SEMARAK ILMU PUBLISHING

Journal of Advanced Research in Applied Sciences and Engineering Technology

Journal homepage:
https://semarakilmu.com.my/journals/index.php/applied_sciences_eng_tech/index
ISSN: 2462-1943

The Level of Building Information Modelling (BIM) for Facilities Management Areas in Malaysia: Preliminary Research Results

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ARTICLE INFO

Article history:
Received 27 November 2026
Received in revised form 20 February 2026
Accepted 15 April 2026
Available online 4 May 2026

Keywords:
Facilities Management; Building Information Modelling; current level

ABSTRACT

Building Information Modelling (BIM) is emerging as a prominent and captivating subject within the construction sector. The discussion on the advancement of BIM and its significant effects on building projects and organisations has garnered primary focus within academic and professional circles. Facilities Management (FM) is the sector that derives an immense advantage from Building Information Modelling (BIM). However, it remains the least advanced in terms of implementation. The perception of BIM for the FM sector in Malaysia has varied since FM has begun to embrace the implementation of BIM nationwide. The aim is to provide the initial findings of the current level of BIM implementation for FM application areas in Malaysia. Each quantitative and qualitative study was used at different phases in the research design. Ten FM practitioners underwent qualitative data collection and analysis. Afterwards, a survey questionnaire was conducted among 36 FM practitioners in Malaysia. The research findings reveal that BIM application for FM in Malaysia is in its early stages, and 19 FM applications are areas for BIM use. The most relevant current levels of BIM adoption in FM areas are locating building components, maintenance and operation, non-capital construction feasibility and planning studies, performance measurement and data management.

1. Introduction

Facilities management (FM) practice is a crucial aspect of the construction life cycle. FM can be described as a unified organisational process to enhance and preserve facility and infrastructure assets to optimise the efficacy of the core function [1]. FM also cover many multi-disciplinary services to sustain and strengthen facility assets to ensure the well- being of users [2]. To perform its tasks efficiently, Facilities Management (FM) must centralise information from various fields under one roof. Structured and systematic management and analysis of information are essential for easing decision- making processes. FM application areas primarily rely on the precision and transparency of

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https://doi.org/10.37934/araset.59.5.921

data generated during the design and construction stage and maintained through the handover period [2].

Facility owners allocate considerable time and financial resources in the challenging screening process through an extensive volume of documentation to extract essential details for the FM system. The issue arises due to the need for more compatibility among several FM data systems and the fragmentation of crucial information [3]. These challenges can be efficiently handled, and FM can be facilitated with the adoption of BIM since BIM can eliminate discrepancies in communication and streamline the interchange and integration of digitally presented data. By applying BIM technology through FM, errors may be reduced, efficiency may be increased, and the value and lifespan of constructed assets may be optimised. As BIM applications develop, the FM sector should embrace and fully utilise all of its functions to gain the possible benefit during the handover phase of buildings and infrastructure [4].

According to Construction Industry Development Board (CIDB) [5], Malaysia has transitioned into the Fourth Industrial Revolution, an era of digitalisation. Building Information Modelling (BIM) is among the significant disruptive technologies that substantially influence the building sector, as identified by the World Economic Forum. The Facility Management (FM) sector has been enhanced with an additional layer of Information Communication and Technology (ICT) due to the 4.0 revolution in construction. A possible approach to address environmental concerns is for Malaysian FM to embrace the use of ICT. The architecture, engineering, and FM industry have observed a tendency towards adopting BIM, a method for modelling building information [6]. In addition, the Public Works Department (JKR), through its Strategic Plan 2021 to 2025, has also targeted the BIM adoption to reach 80% by 2025. The BIM is aimed to be implemented during the planning and design phase and the handover phase related to FM areas [7].

This paper has briefly highlighted the background of BIM, an overview of the literature on BIM for FM, the current BIM adoption in FM Malaysia, and BIM uses in FM application areas. It is aimed to determine the preliminary studies on the current level of BIM implementation for FM application areas in Malaysia. Previous researchers have discussed the application areas of FM. This paper will conclude by providing an overview of the BIM implementation for FM in Malaysia.

2. Literature Review

2.1 Background of BIM

The National Building Specification (NBS) recognises BIM as a way of producing and handling data across the life cycle of a building project [8]. The digital description is expected to include a combination of 3D models with detailed information related to the product, execution, and handover process. This information is structured and encompasses all relevant details. The BIM process and its associated data structures are most accurately described by the ISO 19650 and 12006 standards on a global scale. EU BIM Task Group defines BIM as a collaboration that adds value across the entire life cycle of an asset, facilitated by the creation, compilation, and exchange of shared 3D models and intelligent, organised data. It can broaden its range to encompass the operation and management of buildings, utilising data accessible to building or structure owners through building information management. The furnished data enables governments, authorities, and property managers to make informed decisions based on the information derived from the model, extending beyond the completion of the building construction process [9].

The use of BIM and three-dimensional (3D) models to aid in design duties is becoming more prevalent globally. All the stakeholders involved in the project from numerous fields have access to

the digital data stored in the BIM model. The study found a consensus about 4D, 5D and 6D BIM regarding construction time, budget cost and sustainability information, respectively [10]. This is supported by Smith [11], which shows that the role of BIM extends far beyond just 3D modelling." Facility Management is positioned at the 7D level to gain a thorough understanding and acquire appropriate knowledge concerning the quality and performance of a building structure. This dimension pertains to the operating and maintenance elements of the building. The model incorporates equipment, systems, warranties, and data maintenance schedules. This promotes effective facility administration, decreases maintenance expenses, and prolongs the structure's lifespan. The 7D model assists FM experts in managing the handover phase of data that has been acquired and retrieved. By combining the quality of the facilities with cost control, FM enables organisations to increase building efficiency and enhance the quality of employees' work [12].

BIM facilitates communication and collaboration between building stakeholders by serving as a digital database of a l relevant building data [13]. BIM has many applications, including visualisation, clash detection, estimation, construction scheduling, code review and FM. Moreover, FM represents the handover phase that covers the administration of funds' finances to operate and maintainability. At this stage, building information modelling (BIM) data can be used for various tasks, including space management, component finding, quality control, energy management, asset security, maintenance, and repairs [4].

2.2 Overview of Literature on BIM-FM Areas

BIM is gaining traction in Malaysia, with the government and industry players promoting its adoption. However, BIM implementation has achieved a significant level of BIM literature worldwide aiming to fulfil the stated objectives and review relevant prior research available on the Scopus database. It seeks to provide a current understanding of the literature by employing the search string (("building information model)" OR "BIM") AND "(facilities management)" OR "FM") within the Engineering and Social Sciences subject area. The chosen document types encompass articles, conference papers, conference reviews and reviews. Only materials written in English have been considered for inclusion. Search results reveal that BIM-FM research has grown over the previous decade, with 711 papers commencing in 2014. Table 1 presents the criteria for the inclusion and exclusion of content in the paper.

Table 1
Criteria for article inclusion and exclusion of articles

Selection Criteria	Exclude	Include
Database Name: "Scopus"		
Search Date: December 31, 2023		
Publication Period: 2004-2023		
Keywords: "Building Information Modelling" OR "BIM" AND "Facilities Management" OR "FM"		983
Subject Area: Engineering and Social Sciences	186	797
Document Type: "Articles, Conference Papers, Conference Review and Review"	73	724
Idiom: "Include documents published in English only."	13	711

Based on information extracted from the Scopus database between 2014 and 2023, the study of publication growth in BIM and FM showed a significant rise in publications from 2015 to 2018. During this time, published papers increased from 37 to 91. With 91 publications, 2018 saw the most

publishing growth according to Scopus's index. See Figure 1 for international publishing development.

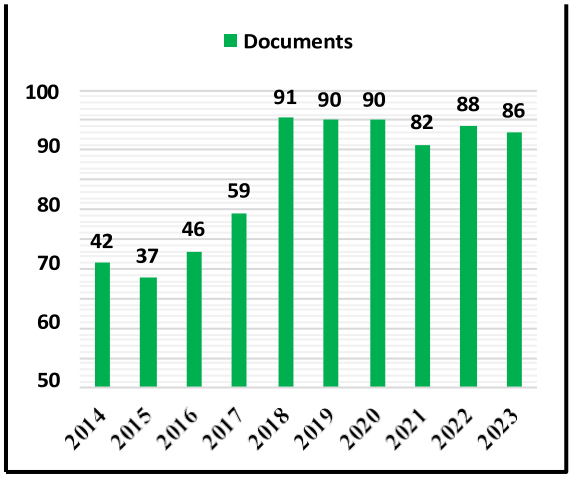

Fig. 1. The annual publication focuses on Building Information Modeling (BIM) and Facility Management (FM) from 2009 to 2023

BIM is an excellent tool for design and construction in the building sector, but its application in facility management and maintenance requires further improvement. By examining nations contributing to articles about BIM in FM, it is possible to identify the most productive countries by reviewing the number of publications they have generated. Table 2 reveals that the United States has the most articles on the use of BIM in FM (150), followed by the United Kingdom (93), Italy (66), and China (59). However, Malaysia remains 11th, with just23 publications from 2014 to 2023. To compete with other developed and emerging countries, Malaysia's publishing on BIM in FM requires greater focus. BIM is expanding in Malaysia, with efforts to improve its adoption and efficacy in the building sector.

Table 2
The top 15 countries in the BIM and FM research field

Countries	Total Publication
United States	150
United Kingdom	93
Italy	66
China	59
Canada	49
South Korea	34
Australia	30
Hong Kong	27
Spain	26
Germany	26
Malaysia	23
Czech Republic	19
Turkey	19
Taiwan	17
Singapore	16

2.3 Current BIM Adoption in FM Malaysia

The adoption of BIM in FM is increasing in Malaysia as the government encourages digital transformation in the construction sector. BIM is currently employed to enhance FM operations' effectiveness, such as energy optimisation, space administration, and maintenance. Based on the report from Construction Industry Development Board [14], several efforts and guidelines, including the BIM Roadmap for FM and the BIM Standards for FM, have been implemented to encourage the adoption of BIM in FM. Nevertheless, there are still obstacles to overcome, including a shortage of BIM proficiency, difficulties with interoperability, and initial expenses. Despite these hurdles, the future of BIM in FM in Malaysia is positive, with increased awareness and initiatives to address adoption barriers. The report suggests a detailed training program to equip individuals and professionals in the building and construction industry and the BIM and FM areas with the necessary skills and knowledge of BIM-FM. The program aims to offer many benefits for FM, such as predicting and forecasting energy expenses for a facility and identifying optimal times for maintenance of newly installed equipment.

According to Durdyev *et al.,* [15], BIM has gained extensive adoption globally across the architectural, engineering, construction, and operations industries. While Building Information Modelling (BIM) is gaining popularity in Malaysia, further research is necessary, particularly on integrating BIM and FM. Reports highlight various benefits of using BIM in FM. As potentially significant contributors to BIM projects, facilities managers should comprehensively understand the BIM process and the value BIM data can offer throughout operations.

According to Ariffin *et al.,* [6], A researcher surveyed to measure the awareness of BIM integration with FM in Malaysia. The survey was conducted using questionnaires given to FM service providers. The findings indicated a moderate level of awareness among respondents concerning the integration of BIM with FM, particularly in the initial stages of the BIM process. This assessment was based on aspects such as the perception of BIM-FM integration, delineating BIM-FM information needs, and utilising BIM to enhance FM practices. The study concludes that FM organisations must be involved in the initial phase of the BIM process to improve BIM utilisation for the entire FM industry.

2.4 BIM Uses in FM Application Areas

The BIM application garnered much interest from the research and professional sectors during the handover period. Table 3 was suggested as a way to understand the current level of BIM implementation in FM areas and find out how interested and experienced the industry is with BIM in FM areas. Many building-related FM domains are showing a great deal of interest in using BIM. BIM serves as a singular data repository with multipurpose building management applications, as explained by Becerik-Gerber *et al.,* [16], such as locating building components, marketing and visualisation, real-time database, maintenance and operation, digital asset creation, space management, non-capital construction feasibility and planning study, energy monitoring systems, emergency management, personnel growth and training, quality control project management and real estate management.

As for study by Abu Bakar and Kamaruzzaman [17], BIM for FM application areas may include locating building components, marketing and visualisation, maintenance and operation, digital asset creation, energy monitoring systems, emergency management, risk management, hazardous waste management and recycling and data management. Hoang *et al.,* [3] addressed maintenance and operation, energy monitoring systems, real estate management, performance measurement,

relocation management, health and safety administration, security management, hazardous waste management, and recycling and data management. Dixit *et al.,* [4] mention marketing and visualisation, real-time database, maintenance and operation, digital asset creation, space management, energy monitoring systems, quality control project management, relocation and data management.

Jasmin [18] locate building components, marketing and visualisation, real-time database, maintenance and operation, space management, non-capital construction feasibility and planning study and emergency management. Both Carbonari *et al.,* [19] and Bolshakov *et al.,* [20] stated locate building components, marketing and visualisation, real-time database, maintenance and operation, digital asset creation, space management, non-capital construction feasibility and planning study, energy monitoring systems, emergency management, personnel growth and training, financial and sustainability management as FM application areas for BIM uses. Lastly, as discussed by Marocco and Garofolo [21], locate building components, marketing and visualisation, real- time database, maintenance and operation, digital asset creation, energy monitoring systems, emergency management, performance measurement, health and safety administration, security management, hazardous waste management and recycling and sustainability management can be used by BIM for FM application areas. According to previous researchers, there are a total of 21 probable application areas in FM that have the potential to be incorporated into BIM.

Table 3
The instrument for FM application areas

FM Areas	[16]	[17]	[3]	[4]	[18]	[19]	[20]	[21]
Locate building components	√	√			√	√	√	√
Marketing and visualization	√	√		√	√	√	√	√
Real-time database	√			√	√	√	√	√
Maintenance and operation	√	√	√	√	√	√	√	√
Digital asset creation	√	√		√		√	√	√
Space management	√			√	√	√	√	
Non-capital construction feasibility and planning study	√				√	√	√	
Energy monitoring systems	√	√	√	√		√	√	√
Emergency management	√	√			√	√	√	√
Personnel growth and training	√					√	√	
Quality control project management	√			√				
Real estate management	√		√					
Performance measurement			√					√
Risk Management		√			√			
Relocation management			√	√				
Health and safety administration			√					√
Security management			√		√			√
Hazardous waste management and recycling		√	√					√
Financial management						√	√	
Sustainability management						√	√	√
Data Management		√	√	√				

3. Research Methodology

In determining the current level of BIM adoption for FM application areas, this study followed three phases, as shown in Figure 2.

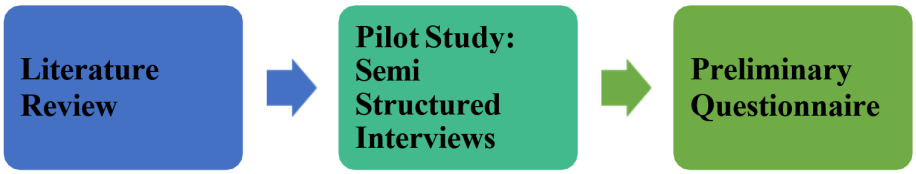

Fig. 2. Research design

3.1 Review of Literature

This study conducted a thorough literature analysis based on prior studies, drawing on previous studies and research conducted by various scholars. The exploration involved both manual searches and online database queries across several reputable sources to identify the application areas of FM utilising BIM. The literature review involves secondary data: books, journal articles, conference proceedings, report theses and dissertations [22].

The literature overview on BIM for FM areas combined two cross-disciplinary components: BIM and FM. Including keywords associated with each area was essential to encompass all facets of BIM and FM. Table 1 displays the two search strings and keywords used to extract data from Scopus and select documents. The authors developed the terms after preliminary searches of essential and relevant papers.

3.2 Pilot Study: Semi-Structured Interview

In Malaysia, BIM is predominantly implemented during the design and construction stages, excluding the transfer phase, concerned with the building's operation and maintenance. Ten experts were interviewed through semi- structured sessions to enhance the understanding of how BIM is applied in FM within the context of Malaysia. This is based on the research conducted on BIM-FM in Malaysia. As per Cresswell, this number of interviews fulfils the required number for the phenomenological study (5-25 interviews) to ensure data reliability [23]. The semi-structured interviews were conducted with 10 respondents in Malaysia to solicit comments on the readability, accuracy, and comprehensiveness of the questionnaire. The objective of this methodology was to confirm the conclusions drawn from the existing literature regarding the use of BIM and to identify additional areas within the FM application areas that can benefit from its implementation in Malaysia. The interview was conducted with engineers, facilities management professionals, architects and academicians who possess the expertise and a comprehensive understanding of the applications of BIM.

The detailed questions are broken into three parts: Part 1: Respondents' background; Part 2: General Current Adoption of BIM for FM in Malaysia; and Part 3: mainly concentrated on BIM uses in FM application areas. To justify the use of BIM in FM stages, it is imperative to comprehend existing FM operations and identify potential areas for enhanced efficiency.

3.3 Preliminary Questionnaire

A preliminary questionnaire survey was carried out using constructs and items chosen from prior research to construct the research instrument for the current study. The questionnaire was modified and completed after conducting a pilot study, during which 10 experts from Malaysia were

interviewed using a semi-structured format. The interviews aimed to get feedback on the questionnaire's clarity, precision, and comprehensiveness.

Several different approaches were utilised to distribute the survey: (1) through an email, (2) telephone questionnaire, and (3). It was also distributed to the organisation. There was a total of 36 responses. The FM organisations in Malaysia must be registered by the Construction Industry Development Board (CIDB), which specialises in building facilities and infrastructure. This represents the unit of analysis.

4. Results and Discussion

4.1 Pilot Study: Semi-Structured Interview

An interview with a semi-structured format was carried out as a research component. The interview consisted of 18 items that were carried forward from the literature review phase to the confirmation phase. The purpose of the interview was to verify the literature findings and confirm the functions discovered from the interviews with 10 FM experts. The interview began with questions about the expert's background and opinions on the FM application areas towards BIM adoption.

4.1.1 Background of respondents

Table 4 presents data on the research participants. The FM experts have specialised knowledge in the Building Facilities and Infrastructure field and serve as representatives of the analytical unit.

Table 4
Respondent background

Respondents	Years pf Experience with BIM	Profession
R1	3 years	Academician
R2	More than 5 years	Engineer
R3	More than 5 years	Engineer
R4	More than 5 years	Architects
R5	4 years	Academician
R6	More than 5 years	Academician
R7	More than 5 years	Facilities Manager
R8	More than 5 years	Facilities Manager
R9	4 years	Architects
R10	3 years	Engineer

The profiles of these responders offer a well-rounded perspective, encompassing practitioners with technical and management backgrounds. Multiple participants have engaged in the design and building stages, while others have assumed responsibility for facility management. Academicians have a crucial role in research elements as well. In addition, these respondents have considerable expertise in BIM, which enhanced the reliability of their replies.

4.1.2 General current adoption of BIM-FM in Malaysia

Based on expert responses, it can be concluded that BIM applications for FM in Malaysia are still in their infancy. According to R3, R7, and R8, BIM is not widely used and has yet to be fully implemented in Malaysia's FM industry. However, R2, R4, and R5 have stated that there is awareness

of the advantages of adopting BIM in FM, but many private companies still need to implement it. Furthermore, R1 and R6 noted that the readiness and adoption of BIM in Malaysia, particularly in the context of FM, still needs to be improved and requires further work. Additionally, R9 and R10 mentioned that BIM in Malaysia is still in the design and construction phase.

4.1.3 BIM in FM application areas

This part presents a detailed discussion of BIM in FM application areas confirmed by expertise experienced in this study. The data derived from the survey among ten respondents are analysed, and their views are compiled in the table that follows:

Table 5
Opinions of BIM for FM application areas

FM Areas	Relevant	Not Relevant
Locate building components	10/10	
Marketing and visualisation	10/10	
Real-time database	10/10	
Maintenance and operation	10/10	
Digital asset creation	10/10	
Space Management	10/10	
Non-capital construction feasibility and planning study	10/10	
Energy monitoring systems	10/10	
Emergency management	10/10	
Personnel growth and training	10/10	
Quality control project management	10/10	
Real estate management	10/10	
Performance measurement	10/10	
Risk Management	7/10	3/10
Relocation management	8/10	2/10
Health and safety administration	10/10	
Security management	10/10	
Hazardous waste management and recycling	10/10	
Financial management	10/10	
Sustainability Management	10/10	
Data Management	10/10	

Based on their knowledge and experience with BIM, the above responses show that interviewees have high confidence in BIM implementation in FM application areas. However, the respondents have yet to propose any new items. Despite this, the findings from this study can serve as a stimulus for future research phases. Two components indicate irrelevant, which are risk and relocation management. According to R3, R6 and R7, risk management components are one of the quality control and management branches. As for relocation management, R6 and R7 stated that it is unfamiliar with FM- related elements. Therefore, only 19 items were proposed, and it can be concluded that 2 items needed to fit the criteria.

4.2 Preliminary Research Results

The outcomes are divided into three primary categories. The data will be tested in terms of feel for data. It provided initial information regarding the scales' sensitivity and an overview of data

classification and submission [24]. As suggested by Yusoff *et al.,* [24], The data will be arranged according to the frequency distribution of demographic parameters and subjected to reliability tests before analysis. The research will analyse each variable's frequency, mean, standard deviation, and minimum and maximum values.

4.2.1 Frequency distribution of demographic variables

To conduct the study, all facilities management organisations in Malaysia must be registered by the Construction Industry Development Board (CIDB), which is responsible for building facilities and infrastructure and will be the unit of analysis. The preliminary survey does not have a fixed number of respondents; typically, it is conducted on a small sample size to test the research instrument and identify potential problems with the research design. It is recommended to use a standard sample size of 30 participants [25]. Hence, 36 respondents are considered enough. It consists of 9 questions regarding respondents' background. Respondents of the study diversified in terms of several demographic variables, as stated in Table 6. The identification of the respondents remained undisclosed. The respondents serve as their organisation's representatives. The data obtained in this section guided the researchers and approved the relevancy of the survey.

Table 6
Demographic variables

Demographic Variables	Frequency	Percentage	Cumulative Percentage (%)
Organisation			
Public	5	13.9	13.9
Private	31	86.1	100.0
Location			
Johor	5	13.9	13.9
Kedah	1	2.8	16.7
Pahang	1	2.8	19.4
Perak	1	2.8	22.2
Sabah	1	2.8	25.0
Sarawak	2	5.6	30.6
Selangor	7	19.4	50.0
Kuala Lumpur	18	50.0	100.0
Professional Background			
Engineers	7	19.4	19.4
Facilities Management	20	55.6	75.0
Architects	1	2.8	77.8
Quantity Surveyor	1	2.8	80.6
Academician	5	13.9	94.4
Technicians	2	5.6	100.0
Involvement in Construction Company			
Less than 1 year	5	13.9	13.9
1-5 years	24	66.7	80.6
6-10 years	5	13.9	94.4
More than 11 years	2	5.6	100.0
Involvement in FM			
Less than 1 year	15	41.7	41.7
1-5 years	18	50.0	91.7
6-10 years	2	5.6	97.2
More than 11 years	1	2.8	100.0
Using BIM Tools			

Yes	22	61.1	61.1
No	14	38.9	100.0
Involvement in BIM			
Less than 1 year	8	36.4	36.4
1-5 years	13	59.1	95.5
6-10 years	1	4.5	100.0
BIM Software Tools			
Revit Autodesk	19	85.4	86.4
Bentley Structure	1	4.5	90.0
AEC Collection	1	4.5	95.5
Cost X	1	4.5	100.0
IR			
Computer Aided Facility Management (CAFM)	7	31.8	31.8
Computerised Maintenance Management System (CMMS)	7	31.8	63.6
Building Automation System (BAS)	1	4.5	68.2
Building Management System (BMS)	6	27.3	95.5
Iviva	1	4.5	100.0

4.2.2 Reliability test analysis

A test was conducted to check the reliability of the survey responses. The test measured the consistency of responses and the extent to which the survey items were free from random errors, thus ensuring consistent results. Table 7 displays the Cronbach's alpha test results, calculating the construct score. The rule of thumb suggests that a score of 0.7 or higher indicates good reliability [24].

Table 7
Summary of Cronbach's Alpha

Constructs	Cronbach's Alpha	No. of Items
Current Level of BIM Implementation for FM Areas	0.840	19

Table 7 shows the scores for the current level of BIM implementation for FM application areas construct, and Cronbach's alpha score met the criterion of at least 0.7. In summary, the outcomes were reliable, avoiding random errors.

4.2.3 Current level of BIM implementation for FM areas

Results in Table 8 show the mean, standard deviation and ranking for each component of the current level of BIM implementation for FM areas. In this analysis, the respondent is more likely to be concerned about locating the building components area, with a mean of 9.94 (Rank 1). It is followed by the second-highest mean of 9.92 (Rank2) on maintenance and operation. Respondents were also very concerned with the components of planning and feasibility studies for non- capital construction and performance measurement; both mean are 9.89. The standard deviation for feasibility and planning studies for non-capital construction is much less than performance measurement, which makes 0.318, Rank 3 and 0.398, Rank 4. The last component respondents think is relevant is security and cleaning, which are used in this FM application area.

Table 8
BIM for FM application areas

	Mean	Std. Deviation	Rank
Locate building components	9.94	0.232	1
Maintenance and operation	9.92	0.280	2
Non-capital construction feasibility and planning studies	9.89	0.318	3
Performance measurement	9.89	0.398	4
Data Management	9.81	0.467	5
Personnel growth and training	9.78	0.485	6
Real-time database	9.78	0.540	7
Space management	9.75	0.554	8
Financial management	9.75	0.604	9
Health and safety administration	9.72	0.615	10
Hazardous waste management and recycling	9.72	0.701	11
Digital asset creation	9.69	0.710	12
Emergency management	9.64	0.683	13
Quality control project management	9.58	0.937	14
Sustainability Management	9.44	1.157	15
Energy monitoring systems	9.33	1.219	16
Real estate management	9.22	1.222	17
Marketing and visualisation	9.17	1.276	18
Security Management	7.97	1.320	19

5. Conclusion

This paper aimed to determine the industry's interest in implementing BIM for the complete FM life cycle. It assists in advancing the field of BIM research and raises general awareness regarding expanding the BIM culture in FM practice. The FM application areas for BIM applications were gathered and identified through a literature review of comparable studies. The pilot analysis found that 19 items were required for a preliminary research analysis. The outcomes were structured within a questionnaire survey comprising 19 FM areas, excluding two items unrelated to the BIM application. The findings reveal that BIM application for FM in Malaysia is in its early stages, and the preliminary results of the questionnaire survey ranked by respondents were all related to BIM adoption in FM application areas.

Due to the short time spent on the research and the small number of respondents employed for the study, the findings of this research cannot be used to generalize the use of BIM in Malaysia. Nevertheless, these data will serve as a foundation for future research to advance a quantitative approach, specifically in developing a framework for integrating BIM and FM.

Acknowledgement

This paper draws upon research grants awarded: Postgraduate Research Grant F10/PGRG/1796/2019 and Research Grant Award F10/RISE/85745/2023.

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