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# Challenges and Opportunities in Implementing Building Information Modeling (BIM) in the UAE Construction Sector: A Project Management Perspective

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**ABSTRACT**

*This study investigates the use of Building Information Modelling (BIM) in the United Arab Emirates's (UAE) construction sector, highlighting its opportunities and challenges from a project management viewpoint. Despite BIM's potential to enhance efficiency and reduce waste, its adoption faces challenges such as resistance to change and lack of top management support. Through quantitative analysis with UAE construction experts, the research identifies key barriers and benefits, including cost savings and improved project timelines. It suggests that increasing BIM awareness, education, and top management support are crucial for its integration into construction practices, aiming to bolster BIM's role in sustainable construction. This contributes to understanding BIM adoption drivers in the UAE construction industry.*

## 1. Introduction

Building Information Modeling (BIM) is gradually being adopted in the United Arab Emirates (UAE) construction sector, crucial for the nation's development and economic activity. Despite the slow uptake due to a lack of awareness and collaboration issues, BIM's opportunities are recognized, especially since Dubai's selection to host EXPO-2020 [1]. BIM integrates data across specialities into a unified platform, enhancing efficiency and reducing waste [2]. The UAE, with the highest BIM activity in the Middle East at 77%, shows a 25% BIM uptake rate, which is significant compared to the USA and Western Europe [3, 4]. Currently, BIM usage in the UAE is limited to 3D visualization, with a low expertise level and reliance on traditional 2D methods. The

research aims to analyze BIM's value, implementation challenges, and impact on project management in the UAE construction industry [3].

The implementation of BIM in the UAE construction industry faces significant challenges despite its recognized benefits [5, 6]. Mehran [7] highlights that ineffective policies and practices, unclear cost-benefit analysis, technological lag, organizational growth, and mindset challenges impede BIM's effective implementation. These challenges include resistance to integrating contractors and suppliers in the early design phase due to increased costs, potential conflicts of interest, and limited negotiation flexibility. Additionally, technical issues like limited understanding of BIM's full capabilities, software challenges, lack of skilled personnel, and the cost of transitioning processes contribute to the industry's reluctance to fully implement BIM [7].

The UAE construction industry is expanding rapidly, influenced by government initiatives and the presence of international companies, leading to larger and more complex projects. However, inconsistent project management practices result in inefficiency and resource wastage. BIM, particularly through 4D and 5D modelling, offers significant potential for revolutionizing project management [8, 9] These models enhance planning and control by integrating time and cost dimensions, thus improving decision-making, reducing waste, and optimizing project execution. The research suggests that adopting BIM could significantly improve planning and control in the UAE's construction sector.

## 2. Literature Review

The UAE stands out for its enlightened leadership, adaptable legislation, cultural diversity, high living standards, and rapid growth in the construction industry, particularly after hosting Expo 2020. Dubai Municipality (DM) mandated BIM usage in specific construction projects, following the UK's lead in public construction projects. BIM adoption in the UAE began in the mid-2000s, evolving from a concept to a crucial element in construction. While awareness of BIM's opportunities exists, the lack of standardized procedures remains a primary challenge. Only 10% of the UAE construction sector is well-informed about BIM. To meet industry demands and global trends, UAE construction professionals must embrace BIM's implementation, recognizing its impact on all project stakeholders [10, 11, 12, 13, 14].

According to Zaini et al. [15], the increasing implementation of BIM is motivated by its ability to raise productivity and efficiency in the construction sector to innovative dimensions. Surprisingly, the UAE has seen rapid expansion in all areas over the past few years, with the construction sector continuing to play a key role in this growth. The Dubai Municipality's Circular No. 196, which states that BIM is to be implemented for the architectural and MEP work, established the initial requirement for BIM in the United Arab Emirates in 2013 [16].
Mehran [7] stated that BIM has offered a way to improve profitability and performance in the construction industry in the UAE. This claim is consistent with research by Olawumi and Chan [17], which states that the use of BIM in a specific construction industry helps stakeholders make well-informed decisions. According to a study by Venkatachalam [18], BIM is essential for constructing complex, environmentally friendly projects in the UAE construction industry. Even though Venkatachalam [18] additionally stated that the UAE is not as far in the process of implementing BIM as other developed countries like the US and the UK, where the main challenge is implementation. Mehran [7] further discovered that resistance to change in the construction

sector results from a lack of BIM standards and understanding, which contributes to the UAE's slow implementation of BIM in the sector. As a result, the UAE is still lagging when it comes to adopting and implementing BIM as an approach for improved efficiency and productivity. The implementation of BIM in the UAE is lagging due to several implementation challenges[18]. Despite some significant projects being done, the implementation of BIM in the UAE seems to be slow.

The construction sector has faced criticism for its traditional and inefficient work methods, marked by a lack of collaboration, poor communication, and unfavourable contract terms [19]. These shortcomings have led to inefficiencies in construction practices. BIM, a relatively recent innovation, has emerged as a solution to enhance construction sector performance. BIM offers opportunities such as improved design, visualization, communication, and project management throughout the project lifecycle [20]. Although the term BIM gained popularity after 2002, the underlying technologies have been in development for decades under the name "design management for a construction project." BIM implementation has been accelerated by software vendor marketing and the industry's desire to achieve performance-related goals through its implementation [21].

According to Eadie et al. [22], the majority of construction projects in the UAE are distinctive in that they provide many uncertainties and challenges. In general, projects in the UAE construction industry are very competitive, extremely fragmented, and risky, with certain specific technical challenges [23]. The UAE is home to many uncommon and distinctive construction projects, such as the 2010 completion of the world's tallest skyscraper, Burj Khalifa [24]. Even though the construction industry in the United Arab Emirates offers a substantial contribution to the national economy, it still faces a few significant challenges. These include significant challenges that impact not just the construction industry but the entire economy due to their scope and correlations to related projects and significant infrastructure projects.

BIM implementation in the construction industry presents both challenges and opportunities. While many challenges have been overcome with the advancement of interconnected systems, whilst several challenges persist. Research by various scholars, including [25, 26, 27], has categorized these challenges into sociocultural, financial, technological, management system, contractual, and legal challenges. These five categories are the primary barriers to effective BIM implementation in the construction sector [28, 29, 30]. This research investigated numerous challenges construction firms encounter while implementing BIM, as there is a shortage of published research on the issue of implementing BIM in the United Arab Emirates. The key challenges encountered when transitioning to a BIM from conventional design are compiled from the literature in the section that follows.

## 2.1 Implementation Challenges

### Sociocultural Challenges

Sociocultural challenges are a significant barrier to effective BIM implementation in the construction industry [25]. Resistance to change is a common human trait, particularly among stakeholders in construction projects [30]. Many individuals are experienced in traditional construction methods, making them resistant to altering their established practices. The lack of education and training in BIM further exacerbates this challenge [31]. Training costs, rapid software evolution, and the fear of change contribute to the reluctance to adopt BIM technology [27].

**Financial Challenges**

Financial challenges, including high costs for worker training and BIM software packages, hinder BIM implementation in construction [26]. These expenses at project initiation often outweigh the savings from streamlined documentation. Lack of financing or subsidies for BIM implementation, especially for small and medium-sized businesses, exacerbates the financial barrier [32].

**Technological Challenges**

Technological challenges hinder BIM adoption in the construction sector. According to Sacks [32], BIM is often used with inappropriate practices, and a lack of expertise in collaborative design and construction practices is evident. Inadequate training and awareness of the importance of incorporating simulated reality into design pose further challenges [33]. Bueno [34] stated that language barriers, unsuitable computer hardware in small and medium-sized businesses, and a lack of management commitment and willingness to collaborate with specialists hinder BIM implementation. The need for continuous hardware and software upgrades adds to the technological challenges [35].

**Managerial Challenges**

Management system challenges in BIM adoption include the organization's lack of understanding required for the transition, a lack of commitment and support from top management, and resistance to significant changes in workflow, responsibilities, and roles [29]. Transitioning to BIM may necessitate the establishment of new roles like BIM Manager, which can lead to resistance from existing roles [1]. Top management's reluctance to adopt BIM can significantly impact the success of the initiative [28].

**Contractual Challenges**

Contract procurement challenges in the construction sector arise from the dominance of conventional processes like Design, Bid, and Build (DBB), which are incompatible with BIM [36,37]. Shifting to integrated procurement systems like Design and Build (DB) or Construction Management at Risk (CMR) is recommended for BIM projects. Integrated Project Delivery (IPD) is considered the most suitable contracting method for BIM, as it promotes teamwork and enhances construction management productivity [1]. However, IPD adoption globally remains weak [38, 39].

**2.2. BIM Implementation Opportunities**

BIM offers numerous opportunities in the construction sector. It simplifies upgrades and allows continuous monitoring by modifying specific model views, enhancing coordination among building systems [40]. BIM accelerates the amount of design data and take-off, improving efficiency. It provides a virtual environment for 3D, 4D, and 5D modelling, simulating tasks impossible in reality [41]. BIM supports feasibility analysis, realistic planning, design, and procurement [42]. Interactive BIM design enhances supply chain efficiency and simplifies project-level workflows [43]. BIM contributes to sustainability by reducing material requirements, promoting recyclable resources, and improving daytime assessments [44]. Overall, BIM facilitates lean construction project management strategies, as demonstrated in research conducted [44].

BIM offers various advantages in sustainable architecture. It promotes energy-efficient design, building structure optimization, and adaptive reuse evaluation. BIM reduces energy and water

consumption through environmental impact assessment [45]. It enhances project management by reconfiguring procedures and incorporating stakeholders through waste minimization, decision postponement, quick deployment, authenticity, and team empowerment [46]. BIM benefits residential structures with warranty tracking, retrofitting planning, and supply chain integration for precise estimates [47]. This contributes to improved project management performance in terms of time, money, and budget.

## 3. Methodology

This research strategy uses statistical data gathered through quantitative approaches to analyse the concepts and principles presented in the reviewed literature [48]. To illustrate data processes, findings must be presented quantitatively [48]. The survey sample comprised construction professionals based in the UAE who were selected at random to represent the entire population. An efficient way to communicate with the public was to use social media platforms to announce the questionnaire and encourage participation. The current research employed a combination of primary data obtained via online questionnaires in the UAE construction sector and secondary data sources, including statistical evidence, census reports, books, journals, academic publications, and websites, to offer a more complete and rounded view of the research. The systematic review of responses to both multiple-choice and closed-ended questions was part of the data analysis process. To accommodate different research objectives, the questionnaire was separated into three separate sections. Expert backgrounds and perspectives on BIM's potential benefits and challenges in the UAE construction sector were discussed in the sections. Likert scale items were included in the questionnaire, which was completed by 41 respondents. A 5-point Likert scale was used to evaluate the significance of opportunities and difficulties, and a similar measure was used to evaluate the relevance of opportunities. The Statistical Package for Social Sciences (SPSS 26) and Microsoft Excel Spreadsheet were used to aid in the quantitative descriptive analysis of the survey data from the construction industry.

## 4. Result and Findings

Demographic information from the UAE construction experts, including education, occupation, organization type, and experience, was collected in section A of the questionnaire and analyzed systematically.

### 4.1. Respondent's Background

The respondent's background encompasses a diverse group of construction industry professionals, including engineers, project managers, and architects, with varied years of experience and affiliations with different types of organizations such as construction companies, design firms, and government agencies.

Table 1. Respondent's Background of the UAE construction experts

| Variables | Frequency | Percentages |
|---|---|---|
| **Qualification** | | |
| Doctorate Degree | 3 | 7.3 |
| First Degree | 24 | 58.5 |
| Masters Degree | 14 | 34.1 |

| **Profession** | | |
|---|---|---|
| Architect/Designer | 5 | 12.2 |
| Engineer (Civil/ MEP) | 11 | 26.8 |
| Planner | 3 | 7.3 |
| Project Engineer | 7 | 17.1 |
| Project Manager | 4 | 9.8 |
| Quantity Surveyor / Estimator | 11 | 26.8 |

The backgrounds of 41 respondents from the construction industry are shown in the table. The majority (58.5%) have a first degree, which is followed by master's degrees (34.1%) and doctoral degrees (7.3%). In terms of profession, the bulk are Quantity Surveyors/Estimators and Engineers (Civil/MEP), each making up about 26.8% of the sample. Architects/designers and project managers comprise smaller percentages, 12.2% and 9.8%, respectively, compared to 17.1% for project engineers. With a 7.3% representation rate, planners are the least. Figures 1 and 2 show the illustration.

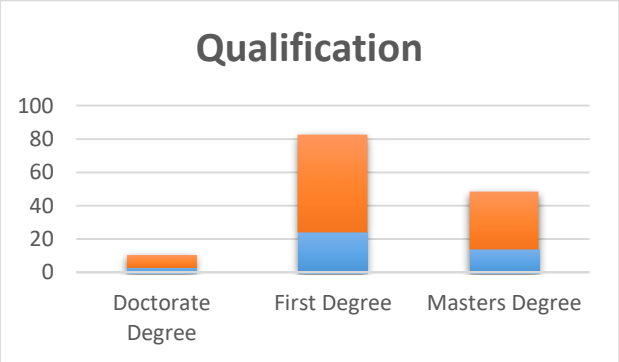


**Figure 1. Respondent's Qualification**

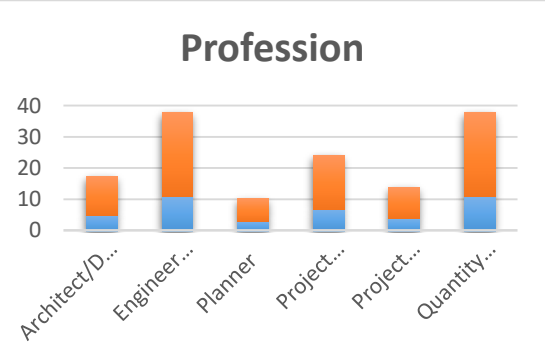


**Figure 2. Respondent's Profession**

### 4.2. The ranking of BIM implementation challenges

The ranking of BIM implementation challenges, along with the calculation of the Relative Importance Index (RII), is presented in Table 2. The RII indicates the significance of these challenges. The table was organized based on the highest RII value for a detailed analysis of the results.

Table 2. BIM Implementation Challenges Ranking

| **BIM Implementation Challenges** | **Total Number (N)** | **A*N** | $RII = \frac{\sum W}{A \times N}$ | **Rank** |
|---|---|---|---|---|
| Resistance to change. | 41 | 205 | 0.912 | 1 |
| The old-style approach of construction. | 41 | 205 | 0.854 | 2 |

| | | | | |
|---|---|---|---|---|
| Significant changes to the workflow. | 41 | 205 | 0.712 | 3 |
| Lack of top management commitment and support. | 41 | 205 | 0.58 | 4 |
| Lack of awareness of the significance of incorporating BIM. | 41 | 205 | 0.566 | 5 |
| Lack of education and training. | 41 | 205 | 0.512 | 6 |
| The cost of worker training. | 41 | 205 | 0.512 | 6 |
| Lack of skilled experts. | 41 | 205 | 0.507 | 7 |
| Lack of organisation understanding. | 41 | 205 | 0.493 | 8 |
| Contract Procurement. | 41 | 205 | 0.473 | 9 |
| The exorbitant cost of BIM software packages. | 41 | 205 | 0.444 | 10 |
| Unsuitable computer hardware. | 41 | 205 | 0.366 | 11 |

The primary objectives include examining challenges in BIM implementation in the UAE construction industry. In Table 4.8, the top five challenges are ranked: (1) resistance to change, (2) conventional construction approaches, (3) workflow changes, (4) lack of top management support, and (5) undervaluing BIM. Challenges such as lack of education, training, and cost, as well as issues related to expertise, organizational understanding, and hardware, were considered less relevant based on participant responses, suggesting they have a limited impact on BIM implementation.

### 4.3. Ranking Opportunities for BIM Implementation

The ranking of BIM implementation opportunities, along with their relative importance index (RII), is presented in Table 3. The RII indicates the significance of these opportunities. The table has been rearranged to provide a detailed analysis based on the highest RII value.

**Table 3.** Opportunities for BIM Implementation Ranking

| Opportunities for BIM Implementation | Total Number (N) | A*N | $RII = \frac{\sum W}{A \times N}$ | Rank |
|---|---|---|---|---|
| Increase project profits. | 41 | 205 | 0.917 | 1 |
| Reduce construction costs. | 41 | 205 | 0.912 | 2 |
| Reduce project duration. | 41 | 205 | 0.883 | 3 |
| Reduce rework. | 41 | 205 | 0.824 | 4 |

| | | | | |
|---|---|---|---|---|
| Reduce document errors and omissions. | 41 | 205 | 0.82 | 5 |
| Maintain repeat business. | 41 | 205 | 0.722 | 6 |
| Market new business. | 41 | 205 | 0.698 | 7 |
| Offer new services. | 41 | 205 | 0.683 | 8 |
| Reduce cycle times and specific workflows. | 41 | 205 | 0.668 | 9 |
| Fewer claims or litigation. | 41 | 205 | 0.634 | 10 |
| Staff recruitment and retention. | 41 | 205 | 0.424 | 11 |

The top five most significant BIM implementation opportunities in UAE construction projects, ranked by importance, include increased project profits, reduced construction costs, shortened project duration, minimized rework, and decreased document errors and omissions. Other factors such as maintaining repeat business, marketing a new business, offering new services, reducing cycle times, fewer claims or litigation, and staff recruitment and retention were rated as less significant, indicating they have a limited influence on BIM implementation opportunities according to participant responses.

### 4.4. Discussion

The article focuses on how Building Information Modelling (BIM) is being used in the construction industry in the United Arab Emirates, emphasising the challenges and opportunities from the perspective of project management. The study finds significant challenges that prevent the effective implementation of BIM, including resistance to change, traditional methodologies, and lack of management support.

However, it lists potential benefits that BIM can provide, such as increased efficiency, cost savings, and reduced project timelines. The results highlight the need for strategic ways to address these challenges, with a focus on the importance of top-level management support, education, and training in creating a supportive environment for BIM integration. This study offers a roadmap for stakeholders to fully utilise BIM adoption to improve project outcomes and sustainability. It also provides insightful information about the dynamics of BIM adoption.

## 5. Conclusion

The top five challenges to BIM implementation are highlighted by the research, which was carried out in the UAE construction industry. These challenges include resistance to change, traditional construction methods, workflow changes, lack of top management support, and undervaluing BIM. It also lists the five main benefits of adopting BIM, including increased project profits, cost reduction, shortened project duration, minimized rework, and fewer document errors. Indexing of relative relevance was applied to the results. The results of the research will help decision-makers prioritise tackling the important problems and challenges found in the research, which will facilitate the application of BIM in sustainable construction projects.

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