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INTEGRATING BIM INTO BUSINESS MODELS OF CONSULTANCY FIRMS: BARRIERS AND ENABLERS

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ABSTRACT

Building Information Modelling (BIM) has revolutionised the construction industry by enhancing collaboration, visualisation, and decision-making throughout project lifecycles. For consultancy firms, especially in Sri Lanka, integrating BIM into their business models (BMs) presents both significant opportunities and complex challenges. This study explores the barriers and enablers associated with incorporating BIM into the BMs of Sri Lankan consultancy organisations. A mixed-methods approach was adopted, combining expert interviews and a questionnaire survey among industry practitioners. Key barriers identified include high initial investment costs, difficulties in maintaining Level of Development standards, and a shortage of BIM-skilled professionals. Conversely, major enablers include greater international opportunities, time savings, and enhanced competitiveness. According to the findings, the financial, technological, and organisational challenges hinder BIM integration; strategic focus on enablers such as proper training, digital transformation, and client awareness can facilitate effective adoption. This study provides valuable insights for consultancy firms aiming to align with global digital transformation trends and highlights the need for further research into BIM-related business model attributes for consultancy firms.

Keywords: *Building Information Modelling (BIM); Business Models; Consultancy Organizations; Sri Lanka.*

1. INTRODUCTION

The construction industry is an important sector in a country's economy, encompassing various stakeholders who collectively drive project success (Badi & Diamantidou, 2017). Consultants play a pivotal role among these stakeholders by offering professional expertise throughout the project lifecycle. Consultancy firms operate as business entities by providing specialised professional services (Zainon et al., 2018) and advising clients on construction projects and investments while ensuring that the project meets design, budget, and regulatory criteria (Azhar, 2011). Specifically, quantity surveying consulting firms provide precise cost estimates and execute cost management strategies, thereby minimising budget overruns and enhancing financial efficiency (Ahmad et al., 2019).

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Therefore, being business entities, consultancy firms must adopt strong and sustainable business models (BMs) to remain competitive and maximise value (Euchner, 2016).

Business models (BMs) provide strategic direction for organisations by articulating the value proposition offered to customers, identifying the target market, and outlining revenue generation mechanisms (Das et al., 2023). According to Martins et al. (2015), BMs are instrumental in generating profitable income while assessing current and future costs to ensure long-term financial sustainability. The BM of a consulting firm must consist of several essential elements that support its success and sustainability (Euchner, 2016). Consultancy firms must integrate these essential elements to their business that enable effective management of fixed costs, such as salaries, office rent, and operational expenses, and market responsiveness to achieve sustained profitability and growth (Bullinger et al., 2016).

To fully capitalise on the potential of their BMs, consulting firms must also remain agile and responsive to technological advancements (Euchner, 2016). Among these, Building Information Modelling (BIM) stands out as a transformative innovation in the construction industry. BIM has transformed the construction industry by enhancing collaboration and decision-making throughout a project's lifecycle. It provides comprehensive insights into the planning, design, and execution of construction projects (Olawumi & Chan, 2018; Perera et al., 2022). BIM creates a digital platform that enhances collaboration and coordination among project stakeholders throughout the project lifecycle, including architects, engineers, quantity surveyors, and contractors (Walasek & Barszcz, 2017). Integrating emerging technologies like BIM within consultancy firms' BM offers strategic opportunities to diversify their services and remain competitive and innovative in this dynamic business environment, and generate new revenue streams (Abbasnejad et al., 2021).

However, successful integration of BIM into BM of consultancy firms requires not only adopting BIM Technology but also realigning business elements facilitating BIM integration. BIM-based Quantity Surveying tools enable consultants to provide more accurate and reliable cost management solutions, increasing market competitiveness (Won et al., 2013). BM can leverage technological advancements into strategic advantages. Therefore, consulting firms must adopt a BM that aligns with BIM implementation. However, implementing BIM requires a significant investment in hardware, software, education, and training, making it an expensive endeavour for many businesses (Suranga et al., 2018). Similarly, integrating BIM into BMs may present several barriers that need to be addressed, alongside enablers that should be strengthened.

However, this area remains underexplored in the Sri Lankan context. While global studies have examined the relationship between BIM and BMs (Mazen, 2013; Fagbenro et al., 2022), local research has primarily focused on the growth and establishment of consulting firms without integrating BIM within their BMs. This gap highlights the need to understand how BIM can be strategically integrated into BMs by initially addressing barriers and strengthening enablers. Accordingly, this research aims to advance the understanding by identifying the barriers and enablers to integrating BIM into the BMs of Sri Lankan consultancy organisations within the construction industry.

2. LITERATURE REVIEW

2.1 BIM IN THE CONSTRUCTION INDUSTRY

Building Information Modelling (BIM) is a digital system that manages construction projects from start to finish (Suranga et al., 2018). It allows stakeholders to visualise, simulate, and assess designs in a virtual space, leading to better decisions and improved coordination (Kocakaya et al., 2019). More than just software, BIM integrates people, processes, and technology to streamline project management across all phases (Zainon et al., 2018). BIM boosts construction efficiency, accuracy, and collaboration (Sadek et al., 2020). It supports real-time teamwork on a shared platform, reducing design flaws and rework. With features like scheduling (4D), cost tracking (5D), and sustainability (6D), BIM improves coordination, minimises delays, and controls costs (Abdel-Hamid & Abdelhaleem, 2023). It also enhances quality control, cuts waste and supports code compliance.

In Sri Lanka, BIM use is still emerging, lagging behind developed countries (Fathima et al., 2024). While large firms and global projects have begun adopting BIM, many local companies continue to rely on traditional methods such as 2D CAD drawings, manual quantity take-offs, and paper-based scheduling and documentation (Perera et al., 2022). Key barriers include low awareness, high costs, and limited technical skills (Olawumi & Chan, 2018).

2.2 SIGNIFICANCE OF BIM FOR CONSULTANCY ORGANISATIONS

Consultants ensure that projects meet client expectations, adhere to regulations, and are completed on time and within budget. Consultancy firms in Sri Lanka face challenges, such as limited technology adoption, regulatory hurdles, and a shortage of skilled labour, which hinder their growth, competitiveness and efficiency (Manoharan et al., 2022).

Consultancy firms in the construction sector can attain competitive advantages, enhanced procedures, and superior project outcomes by incorporating BIM into their workflows (Fagbenro et al., 2022). Quantity Surveying (QS) firms can utilise 5D BIM to improve the precision of cost estimations, hence minimising the risk of budget overruns (Zainon et al., 2018). BIM enables consultants to provide more extensive services to clients, such as real-time cost updates and clash detection among various building systems (Abd & Khamees, 2017). Through BIM adoption, consultancy companies can extend their services with sustainability assessments, lifecycle cost evaluations, and improved project management features (Onososen et al., 2022). The market demands consultants who use advanced technology for project management, and the adoption of BIM technology helps firms claim this valuable market space (Rogers et al., 2015) BIM also helps consultancy firms fulfil client demands for accurate, timely information, leading to better client satisfaction and meeting the industry's precise timing requirements. According to Wang et al. (2020), the use of BIM enables consultants to collaborate with other stakeholders, resulting in faster project delivery while maintaining budget control and ensuring high quality. Therefore, BIM has become a vital tool in the construction industry, significantly impacting the operations and functions of construction consultancy firms.

2.3 BUSINESS MODELS OF CONSULTANCY ORGANISATIONS

Construction consultancy firms showcase their value creation strategies through BMs that outline their operational processes, methods of delivering client value, and profit-generating activities (Rogers et al., 2015). In dynamic business environments, it is essential for companies to quickly identify emerging technologies and develop effective strategies to capitalise on their potential (Fagbenro et al., 2022). Since BMs often drive organisational change, it is crucial to design adaptive BMs that respond to technological advancements and regulatory shifts (Martins et al., 2015). Recent trends are to merge BMs with value-based perspectives like early engagement and lifecycle approaches, further enabling strategic partnerships, technology integration, and strategy formulation. (Das et al., 2023).

A well-designed BM can foster strategic collaboration by integrating technology and corporate strategies to tackle critical challenges, like customer dissatisfaction, market fragmentation, and technology resistance (Martins et al., 2015). Clear pathways for technology adoption enable businesses to enhance resilience and sustain competitiveness in rapidly changing markets (Stone & Parnell, 2023). Integrating BIM into BMs of construction consultancies helps gain competitive advantages, streamlines processes, and improves project outcomes with value additions (Fagbenro et al., 2022). Evolving construction industry demands that Sri Lankan consultancy firms adapt to technologies like BIM to remain competitive and add value to clients. Thus, integrating BIM into a consultancy firm's BM is essential.

2.4 BIM ADOPTION IN CONSULTANCY ORGANISATIONS

Despite BIM's numerous advantages, consulting firms often face significant challenges regarding its implementation (Suranga et al., 2018). Effective adoption of BIM by consultancy firms is frequently hindered by several barriers such as significant initial costs, reluctance toward abandoning traditional processes, and a lack of recognised industry standard protocols (Sun et al., 2015). Collectively, these barriers can hinder the integration of BIM into consulting firms' BM, limiting the ability to gain the full range of BIM advantages. Several studies, as summarised in Table 1, highlight the key obstacles hindering BIM adoption within consultancy organisations.

Table 1: Barriers to BIM adoption for consultancy organisations

Code	Barriers to BIM adoption in consultancy organisations	Authors
B01	High expenses for training staff on new BIM software and integrated practices.	C, J, K, L, N, E, F
B02	Significant initial investment needed for BIM-related software and hardware	A, C, D, K, I
B03	Elevated costs for implementing new processes and BIM technology	C, L, N, I
B04	Insufficient support from top management for adopting BIM practices	C, H, L, N, I
B05	Resistance among professionals to transition to BIM modelling	C, J, E
B06	Limited support for BIM adoption within the company	L, N, C, D, H, J
B07	Lack of standardised procedures, protocols, and guidelines	L, N, C, D, J

Code	Barriers to BIM adoption in consultancy organisations	Authors
B08	Shortage of skilled professionals and in-house expertise to support BIM practices	L, N, C, D, J
B09	Widespread resistance to adopting new processes associated with BIM	L, K, C, H
B10	Inadequate BIM object libraries and modelling standards	L, N, G, F
B11	Limited project opportunities to apply and test BIM capabilities	K, N, C, H
B12	Lack of interoperable platforms for seamless BIM integration	L, N, C
B13	Insufficient comparative research between traditional and BIM-based projects	K, C
B14	Incompatibility issues of BIM with other software platforms, affecting usability	K, B, M
B15	Low satisfaction with the return on investment (ROI) from BIM implementations	I, J, M
B16	Legal uncertainties related to ownership, intellectual property, and insurance	K, L, M
B17	Minimal demand or interest in BIM from clients, reducing motivation for adoption.	J, K, B, M, J
B18	Operational-level reluctance to incorporate BIM in daily workflows	K, M
B19	Reluctance among team members to openly share data in collaborative BIM settings	B, M
B20	Confidence in existing methods	L, N, C, M, G
B21	Compatibility issues during software integration and document sharing	L, N, C, D
B22	Limited market support and weak trends favouring BIM adoption	L, N, C, D
B23	Low industry awareness of BIM's advantages and potential	K, N, H
B24	Lack of comparative cost-benefit analysis to highlight BIM's financial advantages	B, C, H, K, N

A - (Ahmad et al., 2019), B - (Arayici et al., 2011), C - (Gardezi et al., 2014), D - (Gerges et al., 2017), E - (Ghaffarianhoseini et al., 2022), F - (Hamma-adama et al., 2020), G - (Hatem et al., 2018), H - (Khosrowshahi & Arayici, 2012), I - (Nguyen & Nguyen, 2021), J - (Oesterreich & Teuteberg, 2019), K - (Rogers et al., 2015), L - (Sun et al., 2015), M - (Walasek & Barszcz, 2017), N - (Won et al., 2013)

As depicted in Table 1, the main barriers focus particularly on financial constraints and organisational and technological difficulties. Table 1 reveals that high implementation costs, internal resistance to change, limited technical expertise, and inadequate digital infrastructure are the main barriers preventing BIM adoption in consultancy firms.

On the other hand, consultancy firms possess several enablers that can help overcome these barriers and facilitate the effective adoption of BIM. Various authors have identified key enabling factors that support BIM integration within consultancy organisations, which are outlined in Table 2.

Table 2: Enablers of BIM adoption in consultancy organisations

Code	Enablers of BIM adoption in consultancy organisations	Authors
E01	Growing awareness of BIM in global practices	C, D, K, L
E02	Strong leadership and top management support	H, K
E03	Investment in training and development	D, J
E04	Clear BIM standards and protocols	C, H
E05	Support for gaining a competitive advantage in the market	G, H, K
E06	Trend of using BIM for the management of construction project information	E, F, H, K
E07	Providing an overall sustainable construction environment	E, F, H, K
E08	Improving the coordination of construction documents	E, F, H, K
E09	Enhanced visualisation	A, B, E, K
E10	Real-time collaboration among all project professionals and stakeholders	A, B
E11	Systematic training programs for staff integrating R&D strategies	A
E12	Redesigning the organisational structure to suit an effective BIM implementation	A, H, I, L
E13	Building effective client-consultant relationships	A, L
E14	Introducing a digital transformation strategy with realistic objectives	A, E, F, G
E15	Investing in suitable software solutions for a BIM-enabled working environment	G, H, K
E16	Improving coordination processes with external suppliers	C, H
E17	Integration with existing systems	B, I
E18	Client awareness and demand	C, J
E29	Comprehensive cost-benefit analysis	C, H, L

A - (Abbasnejad et al., 2021), B - (Arayici et al., 2011), C - (Azhar, 2011), D - (Babatunde et al., 2020), E - (Badi & Diamantidou, 2017), F - (Elmualim & Gilder, 2014), G - (Gardezi et al., 2014), H - (Gerges et al., 2017), I - (Khosrowshahi & Arayici, 2012), J - (Olawumi & Chan, 2018), K - (Khosrowshahi & Arayici, 2012), L - (Won et al., 2013)

These enablers highlight the strategies, resources, and organisational conditions that can drive successful BIM adoption, such as client awareness, technological integration, and the establishment of standardised protocols. The identified barriers and enablers of BIM adoption in consultancy firms provide a basis for empirically investigating the barriers and enablers associated with BIM integration into Sri Lankan construction consultancy firms' BMs.

3. METHODOLOGY

A mixed-methods approach was employed to gather both in-depth qualitative insights and quantitative data on the integration of BIM into the BMs of consultancy firms. Qualitative data were used to identify the key barriers and enablers specific to the Sri Lankan context, while industry-wide trends and priorities were revealed using quantitative data. Semi-structured interviews were conducted, allowing the researcher to explore predefined information related to the topic from the literature and gain contextual insights. Accordingly, barriers and enablers identified in the literature were presented to

the experts to assess their relevance to the Sri Lankan context, and additional barriers and enablers were also considered. Interviews were conducted with ten industry experts who were purposefully selected based on the criteria outlined in Table 3.

Table 3: Profiles of interviewees of experts

Expert	Designation	Experience > 15 Years	Experience in top management of a Consultancy Firm > 10 years	Experience with BIM
E1	Director	✓	✓	✓
E2	Senior Quantity Surveyor	✓	✓	✓
E3	Director	✓	✓	✓
E4	Director	✓	✓	✓
E5	Director	✓	✓	✓
E6	Director	✓	✓	✓
E7	Director	✓	✓	✓
E8	Director	✓	✓	✓
E9	Director	✓	✓	✓
E10	Director	✓	✓	✓

Barriers identified in the literature and through interviews were used to develop questionnaires for collecting quantitative data. A questionnaire survey was conducted targeting a sample of 45 industry practitioners, selected using a purposive sampling method, who are members of top and middle management in consultancy organisations across Sri Lanka. The collected data were analysed using a content analysis method and statistical methods, such as RII, used to analyse quantitative data from a questionnaire survey.

4. FINDINGS AND ANALYSIS

Expert interviews explore the barriers and enablers associated with integrating BIM into the BMS of consultancy firms within the Sri Lankan construction industry. They provide valuable insights into the key factors influencing BIM adoption and paving the way for the next phase, where the significance of these factors was assessed within the Sri Lankan context. In addition to the barriers and enablers identified in the existing literature, the interviews revealed additional factors that further shaped the integration process, as shown in Table 4.

Table 4: Additional barriers found through expert interviews

Barriers	Percentage of experts	Enablers	Percentage of experts
Maintaining the Level of Development (LOD) details (E2, E4, E5, E6 and E10)	50%	Improved accuracy in estimation and financial forecasting with enhanced credibility (E1, E4, E5, E6, E9 and E10)	60%
Dependence on specific software platforms (E3 and E4)	20%	Time saving due to the enhancement of coordination and reducing rework (E5, E8, E9)	30%
Low trust in the Accuracy of the model (E2)	10%	Long-term cost savings & higher profitability due to efficiency improvements (E7, E8, E10).	30%
Requirement of continuous development and learning (All the Experts)	100%	Adaptability to remote work & cloud collaboration (E1. E4 and E7)	30%
Difficulty in recruiting and retaining BIM-skilled and trained staff (All the experts)	100%	More international opportunities (All the experts)	100%
		Lower risk due to the absence of human errors and minimised rework (E2, E3, E5, E9)	40%
		Support for gaining Competitive advantage (All the experts)	100%

The questionnaire survey, based on barriers and enablers identified through literature and interviews, was conducted to identify key factors in the Sri Lankan context. Of the 45 distributed, 32 responses were received, yielding a 71.11% response rate. Barriers and enablers with an RII above 0.8 were selected to highlight the most critical factors, focusing the analysis on those with the most significant potential impact.

4.1 BARRIERS TO INTEGRATING BIM INTO BUSINESS MODELS

Using RII analysis and ranking, the most significant barriers to integrating BIM into consultancy firms' business models were identified. Barriers with an RII above 0.8 were considered most critical, as shown in Table 5.

Table 4:Significance of barriers to BIM adoption to BMs of Consultancy firms

Barrier	RII Value	Rank
High initial investment for software and hardware	0.961	1
Maintaining LOD details	0.922	2
High expenses for training staff	0.861	3

Barrier	RII Value	Rank
Difficulty in recruiting and retaining BIM-skilled & trained staff	0.850	4
Lack of interoperable platforms	0.822	5
Low satisfaction with ROI	0.822	5
Requirement of continuous development and training	0.811	7
Low industry awareness of BIM's benefits	0.811	7
Low trust in model accuracy	0.805	9
Dependence on specific software	0.800	10

The highest-ranked barrier to BIM adoption is the high initial cost of hardware and software (RII = 0.961), also confirmed by all interviewed experts. Maintaining Level of Development (LOD) details ranks second (RII = 0.922), with experts E2, E4, E5, E6, and E10, noting challenges in keeping models detailed and accurate throughout project phases.

The third and fourth barriers are the high staff training cost and difficulty recruiting and retaining BIM-skilled staff. Experts emphasised this concern; E2 noted, "*We have to allocate some of the user licenses of BIM software just for training staff for about 3 months, which is a high cost for us*". E6 added that trained staff often leave before firms see returns. As a result, many firms feel that the financial ROI from BIM is slow or unclear, and it ranked fifth in the survey, with an RII of 0.822. Inadequate interoperable platforms also rank fifth, reflecting ongoing issues in integrating different BIM tools, as noted by experts E3 and E4.

All the experts emphasised the need for continuous development and training regarding BIM software and its users, due to the rapid pace of software updates and upgrades. In the survey, it ranked seventh. Low industry awareness of the benefits of BIM also took seventh place (RII 0.811). E9 noted that low industry awareness limits the client base of consultancy firms for BIM integration, which affects their BMs. "*Some Sri Lankan practitioners still trust manual methods over BIM outputs due to their extensive experience*" [E2]. Dependency on specific software ranks tenth (RII = 0.800), with E3 and E4 mentioning that being locked into one solution reduces flexibility and raises long-term costs.

Addressing these high-priority barriers is important in facilitating BIM adoption into BMs of construction consultancy firms in Sri Lanka.

4.2 ENABLERS OF INTEGRATING BIM INTO BUSINESS MODELS

Table 6 indicates the enablers for integrating BIM into business models of consultancy firms that carry points above 0.8.

Table 6: Significance level of enablers of BIM adoption

Enabler	RII Value	Rank
More international opportunities	0.956	1
Time saving	0.956	1
Support for gaining a competitive advantage	0.944	3
Proper training programmes for staff	0.944	3

Enabler	RII Value	Rank
Improved accuracy	0.928	5
Enhanced project visualisation	0.928	5
Clear BIM standards and protocols	0.917	7
Real-time collaboration among project stakeholders	0.894	8
Introduction of a digital transformation strategy	0.839	9
Adaptability to remote work & cloud collaboration	0.833	10
Improving the coordination of construction documents	0.833	10
Long-term Cost Savings & Higher Profitability	0.817	11
Growing awareness of BIM in global practices	0.811	12
Having effective client-consultancy relationships	0.811	12
Lower risk of human errors and rework	0.800	14

The top two enablers, with an RII of 0.956, were more international opportunities and time savings. Experts noted increased remote job possibilities related to BIM for Sri Lankan consultants from regions like the Middle East, the UK, and Australia. As E8 stated, "*BIM enables better coordination and reduces rework, saving time compared to manual methods.*"

Support for gaining a competitive advantage and proper staff training (RII 0.944) were the next top-ranked enablers. Experts emphasised that BIM adoption is key to securing international job opportunities with competitive advantages. Proper staff training is possible since "Sri Lanka has better committed resource persons to conduct proper training programmes of BIM" [E2, E7]. BIM's ability to enhance accuracy and project visualisation ranked fifth (RII 0.928). "BIM allows us better to understand the project scope, layout, and sequencing, so that we can make more informed decisions." [E3, E6].

Clear BIM standards and protocols, real-time collaboration, digital transformation strategy, remote/cloud work adaptability, and better document coordination ranked 7–10 (RII > 0.8). Experts noted BIM's globally recognised standards ensure quality and compatibility. "*Currently, most businesses, including us, think of digital transformation, so it will positively affect BIM adaptation.*" [E1]. In addition, "*Consultants demand more advanced documentation management strategies, for which BIM will help.*" [E8]. Long-term cost savings, global BIM awareness, better client-consultancy relationships, and reduced errors/rework ranked 11–14. E7, E8, and E10 highlighted BIM's role in minimizing waste and delays and improving financial outcomes. Experts also noted that BIM can be further strengthened due to established client-consultancy relationships.

Overall, the analysis shows that enablers focused on ROI and workforce capability can accelerate effective BIM integration into consultancy business models.

4.3 DISCUSSION

The study's findings support and extend the existing literature on BIM and BMs. Literature highlighted the BM innovation of consultancy firms with BIM as a key impact, as BIM drives firms to rethink workflows, project delivery, and management approaches. With BIM integration, firms deliver faster, higher-quality, and more cost-effective projects, improving competitive positioning.

This study highlights the key enablers that can support Sri Lankan consultancy firms in effectively integrating BIM into their BMs while addressing and overcoming major barriers. Key enablers include improved accuracy and enhanced credibility (E1, E3, E6), consistent with Zainon et al. (2018). Improved visualisation (RII 0.928) supports better client communication and real-time collaboration (RII 0.894), which builds trust among stakeholders and aligns with Abbasnejad et al. (2021) and Arayici et al. (2011). Critical success factors include training (RII 0.944), leadership support (RII 0.800), and clear standards (RII 0.917), which enable consultancies to maximise BIM's benefits, which were identified as barriers by Gardezi et al. (2014), Won et al. (2013) and Sun et al. (2015) in the literature.

Major barriers include high initial costs and training expenses (RII 0.861), consistent with Oesterreich and Teuteberg (2019) and Rogers et al. (2015). Technical issues, such as maintaining LOD (RII 0.922) and interoperability (RII 0.822), identified in this study align with the findings of Rogers et al. (2015) and Walasek and Barszcz (2017), which highlight operational-level reluctance and disruption of workflows. Organisational resistance (RII 0.778) and limited management support (RII 0.783) reflect organisational, cultural, and governance barriers, as mentioned by Gardezi et al. (2014) and Nguyen and Nguyen (2021), which are highly influenced to the adaptive nature of BMs.

5. CONCLUSIONS

This study aimed to explore the enablers and barriers to integrating BIM into the BMs of consultancy firms in Sri Lanka, highlighting the importance of BIM integration towards competitive advantages, operational efficiency, and enhanced value creation of BMs. When strategically aligned with BMs, BIM adoption significantly drives innovation and project success.

Key enablers include access to international job opportunities, skilled trainers, and alignment with global digital transformation trends, which provide direction to consultancy firms to reform their operations, enhance service offerings, and gain a competitive advantage. However, high upfront costs, resistance to change, and difficulty in recruiting and retaining BIM-skilled and trained staff are the main challenges. By strategically adopting enablers and proactively mitigating barriers, Sri Lankan consultancy firms can gain long-term value and operational efficiency by BIM integration to BMs as a strategic tool and competitive advantage.

Theoretical contributions include a deeper understanding of how BIM integration influences consultancy firms' BMs in a developing country context, concerning enablers and barriers. This study guide on the management of consultancy firms on the key factors that support and hinder BIM integration into their BMs, offering actionable insights.

The study focused on BIM adoption within the Sri Lankan construction industry, specifically targeting the business of quantity surveying consultancy firms. Future research should examine BIM-related business model elements to understand value creation and optimise operations. This will help firms align with digital transformation goals, ensuring sustained competitiveness in the evolving construction sector.

6. REFERENCES

Abbasnejad, B., Nepal, M. P., Ahankoob, A., Nasirian, A., & Drogemuller, R. (2021). Building information modelling (BIM) adoption and implementation enablers in AEC firms: A systematic literature review.

Architectural Engineering and Design Management, *17*(5–6), 411–433. https://doi.org/10.1080/17452007.2020.1793721

Abd, A. M., & Khamees, A. S. (2017). As built case studies for BIM as conflicts detection and documentation tool. *Cogent Engineering*, *4*(1), 1411865. https://doi.org/10.1080/23311916.2017.1411865

Abdel-Hamid, M., & Abdelhaleem, H. M. (2023). Project cost control using five dimensions building information modelling. *International Journal of Construction Management*, *23*(3), 405–409. https://doi.org/10.1080/15623599.2021.1880313

Ahmad, J. K. A., Mohammad, M. F., Hashim, N., Mohamed, M. R., & Ramli, M. A. (2019). Challenges of building information modelling (BIM) from the Malaysian architect's perspective. In E. M. Ahnuar, R. M. Nordin, J. Yunus & N. A. A. Rahman (Eds.), *International conference on built environment and engineering 2018 - "Enhancing construction industry through IR4.0" (IConBEE2018)* (pp. 05003). EDP Sciences. https://doi.org/10.1051/matecconf/201926605003

Arayici, Y., Coates, P., Koskela, L., Kagioglou, M., Usher, C., & O'Reilly, K. (2011). Technology adoption in the BIM implementation for lean architectural practice. *Automation in Construction*, *20*(2), 189–195. https://doi.org/10.1016/j.autcon.2010.09.016

Azhar, S. (2011). Building information modeling (BIM): Trends, benefits, risks, and challenges for the AEC industry. *Leadership and Management in Engineering*, *11*(3), 241–252. https://doi.org/10.1061/(ASCE)LM.1943-5630.0000127

Babatunde, S. O., Ekundayo, D., Adekunle, A. O., & Bello, W. (2020). Comparative analysis of drivers to BIM adoption among AEC firms in developing countries. *Journal of Engineering, Design and Technology*, *18*(6), 1425–1447. https://doi.org/10.1108/JEDT-08-2019-0217

Badi, S., & Diamantidou, D. (2017). A social network perspective of building information modelling in Greek construction projects. *Architectural Engineering and Design Management*, *13*(6), 406–422. https://doi.org/10.1080/17452007.2017.1307167

Bullinger, H.-J., Nagele, R., Rueger, M., & Fischer, D. (2016, September). *Business Model innovation: From technology market to market success.* 2016 Portland International Conference On Management of Engineering and Technology (PICMET). Honolulu, HI, USA. https://doi.org/10.1109/PICMET.2016.7806562

Das, P., Hijazi, A. A., Maxwell, D. W., & Moehler, R. C. (2023). Can business models facilitate strategic transformation in construction firms? A systematic review and research agenda. *Sustainability*, *15*(17), 13022. https://doi.org/10.3390/su151713022

Elmualim, A., & Gilder, J. (2014). BIM: Innovation in design management, influence and challenges of implementation. *Architectural Engineering and Design Management*, *10*(3–4), 183–199. https://doi.org/10.1080/17452007.2013.821399

Euchner, J. (2016). Business model innovation. *Research-Technology Management*, *59*(3), 10–11. https://doi.org/10.1080/08956308.2016.1161396

Fagbenro, R. K., Oyediran, O. S., & Onososen, A. O. (2022). Consulting business workflow and design performance metrics for BIM-based construction design in Nigeria. *ECS Transactions*, *107*(1), 1029–1041. https://doi.org/10.1149/10701.1029ecst

Fathima, F., Jayasinghe, S., Prasadika, J., & Wijerathna, S. (2024). *Drivers of actual usage of building information modelling tools by civil engineering professionals in the construction industry of Sri Lanka.* 2024 International Research Conference On Smart Computing and Systems Engineering (SCSE*)*, Colombo, Sri Lanka. https://doi.org/10.1109/SCSE61872.2024.10550677

Gardezi, S. S. S., Shafiq, N., Nuruddin, M. F., Farhan, S. A., & Umar, U. A. (2014). Challenges for the implementation of building information modeling (BIM) in Malaysian construction industry. *Applied Mechanics and Materials*, *567*, 559–564. https://doi.org/10.4028/www.scientific.net/AMM.567.559

Gerges, M., Ahiakwo, O., Mayouf, M., Austin, S., & Jaeger, M. (2017). An investigation into the implementation of building information modelling in the middle east. *Journal of Information Technology in Construction (ITcon), 22*(2), 1-15. http://www.itcon.org/2017/1

Ghaffarianhoseini, A., Hossain, M., Alduais, N. A. M., Al-Duais, H. S., Omrany, H., & Al-Obaidi, K. M. (2022). A review of using IoT for energy efficient buildings and cities: A built environment perspective. *Energies*, *15*(16), 5991. https://doi.org/10.3390/en15165991

Hamma-adama, M. H., Kouider, T., & Salman, H. (2020). Analysis of barriers and drivers for BIM adoption. *International Journal of BIM and Engineering Science*, *3*(1), 18–41. https://doi.org/10.54216/IJBES.030102

Hatem, W. A., Abd, A. M., & Abbas, N. N. (2018). Barriers of adoption building information modeling (BIM) in construction projects of Iraq. *Engineering Journal*, *22*(2), 59–81. https://doi.org/10.4186/ej.2018.22.2.59

Khosrowshahi, F., & Arayici, Y. (2012). Roadmap for implementation of BIM in the UK construction industry. *Engineering, Construction and Architectural Management*, *19*(6), 610–635. https://doi.org/10.1108/09699981211277531

Kocakaya, M. N., Namlı, E., & Işıkdağ, Ü. (2019). Building information management (BIM), a new approach to project management. *Journal of Sustainable Construction Materials and Technologies*, *4*(1), 323–332. https://doi.org/10.29187/jscmt.2019.36

Manoharan, K., Dissanayake, P., Pathirana, C., Deegahawature, D., & Silva, R. (2022). Labour-related factors affecting construction productivity in Sri Lankan building projects: Perspectives of engineers and managers. *Frontiers in Engineering and Built Environment*, *2*(4), 218–232. https://doi.org/10.1108/FEBE-03-2022-0009

Martins, L. L., Rindova, V. P., & Greenbaum, B. E. (2015). Unlocking the hidden value of concepts: A cognitive approach to business model innovation. *Strategic Entrepreneurship Journal*, *9*(1), 99–117. https://doi.org/10.1002/sej.1191

Mazen, I. (2013). Business model for BIM based service*s*. In *Proceedings of the 30th CIB W78 International Conference* (pp. 545-554). University of Auckland, New Zealand. https://itc.scix.net/pdfs/w78-2013-paper-144.pdf

Nguyen, T.-Q., & Nguyen, D.-P. (2021). Barriers in BIM adoption and the legal considerations in Vietnam. *International Journal of Sustainable Construction Engineering and Technology*, *12*(1), 283-295. https://doi.org/10.30880/ijscet.2021.12.01.027

Oesterreich, T. D., & Teuteberg, F. (2019). Behind the scenes: Understanding the socio-technical barriers to BIM adoption through the theoretical lens of information systems research. *Technological Forecasting and Social Change*, *146*, 413–431. https://doi.org/10.1016/j.techfore.2019.01.003

Olawumi, T. O., & Chan, D. W. M. (2018, January). *Beneficial factors of integrating building information modelling (BIM) and sustainability practices in construction projects*. Hong Kong International Conference on Engineering and Applied Science (HKICEAS 2018), Hong Kong. http://dx.doi.org/10.6084/m9.figshare.19758844

Onososen, A., Musonda, I., & Tjebane, M. M. (2022). Drivers of BIM-based life cycle sustainability assessment of buildings: An interpretive structural modelling approach. *Sustainability*, *14*(17), 11052. https://doi.org/10.3390/su141711052

Perera, U. D. S., Kulatunga, U., Abdeen, F. N., Sepasgozar, S. M. E., & Tennakoon, M. (2022). Application of building information modelling for fire hazard management in high-rise buildings: An investigation in Sri Lanka. *Intelligent Buildings International*, *14*(2), 207–221. https://doi.org/10.1080/17508975.2021.1874858

Rogers, J., Chong, H.-Y., & Preece, C. (2015). Adoption of building information modelling technology (BIM). *Engineering, Construction and Architectural Management*, *22*(4), 424–445. https://doi.org/10.1108/ECAM-05-2014-0067

Sadek, K., El-Bastawissi, I., Raslan, R., & Sayary, S. (2020). Impact of BIM on building design quality. *BAU Journal - Creative Sustainable Development*, *1*(1). https://doi.org/10.54729/2789-8334.1000

Sun, C., Man, Q., & Wang, Y. (2015). Study on BIM-based construction project cost and schedule risk early warning. *Journal of Intelligent & Fuzzy Systems*, *29*(2), 469–477. https://doi.org/10.3233/IFS-141178

Stone, M., & Parnell, B. (2023). Business models of consulting firms: What do their leaders need to know? *Management Consulting Journal*, 6(2), 123–131. https://doi.org/10.2478/mcj-2023-0014

Suranga, J. H., Kolugala, N., Chamitha Sanjani Wijewickrama, M., Epasinghe, E., Jayasena, H., Kolugala, L., & Wijewickrama, M. (2018). *Open BIM adoption in Sri Lankan construction industry*. FOSS4G Asia 2018 Conference, Moratuwa, Sri Lanka. https://www.researchgate.net/publication/338605939

Walasek, D., & Barszcz, A. (2017). Analysis of the adoption rate of building information modeling [BIM] and its return on investment [ROI]. *Procedia Engineering*, *172*, 1227–1234. https://doi.org/10.1016/j.proeng.2017.02.144

Wang, Y., Thangasamy, V. K., Hou, Z., Tiong, R. L. K., & Zhang, L. (2020). Collaborative relationship discovery in BIM project delivery: A social network analysis approach. *Automation in Construction*, *114*, 103147. https://doi.org/10.1016/j.autcon.2020.103147

Won, J., Lee, G., Dossick, C., & Messner, J. (2013). Where to focus for successful adoption of building information modeling within organization. *Journal of Construction Engineering and Management*, *139*(11), 04013014. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000731

Zainon, N., Mohd-Rahim, F. A., Aziz, N. M., Kamaruzzaman, S. N., & Puidin, S. (2018). Catching up with building information modeling: Challenges and opportunities for quantity surveyors. *Journal of Surveying, Construction & Property*, *9*(1), 19–31. https://doi.org/10.22452/jscp.vol9no1.3