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Challenges of BIM Software Implementation in Quantity Surveying Consultancy Firms: The Difference Between Large Firms and Small-and-Medium Enterprises (SMEs)

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ABSTRACT

Inefficiencies and ineffectiveness in delivering construction projects had negatively impacted the industry for decades. However, the emergence of building information modeling (BIM) technology had influenced the construction process with its many benefits toward project success. BIM benefits included reduced project time and cost, improved team collaboration and communication, and improved project quality and performance. Consequently, BIM applications were claimed to provide more reliable working practices for quantity surveyors (QS), especially in establishing their cost estimates. Despite the well-known benefits that spurred BIM employment around the world, the usage of BIM software in Malaysia was still in its infancy, requiring greater deployment by the QS. Furthermore, the literature was scarce in comparing the use of BIM software by large organizations and Small-and-Medium Enterprises (SMEs). As a result, the primary goal of this study was to identify the numerous challenges associated with the adoption of BIM software in both large and SME quantity surveying consultancy firms. Apart from that, this paper identified the availability of BIM software in the construction sector as well as the use of BIM software in those consultancy businesses. A quantitative technique was used, with 393 questionnaire survey forms issued to Malaysian QUANTITY SURVEYING consultant businesses. The data was then analyzed using the Statistical Package for the Social Sciences (SPSS) to generate a reliable and valid result. According to the findings, Cubicost software was the most popular software used by QS specialists. Notably, the results revealed that SMEs face greater challenges than large organizations, particularly those connected to professional help, finance, and time, as well as technical issues. Because large corporations and SMEs differed in nature, this study could provide new insights to policymakers in aiding companies of various sizes in their BIM transformation process. The findings called for more policymakers to work together to improve practitioners' understanding of BIM-based technology. The difficulties of SMEs must be recognized, and policymakers must bridge the gap between large and SMEs to bring Malaysia's construction industry one step closer to a new era of digitalization.

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1. Introduction

In recent times, the adoption of building information modeling (BIM) had risen tremendously in the construction industry. It had significantly enhanced the productivity, efficiency, and quality control of construction performance throughout the life cycle of a building [1]. BIM represented a virtual database of a building's information, allowing various stakeholders to cooperate efficiently and communicate with each other. BIM, in particular, provided a collaborative sharing platform for all stakeholders, allowing information sharing and preventing "information islands" [2]. For this reason, BIM could be operated for various purposes: visualization, estimation, code reviews, clash detections, construction scheduling, and facility management [3].

To remain globally competitive, quantity surveyors (QS) must be ready to adapt to any revolution in the construction sector. There had been various revolutions in the construction industry, ranging from enhanced reality, data ecosystem, and construction software to building information modeling. These revolutions developed various techniques, tools, and software to strengthen productivity and efficiency among construction professionals. In recent years, BIM had become a trending technology in the construction sector [2]. BIM explored the automation that enhanced the effectiveness of cost estimating. Due to increased industry competitiveness and clients' demands for greater efficiency and value for money, estimating became extremely time-consuming and difficult while the project was complex. BIM was therefore essential to give cost estimation with extremely trustworthy and accurate data [4].

Internationally, the use of BIM technology in some industrialized and developing nations had advanced significantly (see Figure 1). Nonetheless, compared with countries like UK and USA, which were considered the frontrunners in adopting BIM, Malaysia was still far from where it should be in the BIM implementation process. The transformation was viewed as an uphill battle because BIM development went through four major stages [2,6]:

i. Level 0 was a conventional stage in which 2D unmanaged CAD drawings were communicated and shared via paper documents and digital representations;
ii. Level 1 was a design-based modeling stage that includes both 2D and 3D information, with 2D utilized for drafting and producing information while 3D was applied in visualization;
iii. Level 2 was a collaboration-based modeling level that was characterized by teamwork and demanded the coordinated flow of information among varied disciplines and participants in the project;
iv. Level 3 was an integration-based modeling stage, often known as fully integrated ''iBIM" and widely referred to as openBIM.

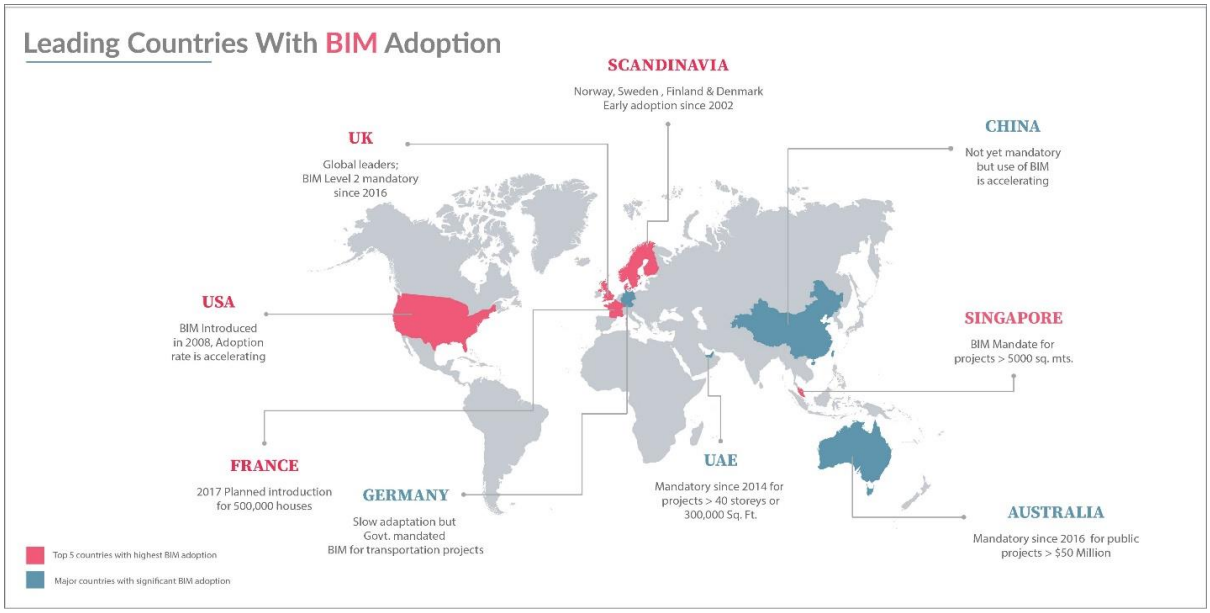

Fig. 1. Leading countries with BIM adoption [5]

In Malaysia, the development of BIM in the private and public construction industries was still in its infancy and at the level 0 (conventional) stage [2]. Furthermore, existing BIM overviews in Malaysian construction were mainly focused on Small-and-Medium Enterprises (SMEs) [7,8] or in general (i.e. did not address company size) [9-11]. There was a scarcity of research that compared the use of BIM technology by large organizations and SMEs [12]. Thus, the purpose of this article was to bridge the gap by uncovering the various obstacles to implementing BIM software in both large and small and medium-sized quantity surveying consultancy organizations. Because large corporations and SMEs differed in nature, this study could provide new insights to policymakers in aiding companies of various sizes in their BIM transformation process.

The rest of this paper was organized as follows. Section 1 introduced the study's problem statement and objectives. BIM adoption, awareness, readiness, and obstacles in Malaysian construction were also discussed. Section 2 addressed the study's research designs and statistical tools, while Section 3 emphasized the study's main findings and compared them to previous literature. Section 4 summarized the study's statistical analysis findings and practical implications, as well as relevant recommendations for increasing BIM use in Malaysia.

1.1 Problem Statement

In this era of digitalization, the construction sector had undergone a transformation period with advanced technologies. Technology had developed rapidly by rooting in every industry and sector worldwide. It made all the practical work became more manageable and more productive. In developed countries, BIM had become the norm of the construction sector, while the tasks had become more complex and challenging. Therefore, BIM was unavoidable in the roles of professionals in the building industry, including the QS. In Malaysia, the implementation of BIM in the quantity surveying industry was vigorously encouraged by the Royal Institutions of Surveyors of Malaysia (RISM), the Royal Institution of Chartered Surveyors (RICS), and the Board of Quantity Surveyors Malaysia (BQSM). It appeared that the industry was still preparing to deal with the BIM-driven stage of transition [9].

BIM had demonstrated its usefulness in supporting experts in the construction business. Even though the technology to embrace BIM was easily available and established, the implementation of

BIM in Malaysia still required improvement. These governments in Malaysia encouraged the use of BIM-oriented Integrated Design in our national marketplaces. However, the rate of BIM software use among Malaysian quantity surveying consultancy businesses required further investigation as Malaysian construction was still lagging behind other sectors in terms of information technology use [7]. In general, the risks associated with information technology (IT) adoption among SMEs were the high investment required in comparison to large corporations. As a result, the adoption and implementation of BIM necessitated significant investment and training [13].

The government played a critical role in ensuring that BIM technology was successfully used in the construction industry. To minimize BIM adoption costs, improve BIM adoption tactics, and promote BIM education, the government, the Architect, Engineer, and Construction (AEC) industry, educational institutions, and BIM providers must collaborate. Furthermore, an adequate framework of BIM courses for different levels of practitioners and contractors must be designed to provide the requisite skills in BIM software implementation. Furthermore, a uniform set of BIM rules and practices was required for standardizing new output and guaranteeing effective communication among stakeholders. As a result, it would be simple to manage and implement [14]. The existing literature, however, was insufficient in comparing large organizations to SMEs in terms of the adoption of BIM software. As a result, the focus of this research was on the challenges of adopting BIM software in organizations of varied sizes.

1.2 Research Objectives

The objectives of the research were as follows:

i. To identify the availability of BIM Software in the market.
ii. To identify the adoption of BIM software in large and SME quantity surveying consultancy firms.
iii. To compare the challenges of adopting BIM software in large and SME quantity surveying consultancy firms.

Since the year 2005, there had been much development in the economy, such as price inflation, change in business trends, and change in structure, a review of the SME definition was carried out in 2013, and a new definition of SME was published at the 14th National SME Development Council (NSDC) meeting in July 2013. The SME definition in 'services and other sectors' was sales turnover not exceeding 20 million ringgit in Malaysia or full-time employees not exceeding 75 workers. Table 1 showed the definition by size of the operation.

Table 1
Definitions by the size of operation [10]

Category	Small	Medium
Manufacturing	Sales turnover from RM300, 000 to less than RM15 million OR full-time employees from 5 to less than 75	Sales turnover from RM15 million to not exceeding RM50 million OR full-time employees from 75 to not exceeding 200
Services & other sectors	Sales turnover from RM300, 000 to less than RM3 million OR full-time employees from 5 to less than 30	Sales turnover from RM3 million to not exceeding RM20 million OR full-time employees from 30 to not exceeding 75

If a company met either condition among the several operation sizes, the smaller size would be used. For example, if a firm's sales turnover came under small enterprise but its employment fell

under medium enterprise, the company would be classified as a small enterprise [10]. In contrast, a large organization in the services and other sectors was defined as having a sales turnover of more than RM20 million and more than 75 full-time employees. As a result, an organization must meet both criteria to be classified as a large organization.

1.3 Adoption Of BIM Software In The Construction Field

In the construction industry, quantity surveying played a significant part in controlling and managing the whole project life cycle cost. Take-off and quantity lists had traditionally required several hours of labor and effort to prepare, with a high chance of human error. With the increasing complexity of construction projects, BIM had become the norm in developed countries' construction. It was believed that QUANTITY SURVEYING would accept BIM to increase efficiency in the cost and value of the construction process [15]. Several types of BIM software were now available in the construction industry, such as Cubicost, iTWO CostX, Computer-Aided Design (CAD) measure, Buildsoft, and so on. Figure 2 depicted the use of BIM software in the construction business.

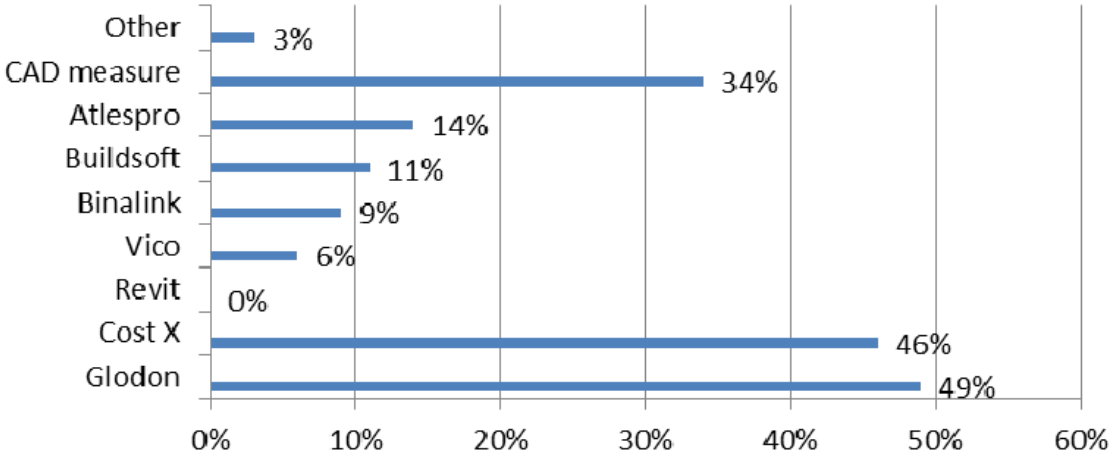

Fig. 2. Adoption of BIM software in Malaysia [16]

The forthcoming section would solely cover the Cubicost and iTWO CostX software because they were the most popular in Malaysia. According to Ting and Nurulhuda [16] survey, the most often utilized BIM software for cost estimation was Cubicost (which was more often known by the name of its company, i.e. Glodon) at 49%, followed by CostX software at 46%.

1.3.1 Cubicost

Cubicost represented a new trend in the local and global building business. It was established by Glodon International Pte. Ltd., which was founded in the Year 1998 in Beijing, China. It was later introduced to Malaysian construction on the Year 2015. Cubicost could be described using two terms: "Cubic" and "Cost". These two words were intended to illustrate the strong relationship between 'Building Information Modeling and 'Quantity'. The amount would be generated with high reliability and quality with the help of BIM, which was critical to the Contractor, Engineer, and Architect. Cubicost software was renowned as a globally acknowledged QS tool since it not only provided precise quantity take-off but also certified the entire lifetime of the construction project and could support big data and additional services such as internet finance services.

There were various types of Cubicost software available on the market, each with its unique usage and applications. Cubicost was an integrated BIM solution for construction costs that incorporated four separate BIM software modules. Almost all common construction expense criteria were covered. Specifically, three quantity take-off software solutions (TRB, TAS, and TME) could be used to handle various types of calculations using BIM technology. Apart from that, TBQ could be used to improve the efficiency of all tendering processes. In this connection, BIM models and reference data could be easily transferable between the four systems to provide the most professional, accurate, and efficient BIM cost estimation experience possible. Cubicost enabled the sharing of models and data throughout the four (4) software upstream and downstream in the business [17].

1.3.2 iTWO CostX

iTWO CostX enabled the viewing of 3D models as well as the take-off quantity for the construction project. It was created by an Australian developer in 2004. This software permitted the transmission and incorporation of BIM data. The data included descriptions, measurements, and object properties, and it integrated all of these data into a single file that comprised a spreadsheet of measurements, estimations, and electronic measurements. CostX had a unique characteristic in that it was compatible with almost all design formats such as DWFx, Revit, JPEG, DWF IFC, JPG, BMP, and 2D drawing formats such as PDF and DWG.

Aside from that, CostX offered a visualization function that was tied to the Revit (3D BIM) format. Furthermore, CostX supported the use of external devices such as plugs to retrieve data from the BIM model. CostX BIM software required the availability of standard classifications for estimating, the reliability of information supplied by the software, the coordination of modifications to BIM models, and the compilation of reports [4]. Furthermore, CostX could be used to divide the building into several zones, such as the ground and ground floors. As a result, each floor amount must be calculated separately from the overall take-off quantities. This software provided a full set of estimation capabilities, including cost analysis tools, a detailed cost workbook, cost monitoring, and cost comparison tools. CostX was thus another chosen software for carrying out the BIM 5-Dimensional application [18].

1.4 The Readiness Of SMEs For BIM Implementation

In comparison to large organizations, SMEs frequently lacked the funding, manpower, and appropriate skills to incorporate new technologies with efficient development methods [19]. As SMEs had significantly fewer resources than large corporations, this section discussed solely SMEs' readiness for BIM deployment. According to Table 2, SMEs had been underrepresented in studies of BIM implementation. Even though the technology for adopting BIM was freely available and fast-evolving, BIM deployment was still slow in these companies.

According to Table 2, all 115 (or 100%) respondents were aware of BIM software, although only 11 (or 9.6%) had prior experience using it. This demonstrated that, in comparison to other countries that were more progressed in this technology, the skill level in implementing BIM software was still very low. This suggested that BIM adoption among Malaysian SMEs construction firms was still lagging.

Table 2
The readiness of BIM adoption by SMEs in Malaysian construction [8]

No	Description	Frequency	Percentage (%)
1	BIM awareness		
	Yes	115	100
2	BIM experience		
	Yes	11	9.6
	No	104	90.4
3	BIM software tools usage		
	Revit (Autodesk)	17	14.8
	None	98	85.2
4	BIM tools proficiency level		
	Beginner	102	88.7
	No experience	13	11.3
5	BIM adoption level		
	Poor adoption	93	80.9
	No adoption at all	22	19.1
6	Years of implementing BIM		
	Less than 2 years	95	82.6
	2-5 years	20	17.4
7	Attended BIM workshop		
	Yes	11	9.6
	No	104	104
8	Numbers of BIM project		
	1 project	11	9.6
	2-5 projects	104	104
9	BIM exposure		
	Industry-led training	7	6.1
	None/Self-taught	108	93.9

Similarly, in a study by Saka and Chan [11], the level of understanding and implementation of BIM in Malaysian SMEs was still low when compared to other nations, particularly the United Kingdom and Australia (see Figure 3). As a result, it emphasized the importance of recognizing the obstacles and opportunities that these firms had in catching up with large corporations' BIM deployment.

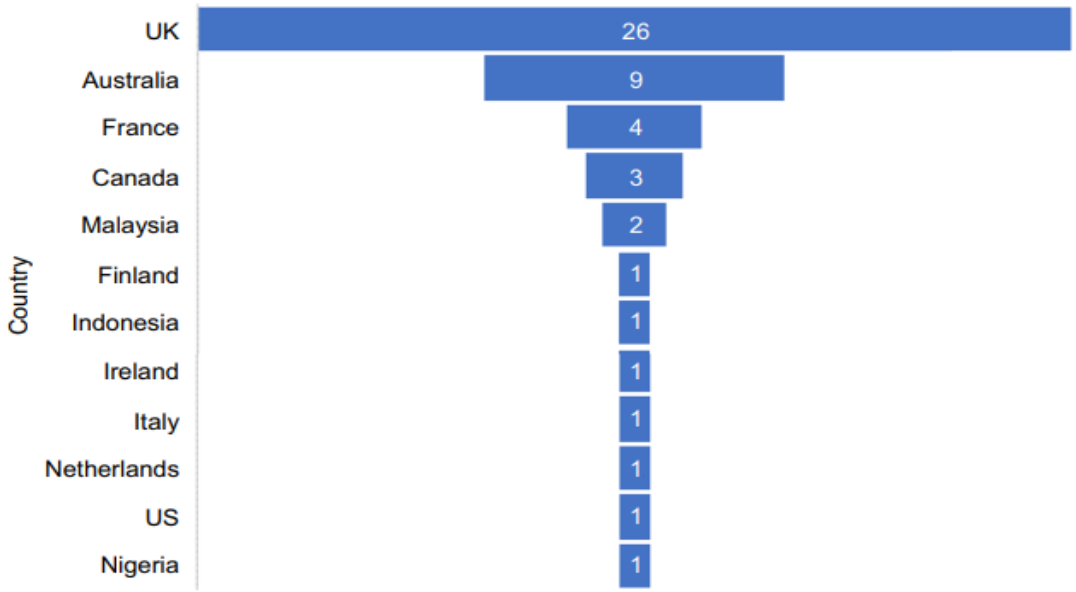

Fig. 3. Level of awareness and implementation of BIM in various countries [14]

1.5 Awareness Of BIM Software In The Quantity Surveying Field

Few studies were highlighting the use of BIM software in big quantity surveying consulting firms. As those articles did not indicate the firm size in the study, this section would solely cover the adoption of BIM in general quantity surveying firms. Wong *et al.,* [20] recognized the BIM capabilities for QS in terms of time, cost, and quality to improve project performance. Exploring the influence of BIM on QS practice, Kulasekara *et al.,* [21] concluded that BIM in addition to providing more accurate cost estimates might also make measurement automation, thus reducing the estimated time and cost of the project. BIM was expected to overcome the shortcomings of traditional methods and provide a more reliable source for volume takeoffs and cost estimation processes. Therefore, it was important to further explore BIM implementation among QS in Malaysia.

However, Ismail *et al.,* [22] found out that the implementation of BIM software was still low in Malaysia (see Figure 4). According to the findings, 68.3% of the interviewees were aware of the use of BIM but had not used it in practice. Only 12.9% of respondents were aware of and used BIM technology in cost estimation. It could be determined that respondents' BIM awareness was high regardless of whether they used BIM technology in their practice. Despite the fact that the BIM revolution had extended to the construction industry worldwide in recent years, the low implementation and delayed development of BIM in Malaysia might be the reason why these respondents had not adopted BIM software.

Awareness	Frequency	Percentage (%)
Aware & currently using BIM in cost estimating	26	12.9
Aware and have used BIM (but not in cost estimating)	19	9.4
Aware of BIM but have not used it	138	68.3
Not aware of BIM	19	9.4
Total	202	100.0

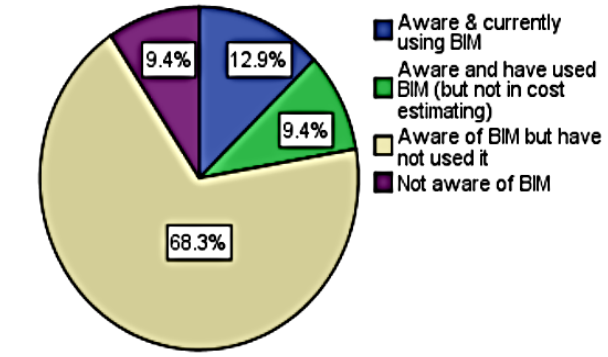

Fig. 4. Distribution of respondents based on awareness of BIM [22]

1.6 Challenges Of Adopting BIM Software In Large And SMEs Organizations

Various challenges had hindered the holistic implementation of BIM software in construction projects. These barriers include resistance to change, human resource and organizational issues, professional issues, financial and time difficulties, and technical issues.

1.6.1 Resistance to change

According to Arayici *et al.,* [23], the construction field was notorious for being resistant to change. A study by Zainon *et al.,* [24] highlighted that it was hard for people to make changes and accept new things in their life as they understand that BIM in the construction business was still a novel concept, and they were the primary driving factor for success in implementing the new technology in their practice. The deployment of BIM software requires employees to practice new skills within their

norms, which might cause staff resistance to change. The issue emerges when most employees were unwilling to invest their time in learning new skills and believed that the traditional manner was the best way to work. For these reasons, people needed more time to adapt to the technological change in the workplace.

Using two rounds of Delphi survey with two respondent groups (academics and practitioners), Olawumi *et al.,* [25] discovered that the industry's resistance to change from traditional working practices was the top obstacle of 38 factors in integrating BIM and sustainable practices in building projects. According to Antón and Díaz [26], if stakeholders were less aware and knowledgeable about the usage of these technologies and the criteria to be considered for sustainability evaluation, their decision-making in the adoption of sustainability and BIM in the construction sector would be impacted. Similarly, Abubakar *et al.,* [27] discovered a societal and habitual resistance among construction industry stakeholders to new and creative development. It had been proposed that construction stakeholders and enterprises fight negative and dynamic changes and development in the industry [25]. As such, the developers were encouraged to be proactive in incorporating BIM and sustainability concepts into their projects to push the goal of sustainable smart urbanization.

1.6.2 Human resource and organizational issues

A study by Chan *et al.,* [28] opined that without modifying some features of organizational structures and strategies, the growth of BIM might not motivate employees to learn and utilize this technology in their job. When a company implements BIM in its building projects, the human resource department would experience a corresponding shift in terms of personnel capabilities, as well as a critical procedural change within the company. This would result in an increase in capability in the construction project's supply chain, which includes designers, contractors, consultants, and developers [29]. Moreover, the staff might feel frightened or anxious as a result of the new technology involved in accepting BIM because they believe their duties would be altered and jobs within the business would be fully taken over by the software and technology required for BIM to work. To this end, convincing staff to embrace the new organizational standard would be a difficult task, necessitating the set up of BIM units or departments within organizations to support its practice and deployment [28].

Furthermore, some corporation believes that their well-known firms would be influenced by the new work norm, which was BIM adoption. When a new IT system was introduced, it had an impact on an organization's business processes. It might also have an impact on the company's considerable pace of output. The risk of creating project outcomes based on the client's current aspirations was also increased [29]. As a result, there was a necessity to ensure that the new workflow method was as similar to the existing one as possible to provide a seamless transition [30]. Also, professional and corporate organizations must train their employees on current and new industry developments as well as provide opportunities for skill and capacity development programs, such as workshops and seminars, where all stakeholders might learn and exchange knowledge and expertise in these ideas [25]. This could minimize the hurdles and reduce the impact of restrictions on BIM implementation in organizations.

1.6.3 Professional issues

A lack of professional BIM expertise in a company was another major impediment to the implementation of the BIM concept. Because the BIM deployment in Malaysia was still at a nascent stage [2], we might be lacking in the availability of BIM professionals and specialists with prior

experience in BIM implementation. However, for BIM technology to be applied properly, it must be supported by BIM experts, consultants, or professionals with the required skills and expertise [29]. One technique for overcoming a lack of BIM expertise, according to Manzoor *et al.,* [31], was to engage BIM specialists and propose prospective suggestions for appreciating the use of BIM technology. Hiring BIM expertise from developed nations would also help overcome the challenge. Before agreeing to integrate and use BIM technology, construction companies could acquire all necessary information from the BIM expertise to ensure that sufficient technical assistance and knowledge was available from the technology partner. Besides, relevant entities such as RISM, RICS, and BQSM could provide professional training activities such as BIM workshops, seminars, and technical forums to improve the entire industry's skills and knowledge of BIM technology. These professional groups could even collaborate with BIM technical specialists to provide guidance and support to companies that were facing issues during the BIM transition process.

1.6.4 Financial and time difficulties

Another barrier hindering the construction firms to be slow in adopting the BIM technology was because of the high cost of BIM software, license, and associated applications [25]. During the BIM start-up stage, construction firms had to upgrade their hardware, implement the necessary software and provide BIM training to their employees. The firm would also be required to periodically upgrade the hardware to run the processing software. Thus, to resolve the technical problems regarding BIM adoption, the financial aspect of the company would be influenced [24]. This becomes a substantial barrier, especially for small-medium-sized enterprises (SMEs) which were generally weak in their financial capability. Furthermore, the company also needs to consider the costs to train and educate its employees on the necessary knowledge to operate the software. Even the firm employs workers who were equipped with the skill and knowledge in BIM as they would move forward to internalize a new working environment in their organization. It showed that implementing BIM software requires the organization to make a huge investment, financially as only the large company could afford the costly technology [29].

For a firm to accept new technology such as BIM, a significant amount of time would be needed, which could be viewed as a significant issue because building projects were heavily influenced by the time [32]. For instance, construction organizations must commit time and money to hire the best professionals to assist them with BIM adoption. Apart from that, the organizations must consider the time required for their staff to complete the training and learn the overall BIM implementation [29]. According to a recent study by Othman *et al.,* [2], Malaysia was still at the "conventional level (level 0)" because BIM projects in Malaysia did not result in cost-and-time savings and increased productivity. To persuade practitioners of the benefits of BIM, the construction industry should either show evidence of how this technology would benefit them or enforce its usage.

1.6.5 Technical issues

A study by Alreshidi *et al.,* [33] highlighted that technical issues were one of the barriers to the success of BIM adoption. That includes interoperability issues, massive data, and limited data storage, as well as a lack of data sharing, tracking, checking, versioning control mechanisms, etc. Excellent practical plans must be made to efficiently communicate and integrate crucial information among the components. This might raise another technical concern as to why BIM had not been chosen by some organizations [29]. Currently, the numerous BIM technologies on the market might increase an individual company's ability to engage with other stakeholders and reliably exchange information. As

such, the stakeholders must analyze the decision of picking BIM software based on the correct analysis of the organization's needs rather than marketing promotion, since this might affect the execution of the building project throughout the entire construction phase.

Aside from that, BIM software requires a strong processor to function properly. As a result, businesses must prepare for an upgrade. Concurrently, the organization must focus on security issues to facilitate smooth communication among stakeholders. Low security would result in challenges with remote communication and information transmission, as well as a loss of confidence among project participants. Furthermore, early adopters who had technical support would find it easier to implement BIM software. Inadequate expertise and experience in BIM adoption highlight the importance of having technical support, particularly for new adopters [34]. Table 3 summarised the challenges of implementing BIM software in consulting quantity surveying organizations of various sizes.

Table 3
The challenges of adopting BIM software in different sizes of consultancy quantity surveying firms

No	Challenges of adopting BIM software	Quantity surveying consultancy firm size			References
		Large	SMEs	General	
1	Resistance to change (Employees' resistance to accept the new technology and new nom of work)			✓	Olawumi *et al.,* [25]
2	Human resource and organizational issues (Lack of human resources to manage the internal organization change)			✓	Chan *et al.,* [28]
3	Professional support (Lack of BIM expert in the organization)	✓			Zainon *et al.,* [29]
4	Financial and Time Difficulties (No sufficient cost and time to support the new technology implementation)		✓		Zainon *et al.,* [24], Zainon *et al.,* [29]
5	Technical issues (Lack of sufficient technology to support the new system of BIM)		✓		Musa *et al.,* [34]

2. Methodology

To collect data for this study, a quantitative approach, i.e. a questionnaire survey, was used. As mentioned earlier in Section 1.2, the objectives of the study were to (a) identify the availability of BIM software in the market; (b) to identify the adoption of BIM software in large and SMEs quantity surveying consultancy firms; and (c) to compare the challenges of adopting BIM software in large and SMEs quantity surveying consultancy firms.

Considering the nature of the study which necessitated statistical analysis, the quantitative method was chosen. Furthermore, this approach was efficient in terms of time, money, and other resources. For all of the items on the questionnaire survey form, five-point Likert scales were used during the development process. The survey form was specifically used to investigate the available BIM software on the market, the adoption of BIM software, and the challenges of adopting BIM software in large and SME quantity surveying consultant organizations.

According to BQSM, there were 393 quantity surveying consulting firms registered in Malaysia in the Year 2022. This set of respondents was chosen because of their knowledge and competence in the entire construction development process, and they would be the people who would profit from the use of BIM software in their organizations. Because there were only 393 firms, they were all chosen as the study's sample size. Before the major distribution of the questionnaire survey form, a pre-test was carried out by distributing the questionnaires to a smaller group of respondents to collect feedback on the questionnaire's validity before finalizing it.

In total, 393 sets of questionnaire Google forms were emailed to Malaysian quantity surveying consulting firms. A total of 72 out of 393 respondents' feedback data had been collected, with an 18.32% response rate. Finally, the obtained data were analyzed with the Statistical Package for the Social Sciences (SPSS). The Pearson Correlation test and Cronbach's alpha test were performed to assess the data's validity and reliability. Following that, frequency analysis was used to categorize the data and segregate the individuals into their appropriate groups. A Chi-square test was also used to determine whether there was a significant relationship between the variables. In addition, the mean score and ranking method were employed to analyze the results.

3. Result

Table 4 showed the general information of respondents such as age, gender, working experiences, level of education, working position, working years in the construction industry, and firm size. The majority of the respondents were of age 20 to 30 years (33.3%), male (58.3%), had an education level up to a bachelor's degree (86.1%), working as an executive quantity surveyor (31.9%), possessing 1 to 5 years of working experience in the construction industry (30.6%), and their firm size was SMEs (77.8%).

Table 4
Adoption of BIM in large and SME quantity surveying consultancy firms

General information	Frequency	Percentage (%)
Age		
20 - 30	24	33.3
31 - 40	20	27.8
41 - 50	20	27.8
51 - 60	8	11.1
Gender		
Male	42	58.3
Female	30	41.7
Level of education		
Bachelor’s Degree	62	86.1
Diploma	7	9.7
Master	2	2.8
SPM	1	1.4
Working position		
Director	8	11.1
Executive Quantity Surveyor	23	31.9
Junior Quantity Surveyor	22	30.6
Manager	19	26.4
Working years in the construction industry		
1 – 5 years	22	30.6
6 – 10 years	14	19.4
11 – 15 years	10	13.9
16 – 20 years	12	16.7
21 – 25 years	5	6.9
26 years and above	5	12.5
Firm size		
Big Company	16	22.2
Small-and-Medium Enterprises (SMEs)	56	77.8
Total	72	100.0

3.1 To Identify the Availability of BIM Software in the Market

The first objective of this study was to determine the availability of BIM software in Malaysia's construction industry. BIM was widely used as an industry-standard word in the building sector. BIM was a type of new digital information technology that might accomplish high-quality and efficient virtual construction and administration. Several types of BIM software had been created and published in the construction sector over the years, such as Cubicost, iTWO CostX, Buildspace, Buildsoft, and so forth. According to Figure 5, BIM knowledge was quite high in the current industry, with the majority of respondents (95.8%) aware of the availability of BIM software on the market. In this regard, the BIM revolution swept throughout the construction industry and was unavoidable.

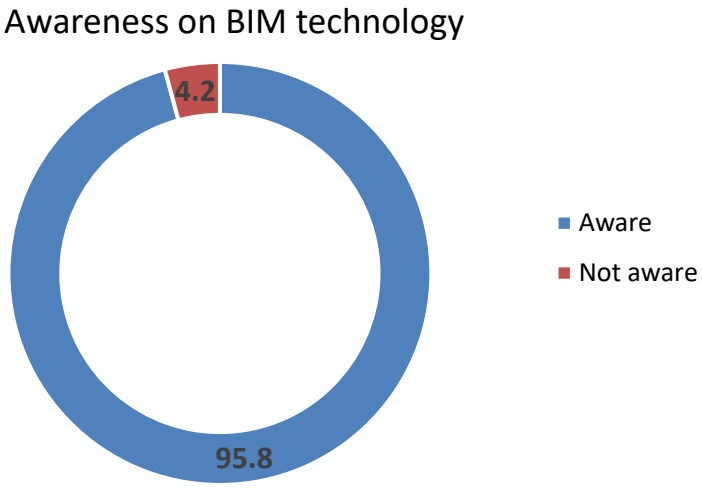

Fig. 5. Awareness of quantity surveying consultancy firms on the existence of BIM technology

3.2 To Identify the Adoption of BIM Software in Large and SME Quantity Surveying Consultancy Firms

The second objective of this study was to identify BIM software adoption in large and small and medium-sized quantity surveying consultancy companies. However, the existing research only identified BIM use among SMEs or the general adoption rate among QS specialists. There was a paucity of information about the rate of BIM adoption in large firms. According to the descriptive analysis shown in Table 5, current BIM software utilization was much higher than that revealed in the previous study [22]. The vast majority of respondents (77.8%) used BIM software in their practice. Nonetheless, 22.2% of respondents did not use or stopped utilizing BIM software at their workplace. Despite the fact that construction players were well aware of the availability of BIM technology, the QS field had not fully used BIM in building projects.

Table 5
Adoption of BIM in large and SMEs quantity surveying consultancy firms

Size of Company	Adoption of BIM software		Total
	Yes	No	
Big Company	11	5	16
Small-and-Medium Enterprises	45	11	56
Total	56	16	72

According to Figure 6, when respondents were asked about the type of BIM software used in their daily practice, Cubicost (25.8%), iTWO CostX (15.7%), Buildsoft (14.7%), CAD measure (7.9%), Atlespro (1.0%), Buildspace (12.6%), Binalink (9.9%), and Revit (12.6%) were the BIM software that had been adopted in the industry. Cubicost had the highest popularity, followed by iTWO CostX. This conclusion was consistent with previous research [16]. As a result, it was possible to conclude that various software was available on the market, and Cubicost was among the most popular items in the sector.

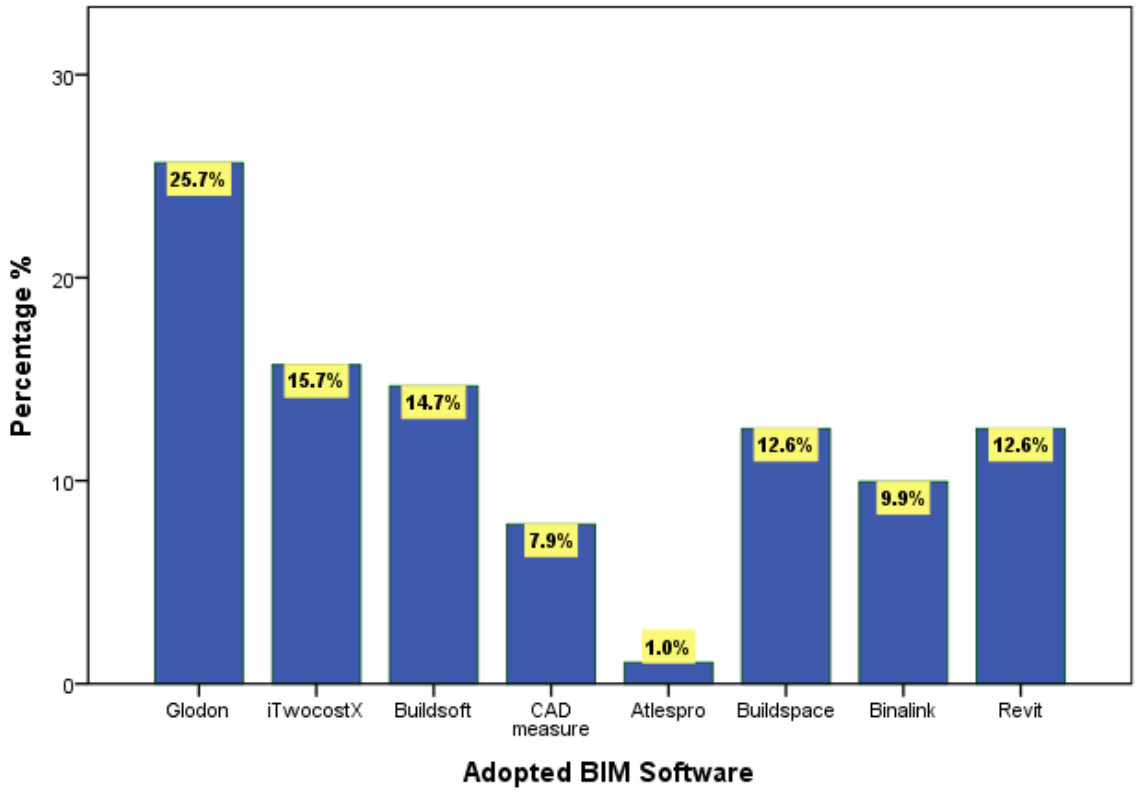

Fig. 6. BIM software adopted by the quantity surveying consultancy firms

3.3 To Compare the Challenges of Adopting BIM Software in Large and SME Quantity Surveying Consultancy Firms

The third objective of this study was to compare the various challenges of implementing BIM software in large and SME quantity surveying consultancy organizations. The existing research neglected the impact of firm size on BIM software adoption. Firms of various sizes would face distinct barriers in deploying new technology. A small firm, for example, would face financial challenges in adopting new technology, but a large firm would often have sufficient financial resources to invest in and integrate new technology. As a result, this section of the study sought to discover the gap between large and SME businesses.

According to Table 6, resistance to change was a prevalent issue experienced by businesses of all sizes. This conclusion agreed with Olawumi *et al.,* [25] opining that the industry's resistance to change from traditional working practices was the top obstacle of 38 factors in integrating BIM and sustainable practices in building projects. The problem arose when people were hesitant to make changes for the sake of a better end as using BIM necessitated hiring an expert to integrate software in their firm. As a result, employees would suspect that established positions were under threat and might be altered.

Furthermore, it was discovered that human resource and organizational challenges were common issues in businesses of all sizes. However, this finding was in line with Chan *et al.,* [28]. The expansion of BIM might not encourage people to learn and use this technology in their jobs unless specific aspects of organizational structures and strategies were modified, such as the set up of BIM units or departments to support the new practice [28]. Apart from that, the organizations must educate their employees on current and emerging industry developments, as well as provide opportunities for skill and capacity development programs, such as BIM workshops and seminars, where all stakeholders could learn and share knowledge and expertise in these areas [25]. Top management of the organizations played a significant role, particularly during the period when individuals were transitioning from traditional workflows to BIM workflows, persuading people of the benefits of BIM, creating strategies for education and learning, and adjusting to new roles.

Table 6
Challenges of adopting BIM software in large and SME quantity surveying consultancy firms

No.	Challenges of Adopting BIM Software	Quantity surveying consultancy firm size	
		Previous Study (Literature)	Current Study (Collected Data)
1.	Resistance to change (Employees' resistance to accepting the new technology and new nom of work)	Large Company & SMEs [12]	Large Company & SMEs
2.	Human resource and organizational issues (Lack of human resources to manage the internal organization change)	Large Company & SMEs [29]	Large Company & SMEs
3.	Professional support (Lack of BIM expert in the organization)	Large Company [29]	SMEs
4.	Financial and Time Difficulties (No sufficient cost and time to support the new technology implementation)	SMEs [24]	SMEs
5.	Technical issues (Lack of sufficient technology to support the new system of BIM)	SMEs [29]	SMEs

Besides, SMEs faced a shortage of professional assistance from BIM experts. This could be because large organizations had the resources to hire BIM specialists to help them overcome the hurdles of using BIM technology. The findings mirrored the distinction between large corporations and SMEs, particularly since SMEs usually lacked the finance, staff, and relevant skills to integrate new technology with effective development strategies [19]. Because BIM specialists, consultants, or professionals with the necessary skills and expertise were critical to the success of BIM adoption [29], this could increase the barriers to BIM implementation, particularly in SMEs.

Apart from that, only SMEs were experiencing financial and time constraints. The result was consistent with the findings of Zainon, Mohd-Rahim's study [24]. This was because SMEs lacked the funds to pay for the high cost of BIM software, licenses, and accompanying applications [25], as well as the time to conduct BIM training programs for their employees. Implementing BIM software, according to Zainon *et al.,* [29], required a huge financial and time investment, as only large firms could afford the expenditure and risk.

Last, but not least, only SMEs were grappling with a lack of support systems and trouble comprehending the intricacy of the software [29]. That included interoperability issues, massive data, and limited data storage, as well as a lack of data sharing, tracking, checking, versioning control mechanisms, etc. [33]. Again, this could be attributed to the SMEs' inadequate resources. To address the difficulties, the policymakers must come up with appropriate solutions, such as subsidies or loans to encourage SMEs to embrace the new technologies.

4. Conclusion

Building Information Modelling (BIM) was a platform that encouraged collaborative operations among all stakeholders in the construction sector. As such, the purpose of this study was to investigate the level of BIM software usage in Malaysia, as well as the obstacles that large and SME quantity surveying firms encountered while applying BIM technology. Generally, the vast majority of QS specialists (95.8%) were aware of BIM technology (see Figure 5). In this regard, 77.8% of the respondents used BIM software in practice, but 22.2% did not use or discontinued using BIM software at their job (see Table 5). This indicated that the move from the traditional technique to BIM implementation was not easy, since some organizations preferred to continue utilizing traditional methods such as 2D drawings and Microsoft Excel sheets in their measuring work and bill of quantities preparation. In terms of BIM software, the majority of QS professionals in Malaysia utilized Cubicost (25.7%) and iTWO CostX (15.7%) in their regular practice (see Figure 6).

The impact of firm size was especially considered to understand the difference between large organizations and SMEs in dealing with the challenges of adopting BIM software. According to Table 6, "Resistance to change" and "Human resource and organizational issues" were constraints to BIM adoption in both large corporations and SME businesses. As such, the companies must be aware that when they decided to use BIM, they must change the thinking of their employees and build their own BIM transition plan. However, SMEs had significantly more problems, such as "Professional support", "Financial and time Difficulties", and "Technical issues" (see Table 6). To mitigate the issues, the top management should seek out BIM expertise, absorb the initial cost, and expand the company's technical support systems to comprehend the software's complexities.

Overall, the findings revealed a disparity in BIM adoption between large firms and SME businesses, with SMEs experiencing more challenges than large firms. As a result, we had to emphasize the difficulties encountered by SMEs and attempt to bridge the gap between large firms and SMEs. Eventually, the rate of BIM software adoption among QS specialists could increase significantly, ushering in a new era of digitization for the Malaysian construction industry.

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