

BIM adoption strategies for SMEs to Manage Construction Project Risk in the Western Cape Province of South Africa

Murendeni Curry NemaKanga¹, Lance Wentzel² and Rainer Haldenwang³

¹⁻³Department of Construction Management and Quantity Surveying, Faculty of Civil Engineering and Built Environment, Cape Peninsula University of Technology, South Africa.

DOI: 10.36108/cbpm/2026.0141

Abstract

The construction industry plays an important role by creating jobs through small and medium-sized enterprises (SMEs). Despite their importance, construction SMEs in South Africa continue to face substantial project risks. The purpose of this research was to determine Building Information Modelling (BIM) adoption strategies that can be implemented by construction SMEs in the Western Cape Province of South Africa to manage construction project risks. A quantitative methodological approach using a structured online questionnaire survey was used. The research data was analysed using only descriptive (percentages, mean, standard deviation, etc.) statistics. The sample population was construction SMEs registered on the Construction Industry Development Board (cidb) register of contractors between Grade 1 and 6 under the General Building (GB) and/or Civil Engineering (CE) categories. The sample size was 25 construction SMEs selected using the voluntary response sampling method. The top perceived BIM strategies include: government grants that support small businesses; offering of continuous professional development and certification programmes and, collaboration between SMEs and larger construction companies and universities. The findings can assist construction SMEs in the Western Cape to understand the relationship between the strategies for adopting BIM and how it can improve the management of project risks contributing to long-term business growth.

Keywords: Building Information Modelling, Construction Project Risks, Small Medium-Sized Enterprises (SMEs)

1. Introduction

The construction industry is a major contributor to global economic development, accounting for approximately 13–15% of global Gross Domestic Product (GDP) and generating significant employment, also through SMEs (McKinsey and Company, 2024). In South Africa, the National Development Plan (NDP) Vision 2030 positions SMEs at the centre of economic growth and job creation. Despite their importance, SMEs in the South African construction sector continue to face substantial project risks, including cost overruns, schedule delays, quality failures, and occupational health and safety incidents (Chiswanda, 2021). The industry remains one of the country's highest-risk sectors, and research indicates that structured risk management practices are underutilised, directly affecting project performance and organisational sustainability (Masea, *et al.*, 2025).

According to Sarvari *et al.*, (2020), BIM as a digital innovation can improve project coordination, reduce rework, enhance transparency, and proactively manage construction project risks through improved visualisation, information sharing, and decision-making processes. Research published by Hall, *et al.*, (2023) has established that BIM adoption in construction SMEs can improve operational efficiency,

collaboration, and project performance; however, adoption remains uneven and often constrained by limited financial resources, inadequate technical skills, organisational resistance, and lack of implementation support (Mashinini *et al.*, 2025). While studies have examined barriers to BIM adoption and broad implementation strategies, insufficient attention has been given to how BIM adoption strategies can specifically support structured construction project risk management within SMEs, particularly in developing country contexts such as South Africa (Makabate *et al.*, 2022; Tsokodayi, 2025).

The Western Cape Province provides an important analytical setting for this study due to its relatively active construction sector, concentration of registered SMEs, and increasing infrastructure and urban development activities, which expose firms to diverse project risks while simultaneously creating opportunities for digital transformation. Despite these developments, limited empirical research exists on BIM adoption strategies for construction SMEs in the province. This knowledge gap constrains SMEs from leveraging BIM as a strategic project risk mitigation tool. Therefore, this study aimed to establish BIM adoption strategies that can be implemented by construction SMEs to manage construction project risk in the Western Cape Province of South Africa.

¹ Corresponding Author

Email address: 220010234@mycput.ac.za; wentzell@cput.ac.za; haldenwangr@cput.ac.za

A quantitative research method was adopted, utilising an online structured questionnaire, with the link to the questionnaire emailed to construction SMEs who are registered on the Construction Industry Development Board (cidb) register of contractors between Grade 1 and 6 under the General Building (GB) and/or Civil Engineering (CE) work categories, in the Western Cape Province of South Africa. The distribution of the questionnaire was guided using voluntary response sampling, and the data was analysed using only descriptive (mean, standard deviation, etc.) statistics.

The following BIM adoption strategies: government grants that support small businesses in adopting digital construction technologies such as BIM; continuous professional development and certification programmes; collaboration between SMEs and larger construction companies, universities, or BIM experts; the creation of clear, standardised BIM protocols across the construction sector; and peer-to-peer learning, where SMEs learn from other SMEs about BIM's ability to manage construction project risks, contribute to closing the existing research gap.

These strategies may assist SME owners, managing directors, operations managers, and project managers in minimising construction project risks, enhancing organisational competitiveness, and supporting innovative growth within the construction industry.

2. Literature Review

2.1. BIM adoption strategies to manage construction project risks within SMEs

Although there have been a few studies highlighting that BIM has significant potential to manage construction project risks, SMEs still face challenges in adoption due to financial constraints, lack of in-house technical expertise and training, lack of awareness, resistance to change, legal and contractual issues and, integration with existing systems (Bamgbose, *et al.*, 2024). Tackling such barriers requires a strategic approach to successfully implement BIM, to address construction project risk as well as investigating the organisational and cultural factors that impact the adoption. To overcome some of these challenges, international strategies and policies have proven effective and could be applied in the South African context. Some of these international strategies will be discussed next.

2.1.1. Government grants

Government grants support small businesses in adopting digital construction technologies through programs that are innovative. They are also effective strategies to support the adoption of BIM within SMEs. These grants minimise the financial weight associated with the setup, training, and acquisition of software (Canada Digital Adoption Program, 2022). Countries like the United Kingdom and Singapore have

government led initiatives that have accelerated BIM adoption amongst SMEs by offering financial assistance, tax incentives, and access to innovation hubs (Enterprise Singapore, 2025). Applying similar initiatives in South Africa could have a major impact on SMEs in overcoming financial and capacity-related challenges relative to BIM adoption.

2.1.2. Development of centralised platforms

These platforms provide open-access to tools like BIM and the delivery of free or affordable training workshops and webinars customised to the needs of small contractors and consultants. Ongoing professional development and certification opportunities can help strengthen internal skills and boost confidence in using BIM. (Maradza and Aigbavboa, 2023). This primarily reduces the risks associated with technical competency and skill deficiencies, which leads to improvements in construction project coordination, time, cost, and quality (Rane, 2023).

2.1.3. Fostering collaboration

Partnerships encourage mentorship opportunities, promote knowledge sharing and provide SMEs with access to essential BIM tools and professional expertise. Encouraging collaboration between small, medium, large construction firms, universities and BIM specialists can support the adoption of BIM. (Gerges, *et al.*, 2021). This strategy mitigates coordination and communication risks, while also indirectly reducing capability-related risks in construction projects (Saka and Chan, 2023).

2.1.4. Clear and standardised BIM protocols

The creation of clear, standardised BIM protocols across the construction sector can simplify the implementation process for SMEs and reduce the confusion surrounding adoption (Akinradewo, *et al.*, 2022). When SMEs operate without a defined set of standards, there is often confusion regarding roles, responsibilities, data formats, and levels of detail required at each stage of the project lifecycle. Applying this strategy reduces coordination and information management risks, while also improving efficiency and reliability across construction project delivery processes (Waqar *et al.*, 2023).

2.1.5. Sharing success stories

Sharing real-life experiences and successful project stories can assist SMEs to fully understand the value of BIM and build confidence in its use (Mvududu, *et al.*, 2023). Platforms such as knowledge hubs funded by governments, conferences and webinars can serve as effective channels for sharing these stories. Peer-to-peer learning where SMEs learn directly from other SMEs is also an effective way to reduce fear and uncertainty around BIM implementation (Ferreira, *et al.*, 2022). To effectively use BIM to manage construction project risks, SMEs need to make strategic

investments and encourage a cultural shift within their organisation (Saka and Chan, 2021). This reduces resistance to BIM adoption by improving awareness, building confidence, and encouraging better project performance through shared experiences (Olanrewaju *et al.*, 2022).

3. Research Methodology

The study utilised a quantitative methodological approach in the form of a structured online questionnaire survey, supported by a positivism philosophy and deductive reasoning. The justification for the research philosophy stems from the fact that positivism views reality as objective and measurable, which seeks to find laws and regularities that apply universally using systematic and quantitative methods (Ali, 2024). The justification for deductive reasoning is that this top-down approach helps explore cause-and-effect links, (Bell, *et al.*, 2022), linking very well with the positivism philosophy and the quantitative methodological approach adopted. The research population for this study was 70 construction SMEs who are registered on the Construction Industry Development Board (cidb) register of contractors between Grade 1 and 6 under the General Building (GB) and/or Civil Engineering (CE) work categories, in the Western Cape Province of South Africa. Seventy, (70) questionnaires were distributed utilising the voluntary response sampling method as described by McCombes (2023), with 25 construction SMEs indicating their willingness to participate and submitting the completed structured online questionnaire. This is a 36% response rate, which according to Akintoye (2000) is acceptable for construction research. Although voluntary response sampling is usually criticised for bias, it was utilised due to its ease and speed of implementation that was required due to time constraints.

Because voluntary response sampling can introduce self-selection bias, steps were taken to minimise its impact. The survey questions were standardised to avoid leading responses, and anonymity was ensured to reduce social desirability effects. Taking into consideration the scope of the study, data was collected from a range of participants to improve representativeness, and findings were interpreted with caution, acknowledging the limitations of the sampling method. By being transparent about these measures, the study aimed to reduce bias and enhance the credibility of its conclusions. The research data was analysed using only descriptive statistics (percentages, mean, standard deviation, etc.). Mean score ranges were as follows: 1.00-1.75 (strongly disagree); 1.76-2.50 (disagree); 2.51-3.25 (agree); 3.26-4.00 (strongly agree). Standard deviation was used to report the variability (how concentrated the data is around the mean) in ranking items that have the same mean score. Only the mean scores of the items were used to show

the central tendency and to rank the perceived BIM strategies in order of having the most effect to having the least effect.

4. Findings and Discussion

4.1. Analysis of respondents' demographic information

Analysis of Table 1 (Appendix 1) shows that 56% of respondents were male and 44% were female. The table further indicates that most respondents occupy managerial or leadership positions with responsibilities related to operational oversight and strategic decision-making. In terms of education, participants possess varied academic backgrounds, reflecting strong technical expertise and relevant qualifications. Overall, the findings highlight a strong presence of SMEs involved in general building activities that demonstrates a degree of operational flexibility within the sector.

4.2. BIM Adoption Strategies for SMEs to Manage Construction Project Risk.

The analysis of the descriptive data in Table 2 (Appendix 2) outlines the perceived strategies for enhancing BIM adoption among SMEs to manage construction project risks, with MS values between 3.26 and 4.00 (strongly agree), and the remainder of the variables with MS values between 2.51 and 3.25 (agree), indicating a strong sense of agreement amongst SMEs. The top MS value related to "Government grants" emerging as "Government led initiatives that accelerate BIM adoption amongst SMEs by offering financial assistance, tax incentives, and access to innovation hubs" ranked first, receiving a mean score (MS) of 3.28. This strategy allows SMEs to overcome financial barriers associated with software acquisition, staff training, and digital infrastructure by providing funding support, tax incentives, and access to innovation ecosystems (Algahtany *et al.*, 2023). The same level of agreement was recorded for "Government grants that support small businesses in adopting digital construction technologies like BIM to manage construction project risks through programs that are innovative" (MS = 3.28). Having the same MS, the ranking of these findings were determined by the standard deviation (SD) score, where the factor with lower SD ranking first. These findings are consistent with existing literature which emphasises that government financial incentives, subsidies, and policy initiatives play a critical role in accelerating BIM adoption among construction SMEs by reducing financial barriers and encouraging digital transformation within the sector (Algahtany *et al.*, 2023). The high ranking of government grant-related strategies suggests that SMEs view financial and institutional support as essential for overcoming BIM adoption barriers and improving construction project

risk management through better collaboration, decision-making, and project efficiency.

With reference to “The development of centralised platforms” the top ranked strategy, “Offering continuous professional development and certification programmes” ranked highest (MS = 3.36), highlighted the importance of building capacity and technical competence in promoting BIM adoption (Saka and Chan, 2023). This was followed by “Open-access to tools like BIM to help manage construction project risks” (MS = 3.32), strengthening the need to make BIM resources more available to SMEs. The ISO 19650 framework highlights the importance of developing organisational competence through training and professional development to ensure that project stakeholders can effectively manage and exchange digital construction information (ISO, 2018).

The top two strategies in the section relating to “Fostering collaboration” was “Collaboration between SMEs and larger companies, universities, or BIM experts” (MS = 3.20) ranked first and “Partnerships encouraging mentorship and knowledge exchange” (MS = 3.08) second, indicating that knowledge sharing and resource pooling can improve BIM implementation. These findings are consistent with the ISO 19650 framework that highlights the importance of coordinated information sharing and structured collaboration between organisations involved in construction projects to improve efficiency and reduce risks (ISO, 2018). The findings suggest that collaboration and mentorship enhance SMEs’ BIM capabilities through knowledge sharing, improving coordination and risk management, while reducing risks linked to poor communication, fragmented information, and weak planning.

“Clear and standardised BIM protocols” was identified as operational, with the strategy, “The creation of clear, standardised BIM protocols across the construction sector” (MS = 3.16) ranked first and “When SMEs operate without a defined set of standards, there is often confusion regarding roles and responsibilities.” (MS = 3.12) ranked last. Similarly, BIM guidelines developed by the National Institute of Building Sciences stress that standardised protocols help organisations operate more efficiently by ensuring consistency in BIM processes and communication across the construction supply chain (National Institute of Building Sciences, 2021). This indicates that clear guidelines and standardisation can reduce confusion and make implementation more efficient throughout the sector. Standardised BIM protocols can therefore improve risk management in SMEs by clarifying roles, ensuring consistent information flow, and streamlining workflows, which reduces communication issues, fragmented processes, and operational inefficiencies (Alashwal *et al.*, 2023).

Finally, “Sharing success stories” was recognised as an influential strategy, with “Peer-to-peer learning, where SMEs hear from other SMEs about the ability of BIM to manage construction project risks,” (MS = 3.24) ranked first, and “Platforms such as knowledge hubs funded by governments, conferences and webinars that can serve as effective channels for sharing success stories” (MS = 3.20) ranked second. Studies show that sharing case studies and experiences between industry participants helps organisations, particularly SMEs, learn from practical BIM applications and encourages wider adoption of digital construction practices (Chance and McAuley, 2023). The findings indicate that showcasing real-world cases of these benefits can help build trust, ease uncertainty and encourage adoption amongst SMEs. Peer learning and sharing BIM success stories reduce uncertainty, support informed implementation, and strengthen planning, collaboration, and risk mitigation, ultimately lowering construction project risks (Saka and Chan, 2023).

5. Conclusion and Recommendations for Further Research

This research endeavoured to establish BIM adoption strategies that can be implemented by construction SMEs in the Western Cape Province of South Africa to manage construction project risk. The study was motivated by the continued exposure of SMEs to cost overruns, delays, safety risks, and weak risk management practices, despite the growing recognition of BIM as a tool that can support better project outcomes. A quantitative methodological approach in the form of a structured online questionnaire was used to gather data from construction SMEs registered on the Construction Industry Development Board (cidb) register of contractors between Grade 1 and 6 under the General Building (GB) and/or Civil Engineering (CE) categories, in the Western Cape Province, South Africa., particularly from the leadership structure of these organisations.

The main findings indicated that SMEs recognise the importance of financial investment in developing skills and providing training, as these are key factors in building confidence and enhancing the technical expertise required for effective BIM implementation. The results also suggest that financial support mechanisms are critical in helping SMEs overcome the high initial costs associated with BIM adoption, including software, equipment, and training. Therefore, strengthening investment in capacity building and providing targeted financial assistance can significantly support SMEs in adopting BIM technologies, ultimately improving their ability to manage construction project risks. The study has practical implications for industry stakeholders and policymakers by emphasising the need for support initiatives that can strengthen SMEs digital transformation and improve construction project

delivery. Societally, increased BIM adoption among SMEs may contribute to a more efficient, competitive, and sustainable construction industry, supporting economic growth and improved infrastructure outcomes.

The following limitations for the study in line with BIM adoption are as follows:

- The study was limited to the Western Cape region in South Africa, and
- Only a quantitative method was used.

Recommendations for future research

- Research could be expanded to a national scale across all South African provinces to provide broader insights;
- Studies could adopt a mixed-method approach, and

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- Additional research could focus on developing a scenario based and practical framework that guides construction organisations through the adoption of BIM by implementing steps and integration with industry standards to manage construction project risks.
- ## 6. Acknowledgement
- The primary author would like to express sincere appreciation to the academic supervisors and institutional support provided throughout the development of this research. The authors also extend their gratitude to the construction industry professionals and SMEs in the Western Cape Province who contributed valuable insights and participated in the study, making this research possible.
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Appendix 1

Table 1: Respondents’ Demography

S/N	Variable	Category	Frequency	(%)
1	Gender	Male	14	56%
		Female	11	44%
	Total		25	100%
2	Age Bracket	20 - 30 years	14	56%
		31 - 40 years	5	20%
		41 - 50 years	6	24%
		51 - 65 years	0	0%
	Total		25	100%
3	Designation	Owner	7	28%
		Managing Director	5	20%
		Operations Manager	2	8%
		Project Manager	11	44%
	Total		25	100%
4	Construction-related Education & Training	Matric Certificate	1	4%
		Diploma in Civil Engineering	2	8%
		Diploma in Construction Management	3	12%
		Advanced Diploma in Construction	3	12%
		Advance Diploma in Quantity surveying	3	12%
		BEng Civil Engineering	1	4%
		BTech Civil Engineering	1	4%
		PGDip in Construction	1	4%
		PGDip in Quantity Surveying	2	8%
		BSc in Quantity Surveying	1	4%
		BSc in Civil Engineering	2	8%
		MSc Quantity Surveying	1	4%
		Master’s in environmental design	3	12%
		Master’s in construction management	1	4%
	Total		25	100%
5	CIDB Class of Work	General Building (GB)	13	58%
		Civil Engineering (CE)	7	22%
		Both (GB & CE)	5	20%
	Total		25	100%
6	CIDB Grade	Grade 1	5	20%
		Grade 2	4	16%
		Grade 3	4	16%
		Grade 4	6	24%
		Grade 5	2	8%
		Grade 6	4	16%
	Total		25	100%

Table 2: BIM adoption strategies that can be implemented by construction SMEs to manage construction project risk.

Variables		Response %				Mean	Std. Dev.	Rank
		Strongly Disagree	Disagree	Agree	Strongly Agree			
		1	2	3	4			
A	Government grants							
1	Government led initiatives that accelerate BIM adoption amongst SMEs by offering financial assistance, tax incentives, and access to innovation hubs.	0%	12%	48%	40%	3.28	0.68	1
2	Government grants that support small businesses in adopting digital construction technologies like BIM to manage construction project risks through programs that are innovative.	4%	8%	44%	44%	3.28	0.79	2
3	Grants that minimise the financial weight associated with setup, training, and acquisition of BIM to manage construction project risks.	0%	12%	56%	32%	3.20	0.65	3
B	Development of Centralized platforms							
1	Offering continuous professional development and certification programmes can help build internal capacity and confidence in BIM use.	0%	8%	48%	44%	3.36	0.64	1
2	Open-access to tools like BIM to help manage construction project risks	0%	4%	56%	40%	3.32	0.69	2
C	Fostering Collaboration							
1	Collaboration between SMEs and larger construction companies, universities, or BIM experts can help in adopting BIM.	0%	16%	48%	36%	3.20	0.71	1
2	Partnerships encourage mentorship opportunities, promote the exchange of knowledge, and provide SMEs with access to essential BIM tools and professional expertise.	0%	16%	60%	24%	3.08	0.64	2
D	Clear and standardized BIM protocols							
1	The creation of clear, standardised BIM protocols across the	0%	12%	60%	28%	3.16	0.62	1

Variables		Response %				Mean	Std. Dev.	Rank
		Strongly Disagree	Disagree	Agree	Strongly Agree			
		1	2	3	4			
	construction sector can simplify the implementation process for SMEs and reduce the confusion surrounding adoption.							
2	When SMEs operate without a defined set of standards, there is often confusion regarding roles and responsibilities.	0%	12%	64%	24%	3.12	0.60	2
E	Sharing success stories							
1	Peer-to-peer learning, where SMEs hear from other SMEs about the ability of BIM to manage construction project risks, is effective in overcoming fear, uncertainty, and misconceptions about BIM implementation.	0%	8%	60%	32%	3.24	0.60	1
2	Platforms such as knowledge hubs funded by governments, conferences and webinars can serve as effective channels for sharing success stories.	4%	8%	52%	36%	3.20	0.76	2
3	Sharing real-life BIM success stories in project risk mitigation and peer experiences would increase confidence in adopting BIM to manage construction risks.	0%	8%	68%	24%	3.16	0.55	3