INTERNATIONAL JOURNAL OF ADVANCED RESEARCH
Volume 2, Issue 1, 2025

ADVANCING BIM ADOPTION IN PAKISTAN: CHALLENGES AND SOLUTIONS

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Keywords
Building Information Modelling (BIM), BIM Implementation Challenges, Construction Industry Pakistan, BIM Adoption Barriers, Mitigation Measures in BIM

Article History
Received: 01 January, 2025
Accepted: 21 February, 2025
Published: 31 March, 2025

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Abstract
Building Information Modeling (BIM) has transformed global construction by improving efficiency, coordination, and decision-making. However, its adoption in Pakistan remains limited due to persistent challenges. This study identifies key barriers to BIM implementation and proposes practical solutions tailored to the local context. A literature review and frequency-based analysis revealed eight major challenges, which were further explored through semi-structured interviews with BIM professionals in Pakistan. The resulting insights informed actionable guidelines to address these barriers. The findings aim to support effective BIM adoption, enhance project delivery, reduce delays, and control costs, contributing to the broader application of BIM in developing countries.

INTRODUCTION

Building Information Modelling (BIM), introduced in the 1970s, has rapidly evolved with the advancement of technologies such as CAD, AI, and IoT, becoming a transformative tool in the global construction industry. BIM enables the creation of digital models that facilitate collaboration, improve design coordination, enable clash detection, optimize resource planning, and reduce errors, ultimately enhancing cost-effectiveness and schedule reliability (Lee & Borrmann, 2020; Sun et al., 2023).

Despite its global success, BIM adoption in Pakistan remains limited. The construction sector in the country is plagued by challenges such as inefficient project management, cost overruns, poor stakeholder collaboration, and low technological integration. Studies highlight that Pakistan's construction industry is still in the infancy stage of digital transformation, where traditional methods continue to dominate, often leading to delays, budget issues, and compromised project quality (Shojaei et al., 2023; Abosaq & Batool, 2024).

This research addresses the gap in understanding the barriers to BIM implementation in Pakistan and aims to equip industry professionals with practical strategies for successful adoption. The study seeks to identify the critical challenges hindering BIM implementation in Pakistan's construction sector and propose actionable mitigation measures to support construction professionals in leveraging BIM for project success.

A qualitative methodology was employed. A comprehensive literature review helped identify global and local BIM challenges, and a frequency method was applied to shortlist eight critical ones. Semi-structured interviews were conducted with BIM

professionals to collect expert insights and develop practical implementation guidelines.

The significance of this study lies in its practical implications. By exploring real-world barriers and proposing realistic solutions, the research contributes to Pakistan's ongoing efforts in modernizing its construction practices. The findings offer valuable knowledge for project managers, supervisors, and BIM practitioners to reduce project delays, enhance decision-making, and improve construction outcomes.

Literature Review

This section provides a comprehensive review of existing literature related to the implementation of Building Information Modeling (BIM), with a specific focus on the construction industry in Pakistan. It explores global and local perspectives on BIM adoption, evaluates its current state in Pakistan, identifies the opportunities and challenges associated with its integration, and highlights the existing research gaps. By critically examining scholarly work and contextualizing it within the unique regulatory, economic, and cultural framework of Pakistan, this review establishes a strong foundation for understanding the key factors influencing BIM adoption and sets the stage for developing context-specific mitigation strategies.

Background of Building Information Modeling

Building Information Modeling (BIM) has emerged as a groundbreaking technological advancement that is reshaping the construction industry globally. It represents a shift from conventional methods to a digital, integrated process that enhances collaboration, efficiency, and sustainability throughout the lifecycle of construction projects (Memon et al., 2023). BIM is not merely a software tool; it serves as a holistic methodology that unifies diverse data into a shared digital model, encompassing all phases from conceptualization to demolition.

Internationally, BIM adoption has accelerated due to its demonstrated benefits such as shortened project durations, cost reductions, improved sustainability, and enhanced coordination. Governments and regulatory bodies in many countries have introduced mandates and incentives to encourage BIM integration in public infrastructure projects. As a result, the construction sector is undergoing a significant transformation, with professionals increasingly relying on digital workflows to achieve better project outcomes.

The evolution of BIM research globally, represented by over 1,500 publications from 65 countries, indicates widespread interest and adoption. These studies cover various stages of BIM implementation across the project lifecycle, from design and construction to operation and decommissioning (Badrinath et al., n.d.).

Figure 1 Global trends in BIM research

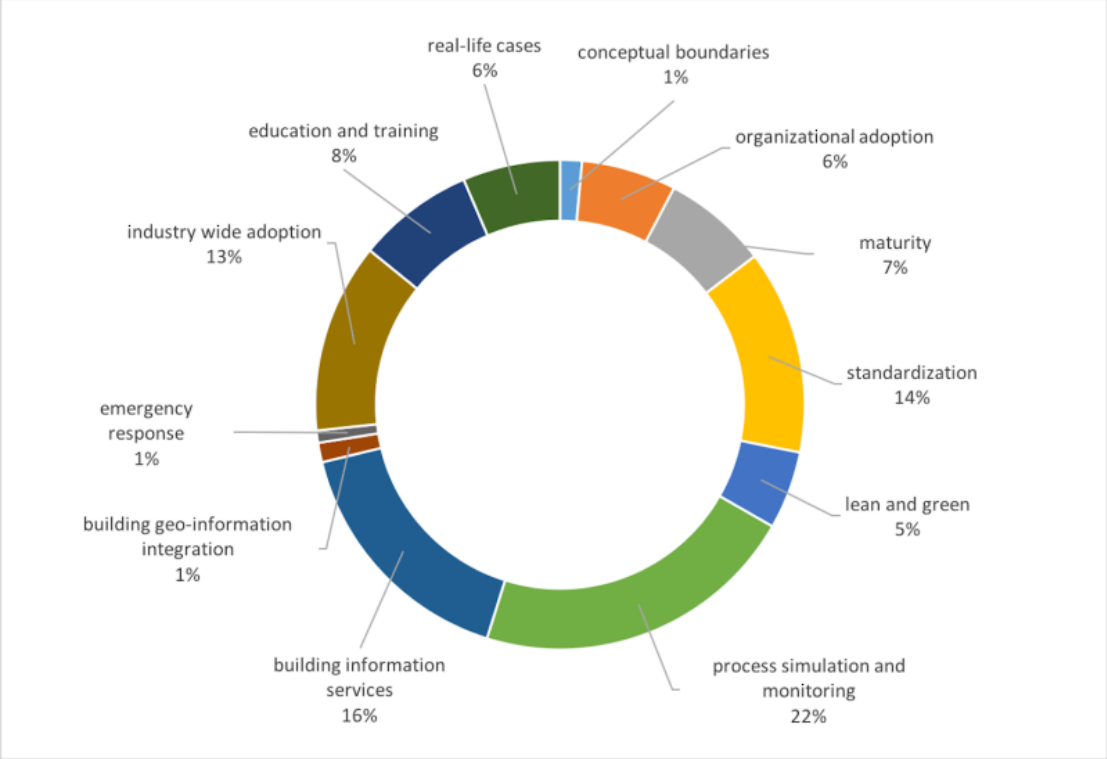

Figure 2 Global trends of BIM Project Cycle

An Overview of BIM Use in the Construction Industry

BIM enables the creation of detailed 3D models that consolidate multidisciplinary data, allowing stakeholders to collaborate in real-time and make informed decisions (Azhar et al., 2015). This collaborative environment facilitates early detection of design errors, minimizing costly delays and rework (Van Tam et al., 2023).

BIM also contributes significantly to sustainability in construction. It provides accurate data on materials and energy use, supporting the development of energy-efficient structures and aiding in green certification processes such as LEED (Pan et al., 2024). Developed countries like the USA, UK, Australia, and Gulf nations have embraced BIM to improve project accuracy and efficiency (Abdalla et al., 2023).

Despite its potential, challenges such as high implementation costs, resistance to change, and the lack of standardization continue to hinder full-scale adoption (Tran et al., 2024). Nonetheless, BIM remains a pivotal tool for promoting sustainability, efficiency, and risk mitigation in modern construction.

Current State of BIM in Pakistan

Building Information Modeling (BIM) adoption in Pakistan remains minimal and is primarily limited to large-scale or internationally funded projects that demand adherence to global standards. In contrast, local firms face barriers such as high implementation costs, lack of technical expertise, and limited awareness, resulting in a fragmented and underutilized BIM landscape (Alam et al., 2023). Bhatti et al. (2018) observed that BIM usage is mostly restricted to 3D modeling, with little integration into full lifecycle analysis or project platforms, and estimated national adoption at only 11%.

Currently, the government has not introduced any formal policies or regulations to mandate BIM in public infrastructure projects. This absence of institutional support further discourages private sector firms from embracing BIM, despite its long-term benefits in cost savings and operational efficiency.

By narrowing the scope to studies within Pakistan, this review captures the regulatory, economic, and cultural challenges that are unique to the local construction sector. The local context significantly differs from developed countries, necessitating customized strategies for BIM integration.

Despite the hurdles, Pakistan presents strong potential for BIM adoption due to rising infrastructure demands and sustainability goals. BIM's capability in energy modeling, lifecycle cost analysis, and waste reduction aligns with national priorities for green construction (Ahmad et al., n.d.; Nawaz et al., 2021). Furthermore, the government's digitization initiatives, along with increasing awareness by regulatory bodies like PEC, signal a gradual shift toward more digital construction practices (Waheed & Abbas, 2023).

Challenges to BIM Adoption in Pakistan

The entrenched reliance on traditional construction methods poses a major cultural challenge to BIM integration. The table below (Table 1) summarizes the key challenges identified through Pakistan-specific research:

Table 1: Challenges to BIM Adoption in Pakistan

Sr No	Challenge	(Farooq et al., 2020)	(Pan et al., 2024)	(Girginkaya Akdag & Maqsood, 2019)	(Khahro et al., 2021)	(Sami Ur Rehman et al., 2022)	(Manzoor et al., 2021)	(Farea et al., 2023)	(Aftab et al., 2023)	(Usama et al., n.d.)	(Hussain et al., 2022)	(Idris et al., 2023)	Frequency
01	Inadequate Training						*	*		*		*	4
02	Complexity of BIM Implementation	*					*		*			*	4
03	High Initial Costs	*	*	*	*	*		*	*		*	*	09
04	Require skilled professionals Or Lack of skilled workforce	*	*	*	*	*		*	*	*	*	*	10
05	Cultural and Organization Challenges						*						1
06	Lack of Stakeholder Collaboration for industry improvement	*		*			*		*	*	*		6
07	Conventional approaches of industry Professions	*	*			*	*			*	*	*	7
08	Data Security Or Data Management issues				*			*		*			3
09	Lack of Client expectations and requirements	*					*	*			*	*	5
10	Maintenance and Sustainability					*	*						2
11	No/Lack of Govt policies & support	*	*		*	*	*			*		*	7

12	Interoperability issues						*						1
13	Continuous learning and development			*			*						2
14	Lack of research on BIM Implementation						*						1
15	Resistance to change	*				*		*	*	*		*	6
16	Lack of standardization and legal framework	*						*		*	*		4
17	Technical challenges	*	*			*	*			*	*	*	7
18	Lack of standards and protocols						*			*		*	3
19	Stakeholder collaboration	*					*			*			3
20	Cybersecurity concerns				*								1
21	Restructuring of organization needed for BIM adoption	*					*					*	3
22	Availability of material					*				*			2
23	Lack of vision of Benefits						*						1
24	Competing initiative						*						1
25	Licensing Issue						*			*			2
26	Misunderstanding BIM or Lack of awareness		*				*		*			*	4
27	Take longer time to develop model		*	*							*		3

Research Gap

Despite BIM's global success, its implementation in Pakistan lacks thorough academic investigation. Notable gaps include limited localized strategies, insufficient empirical data, and a lack of theoretical frameworks addressing socio-economic and institutional barriers. Bridging these knowledge, method, and contextual gaps is essential for fostering effective BIM integration in Pakistan's construction sector.

Research Methodology

Research Approach and Strategy

This study adopts a qualitative research approach, which is particularly suitable for exploring under-researched areas such as the implementation of Building Information Modeling (BIM) in Pakistan's construction sector. Qualitative research focuses on understanding individuals' perceptions, behaviors, and experiences through direct interactions. It allows for a rich, contextual analysis that is not constrained by predefined categories or statistical modeling, making it ideal for complex, real-world problems (Hyginus & Eze, n.d.; Hendren et al., 2023).

Given the limited availability of structured data on BIM in Pakistan and the absence of established theoretical frameworks in the local context, this research is exploratory in nature. The approach facilitates an in-depth understanding of current practices, attitudes, and challenges by engaging professionals through semi-structured interviews and literature review (Siddiqui, 2019; Boton & Forgues, 2018).

The research strategy is guided by practical constraints such as time and access to participants, and is designed to ensure data relevance and contextual accuracy (Mwita, 2022). Exploratory case study design was selected over other qualitative strategies (e.g., ethnography or action research) for its flexibility and focus on deriving insights from expert narratives (Shin et al., 2022). This strategy enables a collaborative investigation between the researcher and participants to develop a grounded understanding of BIM-related barriers in Pakistan.

The research design thus emphasizes subjectivity, context, and expert judgment, recognizing the absence of existing policies or standardized procedures for BIM implementation in the local construction environment. It also aims to maintain methodological rigor through systematic data collection, interpretation, and validation, as recommended by Creswell et al. (2022) and Priya (2021).

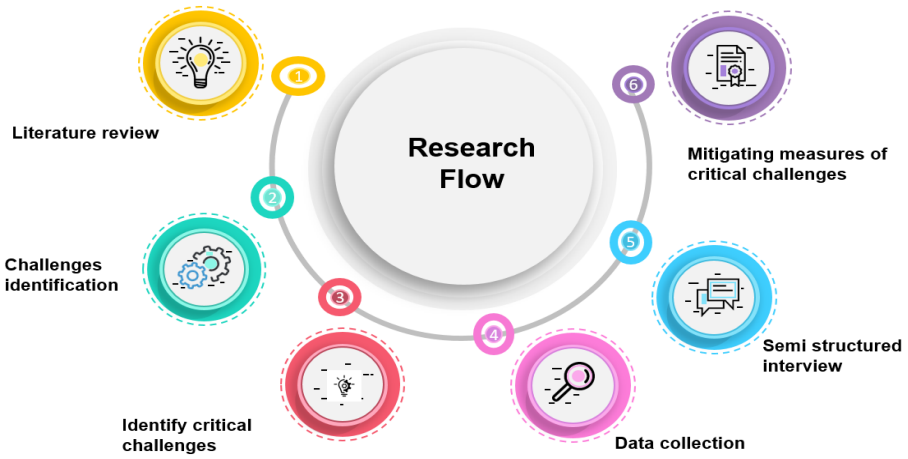

Figure 3 Research flow diagram

The research flow diagram illustrates the sequential process followed in this study, beginning with a literature review to identify general challenges related to BIM implementation. These challenges were then narrowed down to critical issues specific to Pakistan's construction sector. Primary data was collected through semi-structured interviews with industry professionals, allowing for in-depth exploration of these challenges. The qualitative insights obtained were then analyzed to propose practical mitigation measures. This systematic approach ensures a focused investigation, grounded in both existing literature and expert perspectives.

Data Collection and Sampling

This study adopted a qualitative research approach, using semi-structured interviews as the primary data collection method. Semi-structured interviews are favored in qualitative studies due to their flexibility, which allows participants to express their views freely, while still providing enough structure to ensure consistency across interviews (Adeoye-Olatunde & Olenik, 2021). An interview guide was used to maintain focus and facilitate the analysis. Participants were selected based on their direct involvement and practical experience with BIM implementation in Pakistan's construction sector.

A purposive sampling strategy was employed to select information-rich participants relevant to the study objectives. This non-random sampling method ensured that respondents possessed the qualifications, knowledge, and field experience necessary to contribute valuable insights (Muhammad & Kabir, 2016; Shaheen et al., 2019). The minimum eligibility criteria included a Bachelor's degree in Civil Engineering and at least seven years of experience in construction projects.

The sample size was determined using the data saturation approach. After conducting six interviews, no new themes or insights were emerging, indicating saturation had been achieved (Saunders et al., 2018). This sample size is consistent with qualitative research norms (Boddy, 2016).

Table 2: Demography of Respondents

S. No	Qualification	Experience (Years)	Firm Type	Projects Completed	Position
1	BE Civil	15	Construction	9	Project Manager
2	PGD in BIM + B.Arch.	9	Construction & Consultant	6	Resident/Project Engineer
3	MS Structural Engineering	10	Consultant	8	Design Engineer & BIM Expert
4	ME Construction Management	8	Consultant	5	Design Engineer
5	MS Civil Engineering	12	Construction	7	Project Manager
6	MS Structural Engineering	11	Consultant	12	Senior Design Engineer

Table 3: Sampling Summary

Organization Type	Number of Engineers
Construction	3
Consultant	3
Total	**6**

Data Analysis

In qualitative research, various methods are available for analyzing interview data, including grounded theory, thematic analysis, content analysis, and Interpretative Phenomenological Analysis (Castleberry & Nolen, 2018). For this study, **content analysis** was selected due to its suitability for examining textual data systematically and drawing meaningful insights that align with the exploratory nature of the research.

Content analysis offers three primary approaches: **inductive**, **deductive**, and **abductive** (Graneheim et al., 2017). This study employed the **deductive content analysis** method, which is appropriate when the objective is to explore known phenomena within new contexts using pre-established frameworks and theories (Elo & Kyngäs, 2008). This approach begins with a structured coding scheme derived from existing literature and relevant research to guide the data interpretation.

Methods such as Interpretative Phenomenological Analysis (IPA) and narrative analysis were deemed unsuitable for this research. IPA focuses on individual experiences, which was not the central objective of this study, while narrative analysis is appropriate for chronological storytelling, which does not align with the nature of the data collected through semi-structured interviews.

The deductive content analysis allowed the researcher to organize large volumes of qualitative data into meaningful themes, reduce complexity, and draw inferences that directly relate to the research questions. Additionally, quantifying themes in terms of their frequency of occurrence offered further analytical depth (Zhang & Wildemuth, n.d.). This approach was particularly useful for addressing the exploratory questions of the study, enabling a structured yet flexible method of interpreting participant insights regarding Building Information Modeling (BIM) implementation in Pakistan.

Thus, the selected data analysis strategy ensured that both the depth and consistency required in qualitative interpretation were achieved while maintaining alignment with the study's aim and objectives.

Results

Key Challenges Hindering BIM Implementation

A comprehensive analysis of 11 research articles published between 2020 and 2024 identified a total of **27 distinct challenges** related to the implementation of Building Information Modeling (BIM) within Pakistan's construction industry. These

challenges reflect issues across technological, organizational, financial, and regulatory domains. To determine the most pressing barriers, a **frequency analysis** method was employed, focusing on how often each challenge appeared in the reviewed literature. Through this method, **8 critical challenges** were identified, each of which was cited in five or more of the reviewed studies. These challenges were considered the most significant impediments to BIM implementation in Pakistan and were therefore selected for further exploration through expert interviews in the subsequent phase of this research. The frequency of each challenge, along with its brief description, is summarized in Table 4.

Table 4: Critical Challenges Hindering the Implementation of BIM in Pakistan's Construction Industry

SR #	Critical Challenge	Frequency
1	Lack of skilled professionals / Skilled workforce gap	10
2	High initial costs	9
3	Conventional approaches of industry professionals	7
4	Lack of government policies and support	7
5	Technical challenges (interoperability, software, standards)	7
6	Lack of stakeholder collaboration for industry improvement	6
7	Resistance to change	6
8	Lack of client expectations and requirements	5

These identified challenges represent the most frequently reported barriers to BIM implementation in the selected literature and thus serve as a foundation for deeper qualitative inquiry in the following sections.

Mitigating Measures for Critical Challenges in BIM Implementation

1. Lack of Skilled Workforce

One of the most frequently cited challenges was the shortage of trained professionals in BIM. Experts emphasized the importance of continuous training programs, partnerships with academic institutions, and integration of BIM education in curricula to address the skill gap. Industry-led certifications and hands-on training were also highlighted as necessary steps to enhance practical expertise.

Table 5: Mitigating Measures for Lack of Skilled Workforce

Challenge	Expert Excerpt	Expert ID
Lack of Skilled Workforce	Companies should invest in continuous training and development programs to upskill employees in BIM technologies.	1
	BIM training should be incorporated at different levels of construction operations.	2
	Collaboration with educational institutions can enhance the BIM skill force and ensure a pipeline of trained professionals.	3
	Universities should integrate BIM into their curriculum; industry-led programs can bridge the BIM skill gap.	5

2. High Initial Costs

Experts identified high upfront costs as a deterrent to BIM adoption. Suggested measures include offering financial subsidies, shared software licensing models for SMEs, and phased implementation strategies to reduce capital burden. Public-private partnerships and ROI-based adoption planning were also recommended.

Table 6: Mitigating Measures for High Initial Costs

Challenge	Expert Excerpt	Expert ID
High Initial Costs	BIM implementation should be supported by financial incentives or subsidies, especially for SMEs.	1
	Shared software licensing and public-private funding models can ease cost pressures.	4
	Government grants or phased adoption approaches can mitigate the burden of initial investment.	6

3. Conventional Industry Approaches

The persistent reliance on traditional construction methods hinders BIM adoption. Experts recommended awareness programs, pilot projects demonstrating the success of BIM, and industry benchmarking to promote modernized workflows.

Table 7: Mitigating Measures for Conventional Approaches

Challenge	Expert Excerpt	Expert ID
Conventional Industry Approaches	Demonstrating BIM success through real-time pilot projects can shift conventional mindsets.	2
	Industry benchmarking with BIM-enabled firms can highlight performance gaps.	3
	Workshops and seminars for senior professionals can help change outdated practices.	5

4. Lack of Government Policies and Support

Experts emphasized the need for regulatory frameworks, national BIM standards, and government-backed incentives. Policies mandating BIM for public projects and tax breaks for private adoption were strongly suggested.

Table 8: Mitigating Measures for Lack of Government Support

Challenge	Expert Excerpt	Expert ID
Lack of Government Policies and Support	Industry bodies must advocate for national BIM standards and implementation incentives.	2
	Establishing mandatory BIM use in public projects will encourage wider adoption.	3
	Government subsidies and regulation are critical for driving BIM across all project types.	6

5. Technical Challenges

Experts cited a lack of standardized BIM protocols and software interoperability as major concerns. Standardization of processes, investing in compatible platforms, and stakeholder-wide training were suggested as effective mitigations.

Table 9: Mitigating Measures for Technical Challenges

Challenge	Expert Excerpt	Expert ID
Technical Challenges	Adoption of standardized BIM protocols across organizations is essential.	1
	Investment in compatible and scalable BIM software is critical.	3
	Stakeholders should receive collaborative training to overcome technical issues.	6

6. Lack of Stakeholder Collaboration

Collaboration gaps among contractors, consultants, and clients impede BIM integration. Experts advised early stakeholder engagement, shared digital platforms, and integrated project delivery models as key solutions.

Table 10: Mitigating Measures for Lack of Stakeholder Collaboration

Challenge	Expert Excerpt	Expert ID
Lack of Stakeholder Collaboration	Early stakeholder engagement ensures smoother BIM coordination.	2
	Using shared digital platforms fosters real-time collaboration.	4
	Promoting integrated project delivery can improve collaboration and decision-making.	5

7. Resistance to Change

To counter resistance, experts recommended conducting targeted awareness sessions, showcasing pilot projects, and sharing success stories. These actions were believed to be effective in building trust and changing negative perceptions.

Table 11: Mitigating Measures for Resistance to Change

Challenge	Expert Excerpt	Expert ID
Resistance to Change	Conduct awareness sessions and pilot projects to demonstrate BIM benefits.	1
	Sharing success stories from BIM-enabled projects helps change perceptions.	2
	Demonstrating BIM's benefits through tangible outcomes fosters trust.	5

8. Lack of Client Expectations and Requirements

Experts noted that uninformed or passive clients can stall BIM integration. To mitigate this, client awareness programs, contractual BIM deliverables, and value-based presentations were recommended to clarify expectations and encourage adoption.

Table 12: Mitigating Measures for Lack of Client Expectations and Requirements

Challenge	Expert Excerpt	Expert ID
Lack of Client Expectations and Requirements	Clients should be educated on BIM benefits through seminars and direct engagement.	1
	BIM deliverables should be integrated into client contracts to formalize expectations.	3
	Visual presentations showing value-added outcomes help align client expectations.	4

Discussion

The study identified eight critical and interrelated challenges impeding BIM implementation in Pakistan: lack of skilled workforce, high initial costs, traditional practices, lack of government support, technical issues, stakeholder fragmentation, resistance

to change, and unclear client expectations. The shortage of skilled professionals stems from the limited integration of BIM in education and lack of practical training (Ali et al., 2018; Expert 1; Expert 3). High initial costs were found to discourage smaller firms, necessitating financial incentives and phased implementation strategies (Chowdhury et al., 2024; Expert 1; Expert 4). Resistance to digital transformation, embedded in conventional industry practices, remains a key barrier (Hassan et al., 2025; Shojaei et al., 2023; Expert 2). Additionally, the absence of formal BIM policies and national standards hinders adoption across both public and private sectors (Waheed & Abbas, 2023; Expert 3). Technical incompatibility and lack of standard protocols further complicate collaboration (Özturk, 2020; Expert 6). Experts proposed solutions including industry-led training, pilot projects, stakeholder forums, policy reforms, and embedding BIM requirements in client contracts (Memon et al., 2023; Expert 2; Expert 3; Expert 5). Ultimately, a unified effort from government, academia, and industry is essential to overcome these challenges and promote BIM integration for sustainable development in Pakistan's construction sector (Nawaz et al., 2021; Soomro et al., 2024; Expert 4).

Conclusion

In conclusion, this study systematically examined the key challenges hindering the implementation of Building Information Modeling (BIM) in Pakistan's construction industry and identified practical, expert-driven mitigating measures. The findings reveal that the lack of skilled professionals, resistance to change, insufficient governmental support, and high implementation costs serve as the primary barriers to BIM adoption. Additionally, the study identified technical limitations, stakeholder fragmentation, unclear client expectations, and limited awareness as contributing factors. To address these issues, a series of strategic interventions were proposed, including enhanced training and education, government-backed pilot initiatives, development of formal BIM guidelines, and the establishment of collaborative platforms among stakeholders. These measures aim to build industry capacity, foster a culture of innovation, and ensure a structured transition toward BIM integration. The successful implementation of these strategies requires coordinated efforts from regulatory authorities, academic institutions, and construction firms. Overall, the study offers a comprehensive framework to support the digital transformation of Pakistan's construction sector, with potential benefits including improved project efficiency, cost-effectiveness, and sustainability. The outcomes provide a solid foundation for future policy formulation and industry-wide adoption of advanced construction technologies.

Limitations of study

The study is subject to several limitations. In terms of scope, the research is confined to the construction industry of Pakistan, thereby limiting the generalizability of findings to other geographic regions with differing regulatory, economic, and technological contexts. Additionally, the focus on Building Information Modeling (BIM) excludes other digital tools and technologies that may also influence construction practices. Methodologically, the study adopts a qualitative approach through expert interviews, which, although insightful, may introduce subjectivity and limit broader applicability. The purposive sampling technique may have restricted the inclusion of diverse stakeholder perspectives, particularly from marginalized sectors. Empirically, the findings are derived from expert perceptions, which may not comprehensively reflect the on-ground realities across all operational levels of the industry. Moreover, the absence of quantitative analysis constrains the ability to statistically validate the effectiveness of the proposed mitigating measures.

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