Strategies to Overcome BIM Barriers in the AEC Industry of Iran

Tahere Asghari* and V. Paul C. Charlesraj

Department of Design and Architecture, School of Arts and Humanities, University of Huddersfield, Huddersfield, United Kingdom.
asghari.ta@gmail.com , p.c.vasantharaj@hud.ac.uk

Abstract

Building Information Modelling (BIM) has emerged as a transformative digital technology that can improve productivity, reduce errors, and enhance collaboration across construction projects worldwide. Despite its well-recognised benefits, the Architecture, Engineering, and Construction (AEC) industry in Iran continues to encounter substantial challenges in BIM adoption. Research exploring effective solutions tailored to the Iranian context remains limited, creating a gap that this study aims to address. The purpose of this research is to develop appropriate strategies to overcome barriers to BIM implementation within Iran's AEC sector. A comprehensive literature review was conducted to examine barriers and existing strategies at global, regional, and local levels. In addition, semi-structured interviews with Iranian industry experts were carried out to capture practical insights specific to Iran's construction industry. The results indicate that although BIM awareness is gradually increasing, its implementation is hindered by inadequate government support, limited professional knowledge and training, and a significant disconnect between academia and industry practice. Based on these findings, this research emphasizes the need for government-led initiatives, including creating a robust legal and technical framework to mandate BIM, implementing incentive-based measures, and integrating BIM-focused curricula into universities. This study contributes original insights and practical recommendations to accelerate BIM adoption in Iran, supporting broader digital transformation in the construction sector.

Keywords

Building Information Modelling (BIM); AEC industry; Iran; BIM Barriers; Adoption Strategies

1 Introduction

The construction industry has historically struggled with low productivity, inefficient planning, and limited collaboration, with traditional methods in the Architecture, Engineering, and Construction (AEC) sector identified as primary contributors to these challenges [1]. Building Information Modelling (BIM) has emerged over the past decade as a transformative digital technology designed to enhance productivity and improve construction performance [2].

BIM represents a fundamental shift from traditional 2D drawings to comprehensive digital representations of buildings' physical and functional characteristics [3]. As a digital model that organizes and visualizes building information throughout a project's lifecycle [4], BIM encompasses data about building components, structures, materials, and lifecycle processes. This technology enables digital management of design information, facilitating more integrated and data-driven project implementation approaches. Research demonstrates that BIM adoption enhances construction productivity, reduces errors and rework, and improves overall project delivery through better coordination, information sharing, and collaborative decision-making [5]. BIM's digital information management capabilities have significantly transformed traditional construction practices [6].

Globally, many countries have embraced BIM and developed adoption strategies for the AEC sector [7]. The United Kingdom experienced dramatic growth in BIM adoption, rising from 13% in 2011 to 74% in 2018, with similar trends observed across developed regions, including the United States, Europe, and Australia [8]. However, BIM adoption remains low in developing countries, including North Africa and the Middle East, where, despite high awareness in Gulf Cooperation Council (GCC) countries, adoption rates remain insufficient [9].

Several barriers hinder widespread BIM acceptance [10], including a lack of motivation, resistance to change, insufficient knowledge, inadequate technology tools, interoperability issues, and undefined processes and standards [11]. In Iran specifically, the AEC industry faces significant adoption challenges, with only 29.5% of construction companies utilizing BIM tools, while 56.8%

have never encountered BIM and 36.4% lack adoption plans [12]. This research aims to explore obstacles hindering BIM usage in Iran's AEC sector and develop strategies based on expert opinions and literature review to address these barriers.

2 Literature Review

2.1 Barriers to BIM Implementation Worldwide

The global adoption of Building Information Modelling (BIM) remains constrained by a complex set of interrelated barriers despite its well-established potential to enhance project integration, productivity, and decision-making [10]. Existing literature emphasizes that BIM implementation is not merely a technological shift but a systemic transformation requiring alignment across organizational structures, workflows, and stakeholder practices [13]. The literature identifies three dominant categories of challenges. First, technical barriers such as system complexity, interoperability issues, and inadequate data standards [17]. Second, organisational and cultural barriers including resistance to change, and shortages of skilled professionals significantly reduce industry readiness [18]. Third, Legal and institutional barriers further complicate BIM adoption. The absence of regulatory frameworks, and unresolved contractual issues related to liability and intellectual property create uncertainty [19]. However, the relative importance of these barriers varies across regions, particularly between developed and developing contexts [20].

2.2 Barriers to BIM Implementation in the Middle East

In the Middle East, BIM implementation remains at an early stage, where adoption is still limited despite increasing awareness [18]. Unlike developed countries, where technical and legal issues such as data security and interoperability are more prominent, the barriers in the Middle East are primarily driven by organizational and human factors, particularly limited awareness, lack of expertise, and insufficient training [20].

In addition, from a technical perspective, challenges such as interoperability issues, inadequate IT infrastructure, and limited access to advanced BIM tools hinder effective implementation [21]. Financial constraints also play a major role, as high initial investment costs and the absence of clear economic incentives discourage organizations from adopting BIM [18]. Furthermore, weak regulatory frameworks, lack of BIM standards, and limited government support create uncertainty and slow down implementation [22]. Overall, BIM barriers in the Middle East are strongly context-dependent, reflecting broader challenges related to human capital, institutional capacity, and economic conditions, which differ significantly from those observed in developed countries [18]. This highlights the importance of examining BIM adoption barriers within specific national contexts such as Iran.

2.3 Barriers to BIM Implementation in Iran

BIM adoption in Iran remains limited despite its potential to enhance productivity and performance in the construction sector, which plays a significant role in the national economy [12], [9]. Existing studies indicate that BIM implementation is still at an early stage, with low awareness and limited practical experience among industry stakeholders [23]. The literature identifies several key barriers, primarily lack of government support, insufficient regulatory frameworks, and weak organizational readiness. In addition, limited BIM knowledge, shortage of skilled professionals, and resistance to change significantly hinder adoption [24]. Financial constraints and unclear return on investment further reduce motivation for implementation [25]. Overall, BIM barriers in Iran reflect a combination of institutional, organizational, and knowledge-related challenges that require targeted, context-specific strategies.

2.4 Overview of Existing Strategies

The implementation of Building Information Modelling (BIM) requires a structured, strategic approach [27]. Research has identified that effective BIM implementation strategies must include changing organizational approaches, providing appropriate incentives, establishing industry partnerships, integrating BIM into existing processes, and promoting collaboration across the AEC sector [28]. Specific strategies that support successful BIM implementation include investing in BIM-related training programs, supporting adoption through adequate financial and technical resources, ensuring appropriate project budgets for BIM integration, developing technical capabilities required for BIM tools and workflows, cultivating organizational commitment to BIM, promoting collaborative work environments, and establishing robust BIM infrastructure and standards [29].

Governments have been identified as the main beneficiaries and key players in BIM implementation, becoming increasingly active in promoting adoption through various policies and initiatives that can be broadly classified into three approaches: government-driven, industry-driven, and mixed approaches combining both governmental and industry initiatives [30]. Government-led strategies have proven particularly effective in accelerating BIM adoption across multiple countries, with successful implementation measures including establishment of national BIM programs, mandatory BIM requirements, development of BIM standards and protocols, integration of BIM in procurement and tendering processes, awareness and adoption initiatives, development of BIM infrastructure, and the creation of industry-wide BIM classification standards [10].

Research suggests that developing countries need comprehensive BIM implementation models based on theoretical frameworks derived from implementation process theory, incorporating four key strategic elements: top management commitment strategies emphasizing organizational restructuring and cultural change; motivational strategies including regulatory mandates and BIM guidelines development; capacity development strategies focusing on building skills, knowledge, and competencies through education and training programs; and collaborative network relationships creating essential environments for change [18]. BIM implementation in Iran requires a comprehensive approach due to multiple barriers across resource, financial, organisational, regulatory, and market-related dimensions [9]. Efforts toward digitalisation have been initiated by government-related institutions through training programmes, conferences, and the establishment of BIM-focused organisations [26]. These actions reflect increasing recognition of BIM importance within the industry. However, the lack of locally adapted regulations and reliance on international frameworks limit effective implementation [31]. Overall, the need for context-specific strategies tailored to Iran's conditions is highlighted, as limited research has addressed practical solutions to overcome BIM adoption barriers in the Iranian construction sector.

3 Research Methodology

This study adopts a qualitative research design using a two-phase approach to investigate BIM adoption barriers and develop context-specific strategies for the Iranian AEC industry. In the first phase, a structured literature review was conducted to identify key barriers and strategies across global, regional, and Iranian contexts. Relevant studies were collected from academic databases such as Scopus, Web of Science, and Google Scholar using keywords including "BIM adoption barriers" and "BIM implementation strategies." The selected studies were analyzed and grouped into key themes such as technical, organizational, financial, and regulatory factors. The findings from this phase were used to inform the design of the interview questions. Phase Two employed semi-structured interviews with Iranian AEC experts from design firms, contracting organizations, and government bodies, selected purposively for their direct BIM experience (Table 1). This format was chosen for its flexibility to probe unanticipated issues and its capacity to elicit in-depth contextual insights unavailable in the existing literature [32]. While the study is based on three expert interviews, a limitation that restricts generalizability, the focus was on conceptual depth rather than statistical representativeness, with thematic convergence across participants used to assess data sufficiency. Larger-scale validation studies are recommended for future research.

The interview guide, developed from previous studies Marzouk et al. [30], Alreshidi et al. [33], focused on six main themes: existing BIM regulations, government goals and measures, key implementation barriers, facilitators or champions of BIM adoption, recommended strategies, and potential incentives. Initially, eight member companies of the Iranian BIM Association were contacted via email; after no response, participants were approached through WhatsApp and iMessage. Three experts, two managers, and one consultant agreed to participate, representing an acceptable qualitative sample size [34]. Each interview, lasting approximately 40 minutes, was conducted via Google Meet and recorded for analysis.

Table 1. List of interviewees

No	Stakeholder ID	Position	Work Experience	Organisation Type	Area of Expertise
1	Respondent 1	BIM consultant	10 years	Semi-public (Iran BIM Association)	BIM policy development
2	Respondent 2	Director	20 years	Private	Construction management
3	Respondent 3	Manager	12 years	Semi-public (Iran BIM Association)	Training programmes and BIM standard development

3.1 Data Analysis

Interview data were analyses using NVivo software through systematic content analysis. Each participant's responses were coded into themes and subthemes aligned with the study objectives. Following Gray's [30] interpretive approach, the analysis focused on understanding underlying meanings in relation to existing theories rather than simple description. The coding framework identified two main areas: barriers to BIM implementation and recommended strategies for promoting BIM adoption in Iran. Key coded evidence (Table 2) highlighted critical issues such as a lack of government support, the gap between university and industry, and practical strategies, including government incentive schemes and infrastructure development.

Table 2. Summary of Coding in NVivo

Theme	Key Subtheme / Node	Respondent ID	Example of Coded Extract
BIM Implementation Barriers	Lack of government support	Respondent 2	"The main obstacle is the lack of support from government organizations for the implementation of BIM."
BIM Implementation Barriers	The gap between university and industry	Respondent 1	"The lack of university-led applied research to address effective BIM implementation."
Recommended Strategies	Government incentive strategies	Respondent 1	"Reduction of municipal fees in issuing construction approval and permitting."
Recommended Strategies	Infrastructure development	Respondent 1	"Designing and creating urban planning electronic systems with the ability to utilize BIM software infrastructure."

Note: Extracts derived from NVivo qualitative content analysis of expert interviews

4 Results and Discussion

Through NVivo analysis, ten distinct barriers to BIM adoption were identified: (1) lack of government support, (2) lack of awareness among consultants and contractors, (3) limited software infrastructure, (4) the gap between universities and industry, (5) lack of standard frameworks, (6) high implementation costs, (7) resistance from government design and contracting organizations, (8) limited training opportunities, (9) lack of coordination among government bodies, and (10) insufficient communication between academia and industry. Among these, the most critical were the lack of government support, the lack of stakeholder knowledge, and the persistent university–industry gap as shown in Figure 1.

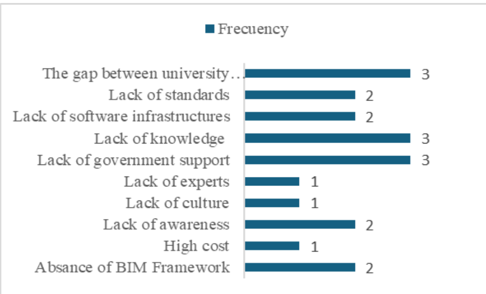

Figure 1. Barriers to BIM adoption

The findings from the semi-structured interviews strongly align with this regional pattern. First, inadequate government support and weak regulatory frameworks emerged as the most critical constraints in the interviews, aligning with previous studies that emphasize the absence of clear BIM standards, mandates, and contractual arrangements in Iran [12], [23]. Second, limited stakeholder knowledge and capacity were widely reported by interviewees, which mirrors global evidence that lack of skills, insufficient training, and resistance to change undermine BIM readiness [11], [14], [17], [27]. Third, the persistent gap between academia and industry, highlighted by respondents and coded as a major barrier in Table 2, echoes findings from both Iranian and international research [9], [18], [12], [23]. Universities in Iran were perceived as insufficiently engaged in applied BIM research and in preparing graduates with practical, implementation-ready skills.

Alongside these core issues, interviewees mentioned high initial costs, fragmented responsibilities among government bodies, limited software infrastructure, and weak inter-organizational coordination. These factors also appear in international and regional studies [10], [14], [18], suggesting that Iran faces many of the same technical and financial challenges documented elsewhere, but under conditions of greater institutional fragility. While the interviews broadly corroborate the literature, they also extend it by providing context-specific nuances for Iran. International and regional studies frequently stress the role of government as a facilitator of BIM through standards, guidelines, and public-sector procurement [30],[35]. However, the Iranian experts went further, identifying the central government, notably the Office of the Vice President for Technology, as the essential initiator of BIM, with a unique capacity to issue binding executive orders. This emphasis on highly centralized, top-down authority reflects the governance structure of Iran and suggests that models of industry-led diffusion, more common in some Western contexts, are less applicable.

The interviews also revealed a mismatch between policy signals and practical enforcement. For instance, participants referred to Tehran Municipality's 10% discount on construction permits for BIM-based projects and to resolutions that reference BIM in national technical systems. These measures indicate emerging recognition of BIM's importance, yet respondents agreed that they have not translated into systematic adoption, partly due to the absence of a comprehensive national BIM roadmap and partly due to uneven technological maturity across regulatory bodies. This provides an important nuance to the literature on public-sector roles [35]: partial or isolated initiatives, without a robust implementation framework, may have limited impact. Furthermore, whereas global studies often emphasize interoperability issues, and advanced standards [19], [21], the interviews suggest that, in Iran, more basic prerequisites, reliable software access, shared modelling protocols, and digital permitting systems, are still not fully in place. The recommendation to develop "urban planning electronic systems with the ability to utilize BIM software infrastructure" (Table 2) highlights that foundational e-government infrastructure is itself a precondition for BIM, a point less prominent in studies of more digitally mature environments.

Several strategic frameworks for BIM implementation can be found in literature, particularly in developing countries. Olugboyega [27] and Ma et al. [10] emphasize four interrelated elements: (1) top management commitment and organisational change; (2) motivational and regulatory strategies, including mandates and guidelines; (3) capacity development through education and training; and (4) collaborative networks and industry partnerships. The interview findings align closely with this structure and provide concrete, context-specific operationalization terms of top-down leadership and regulation. NVivo node summary for recommended strategies can be found in Figure 2.

All interviewees stressed the need for high-level government directives mandating BIM for selected project types and progressively expanding its scope. This mirrors successful international experiences where mandatory BIM requirements, national BIM programs, and integration into public procurement have accelerated adoption [30], [35], [36]. In the Iranian context, such mandates were seen as necessary to move from pilot initiatives to mainstream practice, while also forcing government agencies themselves to upgrade their digital capabilities.

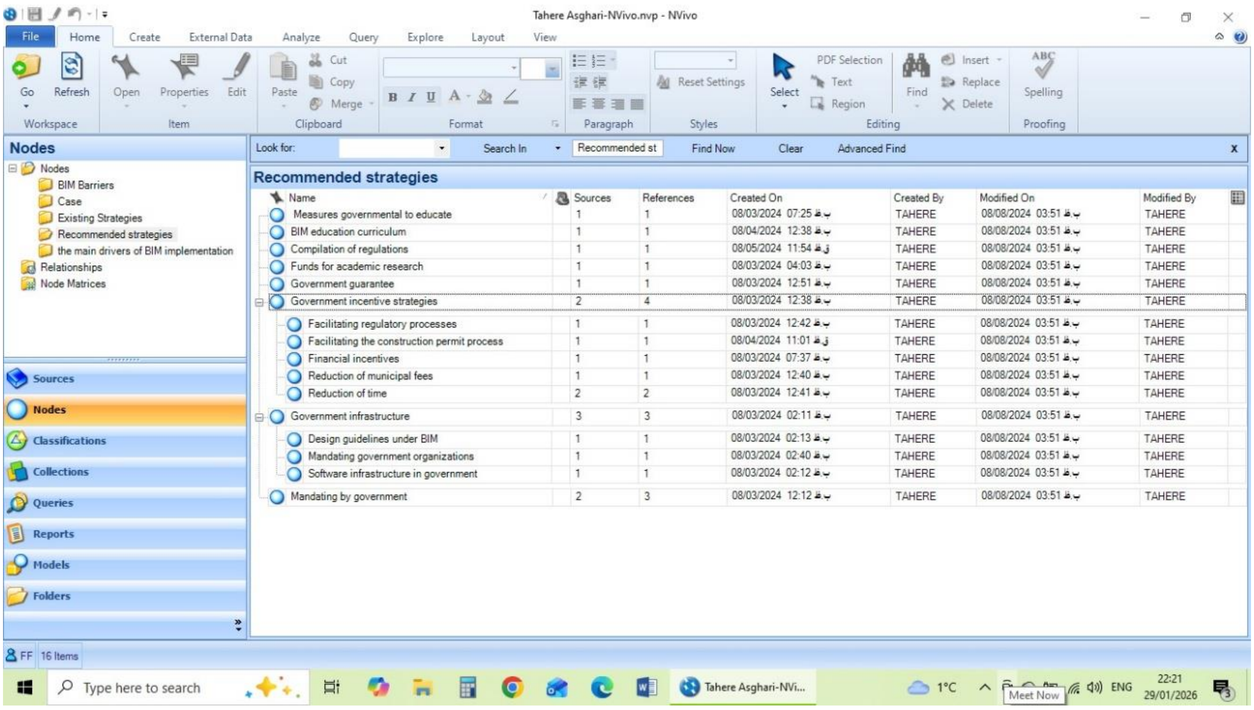

Figure 2. NVivo node summary for recommended strategies

Motivational and incentive-based strategies were the second major cluster of recommendations. Participants proposed streamlined approval processes, reductions in municipal fees, and financial incentives such as discounts on construction and parking permits. These suggestions are consistent with literature that recognizes incentives as effective complements to mandates in mixed policy approaches [35], [36], [38]. The interviews therefore support the view that a combination of regulatory compulsion and economic benefits is likely to be more effective than either approach alone, particularly for resource-constrained firms. Capacity development and education formed the third strategic pillar. Experts called for integrating BIM into university curricula, funding applied research, and expanding professional training opportunities. This directly addresses the university–industry gap identified in both phases of the study and resonates with international evidence that education and continuous professional development are critical success factors for BIM [9], [28], [39]. By explicitly linking curriculum reform and research funding to national BIM objectives, the interviewees extend existing recommendations and emphasize the need for coordinated, state-supported capacity-building.

Taken together, the literature review and interview results indicate that accelerating BIM adoption in Iran requires a dual strategy: strong, centralized government leadership to create a coherent regulatory and technical framework, and sustained investment in human and organizational capacity across the AEC sector. The interviews confirm many barriers previously identified in the literature but also reveal that, in Iran, the absence of an enforceable national BIM framework magnifies other challenges, such as cost, skills, and resistance to change. The proposed strategy therefore comprises three interdependent components: (1) government-led actions, including national BIM standards, clear mandates, and digital infrastructure for BIM-based permitting and procurement; (2) incentive-based policies that reduce financial and administrative burdens on early adopters; and (3) educational and collaborative initiatives to bridge the university–industry gap and develop a skilled BIM workforce.

In addition, continuous professional development and training initiatives for current industry professionals are essential to ensure effective BIM implementation [40]. This emphasis on education and training aligns with global best practices and reinforces the importance of sustained government support for successful BIM adoption. Figure 3 illustrates a visual summary of the recommended strategies for BIM adoption in Iran.

5 Summary and Conclusions

This study examined the barriers to implementing Building Information Modelling (BIM) in Iran's Architecture, Engineering, and Construction (AEC) industry using a comprehensive literature review and semi-structured interviews with experts. Three main barriers were identified: inadequate government support, limited stakeholder knowledge, and a persistent gap between academia and industry. The findings highlight the need for a dual approach combining strong government leadership with targeted capacity-building efforts. To promote BIM adoption, the study proposes three strategic areas: (1) Government-led actions, including legal frameworks and national BIM standards; (2) Incentive-based policies, such as financial benefits and simplified approval processes; and (3) Educational initiatives, emphasizing BIM-focused curricula and collaboration between universities and industry.

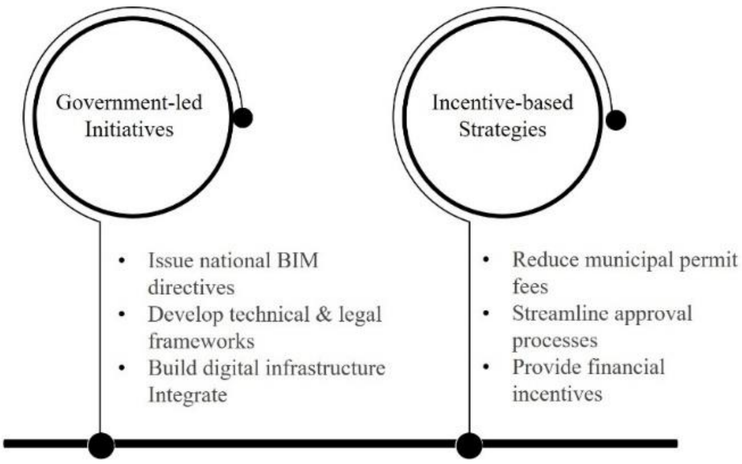

Figure 3. Summary of recommended strategies

Although the study’s scope was limited to Iran and based on a small sample, it provides valuable insights into local challenges and offers a foundation for broader, future research incorporating larger datasets and quantitative analysis. However, one of the limitations of this study is its focus on the Iranian context, which may not fully represent BIM implementation challenges in other regions. The small sample size also limits the generalizability of findings, as the study mainly captured perspectives of industry experts without including clients, policymakers, or academics. Additionally, the research relied primarily on qualitative data, suggesting the need for future studies to incorporate quantitative methods. Expanding the scope to include a larger and more diverse group of stakeholders across different regions of Iran would provide a broader and more comprehensive understanding of BIM adoption and its practical implications.

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