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FROM INERTIA TO INTEGRATION: EVALUATING THE CHALLENGES AND ENABLERS OF BIM IN THE INFRASTRUCTURE SECTORS OF SRI LANKA AND THE MIDDLE EAST

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ABSTRACT

The development of infrastructure using Building Information Modelling (BIM) in Sri Lanka and the Middle East poses its own unique set of challenges, notwithstanding the international recognition that BIM is a game-changing technology in construction. The presence of geographically context-specific technological, organisational, and cultural barriers has hindered consistent BIM implementation. This study was conducted to investigate the challenges and enablers associated with BIM adoption in infrastructure projects across these contexts. The study used a quantitative approach, employing a questionnaire among industry experts comprising engineers, architects, and quantity surveyors involved in the development of BIM infrastructure projects in Sri Lanka and the Middle East region. The collected data were analysed using the descriptive statistical tools, including percentages, weighted average and means, on a 5-point Likert scale to identify critical implementation challenges and enabling factors. The findings revealed that issues such as a lack of qualified professionals, high initial investment, policy gaps, and limited stakeholder awareness were the dominant barriers in both contexts. The study also highlighted key enablers including government mandates, educational initiatives, and improved interoperability through standardised protocols. While the Middle East benefits from structured policies and investment in digital infrastructure, Sri Lanka's progress is driven by academic initiatives and pilot projects. This research may assist industry professionals in identifying the challenges and improving BIM implementation in the construction landscape.

Keywords: *Building Information Modelling; Challenges; Digital Construction; Enablers; Infrastructure Development; Middle East; Sri Lanka.*

1. INTRODUCTION

Building Information Modelling (BIM) is a collaborative virtual platform (Wang, 2024) that supports decision-making throughout the building lifecycle (Singh et al., 2021). Today, BIM is used not only for building projects but also for infrastructure projects

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worldwide. With respect to infrastructure projects, many researchers have pointed out the significance of BIM application in infrastructure due to its complexity and the scale of such projects, highlighting the importance of incorporating innovative and effective technologies to ensure the project meets the set time targets, budget and the quality of the final product (Venkatachalam & Ko, 2017).

Many countries, such as the United Kingdom, the United States, Singapore, and Australia, have incorporated BIM into their plans and policies for developing and implementing infrastructure, improving coordination, reducing rework, and enhancing asset management (AbuMoeilak et al., 2023). Among all the countries implementing BIM, the UAE is known as one of the leading adopters, with an uptake of 77%. It is promoted by the country's sustainable policies and regulatory directives (Fasasi, 2024). While the construction industry in some countries, such as the UAE, Australia, and the UK, mandates promoting BIM to its fullest, Sri Lanka is still in its infancy in implementing BIM due to poor policy frameworks, insufficient strategic direction, and a lack of industry-wide awareness (Moghayedi et al., 2025). Examining these two specifics, differing geographic contexts enable a comparative understanding of how each influencing factor affects the BIM adoption at two levels. It will also provide insights to support improvements in BIM implementation strategies in emerging construction industries, such as in Sri Lanka. Therefore, the Middle East and Sri Lanka were selected as the focus of this study, especially given their contrasting levels of BIM maturity, policy support, and industry readiness. Furthermore, considering the data collection and sample selection, these two contexts were deemed to be the most reliable for this research.

Economic barriers, resistance to change, insufficient training, a divided project team, and poor contract arrangements, especially in developing countries, are among the challenges facing BIM adoption (Barnes & Davies, 2014). However, the success stories of government leadership, stakeholder cooperation, and the relationship between the education system and industry in countries such as Australia, China, and the UAE highlight the importance of such efforts (Ahmed, 2018). BIM is not only a technological breakthrough but also a strategic facilitator of the modernisation of the construction industry and of national development objectives (Hamma-adama & Kouider, 2019). The study will thus critically examine the key factors affecting the implementation of BIM in infrastructure projects in both Sri Lanka and the Middle East to inform future policy, training, and investment decisions aligned with national priorities.

Thus, the study aimed to explore the critical factors influencing the implementation of BIM in infrastructure projects across Sri Lanka and the Middle East. Accordingly, to achieve the aim of the research, the Authors carried out a comprehensive literature review to identify the challenges and enablers of BIM in Infrastructure Projects, thereby investigate the implementation challenges of BIM in infrastructure projects in these two contexts (Sri Lanka and the Middle East Contexts) and finally examine the enablers of the implementation of BIM in infrastructure projects in Sri Lanka and the Middle East Contexts.

2. LITERATURE REVIEW

According to ISO 29481-1:2016, standard BIM in infrastructure is the utilisation of a standardised digital format to depict the physical and operational characteristics of individual infrastructure assets, including roads, bridges, and public utilities, over their lifetimes (Ejekwu et al., 2025). BIM facilitates digital collaboration through the shared data, coordinated task development, and integrated planning across multidisciplinary teams and organisations, leading to a consistent understanding of roles, duties, and project goals. Infrastructure BIM applications do not require the same approach as building projects, as infrastructure projects involve large spatial scales, intricate structures, and multiple contractors (Marzouk & Othman, 2020). In contrast to the vertical development of buildings, which is subject to standard procedures, infrastructure projects involve horizontal development over large territories, which presupposes a complex grid and alterations to the terrain (Zak & Vitasek, 2019).

2.1 EVOLUTION AND ADOPTION OF BIM IN INFRASTRUCTURE PROJECTS

BIM is an important industrial revolution in which a collaborative framework replaces the traditional segmented workflow, and it has evolved over the years into a full-fledged digital platform (Jeon et al., 2025; Newton et al., 2023). The adoption of BIM in infrastructure initiatives continues to rise because of sustainability objectives, which result in a minimum 30% decrease in construction waste, a 20–25% reduction in energy usage, and a near 20% reduction in carbon emissions from optimized designs and effective resource management practices (Letendre & Mitra, 2018).

2.2 CHALLENGES AND ENABLERS OF BIM IMPLEMENTATION IN INFRASTRUCTURE PROJECTS

2.2.1 Technological Challenges and Enablers

BIM software adoption in infrastructure development requires acquisition of highly advanced software personnel training programs, sourcing skilled personnel with digital competencies and hardware upgrades which are significant financial challenges especially for small to medium sized enterprises with limited financial resources (Sood & Laishram, 2024). The late adoption of BIM at the initial stages also owes to the limited benefits of investing in BIM in situations where little or no push for BIM adoption exists (Ngoc et al., 2023). Resistance from Organisational and personal fronts to embracing new technology is another significant obstacle. There is a challenge in sourcing skilled personnel with digital competencies to facilitate this adoption process (Ajirotutu et al., 2024; Hijazi & Omar, 2017). Due to the various software packages, each with its own set of tools, which often limit in information sharing and handover processes across data environments, interoperability has remained a barrier (Broo & Schooling, 2023; Nuttens et al., 2018). Given these challenges, the BIM adoption in the infrastructure sector demands domain-specific software applications that are easy to use and highly interoperable with standards such as IFC, LandsXML, and ISO 19650. In addition, there is also a need to ensure the availability of classification standards to facilitate information sharing and collaboration in the development process (Laitinen et al., 2024; Moradi & Sormunen, 2023; Rotimi et al., 2025; Wijeratne et al., 2024).

2.2.2 Organisational and Managerial Challenges and Enablers

The successful application is hindered in contexts where the government lacks clear BIM guidelines and supporting policies, resulting in the unsystematic and incomplete implementation (Bradley et al., 2016; Liao & Teo, 2018). The barriers to change in traditional organisational frameworks, insulated project culture, inadequate communication standards, and lack of coordination among stakeholders also hinder the implementation of BIM within current project delivery frameworks and cooperation (Hetemi et al., 2020). Factors such as leadership commitment and the roles of client or government bodies are crucial to ensuring the successful execution of BIM in infrastructure projects through a strategic direction at the executive level (Alankarage et al., 2024). The public-sector requirements, integrated into the procurement procedures, stimulate organisations to invest in resources, internal policies, and digital capacities, and specific training promotes professional skills and contributes to the implementation of projects in a more data-driven and collaborative manner, but inappropriate BIM-specific training and reskilled pathways are one of the greatest challenges, especially in the environment of the recent digital transformation (Marsov et al., 2025; Singh & Kumar, 2023).

2.2.3 Cultural and Behavioural Challenges and Enablers

Culture and behavioural issues are major obstacles to successful BIM implementation in infrastructure projects, including insufficient stakeholder knowledge of BIM capabilities, unrealistic expectations about BIM value, and resistance to implementation (Murguia et al., 2021). Lack of trust, information hiding, and communication asymmetry, caused by digital illiteracy and traditional ways of doing things, would impede collaboration and restrict innovation with the help of BIM (Bradley et al., 2016; Brewer & Gajendran, 2012). The key to overcoming these obstacles is specific education, training programs in the industry, and the spread of successful BIM case studies to develop the confidence of the stakeholders, show their business value, and facilitate open communication and planning coordination among the project teams (Nguyen et al., 2022; Soltani et al., 2025).

2.2.4 Economic and Regulatory Challenges and Enablers

The high cost of BIM technology implementation creates significant uncertainty among stakeholders regarding return on investment; thus, financial barriers and doubts about the long-term economic value were identified as significant barriers to its use (Nielsen et al., 2024). The reasons behind the slow adoption of BIM also include outdated construction policies, the absence of digital standards, and ineffective regulatory policies, meaning that BIM adoption in infrastructure projects only gains ground where economic incentives and coordinated policy orientations exist (Farouk & Rahman, 2023). The lack of resistance and stakeholder trust can be achieved through focused education, training programs in the industry, and the popularization of successful BIM cases that show time efficiency and financial cost savings, and effective BIM implementation is possible when the communication channels are open, the planning activities are coordinated, and the Organisational cultures are organized to work collaboratively (Nguyen et al., 2022; Soltani et al., 2025).

2.3 BIM IMPLEMENTATION IN SRI LANKA AND THE MIDDLE EAST

Road and urban development remain the top priority in the Sri Lankan infrastructure sector, and BIM implementation is still at the grassroots level, with universities and market leaders leading the development of the technology rather than the government (Chathuranga et al., 2025; Ruzieh, 2025b). Despite the well-known benefits of increased accuracy and lean construction to be provided by BIM technology, insufficient financial incentives, cultural resistance, and limited technical skills are identified as obstacles to its adoption in Sri Lanka (Oduoza et al., 2023). On the other hand, the Middle East is actively developing, with intensive spending by states and sovereign wealth funds; as such, developed economies such as the UAE and Qatar require BIM for large-scale projects, including the 2022 FIFA World Cup (Ruzieh, 2025a; Zahin, 2024). However, there are improvements in these contexts, problems related to fragmented policies, start-up costs, and the lack of local professionals persist (Nnaji et al., 2025). In comparison, Middle Eastern adoption is driven by governmental regulatory systems and national visions and Sri Lankan development is supported by educational integration and pilot projects to demonstrate value in an environment dominated by customary modes of project delivery (Aamri et al., 2025; Gurumayum, 2025).

3. RESEARCH METHOD

The authors conducted a comprehensive literature review of the challenges and enablers of BIM in infrastructure projects, drawing on journal articles, conference papers, and industry reports. With the understanding that the different contexts of the construction industry carry different challenges in BIM adoption, and to enable the collection of standardised data and support comparative analysis across different contexts, based on the literature findings, a questionnaire survey was administered to investigate the context-based challenges of Sri Lanka and the Middle East (UAE). A quantitative method was chosen to evaluate and compare the barriers and facilitators of BIM implementation among industry professionals. Quantitative research is employed to test patterns across a large population and generate findings that can be generalized to a broader context (Lim, 2025), Quantitative techniques enable one to gather standardized information and analyse statistics, which makes it appropriate to measure and prioritize the most important factors (Huyler & McGill, 2019; Lim, 2025).

This study focused on gathering data from construction professionals with relevant knowledge and practical experience in BIM implementation. Therefore, the questionnaire was administered to professionals with BIM experience, such as Engineers, Architects, and Quantity Surveyors, through purposive sampling, who had a proper understanding to offer. Diversity among professionals, organizations and regions was a focus in sampling, to help make the data more valuable. Furthermore, the sample was drawn from both public and private sectors in Sri Lanka and Middle Eastern countries, ensuring a balanced representation. Although the sample size was comparatively low in number it was considered adequate for the objectives of this study due to the targeted nature of the respondent group. Of the questionnaires distributed, the analysis considered only 52 that the professionals fully completed; the incomplete questionnaires were disregarded in the study. The collected data were then analysed using descriptive statistical tools, such as percentages, counts, weighted averages, and means, on a 5-point Likert scale, as shown in Table 1.

Table 1: Likert scale for the level of criticality of challenges of Implementation of BIM.

Value	Range	Scale
1	1.00-1.08	Low
2	1.81-2.60	Very low
3	2.61-3.40	Moderate
4	3.41-4.20	High
5	4.21-5.00	Very high

In the Likert scale, authors assumed that the distance between “very high" and "high” is the same the distance between “high” and “moderate”. This equal interval assumption allows the calculation of means and the use of parametric statistical techniques (Norman, 2010). Weighted average for each selected factor was calculated using the equation expressed below to conduct the final comparison. The number of responses for each scale point was multiplied by its corresponding Likert value. Thereafter, the result was divided by the total number of responses.

$$WA = \frac{\sum(f \times w)}{N} \qquad (01)$$

where, WA = weighted average, *f* = frequency of responses for each scale point,

w = weight assigned to each response category, and *N* = Total number of responses.

4. FINDINGS AND DISCUSSION

4.1 DEMOGRAPHIC DATA

Ultimately, the 52 valid responses mentioned above were obtained from a diverse range of construction industry professionals as it shown in Table 2 below. Furthermore, these respondents possessed varying levels of professional experience while some of them had exposure to both Sri Lankan and the Middle Eastern contexts.

Table 2: Demographic details of Respondents

	Profession																	
	Quantity Surveyor			Architect			Engineer			Project Manager			Contractor			Sustainability Consultant		
Experiences	SL	UAE	Both	SL	UAE	Both	SL	UAE	Both	SL	UAE	Both	SL	UAE	Both	SL	UAE	Both
< 5 years	10						6	1		3			1			1		
6-10 years				1	5				1		1	2					1	
11-15 years					2			2			2							
16-20 years					2	2	1						1				1	1
> 20 years		1					1		1							1	1	

The demographic profile of the respondents in this research shows that they are balanced in terms of contextual distribution and experience levels. 50% of the respondents have experience in Sri Lanka, while 36.5% have experience from the Middle East. In addition, this data collection was more fruitful: 13.5% of respondents gained experience in both contexts, a significant finding. In terms of experience, the sample is dominated by younger professionals: 42.3% have less than 5 years of experience, while 21.2% have between 6-10 years of experience. Well-experienced professionals are those with 11-15 years of experience (11.5%), followed by those with 16-20 years of experience (15.4%) according to the percentages. 9.6% of overall sample hand more than 20 years of experience. Therefore, with a well-balanced and diverse sample, the study is well positioned to examine the key factors that affect and challenge the BIM implementation in both the contexts.

4.2 IMPACT OF TECHNICAL CHALLENGES ON IMPLEMENTING BIM IN INFRASTRUCTURE PROJECTS

The technical challenges affecting BIM implementation in Middle Eastern infrastructure projects include poor interoperability, integrating BIM, high initial costs, and difficulty linking BIM processes, each marked “very high” by over 44% of respondents. Interoperability had the highest average level of effect (4.30%), while inconsistent data formats had the lowest (3.78%). On the other hand, the majority among the Sri Lankan experts rated the issues shown in Table 3 as either “high” or “Very High”. The highest impact score was given to inconsistent data formats, rated at 3.70, while poor interoperability received the lowest impact score of 3.19. Overall, the findings emphasise that data and integration issues are major technical barriers to BIM adoption in Sri Lanka. Table 3 below illustrates the overall impact of technical challenges in both the contexts.

Table 3: Weighted average impact of technical challenges

	Poor Interoperability	**High Initial Cost**	**Risk of Data Loss**	**Difficult to integrate BIM**	**Inconsistent Data Format**	**Inability to efficiently link BIM**
Middle East	**4.30**	3.93	3.89	4.00	3.78	3.93
Sri Lanka	3.19	3.44	3.41	3.67	**3.70**	3.48

The significance of interoperability and data sharing difficulties is evident from the work by Bradley et al. (2016), who also considered information integration difficulties as major hurdles for the adoption of BIM technology. This indicates that interoperability problems continue to persist in various project environments. The data indicated that the impact of each factor may differ across contexts or countries. This may mainly be due to resource availability, the state of the country's development, and cultural differences. Furthermore, unlike in other countries, Sri Lanka has not advanced in adopting BIM or in developing BIM object libraries, which led the system to end up with inconsistent data formats; the lack of proper institutional insurance for digital assets led companies to lose confidence in the face of data loss; and the highly fragmented nature of the local industry, that may be among the reasons for these results (Thushyanthan, 2019).

4.3 IMPACT OF HUMAN RESOURCE & SKILL CHALLENGES ON IMPLEMENTING BIM IN INFRASTRUCTURE PROJECTS

In Middle Eastern infrastructure projects, many respondents reported a lack of recognition, language and communication barriers, and the misconception that BIM is merely 3D modelling, all of significantly impact the implementation of BIM in these projects. Among these causes, lack of recognition had the highest average impact, followed by language barriers (3.89) and BIM misunderstanding (3.85). The shortage of BIM trainers had the lowest impact (3.52), as shown in Table 4. Overall, the findings highlight that awareness, communication, and understanding are major human-related barriers to BIM adoption. The reason may be the multinational workforce on projects in the Middle East, which also leads to communication issues. Moreover, BIM requires high collaboration, and this communication barrier, compounded by a workforce that speaks multiple languages, can lead to information loss in the Middle East.

In Sri Lanka, over 52% of professionals confirmed that the most critical issues with very high impact are a lack of recognition, BIM being misunderstood as just 3D modelling, and a shortage of BIM trainers. The reason for that is unfamiliarity with the technology, as Sri Lanka is still in the early stages of adopting these new technologies and lacks institutional recognition (Arachchige et al., 2025). It is noteworthy that the lack of recognition was identified as the highest impacting factor in both contexts.

Table 4: Weighted average impact of human & skill challenge

	Lack of Qualified Professionals	Shortage of BIM trainers	Limited BIM education	Delays from untrained staff	BIM misunderstand as just a 3D modelling	Language & Communication Barriers	Lack of Recognition
Middle East	3.67	3.52	3.81	3.78	3.85	3.89	**4.07**
Sri Lanka	3.12	3.44	3.60	3.40	3.96	3.60	**4.76**

4.4 IMPACT OF ORGANISATIONAL & PROCESS CHALLENGES ON IMPLEMENTING BIM IN INFRASTRUCTURE PROJECTS

Table 5 shows that both selected geographic contexts face the highest impact from issues related to transferring BIM from the design stage to construction sites, with a weighted average impact in the Middle East of 3.93 and 3.80 in Sri Lanka. It shows that integrating BIM workflow is also a common issue regardless of the context. At the same time, low contractor involvement ranked the lowest impact (3.56) among respondents from the Middle East. Overall, it is evident that inefficiencies in processes and coordination, and resistance to change, constitute major organisational and procedural barriers to BIM adoption. Among the other factors considered within the Sri Lankan context, issues of poor coordination (3.72) ranked higher than resistance to (3.60). At the same time, delays in clash detection and inflexible delivery systems (3.56) also ranked high.

Table 5: Weighted average impact of organisational & process challenge

	Poor Model coordination	Resistance to Change	Delay in Clash Detection	Issues in transferring BIM from design	Inflexibility of the delivery system	Low Contractor involvement
Middle East	3.67	3.70	3.81	**3.93**	3.70	3.56
Sri Lanka	3.72	3.60	3.56	**3.80**	3.56	3.40

In the Middle East industry Construction industry, contractors play a major role in BIM implementation, given the complexity and size of the projects undertaken (Abdullah et al., 2024). BIM must form a part of their operational processes as well. The high criticality of BIM transfer from design could also be explained by differences in design and construction modes, where current design priorities lie in visual appeal and spatial analysis rather than it does in constructability. In conclusion, coordination gaps, poor process integration, and industry practices are major factors in BIM adoption challenges in Sri Lanka. These factors may be attributed to the industry's perception of BIM while designers still rely on 2D drafting rather than BIM-based information delivery. Furthermore, only a handful of industry professionals and Organisations possess the BIM management capabilities.

4.5 IMPACT OF CULTURAL & AWARENESS CHALLENGES ON IMPLEMENTING BIM IN INFRASTRUCTURE PROJECTS

Table 6 shows, cultural resistance to collaboration (3.81) and lack of awareness (3.74) as the most significant cultural and awareness-related challenges affecting BIM implementation in the Middle East context. More than 37% respondents indicated that awareness issues have a very high impact. On the contrary, the impact of the lack of understanding was relatively lower, at 3.44 on a weighted average. Therefore, these results indicate that, despite existing BIM awareness in the region, collaborative BIM application and lifecycle integration remain limited. The reason behind this observation could be the workforce's diversity of cultures and nationalities, and even though awareness of BIM is relatively high, understanding of it is relatively low (Mehran, 2016). Furthermore, BIM implementation is made mandatory rather than optional.

Table 6: Weighted average impact of cultural & awareness challenge

	Lack of understanding	Lack of awareness	Cultural Resistance to Collaboration	Misconception about the BIM full life cycle value
Middle East	3.44	3.74	**3.81**	3.50
Sri Lanka	3.73	**3.92**	3.87	3.83

In Sri Lanka, cultural resistance to collaboration (3.87) and lack of awareness (3.92) was also identified as factors with a higher impact, with over 44% of the sample indicating a very high impact level for the BIM misconception. These findings demonstrate a low level of understanding of BIM among professionals, and resistance to moving from a conventional process to a more digitalised, technical platform has significantly hindered its implementation in Sri Lanka. The main reasons for this situation are the lack of professionals with knowledge of BIM, legal and institutional awareness, the absence of a national policy for BIM, and the continuation of traditional procurement practices, which result in poor collaboration (Ajirotutu et al., 2024; Hijazi & Omar, 2017).

4.6 IMPACT OF POLICY & REGULATORY CHALLENGES ON IMPLEMENTING BIM IN INFRASTRUCTURE PROJECTS

The policy and regulatory challenges include outdated procurement practices with an average value of 3.92, and lack of government-led BIM strategies (3.83) according to the figures shown in Table 7, with nearly half of the population rating them as having "very high." Impact. Meanwhile, even the poor contractual frameworks and the absence of national BIM standards (3.81) were also highlighted in the UAE context. Hence, these results reinforce the importance of clear policies, updated procurement practices, and even government leadership support for BIM adoption in such developed contexts. Similarly, the Sri Lankan context also experiences the same factors, among them conventional procurement practices that are outdated and instability of Government policies, which have been rated as "High" impact. However, the absence of national standards has been rated as a moderate issue. Overall, the highest impact score among the factors affecting BIM adoption in Sri Lanka was the absence of government-led strategies, rated 3.88. Following this was the policy instability.

Table 7: Weighted average impact of policy & regulatory challenge

	Absence of National BIM standards	Outdated Procurement Practices	Poor Contractual Framework	Lack of government-led BIM strategies	Policy instability disrupting
Middle East	3.81	**3.92**	3.71	3.83	3.77
Sri Lanka	3.44	3.64	3.48	**3.88**	3.76

However, the findings imply that, in the absence of proper policies, stable regulations, and government leadership, the implementation of BIM remains fragmented. This suggest and support the previous researchers' conclusions reported from various contexts (Farouk & Rahman, 2023). Furthermore, the persistence of traditional procurement methods and an ineffective contractual environment discourage stakeholders from embracing the BIM process.

4.7 IMPACT OF FINANCIAL & MARKET CHALLENGES ON IMPLEMENTING BIM IN INFRASTRUCTURE PROJECTS

Table 8: Weighted average impact of financial & market challenge

	Budget Constraints	Uncertainty of ROI	Lack of an incentives program	Absence of Client
Middle East	3.44	3.64	3.48	3.76
Sri Lanka	3.52	3.36	3.72	3.56

The findings in the Table 8 indicated that both contexts are suffering from financial and market challenges, as they are marked as high impact: budget constraints, uncertainty about ROI, lack of an incentive program, and absence of a Client. These records demonstrate the importance of securing client commitment; introducing incentives and proactive measures to address financial uncertainties is mandated. Also, it emphasises the importance of a motivational mechanism for BIM implementation in both contexts. Most importantly, the findings are consistent with the results obtained by previous research which established that implementation cost is one of the major barriers to implementation, especially in the construction industry of developing countries (Nielsen et al., 2024; Sood & Laishram, 2024).

4.8 ENABLERS FOR BIM IMPLEMENTATION IN INFRASTRUCTURE PROJECTS

Based on stakeholder perspectives, several measures can boost BIM implementation in infrastructure projects within Sri Lanka and the Middle East. At the outset, governments should establish mandatory BIM standards for public projects. Policies to help new technologies cover specific expenses, such as tax exemptions, adoption grants, or subsidies, should be supported in developing countries, where paying for the newest technologies is a major barrier. Clear stakeholder responsibility outlining, proper legal foundations, and a BIM-integrated procurement process can lessen uncertainties. Institute contextual accreditation and licensing for BIM users, ensuring their skills are recognised worldwide, and include BIM mandates in the bidding process, regardless of whether the private or public sector, or even public-private partnerships, are the better enablers. Simultaneously, building national BIM knowledge centres and providing access to open-source information ensures that manufacturers and constructors can learn the latest practices and continue to grow. They should encourage users to adopt Common Data Environments (CDEs) to enable swift cross-field collaboration and reduce design issues. Liaisons between BIM task forces in Sri Lanka and Middle Eastern countries can help ensure BIM standardisation is right and share knowledge. Besides, governments and organisations should support demonstration projects to highlight BIM's advantages, identify unforeseen problems, and enhance understanding of its use. Organising annual innovation contests and BIM-infrastructure challenges encourages universities and drives the creation of solutions tailored to local needs. Moreover, aligning BIM policies with the country's digital transformation and smart city objectives will ensure long-term capabilities for communication and maximum importance. There is also a major requirement to regularly organise activities that educate government officials, clients, and decision-makers, aiming to ensure their role in making BIM a standard practice in infrastructure policy and building.

5. CONCLUSIONS

This study investigated the fundamentals that have a vital impact on the implementation of BIM in infrastructure projects in Sri Lanka and the Middle East by using a structured questionnaire to identify key challenges and enablers. The findings demonstrate that BIM implementation barriers are both interconnected and multidimensional. The study revealed high start-up expenses, the absence of national BIM standards, a shortage of technical skills, stringent government requirements, cultural resistance, and a misunderstanding of BIM as a 3D tool as major barriers to BIM adoption. Sri Lanka lacks regulatory systems and monetary rewards, whereas the Middle East suffers from a lack of policy cohesion. However, nations such as the UAE and initiatives like Saudi Vision 2030 are making strides towards this by introducing compulsory policies. Therefore, successful BIM implementation requires not only technological readiness but also policy support, organisational transformation, and more. Leadership commitment, improved training, and the introduction of BIM into procurement activities through grassroots university efforts in Sri Lanka could serve as enablers. Nevertheless, its narrow geographic scope, a sample of 52 respondents, and the use of online surveys limited the study's external validity, as they did not allow for qualitative coverage or assessment of long-term consequences. However, as the final output, this research contributes to existing knowledge by providing a comparative understanding of the BIM implementation challenges and enablers across both developing and developed countries. Further research could delve deeper into this gap through other approaches, such as mixed-methods, and extend the analysis to obtain deeper insight into organisational behaviours, policy implementation processes, and the long-term impacts of BIM implementation across different contexts.

6. RECOMMENDATIONS

The study recommends that the Government mandate BIM in Sri Lanka, at least for public-private partnership projects. Also, introducing financial incentives and tax concessions for BIM-enabled projects can help expand awareness and adoption of BIM in both contexts, enabling many professionals to experience and understand its benefits. Most importantly, construction-related regulatory bodies may increase their efforts to promote BIM in professional development programmes and conduct related workshops, which may also raise awareness among professionals and other stakeholders in the construction landscape. Involvement of academia and industry, as well as Government sponsorship, may provide a platform for sharing resources and promoting BIM awareness through adaptation of international BIM protocols. Future researchers may explore the challenges more effectively using mixed method approach and larger comparative sample sizes. From a pragmatic point of view, the results of this study can help policymakers and industry player enhance BIM standards and strategies for implementation.

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