

Assessing current practices and critical success factors influencing BIM adoption in Sarawak's construction industry

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Abstract

Purpose – This study aims to facilitate the industry on their readiness for building information modelling (BIM) adoption by assessing current practices and critical success factors (CSFs) of BIM adoption in the Sarawak construction industry.

Design/methodology/approach – This paper used a quantitative approach using a questionnaire survey to assess the level of BIM adoption in the Sarawak construction industry by examining current BIM practices and CSF. A total of 345 responses were required, and 295 valid responses were obtained from construction industry players, resulting in a response rate of 85.5%. The data were analysed using descriptive analysis, specifically mean scores and ranking. The questionnaire comprised three sections: demographic information, current BIM practices and CSF of BIM.

Findings – The findings identify the highest and lowest-ranked factors for construction performance (CP) and CSF within the scope of this study. The highest-ranked CP and CSF represent the most influential elements contributing to project success in the Sarawak construction industry, while the lowest-ranked factors indicate areas with minimal impact or lower perceived importance. These results highlight priority areas for industry stakeholders to focus on, as well as aspects that may require further investigation or improvement in future studies.

Research limitations/implications – This study is limited to the construction industry in Sarawak, and the population size of contractors and developers was not considered in the research scope. Future studies should incorporate a broader geographical coverage across divisions and more categories of population size to enhance the reliability and generalisability of the results.

Originality/value – There is no study on the current practices and CSF of BIM in the Sarawak construction industry yet. The significance of this study is to close the research gap by producing and documenting both variables for Sarawak.

Keywords Adoption, Building information modeling, Construction industry, Critical success factors, Current practices, Sarawak

Paper type Research paper



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1. Introduction

Building information modelling (BIM) is commonly known as a collaborative digital process that helps with coordination, optimize cost and high productivity in the construction industry. It has become a pivotal tool in the global construction industry, revolutionizing project management, design efficiency and resource optimization. Globally, BIM implementation has grown exponentially due to its capability to address complex construction challenges, particularly in countries such as the USA, UK, Singapore and South Korea, where strong industry readiness is supported by clear government mandates and standards (Latiffi *et al.*, 2013; Al-Ashmori *et al.*, 2020). BIM is widely regarded as a transformative tool in the Malaysian construction industry, with its implementation in construction projects potentially delivering significant value to the Malaysian government (Latiffi *et al.*, 2013). Malaysia has actively embraced BIM through initiatives like Construction Industry Transformation Programme (CITP) 2016–2020, which emphasizes digital transformation and sustainable construction methods. CIDB and the Public Works Department (PWD) have promoted BIM since RMK-11 in Malaysia. It is expected that BIM implementation in the Malaysian construction industry will become more prevalent through the government's efforts. However, adoption in Sarawak remains at an early stage, with only 14% of organizations having BIM project experience, while the majority still face limitations in training, organizational policies and investment in BIM technologies (Lee *et al.*, 2022). Although the awareness level of BIM is gaining momentum in the Sarawak construction industry, the implementation rate is still very low (Tamjehi *et al.*, 2020). There is significant interest in its adoption, where 95% of the respondents and 75% of the organizations expressed the intention to implement BIM (Lee *et al.*, 2022). Most respondents showed a willingness to adopt BIM mandates and embrace change, suggesting that BIM adoption could be significantly enhanced through government-led policies, localized standards, targeted training initiatives and pilot projects demonstrating tangible benefits. Therefore, the study aims to address these gaps by assessing current BIM practices and critical success factors (CSFs) influencing its adoption in Sarawak.

2. Literature review

The integration of BIM has been identified as a key enabler in Sarawak's Post COVID-19 Development Strategy 2030, supporting digital transformation and infrastructure development initiatives within the state (PCDS_Compressed_22_July_2021, 2021). Despite the increasing awareness of BIM, its adoption remains relatively limited, highlighting the need to understand existing industry practices and the factors influencing successful implementation.

This study is underpinned by the BIM Capability Maturity Model proposed by Succar (2009), which suggests that BIM adoption is influenced by the readiness and maturity of technology, processes and policy within an organization. Accordingly, the literature review focuses on two key aspects of BIM adoption: current BIM practices, which reflect the extent of BIM implementation, and CSFs, which represent the organizational, technical and institutional conditions necessary for successful adoption. Based on the literature review, 17 current BIM practices and 52 CSFs were identified and are summarized in Tables 1 and 2, respectively.

CSFs from various references are compiled and tabulated below, making it an essential reference for this study to access the BIM adoption within the construction sector in Sarawak construction industry.

Despite studies have identified numerous BIM applications and CSFs, BIM adoption remains uneven across the construction industry. Existing research suggests that successful implementation depends not on a single factor but on the combined readiness of people, processes, technology and organizational support (Chan *et al.*, 2019; Ismail *et al.*, 2021;

Table 1. Summary of current practices of BIM from different references

Current practices	References
1. BIM is used to complete design works	Cao <i>et al.</i> (2015); Wang <i>et al.</i> (2022); Kasim <i>et al.</i> (2017); Antwi-Afari <i>et al.</i> (2018)
2. BIM is used as a visualization tool	Cao <i>et al.</i> (2015); Kasim <i>et al.</i> (2017); Antwi-Afari <i>et al.</i> (2018)
3. BIM is used to perform design review and clash detection	Cao <i>et al.</i> (2015); Kasim <i>et al.</i> (2017); Latiffi <i>et al.</i> (2013)
4. BIM is used in quantity take-offs in the construction stage	Cao <i>et al.</i> (2015); Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013); Ismail <i>et al.</i> (2021)
5. BIM is used in bill of quantities (BoQ) preparation	Ismail <i>et al.</i> (2021)
6. BIM is used for collaboration and communication purposes in a construction project among architects, engineers, contractors and clients	Kasim <i>et al.</i> (2017); Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013); Ismail <i>et al.</i> (2021)
7. BIM is used to monitor project timelines and visualize construction scheduling	Wang <i>et al.</i> (2022); Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013)
8. BIM is used in cost estimation at design stage	Cao <i>et al.</i> (2015); Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013); Ismail <i>et al.</i> (2021)
9. BIM is used in offsite fabrication	Cao <i>et al.</i> (2015); Kasim <i>et al.</i> (2017); Antwi-Afari <i>et al.</i> (2018); Ahmad. Zaini <i>et al.</i> (2020)
10. BIM is used for accurate progress payment	Antwi-Afari <i>et al.</i> (2018)
11. BIM is used in sustainability analysis	Cao <i>et al.</i> (2015); Kasim <i>et al.</i> (2017); Antwi-Afari <i>et al.</i> (2018)
12. BIM is used for data management purpose	Kasim <i>et al.</i> (2017); Antwi-Afari <i>et al.</i> (2018); Ismail <i>et al.</i> (2021)
13. BIM model is used for building management purpose	Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013)
14. BIM model is used for asset tagging in facility management	Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013)
15. BIM model is used to monitor the real-time performance of building systems	Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013)
16. BIM data is used to track maintenance schedules	Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013)
17. BIM data is used to predict future needs	Son <i>et al.</i> (2014); Antwi-Afari <i>et al.</i> (2018); Latiffi <i>et al.</i> (2013)

Zaini *et al.*, 2020a, 2020b). However, limited evidence exists regarding the current BIM practices and CSFs within the Sarawak construction industry, highlighting the need for a context-specific assessment to support future BIM implementation.

3. Methodology

This paper conducted quantitative research in the form of a questionnaire survey to assess the level of BIM adoption in the Sarawak construction industry by examining the current practices and CSFs of BIM for the Sarawak construction industry. The minimum sample size required for this study was 345 respondents (Raosoft, 2025), determined using a 95% confidence level, 5% margin of error and 50% response distribution, following the sample size determination approach proposed by Cochran (1977). A stratified sampling approach was adopted in this study. The population was first stratified into four professional groups: architects, engineers, quantity surveyors and BIM specialists to ensure adequate

Table 2. Summary of critical success factors of BIM adoption based on various references

Critical success factors	References
1. BIM standards and guidelines for the construction industry	Ahmad Zaini <i>et al.</i> (2020); Ismail <i>et al.</i> (2021); Sinoh <i>et al.</i> (2020); Chan <i>et al.</i> (2019); Dao <i>et al.</i> (2021); Yaakob <i>et al.</i> (2016); Zaini <i>et al.</i> (2020a, 2020b)
2. Staff to be BIM competent through adequate BIM education and training programs	Ismail <i>et al.</i> (2021); Sinoh <i>et al.</i> (2020); Chan <i>et al.</i> (2019); Yaakob <i>et al.</i> (2016); Aziz <i>et al.</i> (2022); Son <i>et al.</i> (2014); Kasim <i>et al.</i> (2017); Zaini <i>et al.</i> (2020a, 2020b)
3. Financial support from the government to set up BIM system	Ismail <i>et al.</i> (2021); Chan <i>et al.</i> (2019)
4. Willingness of staff to learn new technology	Ismail <i>et al.</i> (2021); Latiffi <i>et al.</i> (2013); Chan <i>et al.</i> (2019)
5. Client's acceptance with BIM projects	Sinoh <i>et al.</i> (2020); Chan <i>et al.</i> (2019); Cao <i>et al.</i> (2015)
6. Change of mindset and awareness of industry players	Sinoh <i>et al.</i> (2020); Aziz <i>et al.</i> (2022)
7. BIM information-sharing protocols	Dao <i>et al.</i> (2021); Yaakob <i>et al.</i> (2016)
8. Organizational structure to support BIM system	Chan <i>et al.</i> (2019); Zaini <i>et al.</i> (2020a, 2020b); Zahrizan <i>et al.</i> , 2014
9. Professional BIM design team with organization	Zaini <i>et al.</i> (2020a, 2020b); Son <i>et al.</i> (2014); Kasim <i>et al.</i> (2017)
10. Continuous investment to upgrade for BIM system within organization	Yaakob <i>et al.</i> (2016)
11. Promotion opportunities from top management	Chan <i>et al.</i> (2019)
12. Specify BIM contents in a contractual agreement	Dao <i>et al.</i> (2021); Yaakob <i>et al.</i> (2016)
13. Specify the content of BIM model via Common Data Environment (CDE)	Dao <i>et al.</i> (2021)
14. High commitment and continuous support from management	Cao <i>et al.</i> (2015); Zaini <i>et al.</i> (2020a, 2020b); Aziz <i>et al.</i> (2022); Son <i>et al.</i> (2014); Zaini <i>et al.</i> (2020a, 2020b)
15. Relevant software available for BIM application	Aziz <i>et al.</i> (2022); Son <i>et al.</i> (2014); Latiffi <i>et al.</i> (2013)
16. Central repository system to store and organize all BIM project-related information	Yaakob <i>et al.</i> (2016); Aziz <i>et al.</i> (2022)
17. Understanding of client	Zaini <i>et al.</i> (2020a, 2020b)
18. Clear business plan, vision and mission from the management	Sinoh <i>et al.</i> (2020)
19. Stable and fast internet network system and power supply infrastructure	Sinoh <i>et al.</i> (2020); Aziz <i>et al.</i> (2022); Zaini <i>et al.</i> (2020a, 2020b)
20. Appropriate hardware, i.e. high-end computers	Sinoh <i>et al.</i> (2020); Aziz <i>et al.</i> (2022)
21. Systematic approach throughout project	Aziz <i>et al.</i> (2022); Zaini <i>et al.</i> (2020a, 2020b); Zaini <i>et al.</i> (2020a, 2020b)
22. Well-defined roles and responsibilities	Dao <i>et al.</i> (2021); Aziz <i>et al.</i> (2022)
23. Other tools and equipment, i.e. drone for reality modelling	Aziz <i>et al.</i> (2022)
24. Agreed deliverables for asset life cycle	Aziz <i>et al.</i> (2022)
25. Promotion and awareness roadshow about BIM	Cheng <i>et al.</i> (2015); Arayici and Khosrowshahi (2012); Zahrizan <i>et al.</i> , 2014

(continued)

Table 2. Continued

Critical success factors	References
26. Incentives given by client such as a tax deduction	Ahmad Zaini <i>et al.</i> (2020); Chan <i>et al.</i> (2019); Zahrizan <i>et al.</i> , 2014
27. Provide grant scheme for BIM training	Ahmad Zaini <i>et al.</i> (2020); Zahrizan <i>et al.</i> , 2014
28. Support and enforcement of BIM implementation by government	Asma <i>et al.</i> (2016); Sinoh <i>et al.</i> (2020); Latiffi <i>et al.</i> (2013); Zahrizan <i>et al.</i> , 2014
29. Client's adoption of BIM for pilot project	Latiffi <i>et al.</i> (2013); Zahrizan <i>et al.</i> , 2014
30. Research collaboration with universities	Zaini <i>et al.</i> (2020a, 2020b), Zaini <i>et al.</i> (2020a, 2020b); Zahrizan <i>et al.</i> , 2014
31. BIM-related curriculum for students in universities	Ahmad Zaini <i>et al.</i> (2020); Zaini <i>et al.</i> (2020a, 2020b); Zahrizan <i>et al.</i> , 2014
32. Private sectors demand the application of BIM in their project	Zahrizan <i>et al.</i> , 2014
33. BIM required by other project team members	Ahmad Zaini <i>et al.</i> (2020); Zahrizan <i>et al.</i> , 2014
34. Development of BIM department within an organization to monitor the application of BIM	Ismail <i>et al.</i> (2021); Son <i>et al.</i> (2014); Zaini <i>et al.</i> (2020a); Zahrizan <i>et al.</i> , 2014; Chan <i>et al.</i> (2019)
35. Require/hire BIM specialist	Zahrizan <i>et al.</i> , 2014
36. Outsourcing BIM specialist	Ahmad Zaini <i>et al.</i> (2020); Son <i>et al.</i> (2014); Zahrizan <i>et al.</i> , 2014
37. BIM software technical support team	Ahmad Zaini <i>et al.</i> (2020); Son <i>et al.</i> (2014); Zahrizan <i>et al.</i> , 2014
38. Top management is decisive in exhibit decision	Sinoh <i>et al.</i> (2020); Son <i>et al.</i> (2014); Zahrizan <i>et al.</i> , 2014
39. Initiate a change on BIM among employees in the design process	Sinoh <i>et al.</i> (2020)
40. Further BIM software training	Sinoh <i>et al.</i> (2020); Chan <i>et al.</i> (2019); Son <i>et al.</i> (2014); Zahrizan <i>et al.</i> , 2014
41. A BIM workflow that is clearly understood	Sinoh <i>et al.</i> (2020); Zahrizan <i>et al.</i> , 2014
42. The use of BIM software	Sinoh <i>et al.</i> (2020); Son <i>et al.</i> (2014)
43. Extensive use of digital libraries, standards and Web resources	Sinoh <i>et al.</i> (2020)
44. Search for a better process of communicating design ideas/solutions to clients	Sinoh <i>et al.</i> (2020); Zahrizan <i>et al.</i> , 2014
45. The use of technology in the project stakeholder's coordination process	Sinoh <i>et al.</i> (2020); Son <i>et al.</i> (2014)
46. Subsidizing the price of BIM software.	Ismail <i>et al.</i> (2021); Chan <i>et al.</i> (2019)
46. Incorporate BIM in construction projects	Ahmad Zaini <i>et al.</i> (2020); Zaini <i>et al.</i> (2020a, 2020b)
48. Specify the duties and power of information management	Dao <i>et al.</i> (2021)
49. Integrated project insurance	Dao <i>et al.</i> (2021)
50. Provide incentives for designers to undergo training process	Ismail <i>et al.</i> (2021)
51. Provide formal approach to monitor level of detailing (LOD) in BIM feature	Kasim <i>et al.</i> (2017)
52. Carry out a virtual meeting in conducting design review process	Kasim <i>et al.</i> (2017)

representation of each subgroup (Taherdoost, 2016). Respondents within each stratum were then randomly selected and invited to participate in the survey to minimize sampling bias (Etikan and Bala, 2017). The study population comprised architects from PAM Sarawak Chapter ($n = 134$), engineers from IEM Sarawak Branch ($n = 2,556$), quantity surveyors

registered with the Board of Quantity Surveyors Malaysia ($n=529$) and BIM specialists listed in CIDB Digital Malaysia with project experience in Sarawak ($n=129$), resulting in a total population of 3,348 professionals. This questionnaire consists of three sections: demographic information, current practices of BIM adoption in Sarawak construction industry and CSFs of BIM adoption in Sarawak construction industry. A five Likert scale was used to rate the level of both constructs.

Table 3 shows the sampling size and number of questionnaires collected from the respondents. A total of 100 questionnaires were distributed to each group for different disciplines. By contrast, all 129 BIM specialists identified from the CIDB Digital Malaysia directory were surveyed due to their direct BIM project experience in Sarawak, making them the most relevant respondents for this study.

A total of 295 responses were successfully collected out of 345, yielding a response rate of 85.5%, which is considered adequate for statistical significance and minimizing non-response bias (Fincham, 2008). The data were analysed using IBM SPSS 25 Statistics through descriptive analysis to summarize the data using frequencies, percentages, means and rankings.

4. Result and discussion

4.1 Demographic information

Table 4 categorizes respondents based on their years of professional experience, which involved 295 respondents. Respondents with 11–20 years of experience form the largest group, comprising 28.8% (85 respondents) of the total sample, followed by those with over 20 years of experience at 27.8% (82 respondents). The third ranking group includes participants with 6–10 years of experience, representing 25.4% (75 respondents), while the group with 1–5 years of experience ranked last, scores 18.0% (53 respondents).

Table 5 shows the highest academic qualifications among 295 respondents. Of the respondents, 171 hold a degree, ranking first. Master’s qualifications ranked second, followed by diploma holders ranked third with 18%, while only four respondents possess a PhD, placing it the last.

Table 6 demonstrates the professional background of the respondents. The majority, 221 respondents (74.9%), are from engineering disciplines, covering civil, mechanical and electrical engineering, ranked first. Architects with 32 respondents (10.8%) ranked second, followed closely by quantity surveyors at 31 respondents (10.5%). The smallest group of Others consist of 11 respondents (3.7%) from BIM experts. This data reflects a strong dominance of engineering professionals in the construction industry among the 295 respondents.

In view of the level of involvement in BIM projects among the respondents, Table 7 shows that 172 respondents (58.3%) reported no involvement in BIM projects, ranked first.

Table 3. Sampling size and number of questionnaires collected from the respondents

Background	Population	Questionnaire distributed	Questionnaire collected	Response rate (%)
Architect	134	100	32	32.0
Engineer (civil, mechanical and electrical)	2,556	300	221	73.67
QS	529	100	31	31.0
Others (BIM specialist)	129	129	11	8.53
Total	3,348	629	295/345	–

Table 4. Years of experience in the industry

Years of experience	Frequency (No.)	%	Rank
11–20 years old	85	28.8	1
More than 20 years	82	27.8	2
6–10 years old	75	25.4	3
1–5 years	53	18.0	4
Total	295	100.0	

Table 5. Highest academic qualification

Highest academic qualification	Frequency (No.)	%	Rank
Degree	171	58.0	1
Diploma	53	18.0	3
Master	67	22.7	2
PhD	4	1.4	4
Total	295	100.0	

Table 6. Professional background of respondents

Background	Frequency (No.)	%	Rank
Engineering (civil, mechanical and electrical)	221	74.9	1
Architect	32	10.8	2
Quantity surveyors	31	10.5	3
Others	11	3.7	4
Total	295	100.0	

Eighty-eight respondents (29.8%) had experience with fewer than five BIM projects, 26 respondents (8.8%) had participated in five to ten projects and only nine respondents (3.1%) had worked on more than ten projects. The result indicates a substantial gap in BIM adoption and experience, as nearly 60% of respondents had no exposure to BIM-related activities, proved that the adoption rate is still low in Sarawak despite the respondents has a high awareness of BIM (Lee *et al.*, 2022), which may be attributed to limited BIM enforcement and the scarcity of BIM-based projects within the local construction industry (Lee *et al.*, 2022; Razali *et al.*, 2025).

Table 8 highlights the distribution of BIM project ownership across different sectors from the 123 respondents who ever involved in BIM projects. It reveals that the governmental sector dominates BIM project ownership, accounting for 97 respondents (78.9% of the total), making it the highest-ranked category. Meanwhile, BIM projects ownership by both government and private sectors represent 15 respondents (12.2%), making it the second-ranked category. These findings align with existing literature mentioning that governments play an important role in pushing BIM implementation in most countries (Hadzaman *et al.* 2015). Private, on the other hand, were identified facing cost as existing barriers to private sector engagement in BIM are well-documented, as noted by Sacks *et al.* (2010), who identified cost and expertise limitations as critical challenges.

Table 7. Number of BIM projects involved by the respondents

No. of BIM projects involved	Frequency (No.)	%	Rank
None	172	58.3	1
Less than 5	88	29.8	2
5–10	26	8.8	3
More than 10	9	3.1	4
Total	295	100.0	

Table 8. BIM project ownership

BIM project ownership	Frequency (No.)	%	Rank
Governmental	97	78.9	1
Both sectors	15	12.2	2
Private	11	8.9	3
Total	123	100.0	

Table 9 illustrates the types of BIM projects involved by 123 respondents who have participated in BIM-related projects. The majority, 54 respondents (43.9%), reported involvement in building projects. Infrastructure projects ranked as second with 40 respondents (32.5%). Further, 29 respondents (23.5%) indicated their involvement in both infrastructure and building projects. This result shows that BIM is still predominantly used for building projects compared to infrastructure projects, aligning with studies showing that building sector show higher interest in BIM adoption due to its significant usefulness in design coordination and visualization purposes ([Sacks et al., 2018](#)).

4.2 Current practices

Table 10 reveals the current practices of BIM adoption in Sarawak. BIM is mostly used as a *visualization tool* at the early BIM adoption stage (CP2), with the highest mean value being 3.02. This finding aligns with [Latiffi et al. \(2013\)](#), whose main reason is its relatively low entry barrier and immediate value in presentations and decision-making. *Clash detection* (CP3) was ranked second, with a mean value of 2.76, and it is one of BIM's most cited benefits, reducing costly rework by identifying conflicts before construction ([Eastman et al., 2011](#)). *Collaboration among stakeholders, such as architects, engineers and contractors*, can see instant value in 3D visualization in avoiding design mistakes (CP6), which is ranked third, with a mean value of 2.68.

Table 9. Types of BIM projects involved

Types of BIM projects involved	Frequency (No.)	%	Rank
Building	54	43.9	1
Infrastructure	40	32.5	2
Both	29	23.5	3
Total	123	100.0	

Table 10. Current practices of BIM adoption in Sarawak

CP	Current practices	Mean	Rank
CP2	I use BIM as a visualization tool	3.02	1
CP3	I developed a BIM model to perform design review and clash analysis	2.76	2
CP6	I use BIM for collaboration and communication purposes in a construction project among architects, engineers, contractors and clients	2.68	3
CP1	I use BIM software and tools to complete design work	2.55	4
CP4	I use BIM software and tools for quantity take-offs	2.5	5
CP7	I use BIM to monitor project timelines and visualize construction scheduling	2.26	6
CP12	I use BIM for data management purposes	2.26	6
CP8	I use BIM for cost estimation at the design stage	2.20	7
CP14	I use a BIM model for asset tagging in facility management	2.15	8
CP13	I use a BIM model for building management purposes	2.13	9
CP17	I use BIM data to predict future needs	2.12	10
CP5	I use BIM software and tools to produce bill of quantities (BoQ) documents	2.09	11
CP15	I use a BIM model to monitor the real-time performance of building systems	1.95	12
CP9	I use BIM for off-site fabrication	1.87	13
CP11	I use BIM for sustainability analysis	1.80	14
CP16	I use BIM data to track maintenance schedules	1.78	15
CP10	I use 5D BIM for accurate progress payments	1.66	16

The findings show that practitioners in Sarawak believed that BIM adoption could foster good coordination and collaboration among stakeholders, considering that it provides visible help with visualization and clash detection. These functions require less can be implemented without having need the industry to be mature in BIM across all project stages. BIM is also mostly used to complete design works in Sarawak; however, the adoption still depends on the requirement of client for digital deliverables.

BIM practices in 4D BIM (time scheduling), data management and quantity take-offs are being adopted in government or high-value projects in other countries, but not in Sarawak. Most local contractors and quantity surveyors are still manually verifying quantities for contractual purposes (Gu and London, 2010). BIM for asset tagging is low in Sarawak because most projects are still focusing on design and construction stages, with minimal integration at operational and maintenance stage. While BIM can also generate BQ production, most of the quantity surveyors are continuing with the manual methods as the BIM models produced by the other team members such as architects and engineers are not completed with all the information that allows the quantity surveyors to perform full take-off (Zainon *et al.*, 2018).

Current practices, such as 5D BIM for progress payments, require integration of cost and schedule data, IoT-linked performance monitoring, sustainability analysis and off-site fabrication are ranked with lower mean values 1.87–1.66 (lowest). This is due to Sarawak has yet to reach the highly integrated level; thus, the industry does not see the need to integrate into their current practices for the time being. All these findings also reflect the current challenges of BIM implementation in Sarawak, where digital construction practices are still developing (Chin, 2025).

4.3 Critical success factors

Table 11 indicates the current success factors influencing BIM adoption in Sarawak. *Appropriate hardware* (CSF20) is the first-ranked CSF. This result aligns with the existing literature studies, indicating that the hardware limitations often delay BIM adoption ([Latiffi et al., 2013](#); [Mohd Nawi et al., 2014](#)). Financial support from the government to set up BIM systems (CSF3) ranked as the second highest, addressing the possibility of the most significant barriers in BIM adoption: the high upfront capital cost.

Other factors, such as *willingness of staff to learn new technology* (CSF4), ranked third, *systematic approach* (CSF21) and *well-defined roles* (CSF22), ranked fourth, and *advanced BIM software training* (CSF40), ranked fifth, highlight the need for capacity building. Skilled workforce is essential to translate BIM tools into project efficiency ([Succar, 2009](#)) and encouraging wider BIM adoption ([Succar et al., 2013](#)).

The government's support and enforcement of BIM implementation (CSF28) ranked sixth, indicating that stakeholders in Sarawak expect a top-down policy direction to drive adoption. This finding is similar to the government's enforcement remaining the main driver of BIM implementation in Peninsula Malaysia ([Eadie et al., 2013](#)). Stable and fast internet network systems and power supply infrastructure ranked sixth, implying that technology is the backbone for BIM collaboration in Sarawak ([Arayici and Khosrowshahi, 2012](#)).

While *subsidizing the price of BIM software* (CSF46, ranked eighth) and *grant schemes for BIM training* (CSF27, ranked ninth) have shown the desire of stakeholders to be supported financially, these align with Southeast Asian studies, highlighting that cost remains to be one of the most CSFs for BIM implementation, particularly on BIM-related software licences and training, both require a high upfront cost ([Arayici and Khosrowshahi, 2012](#)). Ranked equally at ninth is the *change of mindset and awareness* (CSF6), which indicates that the transformation mindset is equally important as technical deployment, implying that the traditional 2D-based workflows are still the current practices in Sarawak.

The lower rankings like *BIM Standards and Guidelines* (CSF1, Rank 30) and *Industry Foundation Class (IFC) compatibility* (CSF53, Rank 28) are technically important for BIM adoption; however, it is not so in Sarawak for the time being. *Outsourcing a BIM specialist* was ranked as the lowest factor, implying that the Sarawak industry prefers to build internal BIM capabilities rather than rely on external consultants. While outsourcing can offer short-term solution to the stakeholders, a long-term solution still requires training up their in-house staff on their technical competency ([Arayici and Khosrowshahi, 2011](#)).

5. Limitations of the study

This study was carried out mostly in Kuching city of Sarawak; thus, the result may not represent other divisions with different competencies and technological capabilities. Although the study achieved a high response rate of 80.8%, the sample size of 295 responses was mostly from public sector, which could have a potential response bias in which participants from the private sector, particularly from smaller and medium enterprises on BIM adoption, might not be represented accurately. While this research engaged professionals such as architects, engineers from all disciplines and quantity surveyors, it may not fully incorporate perspectives from other key stakeholders, such as contractors or clients. This exclusion might limit the overall findings. Furthermore, this research was conducted before the announcement of the BIM implementation policy in Sarawak, so government policies introduced after the study could affect the findings.

Another limitation that needs to be highlighted is the method of data collection. Likert-scale response was used, and it serves as the sole perception measurement; the data might be influenced by social desirability bias, in which respondents might overestimate their capacity

Table 11. Current success factors of BIM adoption in Sarawak

CSF	Critical success factors	Mean	Rank
CSF20	Appropriate hardware, i.e. high-end computers	4.21	1
CSF3	Financial support from the government to set up the BIM system	4.2	2
CSF4	Willingness of staff to learn new technology	4.16	3
CSF21	Systematic approach throughout the project	4.14	4
CSF22	Well-defined roles and responsibilities	4.14	4
CSF40	Advanced BIM software training	4.13	5
CSF19	Stable and fast internet network system and power supply infrastructure	4.12	6
CSF28	Support and enforcement of BIM implementation by the government	4.12	6
CSF15	Relevant software available for BIM application	4.11	7
CSF2	Require staff to be BIM competent through adequate BIM education and training programmes	4.1	8
CSF46	Subsidizing the price of BIM software	4.1	8
CSF6	Change of mindset and awareness of industry players	4.09	9
CSF27	Provide a grant scheme for BIM training	4.09	9
CSF42	The use of BIM software	4.09	9
CSF8	Organizational structure to support the BIM system	4.06	10
CSF10	Continuous investment to upgrade the BIM system within the organization	4.06	10
CSF14	High commitment and continuous support from management	4.07	11
CSF29	Client's adoption of BIM for a pilot project	4.05	12
CSF41	A BIM workflow that is clearly understood	4.05	12
CSF47	State compliance to incorporate BIM in construction projects	4.05	12
CSF9	Professional BIM design team within the organization	4.04	13
CSF24	Agreed BIM deliverables for asset life cycle	4.04	13
CSF31	BIM-related curriculum for students in universities	4.03	14
CSF12	Specify BIM contents in a contractual agreement	4.02	15
CSF17	Understanding of the client's requirements	4.02	15
CSF37	BIM software technical support team	4.02	15
CSF18	Clear business plan, vision and mission from the management	4.01	16
CSF43	Extensive use of digital libraries, standards and Web resources	4.01	16
CSF48	Specify the duties and powers of information management	4.01	16
CSF51	Provide a formal approach to monitor the level of detailing (LOD) in BIM features	4.01	16
CSF16	Central repository system to store and organize all BIM project-related information	4	17
CSF26	An incentive given by the client, such as a tax reduction	4	17
CSF45	The use of technology in the project stakeholders' coordination process	4	17
CSF39	Initiate a change in BIM among employees in the design process	3.99	18
CSF44	Searches for a better process of communicating design ideas/solutions to clients	3.99	18
CSF5	Client's acceptance of BIM projects	3.98	19
CSF7	BIM information-sharing protocols	3.97	20
CSF25	Promotion and awareness roadshow about BIM	3.97	20
CSF38	Top management is decisive in exhibit decision	3.97	20
CSF55	Improve legal and contractual matters related to BIM	3.97	20
CSF35	Require/hire a BIM specialist	3.96	21
CSF34	Development of the BIM department within an organization to monitor the application of BIM	3.95	22
CSF33	Other project team members require BIM	3.94	23
CSF11	Promotion opportunities from top management	3.93	24

(continued)

Table 11. Continued

CSF	Critical success factors	Mean	Rank
CSF23	Other tools and equipment, i.e. a drone for reality modelling	3.92	24
CSF30	Research collaboration with universities	3.92	24
CSF54	Increase the BIM product/software in the market	3.89	25
CSF50	Provide an incentive for designers to undergo the training process	3.88	26
CSF13	Specify the content of the BIM model via the Common Data Environment (CDE)	3.87	27
CSF53	Improve Industry Foundation Class (IFC) compatibility	3.86	28
CSF32	The private sector demands the application of BIM in its projects	3.83	29
CSF1	BIM Standards and Guidelines for the construction industry.	3.8	30
CSF49	Integrated project insurance	3.78	31
CSF52	Carry out a virtual meeting to conduct the design review process	3.78	31
CSF36	Outsourcing a BIM specialist	3.65	32

and readiness towards BIM adoption in Sarawak. This optimism could increase mean scores for CSFs without reflecting actual implementation situation.

6. Recommendations

Future research should consider to include data from other divisions to address the limitation of focusing only on Kuching, Sarawak, as this could provide a more comprehensive understanding of BIM readiness in Sarawak. Since the private sector might be underrepresented in this study, future studies can design a stratified sampling approach to ensure more balanced data collection for both SMEs and larger organizations. Future research should also include contractors and clients. Qualitative approaches such as interviews or focus group discussion could provide a better understanding of the experiences and expectations of the stakeholders. By understanding their challenges, expectations and willingness to adopt BIM, it will provide a clearer picture of the potential barriers and challenges as well as readiness for widespread implementation.

Future research should also target a more refined group of CSFs to address each phase of the project life cycle to tailor strategies for BIM implementation. Since the research was conducted before the announcement of Sarawak’s BIM implementation policy, future studies should examine the policy’s impact towards BIM adoption in Sarawak. Longitudinal research can track changes in BIM adoption rates, practices and challenges following the policy implementation. Additionally, comparative studies between pre- and post-policy adoption phases also can highlight the policy’s effectiveness and room for improvement. A comparative study between Sarawak and other states or regions with higher BIM adoption rates can be conducted as well to analyse differences in practices, policies and stakeholder engagement can provide valuable lessons for improving BIM readiness in Sarawak. Future studies should evaluate the effectiveness of existing technological tools and policy frameworks supporting BIM implementation. Identifying gaps in these areas will guide decision-makers in creating more robust support systems for the industry.

Future research should also incorporate challenges as a moderating variable to better explain variations in BIM adoption readiness. While CSFs identify enabling conditions, challenges identified may weaken the positive influence of these success factors. This approach could provide a more holistic framework, capturing both driving and inhibiting forces that shape BIM adoption maturity in Sarawak’s construction industry.

7. Conclusion

This study reveals that BIM adoption in Sarawak's construction industry is currently at an early stage where it is seen as a solution that provides immediate value. The limitations of the industry were shown in technical capacity, digital infrastructure and organizational readiness. However, the industry has shown a willingness to embrace BIM if it is supported by factors such as adequate hardware, government incentives, capacity-building initiatives and strong policy frameworks. Identifying CSFs highlighted the importance of coordinated efforts between government, industry and academia to address technical, financial and cultural barriers. By leveraging targeted training, localized BIM standards and pilot projects showcasing tangible benefits, Sarawak can progress towards a more mature and integrated BIM ecosystem, unlocking greater efficiency, collaboration and long-term value in its construction sector.

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