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BRIDGING THE GAP: ADVANCING BIM ADOPTION IN THE JORDANIAN CONSTRUCTION SECTOR

Ibrahim Moh'd Saraireh

Assistant Prof., Al-Zaytoonah University of Jordan, Faculty of Engineering and Technology, Civil and Infrastructure Engineering Department, Amman, Jordan, Email:i.saraireh@zuj.edu.jo.

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ABSTRACT

The Jordanian construction sector faces persistent fragmentation, delays, and inefficiencies despite its vital role in national development. Building Information Modeling (BIM), widely recognized as a solution to such challenges, remains underutilized in Jordan. This study aims to investigate the current state of BIM adoption, identifies key barriers and drivers, and assesses potential benefits to propose a localized framework for digital transformation. The methodology involved a quantitative survey of 443 professionals was analyzed using Relative Importance Index (RII) and descriptive statistics, with high reliability (Cronbach's α = 0.937). Results revealed major barriers: lack of BIM awareness (RII = 0.745), limited training centers (RII = 0.729), and insufficient government support (RII = 0.706). Key benefits included improved 3D visualization (RII = 0.854), successful project execution (RII = 0.845) and improved decision making (RII = 0.831). The study recommends government BIM mandates, training centers, and curriculum integration to advance sustainable adoption and enhance project performance.

KEYWORDS

Building Information Modeling (BIM), construction sector, digital transformation, contractual issues, sustainable construction.

1. INTRODUCTION

The construction industry is recognized as a key engine in economic growth in nations and one of the fastest growing markets in the world. Many countries have declared this sector as one of the most challenging ones which still has issues like budget overruns, delays in project completion and conflicts (Kumar and Kumari, 2025). At the national level, construction industries in Jordan accounted for approximately 54,924 jobs and accounted for about 7.7% of the Jordan's total economy in 2015. Jordan's construction sector, however, faced significant problems in productivity with the sector falling from 88.5 percent in 1997 to 68.1 percent in 2008 in public sector and 89.8 percent to 79.4 percent in 2009 in the private sector respectively (Zurub, 2024). In the years from 2003 to 2008, other comparative studies have identified continued issues with construction delays and cost overruns in public sector construction projects (Ghaleb and Ahmed, 2025). The Jordanian construction industry is very disaggregated, suffers from uncertainty and inefficiency. Further, the sector has a low innovation level, with over half of the non-innovations reported in 2010 (Gómez-Cabrera et al., 2024). There are many estimation methods that are widely used, and they often lack the sophistication and efficiency they require; in fact, about 75% of construction projects are still estimated using spreadsheets (Abu-Reishah and Hiyassat, 2023).

Universally, struggles have been made to discover the embracing of (BIM) in the construction sector, emphasizing its growing worth in recent architecture and infrastructure development (Tanko et al., 2024). BIM has been proven to be very effective in improving information integration between different team members, optimizing general business processes, increasing productivity, and reducing the complexity, uncertainty, conflicts and fragmentation typical of traditional construction techniques (Aburumman et al., 2024). The industrial segmentation and lack of clarity in building regulations and codes, suboptimal flows and the absence of innovation are among the challenges faced and are common to the UK construction industry (El Hajj et al., 2023) that hinder progress in Jordan. Obstacles during construction phases for regional development programs have also been systematically assessed (Al-Marsomi & Al-Zwainy, 2023).

Understanding the importance of these challenges, a comprehensive five-year action plan has been put together and disseminated to systematically tackle these challenges, especially on the use of Building Information Modeling (BIM) as a transformative tool to bring the industry to a more efficient operational framework (Xia et al., 2022). This project aims to accelerate the adoption of BIM in the construction industry in Jordan by developing a local BIM adoption framework that addresses the local and regional requirements. The framework allows building companies of any size to audit themselves to check how ready they are for BIM, and points out the possible benefits and room for improvement in implementing BIM. The focus of this review is on Jordan's construction industry, and it seeks to classify the currently in place standards that govern the functioning of this industry and highlight the issues that must be addressed to achieve meaningful progress. The attention then shifts to Building Information Modeling (BIM) technology, which is examined on the following parameters: Basic concepts, different applications, the state of the market, the key points for implementation and experiences learnt from real-life applications from all over the world. In addition, a special theoretical approach was selected to support and help in the BIM integration process.

This review will focus on Jordan's construction industry and seek to classify the current standards governing the industry and highlight the key challenges that must be overcome to achieve meaningful progress. The focus then moves to the Building Information Modeling (BIM) technology, where the basic concepts of BIM are explained, its applications are discussed, the state of the BIM market are presented and key conditions for the successful implementation of BIM are outlined, as well as the experience from the world with BIM case studies. Furthermore, the theoretical framework, specifically designed for supporting and strengthening the efforts towards BIM integration, was carefully chosen and put together.

Researchers conducted several studies on the adoption of BIM in the international context, but very few empirical studies have been conducted in Jordan. Previous research has focused on conceptual frameworks or individual technical applications, but has not focused on contractual dimensions, stakeholders' readiness, or regulatory issues. This study is unique because it is the first to make a large scale quantitative evaluation (443 valid responses) which combines contractual, organizational, and policy aspects. This enables it to create a local implementation framework for the construction industry in Jordan and thus close an essential gap in existing literature.

2. LITERATURE REVIEW

With a lot of discussion and research in the construction and architecture industry, a key element, which is quite extensively studied and discussed, is the Building Information Modeling (BIM) framework for intelligent construction (IC) (Liu et al., 2021). During the last several years there have been a number of studies and case studies that concentrated on BIM tools, their development, efficiency and innovative implementation in the area of architecture, engineering, construction (AEC) and facilities management (FM) (Wang et al., 2024). Recent studies highlight the role of digital modeling and BIM-based automation in improving cost estimation and project efficiency (Aldhamad et al., 2025; Alazawy et al., 2024; Abbas & Al-Zwainy, 2024). Furthermore, several studies on BIM workflows indicate a strong emphasis on collaboration and data management. As time advances, the roster of advantages linked to construction initiatives employing BIM continues to grow and adapt (Godager et al., 2021). In the minds of many, BIM (Building Information Modeling) profoundly enhances project results across several valuation processes throughout a project's lifecycle (Matarneh and Hamed, 2017). Also, BIM has further been explored in claims management and knowledge modeling contexts, highlighting its strategic integration into project management (Aljumaily et al., 2022; Jasim et al., 2021).

The marketplace serves as a primary application, the "shell" that encompasses the complete tech stack, where users can consume products or services directly via a B2C or on-platform store sales channel that runs from a single instance in the platform version of that instance that is acting as the "shell."The current discussion on such frameworks attempts to offer useful suggestions for the use of BIM technologies and their all-encompassing impact on construction design and administration (Bilov et al., 2023). The emphasis on Industrialized Construction (IC) and off-site methodologies illustrates a shift in the industry towards sustainability and new approaches in the technological field (Tran and Nguyen, 2024). It is immediately necessary to examine the literature which is already available, related to BIM, with care. To deepen the understanding of these technologies and the wide range of applications for them in different areas of the building industry. As it would seem from one quick glance, something of value may be learned from this by (both) the big brands and the students that attempted to understand the high-end, never-to-be-possessed.

The lessons are applicable to the superstars and students that found themselves increasingly overwhelmed by the fast-paced and ever-changing elite world. By exploring BIM, stakeholders can better achieve its potential and foster a culture of continuous improvement and strategic growth for the use of AEC. Construction academic research starts with the identification of errors and/or omissions in the current body of knowledge and moves to the development of well-defined questions to be addressed in a more rigorous way. In a way this is a big step forward from a random strolling of ideas to focused goals. The collaborator that drives the process towards consensus on scope and depth of knowledge and towards the future needs of the industry is Frameworks. We want to help define the importance of those frameworks to the industry, beyond just as a blueprint, but as a catalyst for innovation and transformation. To sustain a culture of continuous learning and development, it is crucial to include common practices and methods into the BIM systems. The construction industry is constantly changing, and its supporting frameworks need to evolve to be responsive to the challenges and opportunities that are emerging (Alshehhi et al., 2024). A proactive attitude and active listening are necessary to be able to identify main problems in BIM implementation. This approach underscores the importance of disseminating knowledge, experience and data gained from past and current projects to maximize productivity and enhance individual and group knowledge. This can lead to considerable progress in the construction industry, especially regarding issues such as sustainability and digitalization, and artificial intelligence. The importance of continued research and exploration is emphasized, as it will continue to influence how construction practices evolve in the future, and it is recommended to have an integrative approach that combines theoretical knowledge with practical application (Kordestani Ghalenoei et al., 2024). Also, critical success factors in regional development programs have been extensively modeled using structural equation approaches (Aldhamad et al., 2025; Alazawy et al., 2024; Abbas & Al-Zwainy, 2024).

The skill related to Building Information Modeling (BIM) and its applications in the Architecture, Engineering and Construction (AEC) industry have been analyzed in detail. This study gives an overall view of the impact of BIM and detailed case studies of selected pilot projects for BIM (Chowdhury et al., 2024). Further research focuses also on the strengths, limitations and potential misuses of one of the most common methods used for existing structures, being the 4D BIM approach. The study presents the updated BIM as the basis for future operational management practices and its benefits, as well as the problems faced in implementing it. Furthermore, the major aspects of the BIM implementation process are clearly expressed to increase awareness of the operational potential and further issues related to BIM.

The development of a transformative framework specifically designed for construction and architectural design industry has been carefully built based on a comprehensive assessment and integration of existing scientific research on Building Information Modeling (BIM) (Kordestani Ghalenoei et al., 2024). This framework clearly shows the complex interaction between BIM technologies, principles and methodologies and how it is shaping the evolution of the architecture, engineering, and construction (AEC) industry. Also, Oloto and Adebayo (2023) developed a Sustainable Adoption Support Framework (ASF) to optimize prefabrication adoption in Nigeria’s housing industry, providing insights that can inform broader construction technology adoption such as BIM. The importance of BIM to this shift can't be overstated; BIM offers an in-depth, comprehensive grasp of BIM technologies and its underlying concepts. Furthermore, information collected from the construction industry and previous studies have highlighted the fundamental role BIM is playing in changing the fundamental construction processes, building design processes, and main topics in the field of BIM research (Obi et al., 2021). The framework capitalizes on these learnings to ensure that theory and practice are unified and coherent resulting in a more cohesive approach to the implementation of BIM technologies in today's construction industry.

There is a growing number of materials in the international literature about BIM and there is little empirical research conducted on BIM adoption in Jordan. Most current studies concentrate on theoretical background or specific technical applications without considering the preparedness of stakeholders, regulatory issues, and contextual issues (Matarneh and Hamed, 2017; Obi et al., 2021). This gap highlights the need for more localized research that takes into account the industry-specific drivers, barriers, and strategic enablers in the Jordanian construction industry.

2.1. BUILDING INFORMATION MODELLING (BIM)

The term BIM, which stands for Building Information Modeling, is a catch-all term that means different things to different people, organizations, companies, and software providers in the industry. Each of these groups brings its own unique viewpoint, leading to a diverse array of definitions and applications of BIM within the industry (Wang et al., 2024). I believe the NBIM (National BIM Standard) offers a concise statement for BIM: “A digital representation of physical and functional characteristics of facilities.” This definition allows for a base of justification for how Building Information Models might offer qualities of more than just another digital representation.” It also serves as a collaborative knowledge repository, thereby offering a dependable basis for making well-informed decisions at every stage of a building's lifecycle (Wang et al., 2024). The undeniable boon of this collaborative model is a consequence of the various players involved in the construction project. (Aldhamad et al., 2025; Alazawy et al., 2024; Abbas & Al-Zwainy, 2024 ; Oloto & Iweka, 2022) .

According to (Ahmed, 2025), sustainability of the construction and building industry taken a priority. Novel techniques are refining how projects are constructed and how they perform, as this sector continues to evolve rapidly. This transformation, which comes from an innovative digital environment, namely BIM or Building Information Modeling, is a highly detailed digital model that documents the complete performance attributes of a building. It's also easier ways to design, but design for others, and design for designers, too, to get people working together. With BIM becoming a cornerstone of the industry, data management will continue to play a significant role, striving to ensure smart decisions at every stage of the project. When combined with other technologies like cloud computing and data analytics, BIM can be even more effective, ensuring that teams can collaborate seamlessly and receive information in real-time (Ahmed et al., 2024). The use of BIM is proving to be game-changers to the basic process of work in building & built environment, as improved effectiveness & efficiencies, while at the same time sustainability is contributing to virtually a complete rethinking towards a more modern building paradigm (where efficiency is the rule and precision is the key) with the future in mind. With the changing architectural landscape, the need to make the most of BIM will be one of the main pillars for excellence in building design and management (Abdelalim et al., 2024; Aldhamad et al., 2025 Alazawy et al., 2024; Abbas & Al-Zwainy, 2024).

Building Information Modelling enriches with understanding of its multi-faceted nature including various ways of representing information. Building Information Modeling Global is defined by the American Society of Civil Engineers (ASCE) as: “an intelligent 3D virtual model of a facility that is used by many, with different interests, across its life cycle.” This explanation puts more focus on the collaborating and smart properties of BIM that can be leveraged to make the model useful to different project stakeholders throughout the facility's lifespan (Alnaser et al., 2024). 3D modeling is at the heart of BIM, acting as a versatile collaborative platform that seamlessly combines diverse data from different fields. These include 3D geometry related to architecture, structure, and mechanics but also relevant analytical elements needed to simulate, forecast costs, and verify the compliance with the applicable building regulations (Wang et al., 2023). With so much information in digital format, backed by a variety of software programs used by architects and engineers, visualization becomes easier. It is essential to be aware, however, that there are some features that are more aligned with a particular BIM application and are, therefore, more effective and adaptable to the BIM framework in current usage in the field of architecture (Chowdhury et al., 2024; Aldhamad et al., 2025; Alazawy et al., 2024; Abbas & Al-Zwainy, 2024).

By enabling multiple stakeholders to effectively visualize the complex 3D structure of a building and exchange valuable knowledge and information, BIM technologies help create a collaborative environment for the building. The sophisticated models significantly enhance clients', facility managers' and other stakeholders' engagement in the entire design, construction and operations phases (Cheng et al., 2024). This method helps these people to move from being passive observers to active and confident actors in the process. For this reason, the construction industry is experiencing a great digital transformation, as has been seen in other industries, such as Printing and Publishing, Music and Entertainment, Education, Retail and other industries (Chowdhury et al., 2024). The central principle of this transformative change is 3D Modeling for Building Information, a revolutionary digital model that is changing the fundamental way buildings are conceived, designed, constructed, operated and eventually dismantled. Usually, the process begins with basic 3D modelling tools and gradually evolves with the addition of more advanced features as the organization becomes more knowledgeable and capable (Nikolic et al., 2021). Those capabilities can encompass inbuilt models and sophisticated simulations from data. This constant stream continues until the complete utilization of Building Information Management (BIM) for visualization, integrated data flow, intricate 3D designs, comprehensive analysis, and better digitization collaboration among all stakeholders (Radzi et al., 2025).

3. IMPLEMENTATION ROADMAP FOR BIM IN JORDAN

This paper offering an all-inclusive and joined framework to smooth the active integration of BIM in the speedily growing construction sector in Jordan. However, it's not enough to demonstrate faux-empathy toward BIM and its expressions – it's required to show an understanding of the underlying strategic methodologies and approaches needed to be successful with BIM. This know-how is crucial to ensure that BIM has the maximum possible impact on the entire project and in the overall industry productivity to achieve better project results (Abdelalim et al., 2024). The framework is tailored to the unique and specific issues of the Jordanian building industry, and the thorough analysis underpinning the framework creates a solid base for a strategic approach to tackle the multifaceted issues at hand (Saleh et al., 2024). The pre-conceptualized framework is amorphous in the following three main phases: planning, implementation, and evaluation. There are many key stages in individually staged, which need to be implemented, organized and thought through in a systematic fashion to yield the most favorable outcomes in various project settings. Moreover, the framework emphasizes stakeholder engagement and extensive training as key elements for the sustainable BIM technology development adoption to be successful in the context of modern construction companies in the future. Engaging everyone involved in a project is essential, particularly from the outset of the planning process, as project managers, architects, engineers, contractors and clients are all key stakeholders (Alnaser et al., 2024). Such engagement helps to build a team culture, where everyone involved in the project can learn about all the great advantages of BIM and also get to grips with their particular concerns, questions and reservations that they may have about moving away from old workflows.

In general, the proposed system categorizes a collection of imaginative and utilized approaches that attempt to the unresisting struggle to change that many individuals within the construction sector express when it comes to implementing new technologies and practices. It is hoped that by attentively dealing with these concerns, and by promoting an environment of sensitivity and understanding, the program will seek to embed the "by implementation with bridge design simulation" practices into common operating procedures. This project will not only improve operational efficiency, but also serve as support for current strategic planning and project

delivery outcomes, essential in this modern fast-changing construction environment on.
Besides, the amalgamation of methodical comment apparatuses, continuous assessments and necessary adjustments facilitates the gradual adaptation of the strategic framework. The adaptation is based on the insights gained, observations and experiences as a result of the continuous implementation of BIM Model, a digital representation of the physical and functional characteristics of a project (Hossain et al., 2024). For a variety of projects, ranging in size and complexity (Wang et al., 2024). Creating an environment of support and collaboration is essential, focusing on knowledge sharing, teamwork, and open communication, which helps to reduce the risks that arise from change and promotes the sustainability of BIM practices in the ever-changing landscape of the Jordan construction industry. This is therefore also a strategy that will ease and encourage the use of BIM and provide a solid foundation for ongoing future growth, perception and development in the industry. Its goal is to embrace flexibility in adapting to new challenges and opportunities as they arise in the construction arena, ultimately leading to a stronger and more effective industry that continually evolves while meeting the needs of society (Asaad & Suleiman 2025; Aldhamad et al., 2025; Alazawy et al., 2024; Abbas & Al-Zwainy, 2024).
The issues of monitoring matters were discussed in detail and it was concluded that the lack of adequate rules and detailed guidelines will most likely affect the broad implementation of this type of building modelling. There are a number of employments in the building sector that can be engaged in construction designing, with construction modeling being one of them. It is crucial to develop a well-defined and strong regulatory structure to support the construction sector's effective shift towards advanced digital technologies. It is advisable to complement the use of these new technologies with the inclusion of additional benefits or specific commitments of the stakeholders involved; not only on their own personal judgment (Alhorani et al., 2024). The strategic framework also covers all key elements and is poised to substantially enhance project delivery effectiveness and promote sustainability in Jordan's construction sector. Furthermore, the comprehensive dialogues provide a glimpse into the potential for this comprehensive approach to be an important enabler for larger international projects that plan to implement BIM or other technologies into new markets throughout the globe. The speed of technological advancements is ever increasing and each of us must be reminded that it is essential to learn, adapt and evolve with these very contemporary technologies, in a cooperative way.
Building Information Modeling (BIM) has been identified as a crucial component of Intelligent Construction (IC), and is well established for its benefits in improving collaboration,

information management and outcomes in Architecture, Engineering, and Construction (AEC) industries (Liu et al., 2021; Wang et al., 2024). In addition to being helpful in reducing conflicts and enhancing design quality and workflow efficiency, BIM has been identified as being beneficial in many other ways, when combined with 4D/5D simulations and facilities management (Godager et al., 2021; Chowdhury et al., 2024).

3.1. Importance of BIM in Construction

BIM has converted a main and transformative power in project management in the construction industry. While its acceptance has been steady and somewhat restricted, especially in developing regions where resources can be constrained, it is globally recognized as a formidable tool that offers a wide range of benefits (Zhou et al., 2024). BIM is demarcated as a standardized three-dimensional digital representation of buildings and structures that can be used to enhance collaboration, coordination, and communication among everyone involved in the creation, construction, operation, and maintenance of built assets. In this review, we will explore the various advantages or benefits that BIM can bring to construction processes, particularly in terms of enhancing productivity and streamlining work processes.

The approaches presented in the two sentences are slightly different, which is taken into account when preparing the solution. Please let me know if you would like a different output approach. As the project complexity increases, the need for an integrated approach becomes paramount, and BIM emerges as a solution that bridges the gaps between different project phases and stakeholders (Khan et al., 2024). By implementing BIM, it helps guarantee precise delivery of clinical services and enables better governance, visualization and decision-making throughout the lifecycle of the projects. By doing so, integrating the BIM ecosystem with cutting-edge technologies such as artificial intelligence and operational intelligence will drive construction performance standards higher. By leveraging real-time data and insights, stakeholders can proactively address potential challenges and mitigate risks before they escalate into major issues (Rashidi et al., 2024). The modern construction industry will be able to use BIM as the basis for innovation in formulating innovative delivery and sustainability strategies.

Building Information Modeling (BIM) has been a game-changer in the construction industry, streamlining operations, increasing productivity, and promoting better collaboration among various parties involved in the project. The integration of BIM into project management practices is a revolutionary transformation in the construction industry, moving beyond the current reliance on traditional 2D drawings and paper-based records to a more holistic, efficient, and flexible approach (Yilmaz et al., 2024). The construction industry has many challenges, the chief among them being the multiple relationships between stakeholders that often lead to significant performance problems, inefficiencies and complexities when the projects are executed. However, over the last many decades, a combination of extensive research and careful analysis has proven that the adoption of digitization and improvements in information management practices can help overcome fragmentation and disarray in this field and achieve efficiencies. In this context, Building Info. Modelling (BIM) is a game-changing technology that holds the potential to significantly contribute to the advancement of built environment (Abdelalim et al., 2024). BIM technology is proving to be very beneficial to a broad range of organizations involved with a variety of design fields. This includes architects, structural engineers, MEP (mechanical, electrical, plumbing) engineers, detailers, construction teams, operations and maintenance teams after the project is complete.

The impacts of economic downturns in the construction sector can have a domino effect on the broader economy, and the sector itself is also highly sensitive to these declines. During these periods, the clients may drastically reduce their expenses, thus leading the construction companies to take different steps to lower the cost. This may result in reduced employment and human resource limitations, which ultimately has a negative impact on the capacity to make strategic investments and enhance business resilience, operational efficiency and long-term competitiveness (Diaz Schery et al., 2024). Given these challenges, there is strong case for the use of The acronym for Building Information Management (BIM) technology. Many research projects have indicated that BIM can have a substantial impact on the cost of projects, as well as the amount of rework and errors. Plus, BIM has been linked to improved service delivery and project management efficiencies. (Alnaser et al., 2024). Moreover, BIM, Building Information Modeling can be considered as a facilitator to build a sustainable built environment. When it comes to construction, sustainability can also involve specific environmental goals that can be measured — such as reducing carbon dioxide (CO_2) emissions and waste. This therefore makes deep insight into the life cycle of resources aka understanding the whole professional works responsible for the servicing of resources with resource efficiency focus, the absolute and efficient approach to hasten sustainability by all means. It demands new management approaches, based on data and knowledge, and advanced information technologies (Al-Raqeb et al., 2024). In this aspect, BIM is seen as a technology that helps to manage inputs and outputs of resources in a better way over the entire project life cycle.

The use of advanced frameworks and standardized protocols improves communication and collaboration among project stakeholders, leading to a more shared understanding of the complexities and processes involved in construction projects. In addition to that, the designed elements' structured representation consisting of distinct rules and instructions would spur on the compliance and checking procedures to be automated. Concurrently, minimises risk of adverse outcomes and error associated with project delivery process throughout the project life cycle. Clear, precise communication is emphasized, thereby optimizing operations and emphasizing the importance of teamwork and collaboration in the complex construction environment when problem solving is needed. The industry's development requires the adoption of these improved practices, in which everyone needs to be united on goals and ready for the many challenges that arise. Finally, this strategic integration results in better project performance, and also contributes to the development of a culture of continuous improvement in this industry (Ishola et al., 2024).

BIM's dynamic 3D capabilities are revolutionizing project planning and coordination. It allows for collaborative work of stakeholders in real time, better cost estimation, simulation of design options, and better sustainability performance (Cheng et al., 2024; Wang et al., 2023). The advantages are especially noticeable in large projects with multiple and complex components involving coordination between disciplines.

4. CHALLENGES AND OPPORTUNITIES IN IMPLEMENTING BIM IN JORDAN

In this section, we delve into an extensive strategic framework for the implementation of "In the construction industry, the process of negotiating various aspects of a building project has become increasingly complex. With buildings being constructed much more rapidly than in the past, project teams are gathering together in an 'integrated project team' to communicate about design and construction." "Building information modeling (BIM)" - The new tools of construction, including Building Information Modeling, provide improved information for collaboration between parties and better designs to deliver the integrated building in a more sustainable manner." - BIM allows for better coordination and integration from the start of a project, according to a course run by the University of Dundee (Almayyahi et al., 2025). This, in turn, allows for better efficiencies and, ultimately, better value throughout the project's lifetime. technology specifically in the construction industry of Jordan.

The embracing of BIM is vital for providing the touch. As leaders in 4IR, BIM is integral to the essential digital transformation of construction. Leveraging BIM, organizations can leverage a multitude of advantages, ranging from increased overall productivity to improved integration of design and construction workflows to fostering better collaboration between various stakeholders (Ottaviani et al., 2025). As in Iraq, earlier foundational contributions assessed BIM managers' performance, historical architectural development, and barriers to BIM adoption in Iraq (Al-Zwainy, 2018; Abuarkub & Al-Zwainy, 2018; Al-Zwainy et al., 2017a; Al-Zwainy et al., 2017b; Al-Zwainy et al., 2016). Additionally, BIM helps to reduce the mistakes and omissions that often impede construction projects and produce better results. Even so, the building industry in Jordan has adopted BIM technology at a painfully slow rate, in spite of its numerous benefits. Hence, it is essential to gain more understanding into the strategic implementation of BIM technology in the construction sector in Jordan. This understanding is key to creating and implementing successful strategies to manage a sustainable digital transformation in the sector.

This comprehensive study has three primary objectives, all aimed at enhancing understanding of Building Information Model is a process that involves creating and managing data related to a building's physical and functional characteristics.: first, it seeks to thoroughly assess the current landscape, challenges, and potential opportunities related to the effective implementation of BIM technology; second, it aims to create a structured strategic framework that supports the adoption of BIM technology across various sectors; and third, it strives to provide a detailed road map to guide practitioners and stakeholders in the execution of the proposed strategic framework (Al-Raqeb et al., 2024).

A comprehensive literature search was diligently conducted to provide information to support these aims, with the emphasis placed on any barriers for progress and opportunities for improvement (Oluwole, 2022). The review involved a discussion of the strategic frameworks that have been developed in other contexts, and an overview of what has been successful in the past. Furthermore, semi-structured interviews were carried out with a wide range of built environment professionals with extensive knowledge and experience in the adoption of BIM (Hatami and Rashidi, 2025).

Despite its proven benefits, BIM implementation faces several challenges in developing countries. These include lack of training infrastructure, resistance to change, high software costs, and limited government regulation or incentives (El Hajj et al., 2023; Adeniyi et al., 2024). In the Middle East, particularly in Jordan, these barriers are compounded by institutional inertia and fragmented project delivery systems (Alwashah et al., 2024).

5. STUDY METHODOLOGY

To meet the study’s objectives, the researchers adopted a quantitative approach, using a closed-ended questionnaire to collect and analyze data. This method was chosen to obtain measurable, statistically analyzable results from a broad sample of workers in Jordan’s construction sector. The questionnaire was developed based on a thorough review of relevant prior studies. Experiment management frameworks in engineering and science provide methodological foundations for structured project evaluation (Risan, Al-Azzawi & Al-Zwainy, 2024b).

The questionnaire was distributed to engineers with professional experience in the Jordanian construction sector, where 570 questionnaires were distributed and only 443 questionnaires were completed and returned. The participants' files and responses to the questionnaire were analyzed as shown in the following sections, thus the number of valid questionnaires for analysis reached 443 questionnaires representing 77.71%. Also, all items in the current study have a Cronbach's alpha coefficient of more than 0.7, and the overall Cronbach's alpha coefficient is 0.937, which indicates excellent and high internal consistency of the factors used in this study, and thus this means that the data collected for the study are reliable and acceptable with a high level of reliability (Yavuz et al., 2025).

Beyond Cronbach's Alpha, which confirmed internal consistency ($\alpha = 0.937$), external validation of the data was partially achieved by comparing key findings with prior regional and international studies (Matarneh & Hamed, 2017; Rinchen et al., 2024). This comparative validation demonstrated alignment in terms of top-ranked barriers and benefits. Future studies will expand validation using expert interviews or focus groups to further triangulate the questionnaire data.

The variation observed among samples is attributable to differences in the professional roles and project experiences of the respondents. A stratified sampling approach was utilized to include engineers, contractors, and consultants. While this diversity introduces some variability, it enhances representativeness and reflects the real-world heterogeneity of the industry.

The sample used in this study was purposefully diverse, encompassing a broad cross-section of professionals across the Jordanian construction sector, including engineers, contractors, consultants, and project managers. This diversity was intentional to capture varying perspectives on BIM adoption across different organizational roles and project scales. However, while this heterogeneity enriches the dataset and enhances generalizability, it also introduces inherent limitations in terms of consistency and interpretability of certain responses. Moreover, the study primarily relied on a structured questionnaire.

6. DATA COLLECTION

The collection of research information is related to the key goal and aims of the research, and the data applied in the study must be sufficient to obtain the goal of the study. There are two key classes of data; secondary data, while the other type is primary data. The secondary data in this research supported the main purpose, which is to explain the study problem. On the other hand, according to (Priya et al., 2022). The questionnaire was used in the current research as a main tool for data collection, and accordingly, the developed questionnaire was distributed to the construction sector in Jordan to achieve the study objective.

This research contains three sections, the first section aims to gather background information about the participants, the second section depends on seven main subsections, which cover obstacles in the construction industry, current contractual issues, and the status of BIM in the Jordanian construction sector. In addition, the last section includes BIM adoption strategies, the organization's readiness to adopt BIM, the amendments required to the construction contract to adopt BIM, and the information requirements of the employer.

7. RESULTS AND DISCUSSION

In this research, the relative importance index (RII) was applied to rank each item in a specific part of the questionnaire to assess the levels of contractual problems and obstacles facing the construction industry in Jordan, the potential benefits of BIM, BIM barriers, BIM drivers, and other items in the questionnaire content.

In general, the results in Table 1 suggest a widespread prevalence of contractual problems across the Jordanian construction sector, as indicated by the clustering of RII values between 0.63 and 0.75. This pattern reflects systemic issues such as communication gaps, inconsistent documentation, and ambiguity in contract terms. While CP1 ranked highest, the narrow RII range implies that all issues are of comparable concern and deserve equal attention in reform efforts. These conflicts lead to changes in the design, drawings, and specifications in the contract documents, which requires more time and cost (Azzam et al., 2025). The standard deviation for CP11 (SD = 1.052) is notably higher than for other items, indicating substantial variability in responses. This could be due to differing interpretations of this item among respondents based on their roles and project types. It suggests the need for refining this question in future surveys.

Table 1. Mean, SD, RII and rank of contractual problems in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
Contractual problems of construction industry (CP)	CP1	3.700	1.020	0.753	1
	CP2	3.640	1.030	0.728	2
	CP3	3.460	1.131	0.694	7
	CP4	3.210	1.210	0.633	12
	CP5	3.520	1.119	0.705	4
	CP6	3.330	1.178	0.667	11
	CP7	3.470	1.178	0.695	6
	CP8	3.360	1.172	0.673	10
	CP9	3.470	1.118	0.696	5
	CP10	3.370	1.166	0.678	9
	CP11	3.620	1.052	0.726	3
	CP12	3.430	1.146	0.687	8

The Jordanian construction industry faces a wide range of obstacles, and participants were asked to articulate these obstacles. The results in Table 2 reflect that all identified obstacles are perceived as moderately to highly significant, with RII values ranging from 0.602 to 0.761. The consistent mid-to-high ratings suggest a widespread recognition of institutional and procedural weaknesses, particularly in contract quality and coordination, across the Jordanian construction industry. Furthermore, the results shown that the highest RII value (0.761) was found for obstacle OB1 (weak construction contract), while the lowest value (0.602) was observed for obstacle OB7 (unclear roles and responsibilities between parties). All items fall within the high to medium importance level as suggested by (Alwashah et al., 2024).

The following table presents the key obstacles encountered in the Jordanian construction sector as revealed by survey respondents.

Table 2. Mean, SD, RII and rank values of obstacles facing the construction sector in Jordan

Construct	Items	Mean	SD	RII	Rank
Obstacles of construction industry (OB)	OB1	3.750	1.020	0.761	1
	OB2	3.490	1.178	0.698	3
	OB3	3.340	1.172	0.668	4
	OB4	3.270	1.195	0.645	5
	OB5	3.530	1.119	0.707	2
	OB6	3.160	1.213	0.632	6
	OB7	3.020	1.224	0.602	7

The main part of respondents, as determine in Table 3, indicated that direct procurement is the most common delivery method in Jordan. The analysis shows that the RII value of traditional direct procurement is 0.872, which is the highest value compared to other methods. This result is consistent with the findings of (Boniface et al., 2024) who reported that traditional direct procurement is the most common and preferred method in the public sector. Moreover, the RII ranked direct procurement as the second most common method, while project management and integrated procurement approaches are the lowest two approaches compared to other methods. So, these findings illustrate a dominant reliance on traditional direct procurement methods, as evidenced by the notably higher RII value of 0.872. In contrast, alternative procurement approaches remain underutilized, pointing to a conservative preference in project delivery strategies. The following table provides a summary of the most frequently used project delivery methods in Jordan's construction industry.

Table 3. Mean, SD, RII and rank values of projects delivering methods in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
Project delivering methods (PD)	PD1	4.01	1.045	0.872	1
	PD2	2.17	0.930	0.436	2
	PD3	2.15	0.785	0.433	3
	PD4	2.00	0.674	0.401	4

As determined in Table 4, the maximum RII value (0.657) was found for BIMA3 (BIM system facilitates cooperation between project stakeholders), while the lowest value (0.392) was noted for BIMA2 (BIM is being adopted in the construction sectors in Jordan). According to the RII rankings, BIMA1 (I am familiar with BIM) was placed third, with an RII value of (0.608). Moreover, 56.6% of the respondents stated that they are familiar with BIM, which indicates a relatively low awareness of BIM technology in the Jordanian construction sector. This finding is also consistent with the findings of studies in the South Australian construction industry conducted by (Adeniyi et al., 2024), which concluded that there is not much awareness of BIM and its benefits in the construction industry in South Australia.

As stated above, we can said that the results indicate that most barriers to BIM adoption fall within the medium to high importance range, with top concerns being lack of awareness, training centers, and government support. This points to systemic challenges that require intervention at both policy and educational levels. Thes findings as determine in the following table outline the main barriers that hinder the adoption of BIM as perceived by the participants.

Table 4. Mean, SD, RII and rank of BIM barriers in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
BIM barriers (BIMB)	BIMB1	3.680	1.019	0.745	1
	BIMB2	3.620	1.028	0.729	2
	BIMB3	3.440	1.131	0.688	6
	BIMB4	3.190	1.210	0.635	9
	BIMB5	3.500	1.119	0.706	3
	BIMB6	3.310	1.178	0.661	8
	BIMB7	3.450	1.178	0.690	5
	BIMB8	3.340	1.172	0.667	7
	BIMB9	3.450	1.118	0.690	4

Table 5 shows the BIM barriers and the overall importance of RII values from the respondents' perspectives. Thus, the top three RII values and most significant BIM barriers in the Jordanian construction industry, which were ranked at RII importance level (high to medium), include lack of BIM awareness (RII = 0.745), lack of BIM training centers (RII = 0.729) and lack of support from the government (RII = 0.706). While the bottom three RII values for BIM barriers are cost of software (RII = 0.687), resistance to culture of change (RII = 0.681) and absence of national standards (RII = 0.635. Moreover, lack of BIM specialist in Jordan ranked ninth (RII = 0.635). It can be concluded that the awareness of BIM among participants varies widely, with relatively low RII values overall. This underscores the urgent need for awareness campaigns, especially since BIM familiarity is fundamental to successful adoption and implementation. The following table highlights the levels of BIM awareness among stakeholders within the sector.

The results of the RII test as shown in Table 6 specify that the three main benefits of BIM include 3D visualization, successful project execution and improved decision making. The mentioned benefits were ranked at RII importance level (high). These results are similar to the results reported by (Matarneh and Hamed, 2017), where 85% of the participants believed that BIM can improve visualization in Jordanian construction projects, enhance design plan options. In addition, reduce delays, lower costs, and maximize profitability and productivity.

So, we can said that the results show that respondents widely acknowledge the benefits of BIM, particularly in terms of visualization, data sharing, and conflict detection. All items score relatively high RII values, suggesting a strong perception of BIM as a value-adding tool within the sector. The following table summarizes the benefits associated with BIM implementation as identified by the respondents.

Table 5. Mean, SD, RII and rank of BIM awareness in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
BIM awareness (BIMA)	BIMA1	3.040	1.234	0.608	3
	BIMA2	1.970	1.075	0.392	7
	BIMA3	3.170	1.160	0.657	1
	BIMA4	2.950	1.299	0.591	4
	BIMA5	3.150	1.067	0.632	2
	BIMA6	1.990	1.072	0.398	5
	BIMA7	1.980	1.020	0.397	6

While Table 6 shows that 3D visualization, successful project execution and improved decision making were ranked highest, respondents also valued other BIM benefits such as as-built drawings, data sharing, and conflict detection, which scored slightly lower but still within the high-importance range.

Table 6. Mean, SD, RII and rank of BIM benefits in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
BIM Benefits (BIMB)	BIMB1	4.140	.822	0.827	4
	BIMB2	3.830	0.901	0.762	8
	BIMB3	4.150	0.840	0.831	3
	BIMB4	4.260	0.782	0.854	1
	BIMB5	4.060	0.910	0.811	6
	BIMB6	3.800	1.001	0.760	9
	BIMB7	4.120	0.972	0.823	5
	BIMB8	3.780	0.940	0.756	10
	BIMB9	3.950	0.970	0.791	7
	BIMB10	3.780	0.860	0.756	11
	BIMB11	4.230	0.783	0.845	2

The main drivers of BIM adoption in Jordan were ranked according to the RII results as shown in Table 7. Government efforts have the highest RII value (0.671), which means that it is an important driver of BIM. This finding is strongly supported by (Al-Mohammad et al., 2024), who stated that the government should make efforts to bring about changes and adjustments for BIM adoption. In addition, (Rinchen et al., 2024)conducted a study and showed that BIM adoption suffers from a major obstacle due to lack of support from the government. Then, cooperation between all parties was ranked second, while efforts of construction associations were placed third with an RII value (0.462).

The prior outcomes highlight the essential role of government as the leading driver of BIM adoption, followed by cooperation between stakeholders. The overall moderate RII values suggest room for strengthening these drivers through institutional collaboration and regulatory action. The table below presents the driving factors that facilitate BIM adoption in the local construction sector.

Table 7. Mean, SD, RII and rank of BIM drivers in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
BIM Drivers (BIMD)	BIMD1	3.300	1.362	0.671	1
	BIMD2	2.310	1.071	0.474	3
	BIMD3	2.020	1.051	0.408	5
	BIMD4	2.210	0.997	0.446	4
	BIMD5	2.530	1.178	0.558	2

There are several factors that influence BIM adoption in the construction industry in Jordan. The research results indicated that BIM adoption strategies and organizational readiness were the main issues that influenced BIM adoption in any location. As shown in Table 8, BIMS3 (developing the contract by making BIM technology mandatory in government projects) was ranked as the first effective strategy for BIM adoption in construction projects, with an RII value of 0.718. Moreover, BIMS4 (developing academic teaching of BIM) was ranked last, with an RII value of 0.550. These results are similar to the findings of Mohammed (2018). It can be said that the above strategies are of great importance as a roadmap for facilitating BIM adoption in the construction industry in Jordan. In below results, the RII rankings reveal that policy-driven strategies such as mandating BIM in public projects hold the most promise for accelerating adoption. Academic reform and contractual adjustments are also noted as pivotal, albeit currently underdeveloped. The following table highlights the strategic actions considered effective for enhancing BIM adoption in Jordan.

Table 8. Mean, SD, RII and rank values of BIM adoption strategies in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
BIM adoption strategies (BIMS)	BIMS1	3.360	1.386	0.672	2
	BIMS2	2.930	1.431	0.587	3
	BIMS3	3.580	1.282	0.718	1
	BIMS4	2.760	1.398	0.550	4

Technology is very essential for BIM adoption, and it is a key issue for an organization's readiness to use BIM. Table 9 ranks the technology components based on their RII values. OR2 (My construction organization has an active communication system) is ranked first, with an RII value of 0.686. Besides, OR1 (My construction organization applies modeling software and hardware) is ranked second, with an RII value of 0.595. The last item OR3 (My construction organization encourages information exchange) is ranked third, with an RII value of 0.516.

The mentioned findings underscores a limited level of technological readiness among organizations, with only communication systems showing moderate strength. There is a clear need for improvements in software use and information-sharing practices to support BIM implementation effectively. The following table reports the technological readiness of organizations in Jordan regarding BIM adoption.

Table 9. Mean, SD, RII and rank values of technology items of organization readiness in the Jordanian construction sector

Construct	Items	Mean	SD	RII	Rank
Organization's readiness process technology (OR)	OR1	2.590	1.337	0.595	2
	OR2	2.680	1.402	0.686	1
	OR3	2.510	1.307	0.516	3

8. CONCLUSION AND FUTURE DIRECTIONS

This study provides a comprehensive analysis of the current status of Building Information Modeling (BIM) adoption in Jordan's construction sector. Through a quantitative investigation involving 443 professionals, the research identified major challenges impeding BIM integration—most notably a lack of awareness, insufficient training infrastructure, and limited governmental support. At the same time, key benefits were highlighted, such as improved design accuracy, enhanced collaboration, and significant time and cost savings

While Table 6 shows that 3D visualization, successful project execution and improved decision making were ranked highest, respondents also valued other BIM benefits such as as-built drawings, data sharing, and conflict detection, which scored slightly lower but still within the high-importance range. Furthermore, a critical insight gained from this study is the measurable impact of BIM adoption strategies on industry readiness and performance. Strategies such as mandating BIM use in public projects (RII = 0.718) and upgrading academic BIM instruction (RII = 0.550) showed potential to systematically enhance capability. These strategies directly address root barriers—such as lack of awareness and training infrastructure—and can accelerate BIM integration if supported by policy. Therefore, a phased national strategy combining legislative enforcement, educational reform, and industry-wide training is recommended to realize long-term transformation in Jordan's construction sector.

8.1. Practical Recommendations

1. Policy Intervention: Enact government regulations that mandate BIM use in public infrastructure projects.
2. Educational Reform: Integrate BIM training modules into engineering and architecture programs at the undergraduate and graduate levels.
3. Industry Collaboration: Establish BIM training hubs through partnerships between universities, professional bodies, and private firms.
4. Financial Support: Provide software subsidies or open-source alternatives to reduce implementation costs for SMEs.

8.2. Future Research Directions

Future studies may adopt a qualitative approach—through expert interviews or focus groups—to deepen the understanding of behavioral resistance and organizational dynamics affecting BIM adoption. Comparative cross-country studies in similar developing economies may also offer valuable benchmarking. Furthermore, longitudinal research could track the impact of BIM policies over time to assess the long-term success of digital transformation strategies.

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