
Lack of standardized processes and guidelines for implementing BIM in the construction industry	▪ Improvise the Standard Manual and Guidelines to adopt BIM in the projects
Lack of standard BIM protocols on how to exchange data between software	▪ Standard Manual and Guidelines to implement BIM in projects
Existing hardware incapable of running BIM software	▪ Standard Manual and Guidelines to implement BIM in project
BIM software is complicated to use	▪ Standard Manual and Guidelines to implement BIM in projects

5 Conclusion and Recommendation

Building Information Modelling (BIM) has been proven to be an effective technology as there are various potential benefits offered through its innovation platform. Whether it is compulsorily mandated or voluntarily executed, the implementation of BIM technology is not a sole government responsibility but also requires cooperation amongst the project stakeholders within the construction industry. The government alone, cannot be working in silos in promoting and spreading the importance of implementing BIM. It can be seen that the implementation of BIM in the Sabah construction industry is still at a sluggish level, although some project stakeholders are aware of the BIM benefits. This could perhaps indicate that the strategies done by the authority are not widely publicized among the construction players in Sabah. This is not an easy task for the government to manage the project stakeholders that eschew advanced technologies. Thus, coherent strategies are essential to be implemented to embark on this new technology of BIM. The government should continuously support and monitor the BIM development through incentives and policies especially by focusing on SMEs. The project stakeholders should make strategy to gradually change their mindset and accept commodities that could potentially bring benefits to their companies. It is recommended that future research be conducted to further examine the internal and external factors aligning with the challenges and strategies to implement BIM technology in the Malaysian construction industry. The findings could probably harness the BIM execution towards minimizing risks

and providing a better solution to the many unresolved issues in the construction projects.

Conflict of Interest

The authors declare that there is no conflict of interest.

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