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ОЦЕНКА ПРЕИМУЩЕСТВ И ПРЕПЯТСТВИЙ ВНЕДРЕНИЯ BIM ДЛЯ УСТОЙЧИВОГО УПРАВЛЕНИЯ ОБЪЕКТАМИ (SFM) В ИРАКЕ

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АННОТАЦИЯ

Введение. *Информационное моделирование зданий (BuildingInformationModeling, BIM) представляет собой ключевую устойчивую практику, которую недавно начала осваивать строительная отрасль Ирака. Несмотря на значительное внимание к преимуществам и препятствиям внедрения BIM в архитектурно-строительной отрасли (AEC), вопросы применения этой технологии в устойчивом управлении объектами (SFM) остаются недостаточно изученными. Цель исследования – изучить факторы, влияющие на внедрение BIM для устойчивого управления объектами (SFM) в строительной отрасли Ирака.*
Материалы и методы. *Для определения множества факторов, способствующих преимуществам и препятствиям применения BIM для SFM, был проведен детальный обзор разнообразных исследований. В исследовании был использован опросник, в котором приняли участие 119 иракских специалистов в области строительной инженерии. Для ранжирования преимуществ и препятствий применялся индекс относительной важности (RII). Кроме того, для определения пяти наиболее значимых препятствий использовались статистические методы.*
Результаты. *В результате проведённого исследования были выявлены ключевые преимущества и препятствия внедрения технологии BIM в устойчивое управление объектами (SFM) в строительной отрасли Ирака. К основным преимуществам относятся упрощённый доступ к информации и документации, создание централизованной системы для управления техническим обслуживанием объектов и сокращение материальных отходов в период эксплуатации проекта. Среди значимых препятствий выделяются отсутствие кооперативной рабочей среды, сопротивление переходу от традиционных методов эксплуатации и недостаточная поддержка экологически ориентированных подходов со стороны высшего руководства.*
Обсуждение и заключения. *Эти результаты подтверждают необходимость разработки стратегий для преодоления препятствий и повышения эффективности внедрения BIM в SFM. Исследование предлагает рекомендации для развивающихся стран по оптимизации устойчивого управления объектами (SFM) через внедрение BIM, акцентируя внимание на факторах, способствующих его адаптации и улучшении управления объектами с использованием преимуществ технологии BIM.*

КЛЮЧЕВЫЕ СЛОВА: *информационное моделирование зданий (BIM), строительная отрасль, устойчивое управление объектами, SFM, преимущества BIM, недостатки BIM, Ираке*

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MEASURING ADVANTAGES AND CHALLENGES OF ADOPTING BIM FOR SUSTAINABLE FACILITY MANAGEMENT IN IRAQ

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ABSTRACT

Introduction. *BIM (Building Information Modeling) is one of the important examples of sustainable practices that the construction industry in Iraq has recently adopted. Many studies in recent years have discussed advantages and problems of BIM in architectural and construction (AEC) industry. However, there is a limitation in these studies in terms of finding out the advantages and challenges of BIM in sustainable facility management. The research aims to investigate the factors influencing the implementation of BIM for sustainable facility management (SFM) in Iraq's construction sector.*
Materials and methods. *A thorough review of a variety of research was done to determine the numerous factors that contribute to the advantages and obstacles in BIM for SFM. A questionnaire has been used to interview 119 Iraqi specialists in construction engineering. The relative importance index (RII) was used to rank the advantages and obstacles. Furthermore, the research employed statistical techniques to determine the five most important obstacles.*
Results. *Three key advantages of adopting BIM in SFM have been identified, particularly, facilitating access to the relevant information, ensuring accurate documentation, supplying a centralized and coherent system for managing construction maintenance, reducing material wastes during the project operation period. Besides, the following three most common obstacles have been distinguished: absence of a cooperative workplace environment, resistance of FM stakeholders to leave its traditional approach of operation, and insufficient support and attention of senior management to environmentally friendly methods.*
Discussion and conclusion. *The results obtained have demonstrated the need for strategies addressing the challenges and improving efficiency of BIM in SFM. The research provides stakeholders in developing countries with guidance to effectively SFM by promoting the factors that propel BIM adoption and improving facility management by leveraging BIM technology advantages.*

KEYWORDS: *building information modelling (BIM), construction industry, sustainable facility management, SFM, BIM advantages, BIM obstacles, Iraq*

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INTRODUCTION

By 2030, the architectural, engineering, and construction (AEC) sector is expected to contribute a substantial 15% of the global gross domestic product (GDP) [1], when the world's population is predicted to reach over 8.5 billion people [2]. City development is a significant relevance to the building sector. The building industry's materials serve as fundamental resources for society as well as various sectors of the economy by constructing necessary infrastructure and the external environment [3]. It is therefore anticipated that the effects on the economy will be greater than the direct contribution to GDP. In Europe, the construction sector is accountable for 40% of carbon dioxide emissions, 37% of energy usage, and 40% of waste production. The operation stage, which lasts the longest in a construction's lifetime, is when these issues mainly arise. With an operational life of 30 to 50 years, the operating stage accounts for 80 percent of the total cost and lasts approximately 5 to 7 times more than the design and building stages [4]. Providing high-quality services, optimizing costs, and reducing energy use and emissions of greenhouse gases all depend on efficient management of the operation and maintenance stage. Facility managers must use innovation in the management system to meet these criteria. The modern era has seen significant changes in the construction industry, and a lot of study is being done to increase excellence and productivity through applying new tools, techniques, and execution strategies into practice [5]. Building information modeling (BIM) is a novel approach that shows promise for the Architecture Engineering and Construction (AEC) sector which aims to efficiently design, build, and manage constructions in order to achieve the sector's long-standing quality objective [6]. Despite being around for a while, BIM has recently gained a lot of interest, as seen by the growing trend of its application in construction projects [7, 8]. The use of BIM to lower construction costs and speed up project delivery is a noteworthy example of a policy approach meant to achieve these objectives, as evidenced by the US and UK government's construction initiatives. It has been noted that several countries, such as the United States and Finland, require AEC businesses to provide BIM, or Industry Foundation Class (IFC) papers when they are carrying out government infrastructure projects [9]. BIM application in Iraq is still in its primitive stage and lacks legislative measures intended for its application in the building industry [10]. Furthermore, there is a lack of comprehensive research in Iraq related to BIM projects involving sustainable facility management (SFM).

Sustainability practices are essential for organizations as they have a massive influence on organizational success. According to [11,12], sustainability practice at the organizational level is about simultaneously meeting social and environmental requirements while also increasing the profitability of the company and seeking ethical business procedures as well as It also involves creating jobs that are sustainable and adding value for all stakeholders. In general, when an organization uses green, environmentally friendly, or sustainable resources, it is putting the sustainability concept into effect. In order to reduce the negative impacts on the environment, participants engaged in the development and management of constructions, particularly organizations, sprang into action to develop and operate structures in an environmentally friendly way. The purpose of facility management (FM) is to preserve the performance, comfort, safety, and functioning of a built environment while it is in use [13, 14]. The goal of SFM, is to decrease the adverse effects that buildings have on both the environment and its residents [15]. These methods are becoming more widely recognized as successful ways to promote the growth of the building industry [16]. Due to its dependence on modern technology and effective construction processes, BIM has been widely acknowledged as a promising avenue for offering significant benefits to the AEC sector [17]. Planning, designing, constructing, and managing buildings and infrastructure can be done more successfully with the use of building information modeling (BIM) tools [18]. A 3D digital representation of interior and exterior construction envelopes, together with mechanical, electrical, and plumbing components, are frequently included in models. According to Ahmad and Thaheem [19], collaboration is crucial to using BIM as a useful technique for the creation of sustainable systems and increasing the number of applications for sustainable building. BIM can provide major benefits to all project stakeholders by providing substantial resources over the sustainable building process [20]. Furthermore, at the project operation phase, BIM may produce and modify data on energy use and offer an effective information workflow [21]. Building Information Modeling (BIM) has promise in creating a structure for information exchange that encourages cooperation amongst many parties involved in the sustainable building process. This makes it easier for data to be exchanged, processed, and transformed within the BIM system, which in effect creates an optimal atmosphere for these kinds of activity [22].

Iraq's construction industry is among the largest in the Middle East, and there are numerous development projects in progress. As stated in "Iraq vision for Sustainable Development 2030," the country is dedicated to achieving its developmental goals. Although the sources that are provided do not specifically reference budgetary amounts, the vision highlights quantifiable objectives and important concerns including environmental sustainability, education, and a diverse economy. Thus, it is an appropriate time for the AEC sector in Iraq to adopt BIM in order to contribute to the global trend towards sustainable development that has been witnessed in countries like the US, the UK, and Finland. Even though there have only been a few studies on the topic, a thorough analysis of the literature shows that Iraq has not yet completely benefited from BIM's potential advantages for SFM [10, 23, 24]. It is unknown, though, what advantages and disadvantages there may be to using BIM in SFM. The aim of this research is to provide the basis for future investigations into Building Information Modeling (BIM) in Iraq by identifying possible research topics, gaps in the literature, and advantages and disadvantages of using BIM for SFM. In order to ascertain the advantages, challenges, and potential for BIM implementation in SFM, a questionnaire survey was carried out.

LITERATURE REVIEW

BIM Technology and Its Application

BIM has been in use in the architectural, engineering, and construction (AEC) industry for more than 20 years, and it is represented as a technical and practical revolution [25]. By processing CAD drawings, IT disrupts the method in which plans are produced in the building industry while saving a significant amount of time and accuracy. Datta et al. [26] demonstrate that BIM is a comprehensive technology that combines, expands, and cooperatively distributes all process and product data across the project stakeholders.

Nowadays, stakeholders are attempting to maximize the operational effectiveness of ongoing building activities for the purpose of guaranteeing the successful completion of construction tasks of the highest caliber. Many modern building projects are using BIM technology, according to current trends [27]. The discussion on BIM deployment is mostly focused on using technology to enable collaboration between various project stakeholders. Some academics have proposed that BIM tools provide a basis for bringing about a change in data management in the AEC industry [28]. On the other hand, others contended that effective BIM use requires technological upgrading in order to comply with the complex operational procedures of building assignments [29, 30, 31]. furthermore, the implementation of BIM technology, the design and construction stages are getting more academic attention nowadays. Emphasis has been placed on the immediate, observable results from the very beginning of the construction process, regardless of long-term advantages [32, 33, 34, 35, 36]. The most common application of BIM has been seen in the early stages, based on adoption levels; however, adoption and use for FM are still relatively new [37, 38], especially when considering the advantages, it offers organizations (as compared to projects). Furthermore, in light of the differences between the management of public funds and private organizations, the adoption of BIM offers an advantage that is significantly various from that of private organizations. As a result, there are several differences in BIM deployment, including training scalability. Stated differently, how can training be implemented at such an enormous scale, and who gets trained first—hospitals, educational institutions, or other public infrastructure—if the public sector is to supply it? These discrepancies support the need for additional research.

Advantages and Obstacles of BIM for FM

These days, the majority of contracts demand the delivery of printed documents that include inventories of equipment, product information sheets, guarantees, lists of replacement components, schedules for preventative maintenance, etc. Property owners and building managers need this information to assist their facility management. Currently, information is delivered to the operation and maintenance stage manually by traditional methods. Most of the time, the information delivered is insufficient and inaccurate [39]. One of the key goals of utilizing BIM in FM is delivery efficiency [40]. BIM data gathered throughout the construction process will lower the cost and time needed to gather and construct FM systems, considering the present interoperability issues [41, 42]. It is not necessary to duplicate data on assets when suppliers' information may be captured within 3D parametric objects [43]. BIM is thought to be a facilitator for enhancing data dependability and quality, which will lead to as more people become accustomed to working in a BIM environment, it will boost worker productivity and enhance data quality [41]. Additionally, it has been suggested that the use of BIM in FM will make it easier for facility managers to participate in the future from a very early design phase as well as a 6D BIM allows to monitor the condition of the building in real time [44, 45]. It is expected that the application of BIM in FM will offer methods for managing building process information that can be utilized in subsequent designs [46]. BIM technology and related tools, like as laser scanning, should decrease the cost and improve the accuracy and dependability of information produced for renovation construction [47].

Understanding the value of information in BIM and developing a successful BIM-FM framework, the first obstacle is managing the quality of data entry, particularly for existing structures that did not use BIM throughout the design and construction stages [48]. According to Khemlani, these data are frequently erroneous or nonexistent because the model is not an exact representation of the facility as it was constructed because it has not been updated with any architectural changes made during the design phase [49]. Another significant obstacle facing the FM sector is the cultural attitude to the adoption of novel methods and technologies. The facilities management sector is quite conservative when it comes to new technology; therefore, until the advantages of BIM for facilities management are effectively proven, its adoption rate will stay low [50]. The absence of BIM expertise and knowledge among facilities management specialists leads to the lack of client awareness [46]. Thus, these two elements work in concert to generate a vicious cycle that hinders the use of BIM in FM implementations. As BIM for FM purposes demands ongoing maintenance to maintain value for the construction and its owners, this is actually a highly serious challenge [50]. The majority of contract documents still need paper copies of product data sheets, guarantees, lists of replacement components, equipment inventories, preventative maintenance plans, and other paperwork. This frequently results in data that is hard to acquire and use in order to improve FM efficiencies.

Implementing BIM for FM in Iraq and Developing Countries

The operation and maintenance stage of projects is the longest stage in the construction life span [51]. According to Beddiar and Imbault, it makes up 74% of the whole cost, which includes power, renewal, and maintenance [52]. One of the building and real estate industries with the quickest growth is FM [53, 54]. A significant concern for both economic and environmental considerations is the requirement for effective management of buildings during the operation stage. Furthermore, a number of governments (such as those in the USA, and UK) have emphasized the necessity of revolutionizing the FM industry by accelerating the incorporation of digital technology [54, 55]. BIM technology has been applied in Iraq for more than twenty years, and was successfully incorporated into a number of large-scale projects, including Al Mina Stadium [56], Najaf Hospital [57], Karbala International Airport Project [10] and Central Bank of Iraq- CBI [58].

Figure 1 – Large construction projects in Iraq based on BIM [10, 56, 57, 58]

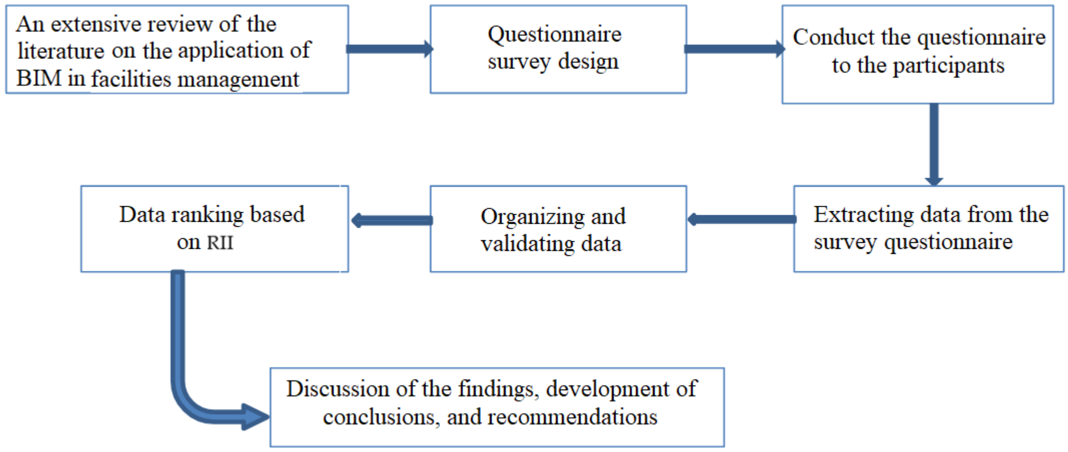

Figure 2 – Survey design
Source: compiled by the authors.

However, adopting BIM for sustainable facilities management is still in the beginning phases in Iraq because of a number of issues, including inadequate infrastructure, unstable government conditions, and a lack of qualified technical and professionals. Recent research indicates that inadequate government support for technology improvements and inadequate training investment are impeding Iraq's construction and building management industries, Because of this, even though BIM has been shown to improve sustainability and energy efficiency, its widespread popularity has been slow [59]. Furthermore, the incorporation of BIM into long-term facilities management techniques is limited in Iraq due to major obstacles in the availability of current data and resources [60]. On the other hand, the use of BIM technology has grown faster in other developing countries, such Africa and Latin America. BIM technology are being used by governments like South Africa and Brazil to further sustainability objectives. In order to enhance the sustainability of buildings and lower the environmental impact of new constructions, BIM has been involved for the public and private building endeavors in Brazil [61]. The use of BIM in South Africa has advanced significantly, mostly as a result of government regulations requiring the use of BIM in major projects in order to increase sustainability. With an emphasis on improving project outcomes through better design, less waste, and optimum energy usage in construction, the South African government's National BIM Strategy has played a key role in establishing the framework for BIM incorporation [62]. In addition to successfully adopting BIM, these countries have also achieved significant progress in workforce education and the development of their own expertise in sustainable facilities management [63].

MATERIALS AND METHODS

Questionnaire Design

The seven different parts that comprised the entire study effort are shown in Figure 2. These steps were taken in order to assess important issues regarding the advantages, obstacles, and other aspects of using BIM for sustainable facility management (SFM) in Iraq. It was found that the literature review and questionnaires were the most appropriate method for this kind of study. The survey was created using recent studies on FM and BIM in particular. As the main research method, a literature review was conducted to ascertain the extent and range of the present advantages and obstacles to the application of BIM in FM. The information gathered relates to both the Iraqi and international building industry. Furthermore, Google Scholar, and Scopus were chosen as the main databases for the factor collection procedure.

The study articles were more easily organized in the databases by using keywords like "building information modeling or BIM", "Sustainable facility management (SFM)","obstacles","advantages","-BIM in the Iraq construction industry," and "Global perspective of BIM and FM in AEC sector." After the study was analyzed, a questionnaire was created that took into account the literature as well as additional sources, as indicated in Table 1, and included 16 advantages and 14 obstacles to major considerations. The study articles that were selected for the survey design was organized using the years 2014 through 2024.

Data Collection

As earlier mentioned, a customized questionnaire was designed with the objective of collecting data by means of email and in-person interviews. The questionnaire was distributed to experts employed in the public and private building industries in Iraq. The survey consisted of three parts. The first part of the survey comprised fundamental demographic inquiries about the participants, including their age, sex, profession, and years of experience in the industry. Furthermore, the survey asked participants to rank 14 obstacles and 16 advantages. Using a Likert scale, the authors developed a survey in accordance with previous research [21]. Likert scale-based survey questionnaires are a good choice since they are simple to complete and produce accurate data based on participants' real experiences [2]. The study participants were requested to categorize their answers to a specific subject into five categories: strongly disagree, disagree, neutral, agree, and strongly agree. In the final section of the survey, participants were asked to provide their opinions regarding the most obstacles facing Iraqi facility management.

Most of responds came from recently constructed Iraqi sites. We needed six weeks to collect all of the information. Over half of those who participated had been in the building industry for more than five years, and the majority of the participants had knowledge in the subject. The questionnaires were completed by 130 individuals, and the answers were derived from their evaluations on a standard 5-point Likert scale, which revealed their opinions regarding the degree of significance. After removing datasets that were incorrect or unfinished, only 119 were left for analysis. This translated into a about 91.53% total response rate.

RESULTS AND DISCUSSION

Demographic Details

As shown in Table 1, the survey was given to 119 individuals from the construction industry who have Knowledge in sustainable practices involving in building projects. Among the respondents, there were the following participation percentages: 43.7%, 27.7%, 6.7%, 17.6%, 3.4% and 0.9% for site engineers, Other, project engineers, academics, design engineers and owners, respectively. Over 84% of the participants were older than 25 years of age. On the other hand, 40.4% of those surveyed had less than five years of professional experience in the construction sector.

Using Cronbach's Alpha for Reliability Analysis

According to the results of the Cronbach's alpha test for the advantages, the acquired value of 0.934, as shown in Table 2, was considered sufficient and fell within the category of "excellent" with regard to internal consistency.

Table 1

Participant data

Source: compiled by the authors.

Information about	Categories	Percentage
Gender	Male Female	71.4% 28.6%
Age	21-25 25-30 30-35 35-40 40 up	16% 30.3% 16% 10% 27.7%
Job title	Project engineer Design engineer Site engineer Owner Academic Other	6.7% 3.4% 43.7% 0.9% 17.6% 27.7%
Year experience	Less than 5 5-10 10-15 15-20 More than 20	40.4% 17.6% 11.8% 15.1% 15.1%

Table 2
Cronbach's alpha value for advantages
Source: compiled by the authors.

Number of items	Cronbach's Alpha for advantages	Category
16	0.934	Excellent

Table 3
Cronbach's alpha value for challenges
Source: compiled by the authors.

Number of items	Cronbach's Alpha for obstacles	Category
14	0.901	Excellent

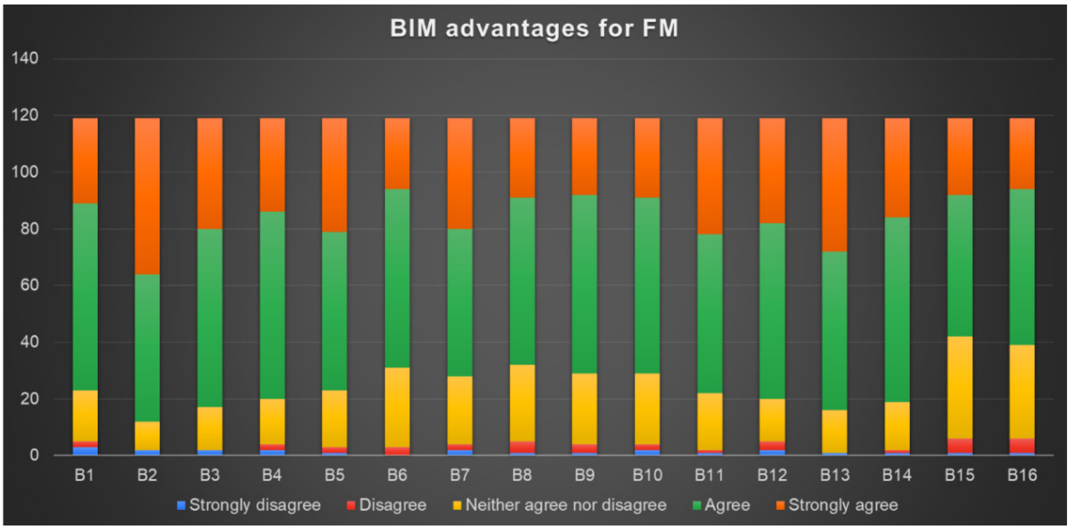

Figure 3 – Attitude to BIM advantages for project management
Source: compiled by the authors.

On the other hand, Table 3 shows a Cronbach's alpha test value of 0.901 for the obstacles. When it came to the data's internal consistency, the result was within the " Excellent" category.

Ranking of Advantages

Participants' responses to statements on their opinions about the advantages of adopting BIM, with 1 representing Strongly Disagree and 5 representing Strongly Agree, are shown in Figure 3.

The overall findings of the statistical analysis of all 16 advantageous criteria taken into account in the present study are shown in Table 4. The first column lists each component's identity. The overall relevance of each component was ranked using Equation (1) which represented the Relative Importance Index (RII). Table 4 additionally includes a list of the elements' means and relative ranking. The range of mean values was 4.32 to 3.81.

$$RII = \frac{\sum W}{(A \times N)}. \quad (1)$$

Where:

RII: Relative Importance Index.

∑W: Sum of all weights/scores assigned by respondents to a factor. A: Highest possible value on the rating scale.

N: Total number of respondents.

As shown in Table 4, "Facilitate the access relevant information, ensuring accurate documentation", "Supplying a centralized and coherent system for managing construction maintenance", "Promote the reduction of material waste during the project operation period", "Reducing the overall project costs", "Improving the management procedure throughout the entire life span of buildings". "Monitoring performance", "Enhancing construction performance", "Improved space management" and "Encouraging the use of clean energy efficient technology" were the most important advantages of integrating BIM into the building sustainable facility management (SFM) in Iraq. Moreover, all of these factors were considered high important level as their relative importance index (RII) were higher than 0.8. The key components of using BIM to create SFM in Iraq that had a middling level of advantage were then determined.

Table 4
BIM benefits ranking based on respondents' answers (n=119)
Source: compiled by the authors.

ID	Advantage	RII	Mean	Rank
B1	Support for effective resource management	0.798	3.991	10
B2	Facilitate the access relevant information easily, ensuring accurate documentation	0.865	4.327	1
B3	Promote the reduction of material waste during the project operation period	0.830	4.151	3
B4	Improved space management	0.811	4.058	8
B5	Monitoring performance	0.821	4.109	6
B6	Enhancing construction safety and health performance during maintenance and renovations	0.784	3.924	13
B7	Encouraging the use of clean energy efficient technology	0.808	4.042	9
B8	Improving the analysis of energy usage patterns and implementing sustainable strategies into practice	0.783	3.916	14
B9	Enhancing ventilation effectiveness	0.788	3.941	12
B10	Providing thermal building lifecycle analysis	0.788	3.941	11
B11	Reducing the overall project costs	0.826	4.134	4
B12	Enhancing construction performance	0.816	4.084	7
B13	Supplying a centralized and coherent system for managing construction maintenance	0.848	4.243	2
B14	Improving the management procedure throughout the entire life span of buildings	0.821	4.109	5
B15	Predicting energy savings	0.763	3.815	16
B16	Increasing building life	0.764	3.823	15

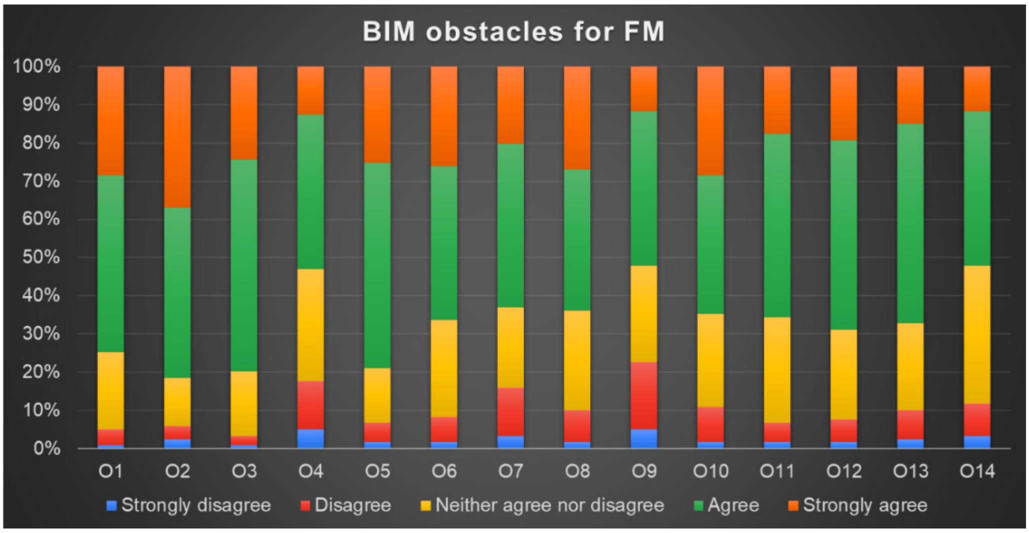

Figure 4 – Attitude to BIM advantages for project management
Source: compiled by the authors.

Among them, "Support for effective resource management", "Providing thermal building life-cycle analysis", "Enhancing ventilation effectiveness", and "Enhancing construction safety and health performance during maintenance and renovations", "Improving the analysis of energy usage patterns and implementing sustainable strategies into practice", "Increasing building life" and "Predicting energy savings". Their RII values, which ranged from 0.798 to 0.763, demonstrated the significant advantages of utilizing BIM to create a sustainable facility management. The similarity of these RII ranks was also noted in the mean value data, which showed relatively little differences in the weights of the various components. Therefore, the use of BIM in SFM resulted in significant advantages for each factor.

Ranking of the obstacles

Participants' responses to statements on their opinions about the obstacles of adopting BIM, with 1 representing Strongly Disagree and 5 representing Strongly Agree, are shown in Figure 4.

Table 5
BIM challenges ranking based on respondents' answers (n=119)
Source: compiled by the authors.

ID	Obstacles	RII	Mean	Rank
O1	Insufficient of senior management support and attention environmentally friendly methods	0.795	3.975	3
O2	Absence of a cooperative workplace environment	0.820	4.101	1
O3	The resistance of FM stakeholders to leave its traditional approach of operation	0.800	4.000	2
O4	High cost of implementation	0.686	3.429	13
O5	Insufficient depth of knowledge and proficiency to use BIM-FM related analysis software	0.792	3.958	4
O6	Uncertainties in contracts and a deficient legal framework	0.765	3.824	5
O7	Absence of skilled staff	0.728	3.639	11
O8	Project strategies, policies, and organizational issues	0.758	3.790	7
O9	High personnel training costs	0.672	3.361	14
O10	Absence of well-defined guidelines for application BIM for FM	0.761	3.807	6
O11	Inadequate guidelines for exchanging facility management information	0.750	3.748	9
O12	Lack of a comprehensive framework and application strategy	0.758	3.790	8
O13	Not enough information to properly record FM-related details	0.739	3.697	10
O14	Inaccurate predictions for the analysis of energy	0.697	3.487	12

The overall findings of the statistical analysis of all 14 obstacles criteria taken into account in the present study are shown in Table 5. The first column lists each component's identity. The overall relevance of each component was ranked using Equation (1) which represented the Relative Importance Index (RII). Table 5 additionally includes a list of the elements' means and relative ranking. The range of mean values was 4.10 to 3.361.

Furthermore, Table 5 demonstrates that "Absence of a cooperative workplace environment", "The resistance of FM stakeholders to leave its traditional approach of operation" were the most important obstacles of integrating BIM into the building sustainable facility management (SFM) in Iraq where their factors were considered to be of high importance with Relative Importance Index (RII) above 0.8. Moreover, the factors that were considered to be moderate obstacles were identified, among them, "Insufficient of senior management support and attention environmentally friendly methods", "Insufficient depth of knowledge and proficiency to use BIM-FM related analysis software", and "Uncertainties in contracts and a deficient legal framework", "Absence of well-defined guidelines for application BIM for FM", "Project strategies, policies, and organizational issues", "Lack of a comprehensive framework and application strategy", "Inadequate guidelines for exchanging facility management information", "Not enough information to properly record FM-related details" and "Absence of skilled staff". Their relative importance index ratings ranged from 0.795 to 0.728. It was additionally found that" Inaccurate predictions for the analysis of energy," "High cost of implementation," and " High personnel training costs " were among the barriers to use BIM in SFM that had less influence between the factors. Their relative importance index ratings ranged from 0.697 to 0.672.

RECOMMENDATIONS FOR ORGANIZATIONS LOOKING TO IMPLEMENT BIM TECHNOLOGY IN FM

Based on a thorough examination of data gathered from the Google Scholar and Scopus databases, the following strategic recommendations are proposed as a solution to the challenges faced in adopting BIM in FM:

- Policy and Standards: Governments and local organizations should establish clearer policies and standards to promote BIM implementation and support sustainability objectives [60]. as well as encourage the passage of laws that facilitate digital transformation, such as those pertaining to data protection, technology adoption requirements, and financial incentives.
- Invest in training and education: To improve professional skills and raise awareness of BIM's advantages for sustainability, extensive training programs are required [63]. Investing money into thorough training programs may help close knowledge gaps and guarantee that FM experts are adept at using BIM tools and procedures [64]. Provide training courses, conferences, and workshops on a regular basis to keep FM professionals aware of best practices and new developments in technology [65].

- Cooperation and communication: Enhancing stakeholder collaboration may improve the project's results as a whole, save time, and cut down on waste [66]. Using the BIM Execution Planning (BEP) Guide and the AEC (UK) BIM Protocol V2.0, will help improve cooperation and communication throughout the construction process, which is necessary for effective BIM adoption [58].
- Financial assistance and motivation: One of the obstacles to embracing BIM technologies was found to be high implementation costs. Offering financial assistance and motivation in the form of government grants, subsidies, or low-interest loans to companies investing in digital FM technology could assist in reducing the challenge and encourage wider use [65].

PRACTICAL OUTCOMES OF THE STUDY

There are several advantageous inferences that may be made from this study. To begin with, if the general acceptance of BIM is to rise, it must be supported by academics, government's stakeholders, and other building industry players. Despite a lack of knowledgeable and experienced professionals in the field of building information modeling (BIM), Iraqi academic curricula for built environment courses only include minimal BIM training. Construction industry academics are also strongly encouraged to support BIM, as they have a significant impact on students' BIM training. Furthermore, if fully adopted, BIM technology may reduce inefficiencies in the building industry and provide the way for the integration of other emerging technologies that are relevant to the construction industry. Lastly, by implementing the required changes to current policies, the government's stakeholders may show its support for BIM technology by creating an environment that facilitates its widespread application in the construction industry. The government's stakeholders may utilize the barriers that have been found in this study to increase the usage of BIM in the building industry in Iraq.

According to recent estimates, the Iraqi Ministry of Education stated that the country urgently needs over 12,000 additional schools to meet the increasing number of students—an approximate 3.2 million children are not attending school at the moment. To address this problem, the Iraqi government signed contracts with "Power China" and "Sino Tech" Chinese construction companies to construct 1,000 sustainable school buildings before the end of 2024 as part of an ambitious project to construct a total of 8,000 schools across the country. This program is consistent with the government of Iraq's endeavors to reconstruct the educational system following years of warfare. This study also helps ensure that these school buildings are developed properly and sustainably in the future.

CONCLUSIONS AND RECOMMENDATIONS

Recently, BIM technology has become a game-changing innovation for building sustainable facility management (SFM) in the AEC industry. Thus, the goal of the current study is to investigate the advantages and obstacles of using BIM for SFM in Iraq. A comprehensive review of the literature was done to determine the different aspects that lead to the advantages and obstacles of using BIM for SFM. The relative importance index (RII) is used to rank the advantages and obstacles. The key advantages of adopting BIM in SFM were "Monitoring performance (RII = 0.866)", "Enhancing construction performance (RII = 0.849)", "Improved space management (RII = 0.830)", "Support for effective resource management (RII = 0.827)", and "Support for effective resource management (RII = 0.822)". On the other hand, "Absence of a cooperative workplace environment (RII = 0.82)", "The resistance of FM stakeholders to leave its traditional approach of operation (RII =0.80)", "Insufficient of senior management support and attention environmentally friendly methods (RII = 0.795)", "Insufficient depth of knowledge and proficiency to use BIM-FM related analysis software (RII = 0.792)", and "Uncertainties in contracts and a deficient legal framework (RII = 0.765)" were the top five obstacles to implementing BIM building SFM in Iraq. There was also discussion on ways to reduce the obstacles, which include minimizing the high cost of resources, well-defined management systems, and worker training.

Theoretically, this work fills a knowledge gap and helps stakeholders understand the advantages of using BIM technology to construct SFM. It also serves as a helpful reference. This is the first investigation, as far as the authors are aware, that looks at how to determine advantages and obstacles to the broad application of BIM for SFM in Iraq. To assist stakeholders for operation sustainable building projects effectively, this research suggests applying a BIM-based research technique with ongoing, active projects. This study also implies that alternative frameworks can be created by researchers using the same collection of qualitative and quantitative data. Although the goals and objectives of this study were successfully met, it is not without its shortcomings. The initial caveat is that because the study was limited to Iraq, cultural differences may cause the findings to be different in other countries. In addition, the sample size of the quantitative study might be expanded to find out additional information regarding how to reduce obstacles to BIM implementation. Lastly, these caveats offer a way for further researchers to verify our findings through case studies of accomplished construction projects.

REFERENCES

1. Olanrewaju, Oludolapo Ibrahim, John E. Idiake, and Luqman Oyekunle Oyewobi. Global economic recession: Causes and effects on Nigeria building construction industry. *Journal of Surveying, Construction and Property*. 2018; 9-18. DOI: https://doi.org/10.22452/jscp.vol9no1.2.
2. J. L. a. T. W. Graham Robinson. A global forecast for the construction industry to 2030. 2021. https://www.oxfordeconomics.com/resource/future-of-construction/ (accessed)
3. Datta, Shuvo Dip, et al. Critical project management success factors analysis for the construction industry of Bangladesh. *International Journal of Building Pathology and Adaptation*. 2023. DOI: https://doi.org/10.1108/ijbpa-01-2022-0006
4. Messner, John. The lifecycle of a building project. *Fundamentals of Building Construction Management* 2022.
5. Datta, Shuvo Dip, et al. Assessment of crisis factors in the construction industry of Dhaka city in Bangladesh. *6th International Conference on Engineering Research, Innovation and Education School of Applied sciences & Technology*. SUST, Sylhet, Bangladesh. 2021.
6. Fitz, Daryn V., and Noha Saleeb. Examining the quality and management of non-geometric building information modelling data at project hand-over. *Architectural Engineering and Design Management.* 2019; 15.4: 297-310. DOI: https://doi.org/10.1080/17452007.2018.1560243
7. Assafi, Mohammad Nafe, et al. Development and validation of a framework for preventing and mitigating construction delay using 4D BIM platform in Bangladeshi construction sector. *Construction Innovation*. 2022; 23.5. DOI: https://doi.org/10.1108/CI-08-2021-0160.
8. Vilutienė, Tatjana, Arvydas Kiaulakis, and Darius Migilinskas. Assessing the performance of the BIM implementation process: a case study. *Revista de la construcción.* 2021; 20.1: 26-36. DOI: https://doi.org/10.7764/RDLC.20.1.26.
9. Jiang, Rui, et al. Government efforts and roadmaps for building information modeling implementation: Lessons from Singapore, the UK and the US. Engineering. *Construction and Architectural Management.* 2022; 29.2: 782–818. DOI: https://doi.org/10.1108/ECAM-08-2019-0438.
10. Hassan, Munaf Fouad, and Sajeda Kadhum Al-Kindy. Exploring the Challenges and Opportunities of BIM Implementation in Major Architectural Projects in Iraq. *International Journal of Sustainable Development & Planning*. 2023; 18.6. DOI: https://doi.org/10.18280/ijsdp.180619.
11. Ogunbukola, M. Sustainable Business Practices and Profitability: Balancing Environmental Responsibility with Financial Performance. ResearchGate; https://www.researchgate.net/publication/384291322_Sustainable_Business_Practices_and_Profitability_Balancing_Environmental_Responsibility_with_Financial_Performance. 2024. (accessed)
12. Hasanuddin, Bakri, et al. "Sustainable Business Practices: Integrating Environmental and Social Responsibility into Management Strategies." *Global International Journal of Innovative Research*. 2024; 1.3: 220–226. DOI: https://doi.org/10.59613/global.v1i3.36
13. Juhari, Mohammad Lui, et al. Developing a safety and health practices in building model of physical environment, facility management, and worker perception: Structural equation modeling approach. *Heliyon*. 2024; 10.22 DOI: https://doi.org/10.1016/j.heliyon.2024.e40396
14. Bortolini, Rafaela, and Núria Forcada Matheu. Facility managers' perceptions on building performance assessment. *Frontiers of Engineering Management*. 2018; 5.3: 324–333. DOI: https://doi.org/10.15302/J-FEM-2018010
15. Okoro, Chioma Sylvia. Sustainable facilities management in the built environment: A mixed-method review. *Sustainability*. 2023; 15.4: 3174. DOI: https://doi.org/10.3390/su15043174
16. Ahmadian F.F., Alireza, et al. BIM-enabled sustainability assessment of material supply decisions. Engineering. *Construction and Architectural Management*. 2017; 24.4: 668–695. DOI: https://doi.org/10.1108/ECAM-12-2015-0193.
17. Lu, Yujie, et al. Building Information Modeling (BIM) for green buildings: A critical review and future directions. *Automation in Construction*. 2017; 83: 134–148.
18. Ibrahim Azira, et al. "Building Information Modeling (BIM) in Green Building Projects. *International Journal of Academic Research in Business and Social Sciences*. 2023; 13.12: 418–425. DOI: https://doi.org/10.6007/IJARBSS/v13-i12/19849
19. Ahmad, Tayyab, and Muhammad Jamaluddin Thaheem. Developing a residential building-related social sustainability assessment framework and its implications for BIM. *Sustainable Cities and Society.* 2017; 28: 1–15. DOI: https://doi.org/10.1016/j.scs.2016.08.002.
20. De Carvalho, Adrieli Cristina Vieira, Ariovaldo Denis Granja, and Vanessa Gomes Da Silva. A systematic literature review on integrative lean and sustainability synergies over a building's lifecycle. *Sustainability.* 2017; 9.7: 1156. DOI: https://doi.org/10.3390/su9071156.
21. Datta, Shuvo Dip, et al. Investigation on the generation of construction wastes in Bangladesh. *International Journal of Construction Management*. 2023; 23.13: 2260–2269. DOI: https://doi.org/10.1080/15623599.2022.2050977.
22. Mi, Zihan, and Jiaxin Li. Maximizing project efficiency and collaboration in construction management through building information modeling (BIM). *Applied and Computational Engineering*. 2024; 72: 24–29. DOI: https://doi.org/10.54254/2755-2721/72/20240986
23. Mahdi, Mahmood Maad, and Dana Khider Mawlood. Challenges facing the implementation of building information modeling (BIM) techniques in Iraq. *Zanco Journal of Pure and Applied Sciences.* 2020; 32.4: 48–57.
24. Saeed, Yousif S. BIM technology strategies in designing sustainable cities. *Journal of Duhok University.* 2023; 26.2: 89–98. DOI: https://doi.org/10.26682/csjuod.2023.26.2.10.
25. Foster, John D., Jess W. Everett, and William T. Riddell. Compatibility of Sustainable Facility Management and Building Information Modeling Applications: *The Role of Naming Conventions. Sustainability*. 2023; 15.2: 1482. DOI: https://doi.org/10.3390/su15021482.
26. Datta S.D., Rahman Sobuz M.H., Mim N.J., Nath A.D. Investigation on the effectiveness of using

building information modeling (BIM) tools in project management: A case study. Rev. Constr. J. *Constr.* 2023: 306–320. DOI: https://doi.org/10.7764/RDLC.22.2.306.

27. GhaffarianHoseini A., Tien Doan D., Naismith N., Tookey J., GhaffarianHoseini, A. Amplifying the practicality of contemporary building information modelling (BIM) implementations for New Zealand green building certification (Green Star). *Eng. Constr. Archit. Manag*. 2017: 696–714. DOI: https://doi.org/10.1108/ECAM-02-2016-0043.

28. Yilmaz G., Akcamete A., Demirors O. A reference model for BIM capability assessments. *Autom. Constr.* 2019; 101: 245–263. DOI: https://doi.org/10.1016/j.autcon.2018.10.022.

29. Röck M., Hollberg A., Habert, G.; Passer, A. LCA and BIM: Visualization of environmental potentials in building construction at early design stages. *Build. Environ*. 2018: 153–161. DOI: https://doi.org/10.1016/j.buildenv.2018.05.006.

30. Oraee M., Hosseini M.R., Edwards D.J., Li H., Papadonikolaki E., Cao D. Collaboration barriers in BIM-based construction networks: *A conceptual model. Int. J. Proj. Manag.* 2019: 839–854. DOI: https://doi.org/10.1016/j.ijproman.2019.05.004.

31. Ansah M.K., Chen X., Yang H., Lu L., Lam P.T.I. A review and outlook for integrated BIM application in green building assessment. Sustain. *Cities Soc.* 2019; 101576. DOI: https://doi.org/10.1016/j.scs.2019.101576.

32. Cheng Qiuli, et al. Leveraging BIM for Sustainable Construction: Benefits, Barriers, and Best Practices. *Sustainability*. 2024; 16.17: 7654. DOI: https://doi.org/10.3390/su16177654

33. Bolshakov Nikolai, Alberto Celani, and Liliya Azhimova. Integrating BIM in operation and maintenance stage. Proceedings of FORM 2022: Construction The Formation of Living Environment. Cham: Springer International Publishing. 2022: 489–496. DOI: https://doi.org/10.1007/978-3-031-10853-2_46

34. Farghaly K., Abanda F.H., Vidalakis C., Wood G. Taxonomy for BIM and Asset Management Semantic Interoperability. J. Manag.Eng. 2018. DOI: https://doi.org/10.1061/(ASCE)ME.1943-5479.0000610.

35. Hassan H., Taib N., Rahman Z. Virtual Design and Construction: A New Communication in Construction Industry. In Proceedings of the 2nd International Conference on Digital Signal Processing, Tokyo, Japan, 25–27 February 2018; Association for Computing Machinery: New York, NY, USA, 2018: 113. DOI: https://doi.org/10.1145/3193025.3193062.

36. Lavikka R., Kallio J., Casey T., Airaksinen, M. Digital disruption of the AEC industry: Technology-oriented scenarios for possible future development paths. *Constr. Manag. Econ.* 2018: 635–650. DOI: https://doi.org/10.1080/01446193.2018.1476729

37. Teicholz P.M. BIM for Facility Managers; John Wiley & Sons: Hoboken, NJ, USA, 2018: 332. DOI: https://doi.org/10.1002/9781119572633

38. Le A.T.H., Domingo N., Rasheed E., Park K.S. Building Maintenance Cost Planning and Estimating: A Literature Review. In Proceedings of the 34th Annual ARCOM Conference, ARCOM 2018, Belfast, UK, 3–5 September 2018; Association of Researchers in Construction Management: Belfast, UK, 2018: 697–706

39. Rogage Kay, and David Greenwood. Data transfer between digital models of built assets and their operation & maintenance systems. *Journal of Information Technology in Construction*. 2020; 25: 469–481. DOI: https://doi.org/10.36680/j.itcon.2020.027

40. Carvalho, Ana Thereza, et al. BIM model to support O&M tasks. 2023.

41. Thabet, Walid, Jason Lucas, and Sai Srinivasan. Linking life cycle BIM data to a facility management system using Revit Dynamo. *Organization, technology & management in construction: an international journal*. 2022; 14.1: 2539–2558. DOI: https://doi.org/10.2478/otmcj-2022-0001

42. Jibrin I.M., et al. Application of BIM Implementation Process in the Operation and Maintenance of Information Management System in Building Facilities. *Environmental Technology and Science Journal*. 2024; vol. 14, no. 2: 42–50. DOI: https://doi.org/10.4314/etsj.v14i2.6.

43. Shen W., Hao Q. and Xue Y. A loosely coupled system integration approach for decision support in facility management and maintenance. *Automation in Construction*. 2012; Vol. 25: 41–48. DOI: https://doi.org/10.1016/j.autcon.2012.04.003.

44. Ilyinova V.V., Mitsevich V.D. International experience in using BIM technologies in construction. *Russian Foreign Economic Bulletin*. 2021; 6: 79–93. DOI: https://doi.org/10.24412.2072-8042-2021-6-79-93

45. Wei Muyun. BIM Driving Innovation in Construction Industry: Advancements in Building Lifecycle Management and Facility Management. *Advances in Economics, Management and Political Sciences*. 2024; 121; 1–6. DOI: https://doi.org/10.54254/2754-1169/121/20242291

46. Altwassi Esraa J., et al. From Design to Management: Exploring BIM's Role across Project Lifecycles, Dimensions, Data, and Uses, with Emphasis on Facility Management. *Buildings*. 2024; 14.3: 611. DOI: https://doi.org/10.3390/buildings14030611

47. Zhan Yuan, Yu Peng, and Changrong Xiong. Application of BIM in Renovation Design of Existing Buildings. *International Conference on Urban Climate, Sustainability and Urban Design. Singapore: Springer Nature Singapore*. 2023. DOI: https://doi.org/10.1007/978-981-97-8401-1_18

48. Le Hoai Nam, et al. BIM Related Technology Enabled Facility Management for Buildings: Challenges and Potential Research Directions. International *Journal of Sustainable Construction Engineering and Technology*. 2024; 15.4: 130–145. DOI: https://doi.org/10.30880/ijscet.2024.15.04.010

49. Khemlani L. BIM for facilities management, AEC Bytes. 2011.

50. Durdyev, Serdar, et al. "Barriers to the implementation of Building Information Modelling (BIM) for facility management. *Journal of Building Engineering*. 2022;46: 103736. DOI: https://doi.org/10.1016/j.jobe.2021.103736

51. Peng Yang, Jia-Rui Lin, Jian-Ping Zhang, et Zhen-Zhong Hu. A hybrid data mining approach on BIM-based building operation and maintenance. *Building and Environment.* 2017; 126: 483-95. DOI: https://doi.org/10.1016/j.buildenv.2017.09.030

52. Beddiar, Karim, et Fabien Imbault. BIM et énergétique des bâtiments. Dunod, 2017.

53. Ariffin, Khadijah Md, Sani Inusa Milala, and Rozilah Kasim. Facilities Management Business Opportunities. *International Journal of Sustainable Construc-*

tion Engineering and Technology. 2022; 13.2: 258–267. DOI: https://doi.org/10.30880/ijscet.2022.13.02.023

54. Wong J.K.W., Ge J., He S.X. Digitisation in facilities management: A literature review and future research directions. 2018; 92: 312–326. DOI: https://doi.org/10.1016/j.autcon.2018.04.006

55. SmartMarket Report. The Business Value of BIM for Construction in Major Global Markets; McGraw Hill Construction: New York, NY, USA, 2014.

56. Schumacher J., Otani R.K. Advanced computational modeling in multidisciplinary design. *In 20th Analysis and Computation Specialty Conference*. 2012: 231–244. DOI: https://doi.org/10.1061/9780784412374.021

57. Hamada H.M., Haron A.T., Zahrizan Z.Z., Humada A.M.. Implementation of 4D/BIM in the Iraqi construction industry. *International Journal of Engineering Systems Modelling and Simulation*. 2017; Vol. 9 (4): 227–236. DOI: https://doi.org/10.1504/IJESMS.2017.087556

58. Mohammed, Huda Saaduldeen, and Mustafa A. Hilal. Improving Building Information Modeling (BIM) Implementation throughout the Construction Industry. *Journal of Engineering*. 2024; 30.02: 85–104. DOI: https://doi.org/10.31026/j.eng.2024.02.06

59. Al-behadili, Karrar Abbas, Yusuf Mohamed Ali, and Elsheikh Asser. Using BIM for building maintenance management in Iraq. E3S *Web of Conferences*. 2023; Vol. 402. EDP Sciences. DOI: https://doi.org/10.1051/e3sconf/202340207007

60. Romanovich Marina, Albehadili Karrar Abbas, and Ali Yusuf Mohamed. Benefits and challenges of implementing BIM in the AEC industry in Iraq. *BIM in construction & architecture*. 2021. DOI: https://doi.org/10.23968/BIMAC.2021.001

61. de Assis Santos Wanderley, Ayanna Karina, Alberto Casado Lordsleem Júnior, and Joaquin Humberto Aquino Rocha. Requirements for BIM implementation in AEC companies: a Brazilian case study. *Revista de la construcción*. 2023; 22.2: 455–473. DOI: https://doi.org/10.7764/RDLC.22.2.455

62. Dywili, Siyabulela, Clinton Aigbavboa, and Didibhuku Thwala. Adoption of Digital Technologies by Built Environment Professionals: A Review from South African Context. *International Conference on Infrastructure Development in Africa.* Cham: Springer Nature Switzerland. 2023. DOI: https://doi.org/10.1007/978-3-031-69606-0_26

63. Kineber, Ahmed Farouk, et al. Challenges to the implementation of building information modeling (BIM) for sustainable construction projects. *Applied Sciences.* 2023; 13.6: 3426. DOI: https://doi.org/10.3390/app13063426

64. Babatunde Solomon Olusola, Chika Udeaja, and Adedayo Opeyemi Adekunle. Barriers to BIM implementation and ways forward to improve its adoption in the Nigerian AEC firms. *International Journal of Building Pathology and Adaptation*. 2021; 39.1: 48–71. DOI: https://doi.org/10.1108/IJBPA-05-2019-0047.

65. Alrubaidi, Mohammed. Evaluating the Effects of Digital Transformation on Facilities Management Projects in Saudi Arabia: Overcoming Challenges and Seizing Opportunities. *Open Journal of Civil Engineering*. 2024; 14.4: 536–569. DOI: https://doi.org/10.4236/ojce.2024.144030

66. Kineber, Ahmed Farouk, et al. Impact of overcoming BIM implementation barriers on sustainable building project success: a PLS-SEM approach. *Buildings*. 2023; 13.1: 178. DOI: https://doi.org/10.3390/buildings13010178.

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