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Issues and Challenges of Building Information Modelling (BIM) Implementation in Facilities Management

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ABSTRACT

Building Information Modelling (BIM) is one of the industry's emerging construction technologies. However, BIM adoption for Facilities Management (FM) has not yet been acknowledged. Traditional processes continue to drive FM in Malaysia, signalling the country's economic development and competitiveness. The likely cause is a lack of comprehension of information exchange on the BIM platform throughout the life cycle of the project. Consequently, the aim of this research is to explore and analyse the challenges and strategies associated with the implementation of BIM in FM, with the goal of providing actionable insights to enhance the adoption and effectiveness of BIM in the FM sector. The objectives of the research are to investigate the issues and challenges of BIM implementation in FM and to study the strategies for implementing BIM in FM. This research is using a quantitative method, by online questionnaire survey and SPSS software, to analyses the collected data. Non-probability sampling was applied as the method of sampling. 57 questionnaires were distributed to FM corporate companies in Malaysia based on the MAFM website, but only 19 responses with a 33% response rate were received. The findings of this study revealed a variety of issues and challenges with BIM implementation in Malaysian FM. One of the issues with BIM implementation in FM is the lack of integration between BIM and FM. However, the incompatibility of building automation systems and other FM technologies with BIM typically causes interoperability issues. As a result, government support for promoting BIM in the construction industry, as well as BIM education and training, is critical for increasing BIM adaptation in AEC organisations.

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INTRODUCTION

The literature states that the implementation of BIM in Facilities Management (FM) requires addressing several concerns and challenges. According to Stride et al. (2020), it is necessary to consistently update as-built models whenever changes occur in the real world. Failure to do so will lead to an imprecise representation of the facility, impeding the capacity to identify construction components in the model, therefore negating the time and cost benefits obtained (Stride et al., 2020). The utilisation of BIM in FM is essentially linked to the efficient management of information exchange among stakeholders during the entire project's duration and the facilitation of the transition process to FM. Nevertheless, the lack of automation in this information flow presents technological challenges, including the need to enhance the interoperability between Building Information Modelling (BIM) and Facility Management (FM) systems (Matane et al., 2019). Matane et al. (2019) argue that the lack of interoperability capabilities results in insufficient data management. Furthermore, the widespread use of different Building Information Modelling (BIM) and Facility Management (FM) platforms poses a substantial problem in effectively implementing BIM in FM due to interoperability issues. Hence, the aim of this research is to explore and analyse the challenges and strategies associated with the implementation of BIM in FM, with the goal of providing actionable insights to enhance the adoption and effectiveness of BIM in the FM sector.

LITERATURE REVIEW

BIM and FM development in Malaysia

BIM is becoming increasingly important and globally indispensable to ensuring that the planning, design, construction, operation, and administration of buildings are highly efficient and collaborative. The National Cancer Institute in Putrajaya was the first building project in Malaysia to utilise Building Information Modelling (BIM) in 2010. BIM has been included into government-funded construction projects following the Mes Group's involvement in 2020. From the facility management perspective, Building Information Modelling (BIM) can be defined as a dynamic database that enables the accurate management and regulation of building information from inception to end-of-life. This solution allows owners to efficiently oversee facilities during the facility management phase (Samsuddin and Zaini, 2022).

In accordance with the regulations set by the Malaysian government, the Construction Industry Development Board (CIDB) is responsible for supervising the implementation of Building Information Modelling (BIM) in Malaysia, as stated by Ismail et al. (2019). The implementation of Building Information Modelling (BIM) in Malaysia was started in 2007 by the Malaysian Public Works Department (PWD), initially for internal projects. However, since 2009, the private sector has been the main driver of BIM adoption in Malaysia (CIDB, 2013). The building Industry Development Board (CIDB) introduced Building Information Modelling (BIM) as a platform to enhance the success of building projects. The first BIM Conference took place in Malaysia in 2009, where CIDB encouraged other industry participants to adopt BIM in their operations (CIDB, 2013). In 2010, it was reported that the National Cancer Institute Putrajaya would be the first Building Information Modelling (BIM) project in the country.

Facilities Management (FM) encompasses a wide array of activities, including maintenance operations, repair work, workspace management, energy planning and management, renovation, refurbishment, retrofitting, administrative and office services, emergency planning and management, financial management, and training of FM personnel to ensure the efficient and effective operation of physical assets (Atkin & Brooks 2021). To effectively manage these diverse and complex processes, the FM industry in Malaysia must embrace digitalisation and leverage various information and communication technologies.

Durdyev et al. (2022) state that one (1) advantage that is commonly mentioned in the literature is the capacity to keep documents and other data. All the paperwork needed to run and maintain a facility, including operation instructions, warranties, designs, and product specifications, may be kept in one (1)

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unified digital archive using BIM. The superiority of digital document archiving and its advantage over traditional paper documentation are emphasised in the research evaluated by Antón & Díaz (2014). A digital CAD model can be used and interpreted through BIM during the FM stage. The facility manager can find building components more easily, especially in areas that are inaccessible, with the help of this 3D model; the component number and product information can also be quickly found on the BIM database.

The BIM can be used to record other data, such as the product source and the repairman's phone number, facilitating a smooth transition between issue detection, identification, and resolution in real time. Unlike reactive maintenance, which has been shown to be an ineffective mode of operation, BIM FM enables the analysis and scheduling of maintenance requirements (Gerish et al., 2017). During the FM phase, another use of BIM is energy usage monitoring and management. Utilising BIM, energy performance during operation may be monitored and simulated, assisting in the detection of any variations from the recorded data.

Muhammad & Mustapa (2020) state that the identification of collaborative settings is the primary emphasis of the developing field of BIM research in the building industry. Utilising facility data over the course of the facility lifecycle to establish a secure, healthy, productive, and efficient work environment is the only goal of BIM for FM. Its utilisation is still restricted even though its potential to help FM is recognised (Dixit et al., 2019). including 2004 until 2017, BIM was the most common digital technology discussed in FM articles (including technical papers, publications, and remarks from industry). Similarly, the sector is experiencing rapid growth in domains such as BIM programming, standardisation, and acceptance. Despite the recognition of its potential to assist with FM, the utilisation of it remains limited (Dixit et al., 2019).

Some of the major challenges facing the integration of BIM for FM include giving more focus to long-term strategic goals, addressing data interoperability issues, converting building information into practical business knowledge for facility management, establishing customised data standards that meet the specific needs of each owner, and involving facility managers in the early stages of BIM development (Farghaly et al., 2019). The lack of consensus among academics and industry practitioners about the efficient and practical information exchange process between FM systems and BIM is a major challenge, as highlighted by Martaneh et al. (2019).

Tackling these difficulties necessitates a comprehensive and diverse strategy. It is crucial to take the necessary steps to improve long-term strategic goals, enhance data interoperability, and transform building information into tangible business knowledge for facility management. Furthermore, it is imperative to involve facility managers in the first phases of BIM development to guarantee that BIM solutions adequately address practical operational requirements. Although Malaysia has made notable progress in using BIM, especially in public sector projects, there is still a considerable amount of work required to completely incorporate BIM into FM processes. The combination of government assistance, technological developments, and a collaborative industrial culture will play a crucial role in overcoming current obstacles and fully harnessing the promise of BIM in facilities management. The thorough incorporation of this integration will finally result in enhanced, proficient, and enduring building management techniques throughout the country.

Issues and Challenges of BIM implementation in FM

Tsay et al. (2022) have identified that the main challenges in implementing BIM in FM operations are related to current work processes and organisational structures, particularly the absence of clearly defined roles and responsibilities. The exchange of information between Building Information Modelling (BIM) models and Facility Management (FM) systems is an intricate process (Matarneh et al., 2019), and there is currently a dearth of comprehension regarding the precise prerequisites for using BIM in FM. This encompasses ambiguities regarding the necessary information, the appropriate timing for its provision, and the individual accountable for giving it (Gao & Pishdad-Bozorgi, 2019). Furthermore, the industry is

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undergoing significant expansion in areas such as BIM programming, standardisation, and adoption. Although its potential to aid with FM has been acknowledged, the use of it is still restricted (Dixit et al., 2019).

Key obstacles in the implementation of BIM for FM include prioritising long-term strategic objectives, resolving data interoperability problems, transforming building information into actionable business insights for facility management, creating tailored data standards that align with individual owner requirements, and engaging facility managers in the initial phases of BIM development (Farghaly et al., 2019). The absence of agreement among scholars and professionals in the field about the effective and feasible information exchange procedure between Facility Management (FM) systems and Building Information Modelling (BIM) poses a significant obstacle, as emphasised by Martaneh et al. (2019).

Addressing these challenges requires an all-encompassing and varied approach. It is imperative to implement the required measures to boost long-term strategic objectives, optimise data compatibility, and convert building information into practical business insights for facility management. Moreover, it is crucial to include facility managers from the first stages of BIM development to ensure that BIM solutions effectively meet real operational needs. Malaysia has achieved significant advancements in the use of Building Information Modelling (BIM), particularly in public sector projects. However, there is still a substantial amount of work needed to fully integrate BIM into Facility Management (FM) operations. The convergence of government aid, technology advancements, and a cooperative industrial ethos will be pivotal in surmounting existing challenges and effectively using the potential of BIM in facilities management. The comprehensive implementation of this integration will ultimately lead to improved, efficient, and long-lasting building management practices nationwide.

The implementation of Building Information Modelling (BIM) in Facility Management (FM) faces challenges and difficulties, as highlighted by Tsay et al. (2022). These obstacles primarily stem from existing work processes and organisational structures, specifically the lack of well-defined roles and responsibilities. The process of exchanging information between Building Information Modelling (BIM) models and Facility Management (FM) systems is a complex task (Matarneh et al., 2019), and there is still a limited understanding of the specific criteria for utilising BIM in FM. This includes uncertainties regarding the required information, the date of its delivery, and the responsible individuals for providing it (Gao & Pishdad-Bozorgi, 2019).

According to Mostafa and Alaqeeli (2022), a lack of the required knowledge and skills to embrace new technologies is a significant obstacle that might result in implementation delays. The study additionally identifies three (3) regulatory parameters that influence BIM-based team coordination: participant quantity, team diversity, and top decision maker involvement. While asset owners are essential for BIM accreditation in facility management (FM), a considerable portion of them lack the requisite technical expertise and understanding to efficiently handle, supervise, and govern BIM activities throughout the operational and maintenance stages. Moreover, most asset owners possess a restricted comprehension of the implementation standards for Building Information Modelling (BIM) in Facility Management (FM) practice. This is a result of unclear job assignments and limitless duties. A non-traditional BIM workflow structure, together with the widespread existence of role ambiguity. In the absence of established processes for managing or verifying BIM data, individuals face a significant burden when it comes to communicating information with other teams.

Moreover, the literature recognises that individuals' motivation, knowledge, and skills, along with the organisational culture, exert a substantial influence on the deployment and use of BIM (Siebelink et al., 2021). The construction industry has a mostly unsupportive organisational culture that hinders the implementation of Building Information Modelling (BIM). This culture is commonly characterised by a dearth of goal setting and a strong emphasis on collaborative effort (Cheung et al., 2011). The lack of intrinsic motivation resulting from the perception of complexity, perceived disadvantages, time limitations,

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and lack of confidence in technology significantly impedes the adoption of BIM and perpetuates the usage of traditional methods (Adriaanse et al., 2010).

Despite the various advantages of BIM, certain difficulties described in the literature significantly hinder the widespread adoption of BIM in facility management. According to Durdyev et al. (2022), BIM is anticipated to be utilised during the FM phase only if it has been previously employed in the design and construction phases of the project. This is because the implementation of BIM necessitates a substantial initial investment. Costs will be incurred for the purchase of software, hardware, and the training of staff. The author also observed that using BIM for just one (1) phase of a project is often deemed impractical due to the substantial initial costs involved. By applying Building Information Modelling (BIM) for Facility Management (FM) on a larger scale, there is a potential for increased availability and reduced costs of this technology.

The implementation of BIM in Facilities Management is impeded by organisational, procedural, and cultural obstacles, despite its potential to bring about a significant transformation. To tackle these problems, a comprehensive strategy is needed, which involves improving knowledge and expertise, defining clear roles and duties, and promoting a nurturing organisational environment. By surmounting these obstacles, the construction sector may fully actualise the advantages of BIM, resulting in enhanced efficiency and effectiveness in facility management operations.

Strategies of implementing BIM in FM

Government support is essential in promoting the use of BIM (Husain et al., 2018). Therefore, it is recommended that governments adopt a more proactive approach in promoting Building Information Modelling (BIM) in the construction industry. This should include exploring the use of BIM at all stages of a project's lifespan and enacting legislation to protect intellectual property and digital asset ownership. Concurrently, businesses and government organisations may offer additional educational opportunities to professionals to help them reduce costs related to the adoption of BIM (Wu et al., 2021). The Malaysian government must acknowledge the benefits of Building Information Modelling (BIM) and continue to promote its use in private-sector projects. If the expenses of BIM software were subsidised, the private sector could participate in the experimental stages of BIM. Education and training in BIM are essential for promoting the use of BIM in Architecture, Engineering, and Construction (AEC) firms (Munianday et al., 2022). Both schools and professional groups consider BIM education to be essential for enhancing BIM specialist learning and recruitment in the field (Wu and Issa, 2013).

Legislation is the main catalyst for the industry's shift towards BIM. This has significant ramifications for individuals who are responsible for setting regulatory requirements and voluntary standards (Georgiadou, 2019). Since 2009, the deployment of BIM (Building Information Modelling) has been mandatory for all public sector projects with a budget exceeding RM100 million (RTM, 2020). Similarly, it is widely thought that the government has a crucial role in facilitating the adoption of BIM. Wong et al. (2010) examined the roles played by the public and commercial sectors in achieving effective BIM deployments across different nations. Their finding was that aggressive government intervention is crucial for the extensive adoption of BIM. This can be attributed to the fact that government support fosters an ideal setting for uniform and reliable legal systems, education, and research and development (R&D) in BIM.

Munianday et al. (2022) assert that training is universally acknowledged as a pivotal element for the effective execution of BIM. Moreover, it is crucial to develop a comprehensive training plan that precisely outlines the anticipated training needs and the resources that are at hand. Furthermore, the implementation of efficient and skillfully designed training and educational programmes plays a crucial part in augmenting the expertise and understanding of personnel in regard to BIM concepts and technologies. The assessment of training completion should include evaluations of learning outcomes, behavioural reactions, and expectations of the degree to which training programmes have improved trainee values and led to greater

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work performance (Munianday et al., 2022). In order to exceed the expectations of end-users and cultivate a long-term commitment to continuous growth, it is imperative to undergo comprehensive training and education. Staff training is a crucial component in the integration of BIM inside an organisation (Wan Mohammad et al., 2018). Moreover, it is crucial for management to provide the necessary tools and technology for the adoption of Building Information Modelling (BIM), together with the expertise to efficiently utilise them. This also demonstrates the organisation's technical readiness to use BIM (Sinoh et al., 2020).

For BIM to be widely and successfully implemented in the construction sector, a comprehensive and diverse strategy is required. Strong government backing, extensive educational and training initiatives, strategic legislative measures, and effective organisational readiness are all crucial elements. To fully exploit the advantages of BIM, the construction sector should focus on these areas, resulting in improved project outputs that are more efficient, effective, and inventive.

METHODOLOGY

The main aim of this study is to investigate the difficulties related to the implementation of Building Information Modelling (BIM) in Facilities Management (FM). The study specifically examines 57 corporate businesses in Malaysia that operate in the FM sector, which were found using the MAFM website. Through the utilisation of a significant sample size, the study attained a response rate of 33%, resulting in a thorough comprehension of the building industry.

To gather quantitative data, a questionnaire survey was utilised. The collected data was then analyzed using a 5-point Likert scale to evaluate the level of agreement with statements regarding BIM and FM integration. The findings from this analysis are presented through various charts and tables, offering clear visual insights into the study's results.

ANALYSIS AND FINDINGS

Table 1. Descriptive statistics on the Issues and Challenges of BIM Implementation in FM

Issues and Challenges of BIM Implementation in FM	Mean Value	Standard Deviation (SD)	Ranking
Lack of integration between BIM and FM systems	4.68	0.95	1
Lack of top management support for innovative BIM process	4.68	0.75	2
Lack of BIM knowledge amongst building owners and operators	4.68	0.75	3
Limited BIM maturity and/or capability	4.63	0.76	4
Unclear BIM requirements for FM at early project stages	4.58	0.84	5
Impact on current processes and lack of awareness about this impact	4.37	0.96	6
Lack of BIM knowledge implementation guidance	4.37	0.96	7
High cost of BIM implementation process in FM	4.37	0.83	8
Potential benefits of BIM for FM are not clearly identified	4.32	0.82	9
FM only uses BIM if it was used during design and construction	4.26	0.87	10
BIM software is complicated to use	4.21	0.98	11

Source: Authors (2024)

This section (Table 1) comprises eleven (11) questions rated on a 1 to 5 Likert scale. Respondents are required to indicate the level of significance, ranging from extremely inconsequential to very substantial.

https://doi.org/10.24191/ bej.v21iSpecialIssue.2420

The absence of integration between BIM and FM systems has resulted in the highest mean value of 4.68 (SD = 0.946). Teicholz (2013) provided evidence that interoperability challenges arise due to the lack of compatibility with building automation systems, other FM technologies, and BIM. Besides, the second highest ranking of challenges are FM teams face challenges in managing information, particularly because existing FM systems lack interoperability. Furthermore, the absence of support from senior management for new BIM procedures is listed as the second largest concern, with a mean value of 4.68 (SD = 0.749). Sieblink et al. (2020) assert that the construction industry possesses an organisational culture that is generally uncooperative, impeding the successful deployment of BIM. This culture is often defined by the lack of setting goals and focusing on teamwork. Adriaanse et al., (2010) recognised that the usage of BIM is hindered by a lack of internal motivation caused by the perception of complexity, drawbacks, time constraints, and scepticism of technology. As a result, traditional methodologies continue to be used.

According to Table 1, one of the least major issues in the adoption of BIM is the complexity of BIM software, with a mean value of 4.21 (SD: 0.98). Tsay et al. (2022) identified that the main challenges in adopting BIM software for FM operations are related to current work processes and organisational structures, specifically the absence of clearly defined roles and responsibilities. Furthermore, the second-lowest position is assigned to facilities management (FM) experts who solely employ building information modelling (BIM) during the design and construction stages, with an average rating of 4.26 (SD: 0.87). Durdyev et al. (2022) found that the use of BIM in the facility management (FM) phase is more probable when it has been previously employed in the design and construction phases of the project.

The primary obstacles to the implementation of BIM are the absence of integration and interoperability between BIM and FM technologies, exacerbated by an uncooperative organisational culture and inadequate senior management support. In contrast, the least important problems are associated with the intrinsic intricacy of BIM software and its restricted utilisation by FM specialists during particular project stages. Addressing these challenges requires a focus on improving interoperability, fostering a cooperative culture, and ensuring comprehensive support from senior management to facilitate the broader adoption of BIM in FM activities.

Table 2. Descriptive statistics on the Strategies of Implementing BIM in FM

Strategies of Implementing BIM in FM	Mean Value	Standard Deviation (SD)	Ranking
Government support by promoting BIM in the construction industry	4.79	0.92	1
BIM education and training are critical for increasing BIM adoption in AEC organisations	4.63	0.96	2
Employing BIM experts to monitor FM	4.58	1.12	3
Develop a comprehensive plan for training needs and resources.	4.58	0.96	4
Budget allocation by government	4.47	1.02	5
Provision of legislation of BIM usage	4.42	0.77	6
Technology and provision of trial software	4.42	0.84	7
Complimenting BIM with geographic information system (GIS) functionality add value to BIM software solution for FM	4.05	1.13	8

Source: Authors (2024)

Table 2 explores options for applying BIM in FM through eight (8) questions rated on a Likert scale from 1 to 5, indicating significance from extremely inconsequential to very substantial. The highest-rated factor is the government's promotion of BIM in the building industry, with a mean value of 4.79 (SD: 0.918). Husain et al. (2018) emphasise that government support is crucial for BIM deployment, suggesting that governments should actively promote BIM at all project stages and implement laws to protect intellectual property and digital assets. The second most significant factor is the importance of BIM

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education and training, with a mean value of 4.63 (SD: 0.955). Munianday et al. (2022) emphasise the importance of BIM education and training in fostering the adoption of BIM in AEC enterprises. Professors in the construction business are urged to embrace Building Information Modelling (BIM), which has a substantial impact on their students' education. Several nations have implemented BIM skill training programmes in higher education institutions, serving as the basis for architecture, engineering, and construction fields. Collaborating with institutions and promoting a culture focused on research can enhance the implementation of BIM.

Less important techniques include offering trial software and technology, which has an average value of 4.42 (standard deviation: 0.84) and using GIS capabilities to enhance BIM software for facility management, with an average value of 4.05 (standard deviation: 1.13). Sinoh et al. (2020) affirm that successful utilisation of BIM necessitates management to furnish the essential software, technology, and skills, thereby showcasing the organisation's technical preparedness for BIM implementation.

The most crucial variables in increasing BIM adoption in the FM sector are government assistance and education and training in BIM. It is advisable for governments to actively advocate for the use of Building Information Modelling (BIM) and enforce legislation to ensure its implementation. Similarly, educational institutions should integrate BIM training into their curricula. In contrast, the importance of trial software availability and integration of GIS capability is judged to be quite low. Effective BIM adoption relies on the presence of essential technology and knowledge, emphasising the need of organisations being adequately equipped from a technical standpoint.

CONCLUSION

The study focuses on the significant obstacles and approaches related to the acceptance and execution of Building Information Modelling (BIM) in Facilities Management (FM) in Malaysia. The study, which involved 57 FM corporate organisations discovered through the MAFM website and achieved a response rate of 33%, offers useful insights into the present status of BIM integration in the Malaysian FM sector.

The main obstacles identified encompass the absence of cohesion between BIM and FM systems, inadequate backing from top-level executives, and a general deficiency of BIM expertise among building proprietors and operators. The complexity and inefficiency of sharing information between BIM models and FM systems are exacerbated by the absence of clearly defined roles and responsibilities within existing work processes and organisational structures. The lack of interoperability exacerbates data management concerns, resulting in substantial operational challenges.

Another significant barrier is the exorbitant budget associated with BIM deployment, encompassing costs for software, hardware, and employee training. The financial burden frequently deters organisations from adopting BIM, particularly if it has not been employed during the design and construction stages of the project. Moreover, the construction industry's organisational culture is characterised by a perceived complexity and technical scepticism, which acts as a barrier to the wider adoption and utilisation of BIM.

Despite these challenges, the study identifies several strategies that could facilitate the successful implementation of BIM in FM. Government support is deemed crucial, with recommendations for proactive promotion of BIM, legislation to protect intellectual property, and subsidies for BIM-related expenses. Education and training are also highlighted as essential for increasing BIM adoption in AEC firms. Incorporating BIM training into educational curricula and providing supplementary educational opportunities can significantly enhance the skills and knowledge of BIM professionals.

Furthermore, employing BIM experts to oversee FM, developing comprehensive training plans, and ensuring technical readiness by providing the necessary software and technology are critical steps towards

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effective BIM implementation. The integration of geographic information system (GIS) functionality with BIM software is also suggested to add value to FM operations.

BIM presents transformative potential for Facilities Management, its full benefits can only be realised through a structured framework that promotes integration, supported by robust educational programs and government policies. Addressing the identified challenges through a multifaceted approach involving strong governmental support, comprehensive training, and technological readiness will enable the construction and FM sectors in Malaysia to fully leverage the benefits of BIM. This will lead to more efficient, effective, and sustainable building management practices, ultimately reinforcing the economic and competitive edge of the industry.

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CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Nor Audra Laily Mohd Sabri carried out the research and wrote the article. Siti Norazniza Ahmad Sekak conceptualised the central research framework and supervised the research progress. Yusmady Md Junus anchored the review, prepared revisions and approved the article submission.

REFERENCES

Adriaanse A, Voordijk H, Dewulf G (2010). Adoption and use of interorganizational ICT in a construction project. *Journal of Construction Engineering and Management, 136*(9): 1003–1014. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000201

Antón, L. Á., & Díaz, J. (2014). Integration of Life Cycle Assessment in a BIM environment. *Procedia Engineering, 85*, 26–32. https://doi.org/10.1016/j.proeng.2014.10.525

Atkin, B. & Brooks, A. (2021): Total Facilities Management (5th edition). USA: John- Wiley & Sons, Inc.

Berita RTM (2020), Kementerian Kerja Raya sasar 80% teknologi Model Maklumat Bangunan (BIM) di dalam industri pembinaan tempatan menjelang 2025, National Public Broadcaster of Malaysia, available at: https://berita.rtm.gov.my/index.php/nasional/22173-kementerian-kerja-raya-sasar80-

Cheung S O, Wong P S, Wu A W (2011). Towards an organizational culture framework in construction. International Journal of Project Management, 29(1): 33–44. https://doi.org/10.1016/j.ijproman.2010.01.014

CIDB, "BIM in Malaysia," 2013. [Online]. Available: https://www.bimcenter.com.my/teknologi-model-maklumat-bangunan-bim-di-dalam-industri-pembinaan-tempatanmenjelang-2025

Durdyev, S., Ashour, M., Connelly, S., & Mahdiyar, A. (2022). Barriers to the implementation of building information modelling (BIM) for facility management. *Journal of Building Engineering, 46*, 103736. https://doi.org/10.1016/j.jobe.2021.103736

Dixit, Manish K.; Venkatraj, Varusha; Ostadalimakhmalbaf, Mohammadreza; Pariafsai, Fatemeh; Lavy, Sarel (2019). Integration of facility management and building information modeling (BIM). Facilities, (), F-03-2018-0043–. https://doi.org/10.1108/F- 03-2018-0043

Farghaly K, Abanda FH, Vidalakis C and Wood G 2019 BIM-linked data integration for asset management. Built Environ Proj Asset Manag. 9489–502. https://doi./org/10.1108/BEPAM-11-2018-0136

Gao, X., & Pishdad-Bozorgi, P. (2019). BIM-enabled facilities operation and maintenance: A Review. *Advanced Engineering Informatics, 39*, 227–247. https://doi.org/10.1016/j.aei.2019.01.005

Gerrish, T., Ruikar, K., Cook, M., Johnson, M., Phillip, M., & Lowry, C. (2017). Bim application to building energy performance visualisation and management: Challenges and potential. *Energy and Buildings, 144*, 218–228. https://doi.org/10.1016/j.enbuild.2017.03.032

Georgiadou, M. C. (2019). An overview of benefits and challenges of building information modelling (BIM) adoption in UK residential projects. *Construction innovation, 19*(3), 298-320. https://doi.org/10.1108/CI-04-2017-0030

Hosseini MR, Roelvink R, Papadonikolaki E, Edwards DJ and Pärn E (2018) Integrating BIM into facility management Typology matrix of information handover. *International Journal of Build Pathology Adaptation*. 362–14. https://doi.org/10.1108/IJBPA-08-2017-0034

Ismail, N.A.A., Yousof, M.N.M. and Adnan, H. (2021), "BIM adoption in managing construction risks amongst Malaysian quantity surveyors: current practice and challenges", *International Journal of Sustainable Construction Engineering and Technology, Vol. 12* No. 3, pp. 166-175. https://doi.org/10.1016/j.rineng.2024.102013

Mes Group. Building Information Modeling - BIM. (2020, September 12). Retrieved from https://www.mesgroup.asia/eng/home

Mostafa, A., & Alaqeeli, A. (2022). Benefits and challenges of integrating IOT, VR & AR in the BIM-based facility management process: Literature and case-based analysis. *Journal of Engineering Research, 6*(4), 25–40. https://doi.org/10.21608/erjeng.2022.265269

Matarneh, S. T., Danso-Amoako, M., Al-Bizri, S., Gaterell, M., & Matarneh, R. (2019). Building information modeling for Facilities Management: A literature review and future research directions. *Journal of Building Engineering*, 24, 100755. https://doi.org/10.1016/j.jobe.2019.100755

Munianday, P., A. Rahman, R., & Esa, M. (2022). Case study on barriers to building information modelling implementation in Malaysia. *Journal of Facilities Management*. https://doi.org/10.1108/jfm-10-2021-0132

Muhammad, M. Z., & Mustapa, M. (2020). A review of facilities information requirements towards enhancing building information modelling (BIM) for Facilities Management (FM). *IOP Conference Series: Materials Science and Engineering, 884*(1), 012033. https://doi.org/10.1088/1757-899x/884/1/012033

Samsuddin, N., & Ahmad Zaini, A. (2022). Conceptual Framework of information exchange processes in building information modelling (BIM) for Facilities Management. *IOP Conference Series: Earth and Environmental Science*, 1022(1), 012014. https://doi.org/10.1088/1755-1315/1022/1/012014

Sinoh, S. S., Othman, F., & Ibrahim, Z. (2020). Critical success factors for BIM implementation: a Malaysian case study. *Engineering, Construction and Architectural Management, 27*(9), 2737-2765. https://doi.org/ 0.1108/ECAM-09-2019-0475

https://doi.org/10.24191/ bej.v21iSpecialIssue.2420

Siebelink, S., Voordijk, H., Endedijk, M., & Adriaanse, A. (2021). Understanding barriers to BIM implementation: Their impact across organizational levels in relation to BIM maturity. *Frontiers of Engineering Management, 8*, 236-257. https://doi.org/ 10.1007/s42524-019-0088-2

Teicholz, P. ed. (2013), *BIM for Facility Managers*, John Wiley and Sons.

Tsay, G. S., Staub-French, S., & Poirier, É. (2022). BIM for facilities management: An investigation into the asset information delivery process and the associated challenges. *Applied Sciences, 12*(19), 9542. https://doi.org/10.3390/app12199542

Mohammad, W. N. S. W., Abdullah, M. R., Ismail, S., & Takim, R. (2019). Technology-organisation-environment framework for building information modelling (BIM) adoption challenges for contractor's organisations in Malaysia. *Journal of Computational and Theoretical Nanoscience, 16*(5-6), 2282-2288. https://doi.org/10.1166/jctn.2019.7885

Wong, A. K., Wong, F. K., & Nadeem, A. (2010). Attributes of building information modelling implementations in various countries. *Architectural engineering and design management, 6*(4), 288-302. https://doi.org/10.3763/aedm.2010.IDDS6

Wu, P., Jin, R., Xu, Y., Lin, F., Dong, Y., & Pan, Z. (2021). The analysis of barriers to BIM implementation for industrialized building construction: A China study. *Journal of Civil Engineering and Management, 27*(1), 1-13. https://doi.org/10.3846/jcem.2021.14105

Wu, W., & Issa, R. R. (2013, January). BIM education for new career options: an initial investigation. In BIM Academic Workshop, Washington, DC. US, 11th January. https://doi.org/10.13140/2.1.3570.2406

https://doi.org/10.24191/ bej.v21iSpecialIssue.2420