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BUILDING INFORMATION MODELLING ADOPTION IN SMALL AND MEDIUM-SIZED ENTERPRISES: A BIBLIOMETRIC ANALYSIS REVIEW

Elma Dewiyana Ismail[1*], Noor Akmal Adillah Ismail[2], Mohd Faiz Shapiai[3]

[1] Fakulti Alam Bina, Universiti Teknologi MARA, Malaysia
Email: dewiyana@uitm.edu.my
[2] Fakulti Alam Bina, Universiti Teknologi MARA, Malaysia
Email: noorakmal@uitm.edu.my
[3] Malaysian Public Works Department, Malaysia
Email: faizs@jkr.gov.my
[*] Corresponding Author

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Abstract:

This review paper analyses the knowledge composition of building information modelling (BIM) adoption and its application to small and medium-sized enterprises (SMEs). SMEs play an essential role in a country's economy, as they contribute to employment, innovation, and economic growth. On the other hand, BIM is considered an advanced technology that improves the accuracy and efficiency of construction projects. BIM enables better project planning, execution, and management, minimising the impact on the environment and the waste of resources. This aligns with the sustainability goal of reducing energy consumption and maximising material utilisation. Through a bibliometric review, 239 articles were gathered from the Web of Science (WoS) repository. These publications were examined, and VOSviewer was used for visual mapping to identify themes and trends in the literature. The first analysis, bibliographic coupling, identified five clusters representing different themes within the research area. However, only 4 clusters were discussed, focusing on the most impactful themes. The second analysis, co-occurrence, consists of three main clusters that reveal the primary research areas. The integration of both analyses offers a profound understanding of BIM and SMEs. Furthermore, it emphasises the importance of awareness and education programs, technical support, and technological advancements to enhance BIM adoption. These findings can offer advantageous perspectives for practitioners and academics.

Keywords:

Building Information Modelling (BIM), BIM Adoption, Small and Medium Enterprises (SMEs), Bibliometric Analysis

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Introduction

Building Information Modelling (BIM) is a technology widely used in the construction industry to support design, project management and documentation. (Durdyev et al., 2022; Hall et al., 2023). BIM enables the visualisation of three-dimensional (3D) digital representations that include the functional and physical details of the building. Developed countries such as the United Kingdom and the United States have been using BIM for several decades. (Al-sarafi et al., 2022). There is much evidence of the use of BIM in large organizations, but the adoption of BIM in small and medium-sized enterprises in Malaysia is still lagging. (Arif et al., 2021).

Small and medium-sized enterprises (SMEs) have received less attention in previous research on this topic than large organizations in developed countries. Studies investigating the adoption of Building Information Modelling (BIM) within SMEs are relatively few, and research from developing countries remains particularly scarce. A comprehensive review examined BIM adoption among SMEs between 2009 and 2019 using data extracted from the Scopus database, providing valuable insights into the trends and developments in this field during that period. (Makabate et al., 2022).

Notable studies have examined the barriers to Building Information Modelling (BIM) adoption among small and medium-sized enterprises (SMEs), revealing critical insights into the challenges faced by these organizations. The findings highlight that such barriers extend beyond technical or financial limitations and are also shaped by social and organizational factors (Ahmad Latiffi et al., 2014; Saka & Chan, 2020). These studies emphasise that the successful adoption of BIM in SMEs must be driven by the organization's intrinsic motivation and commitment to change. To further explore BIM adoption among SMEs, two research objectives are outlined below.

(1) To determine emerging trends in BIM and SME literature by applying bibliographic linkage analysis.
(2) To explore the future trends of BIM adoption by analyzing keywords.

The article is divided into two parts. Part 1 presents the position of BIM and SMEs, followed by the objectives of the study. The second part describes the methodology used based on a bibliometric analysis. Section 3 describes the findings, followed by the discussions. Section 4 presents the implications. Sections 5 and 6 discuss the limitations and future research directions. Finally, the conclusion is formulated in section 7.

Methodology

Bibliometric Approach

A bibliometric approach uses a quantitative method in which bibliographic databases are analyzed using science mapping. (Donthu et al., 2021). Science mapping is an analytical method used to examine the relationships between fields and disciplines based on bibliographic databases such as Scopus, PubMed, Web of Science (WOS), and Dimensions. (Zupic & Čater, 2015)The main objective of this approach is to develop specific structures in relation to the research fields by categorizing them into various groups based on keywords, documents, journals, countries, authors and institutions. The bibliometric evaluation goes hand in hand with the quantitative nature of the meta-analysis and the qualitative nature of the systematic

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literature review (Linnenluecke & Marrone, 2020). The analysis of this study is presented below:

1. Bibliographic coupling: The primary function of using bibliographic coupling is to analyse the strength of two publications that cite the third and form similarities in the domain of researchers (Donthu et al., 2021; Farrukh et al., 2020) . This allows the analysis to assess how a given topic is currently structured (Fauzi et al., 2023). Through this analysis, researchers can perceive recent contributions to the field that have not yet had a significant impact (Bretas & Alon, 2021).
2. Co-word analysis: This analysis examines the occurrence of keywords in the publications and suggests relevant concepts that are displayed on the (Fauzi, 2022). In co-word analysis, keywords are retrieved from the abstracts, titles, and keywords of publications (Van Eck & Waltman, 2014). In bibliometric analysis, co-word analysis is the only method that can introduce themes within a field of study. For this reason, it can predict patterns and suggest future developments (Donthu et al., 2021).

Research Design and Data Collection Procedure

Search strings are a must (Table 1) when conducting a bibliometric analysis review. The main reason is to utilise keywords to identify publications. The chosen keywords are related to BIM adoption and SMEs. Only journal publications from the Web of Science (WoS) database were selected. Some publications were excluded from this review, including books, chapters from books, conference proceedings, and editorials. Journals indexed in the Web of Science (WoS) are rigorously peer-reviewed, ensuring the validity and quality of the published articles (Kumar et al., 2021). VOSviewer version 1.6.18 software was adopted for the science mapping review.

Table 1. WoS Database Search String

Keywords	Justification
"BIM" OR "building information modelling " OR "building information modelling"	Identification of literature related to BIM
"Adoption" OR "Adopt*"	Identification of literature related to BIM adoption
"SME" OR "SMEs" OR "Small" OR "small-medium" OR "enterprise" OR "micro"	Identification of literature related to small and medium firms.

Findings And Discussion

The initial research for this bibliographic analysis was conducted on July 7, 2024, using the Web of Science (WoS) database from 2007 to 2024. The search led to 239 articles. The total number of citations was 4,421, excluding 4,308 self-citations. The average citation for this string is 26.51, and the H-index is 42. Figure 1 presents the quantity of published articles and citations on BIM in SMEs. The trend identified a rising interest and research activity in BIM in SMEs, notably from 2017 onwards.

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Based on the trend, it is evident that this topic is generating interest from scholars and academicians regarding the importance of BIM to SMEs. The increase in citations and publications related to BIM and SMEs is expected and will contribute to both academia and the construction industry.

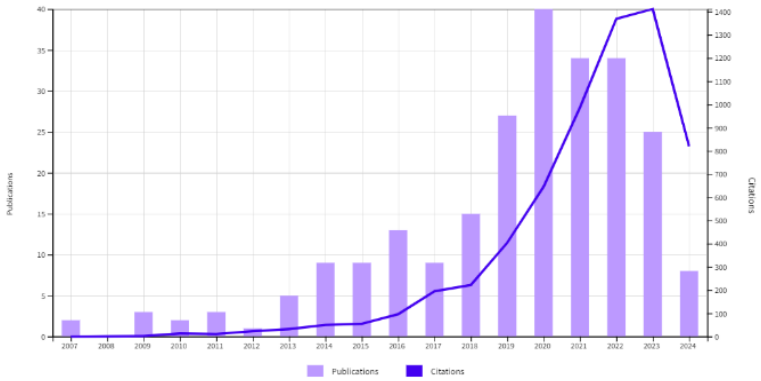

Figure 1: Publications and Citation Numbers on BIM in SMEs

Source: Web of Science

Bibliographic Coupling

A total of 239 documents met a threshold of 33 citations, with 56 documents exceeding this threshold. A total of 56 publications created 5 clusters. The top documents based on total link strength (TLS) are (Saka et al., 2020) (189 TLS), (Santos & Aguiar Costa, 2017) (184 TLS) and (Awwad, 2020)(146 TLS). Several attempts were made towards the testing threshold level to produce a reliable map and appropriate clusters. The threshold should not be set too high, as excessive filtering may restrict the number of publications displayed in the network map (Rejeb et al., 2022).

Table 2: Top 10 Documents in Bibliographic Coupling Analysis

No	Keywords	Occurrences	Total Link Strength
1	(Saka & Chan, 2020)	42	189
2	(Santos & Aguiar Costa, 2017)	203	184
3	(Awwad, 2020)	35	146
4	(Vidalakis et al., 2020)	39	136
5	(Demirkesen & Tezel, 2021)	37	132
6	(M.E. Sepasgozar et al., 2021)	99	130
7	(Ahuja et al., 2020)	66	121
8	(Hosseini et al., 2018)	76	119
9	(Georgiadou, 2019)	72	119
10	(Li et al., 2020)	34	118

Figure 2 shows a bibliographic coupling visualisation. There are five visible independent clusters. However, depending on the most significant clusters, only four clusters were included in this article. Each cluster represents a label based on inductive interpretation. The themes are recognized by re-examining the representative articles and synthesizing them

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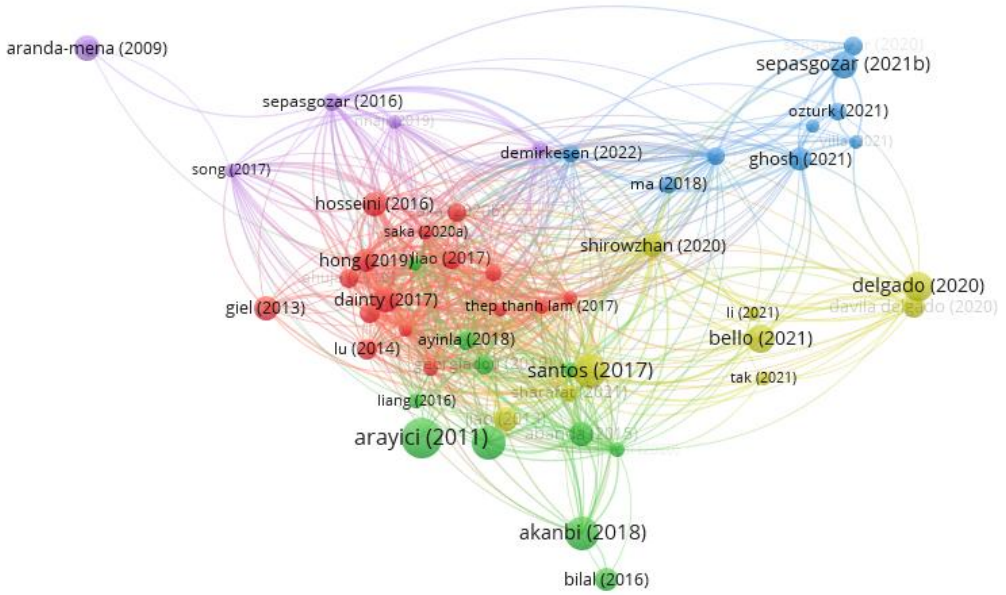

Figure 2: BIM in SMEs (Bibliographic coupling)

Source: Author's own work

Cluster 1, which consists of 16 items, is labelled "Drivers of BIM Adoption in SMEs." Research has shown that the most significant factors contributing to the proliferation of BIM in SMEs include organizational readiness, BIM features, and both internal and external environmental determinants, indicating that BIM adoption is a multifaceted socio-technical system (Saka & Chan, 2020). It has also been found that the proficiency of existing staff in utilizing BIM applications positively influences the development of an organizational knowledge-based system, thereby affecting the organization's determination to adopt BIM (Hong et al., 2019). Furthermore, additional research has identified three critical success factors that are performance control, external consultants, and knowledge transfer as key enablers of successful BIM implementation

Cluster 2 (green): Cluster 2 represents 11 items and is labelled "awareness and variations in BIM adoption". A study revealed that small and medium-sized enterprises (SMEs) generally possess a conceptual understanding of what Building Information Modelling (BIM) entails (Vidalakis et al., 2020). However, their awareness of the current BIM software support system is still lacking. Despite the widespread awareness of Building Information Modelling (BIM), small and medium-sized enterprises (SMEs) continue to face financial challenges in funding the development of digital skills (Georgiadou, 2019). A conceptual model for Building Information Modelling (BIM) technology was developed to differentiate between the "Laggards" and "Late Majority" and the "Innovators," enabling change agents to tailor adoption strategies for each group (Ayinla & Adamu, 2018).

Cluster 3 (blue): Cluster 3 has 9 items and is labelled "digital innovations in construction". A significant interaction between lean construction principles and Building Information Modelling (BIM) has been identified, demonstrating their combined effectiveness in managing workflows and minimizing inconsistencies (Sepasgozar et al., 2018). In addition, there are also many unexplored domains in this area. The findings indicate that IoT capabilities are not considered. Several key drivers of IoT adoption have been identified, including

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interoperability, data privacy and security, flexible governance structures, and effective business planning and models (Ghosh et al., 2021).

Cluster 4 (yellow): Cluster 4 represents 9 items and is labelled "technological integration in construction". Delgado et al (2019) verified six augmented reality and virtual consisting of stakeholder engagement, design support, design review, construction support, operations and management support, and training. Davila Delgado et al (2020) pointed out that the main benefits of using AR and VR are that they improve project delivery and enable new and improved services.

The following table 3 presents the summary of the bibliographic coupling analysis with cluster number and colour, labels, number of publications, and representative publications.

Table 3: Bibliographic Coupling Analysis on BIM Adoption in SMEs

Cluster No and colour	Cluster label	Number of publications	Representative publication
1 (red)	Drivers of BIM Adoption in SMEs	16	(Awwad, 2020; Saka et al., 2020; Yang et al., 2021)
2 (green)	Awareness and Variations in BIM Adoption	11	(Ayinla & Adamu, 2018; Georgiadou, 2019; Vidalakis et al., 2020)
3 (blue)	Digital Innovations in Construction	9	(Ghosh et al., 2021; M.E. Sepasgozar, 2020)
4 (yellow)	Technological Construction Integration	9	(Davila Delgado et al., 2020; Delgado et al., 2019)

Co-word Analysis

By referring to a similar source, the co-word analysis presents 24 out of 1199 keywords that met 14 thresholds, producing three clusters. The threshold was also tested several times, similar to bibliographic coupling. For the co-occurred keyword, the top three highest are "BIM" (80 occurrences), followed by "construction" (57 occurrences) and "implementation" (56 occurrences) (see Table 4).

Table 4: Top 15 Keywords in The Co-Occurrence of Keywords Analysis

No	Keywords	Occurrences	Total Link Strength
1	Implementation	56	227
2	BIM	80	199
3	Construction	57	171

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4	Management	41	169
5	Adoption	36	137
5	Design	42	135
7	Innovation	29	119
8	Technology	28	116
9	Performance	24	93
10	SMEs	20	86
11	Information	24	82
12	Benefits	17	77
13	Construction Industry	21	76
14	Projects	17	74
15	Building Information Modelling (BIM)	26	73

Figure 3 depicts the linking structure of the co-word analysis. It clearly identifies three clusters denoting three diverse themes. In accordance with the author's inductive interpretation, the clusters are presented below:

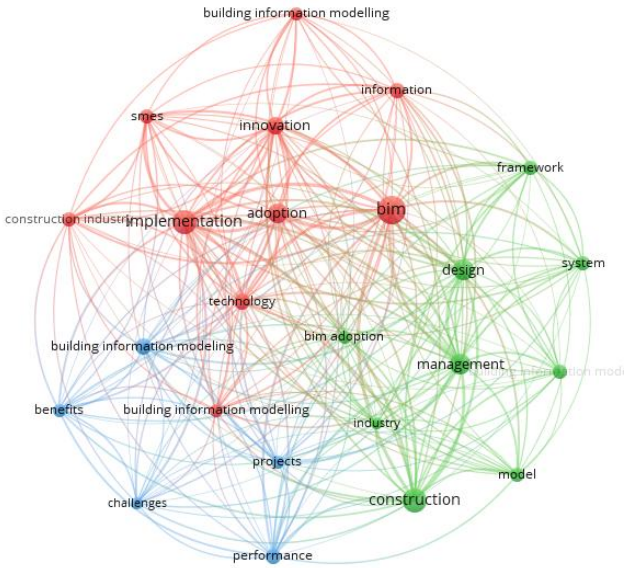

Figure 3: Co-Word Analysis on BIM Adoption among SMEs

Source: Author's own work

Cluster 1 (red): With 10 words, cluster 1 is themed as "BIM, adoption, implementation, technology". Hajj, Martínez Montes and Jawad (2021) stated the most ranked barriers to BIM adoption were limited knowledge and BIM awareness commercial issues and investment costs, limited skills and BIM professionals, interoperability and lack of demand from clients. Pan et al. (2024))demonstrated that the application of BIM to new construction projects provides added value in many areas, including improved transparency, increased quality, scheduling, cost security, and optimized life cycle cost analysis. The authors suggested that future studies are needed to ensure the full integration of BIM's potential with other advanced technologies and tools. While the adoption of Building Information Modelling (BIM) offers numerous opportunities and benefits across project stages, there remain notable gaps between the theoretical advantages and the benefits perceived by industry practitioners during implementation (Pidgeon & Dawood, 2023).

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Cluster 2 (green): With 9 words, cluster 2 is labelled "Construction Management and BIM Adoption". Tran, Tran, and Nguyen (2024) identified six significant constructs in relation to BIM adoption in enterprises. These are "technical feasibility (TF), human resources and management (HRM), company business vision (CBV), political environment (PE), economic viability (EV), and legal aspects (LA)". From this study, the strongest impacts on managers when analyzing the BIM factors are HRM, TF, and CBV. The authors suggested that future research should be conducted in different geographical areas and that users' behavioural intentions and behaviours when adopting BIM should also be investigated. Parsamehr et al. (2022) , in their article, focused on the four most important factors of construction management, namely schedule, cost, quality and safety management, in relation to the ability of BIM to monitor these components. The review outcomes indicate that the researchers' primary focus was on developing automated BIM-based predictive models and enhancing communication and collaboration among project stakeholders.

Cluster 3 (blue): With 9 words, cluster 3 is labelled "Challenges of BIM". Although the benefits of BIM are proven, significant challenges remain, including lack of digital skills, high initial investment costs, and insufficient collaboration frameworks. These barriers are particularly pervasive among SMEs in developing countries. The analysis indicates that such challenges are not uniformly distributed; for instance, financial barriers are more pronounced in Asia, whereas contractual and legal frameworks dominate concerns in Europe. Such regional nuances highlight the need for targeted interventions. Moradi and Sormunen (2023) have identified eight challenges associated with lean construction and BIM, including high initial costs, lack of collaboration, lack of skilled labour and lack of compatible contractual frameworks. The authors also recommend that future research should seek to answer questions related to mandatory standards, rules and regulations and to acquire the competencies required to integrate LC, BIM and sustainability. The main challenges associated with trust in Building Information Modelling (BIM) projects include issues related to cost, collaboration, system functionality, service quality, policy frameworks, as well as knowledge and expertise (Farouk et al., 2023; Ibrahim et al., 2022).

Table 5: Summary of Co-Word Analysis on BIM Adoption in SMEs

No	Keywords	Occurrences	Total Link Strength
1 (red)	BIM Adoption and Implementation Technology	10	227
2 (green)	Construction Management and BIM Adoption	9	199
3 (blue)	Benefits and Challenges of BIM	5	171

Implications

This study provides several implications for management and practice in relation to BIM adoption and SMEs. Challenges, barriers and management are discussed in several clusters. Organizational readiness and awareness play an important role in the adoption of BIM in SMEs. The organization's management should assess internal and external environmental factors in terms of the organization's readiness to adopt BIM (Saka et al., 2020). In addition,

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training and development programs are essential for the improvement of employees in the use of technology (Treviño-Elizondo & García-Reyes, 2023) . Implementing this approach will ensure that employees are adequately equipped to use BIM tools effectively. The adoption of BIM is considered a multifaceted socio-technical system. A holistic approach that integrates advanced technology with social and organizational transformation should be a key managerial objective to ensure the successful adoption of BIM (Chowdhury et al., 2024). For SMEs, strengthening internal digital capability is essential, as empirical studies consistently show that BIM adoption leads to tangible and measurable gains including productivity improvements of reductions in rework, and project cost savings through improved coordination and minimized errors (Das et al., 2025; Gharaibeh et al., 2024). These outcomes highlight the strategic value of BIM for resource constrained SMEs.

Many SMEs still lack awareness of BIM software support systems (Chen et al., 2025; Georgiadou, 2019) . From a managerial perspective, SMEs should prioritize structured digital upskilling programs, certification-based training, and continuous workforce development to enhance employees' readiness to operate BIM systems. In this context, managers need to increase awareness programs on the current digital technologies' applications (Omrani et al., 2024). Programs such as workshops, exhibitions and seminars should be organised annually to raise awareness among stakeholders in the construction industry (Al-ashmori et al., 2020; Othman et al., 2020). Beyond ad hoc initiatives like workshops and seminars, structured capacity-building programs are necessary. National agencies such as the Construction Industry Development Board (CIDB) Malaysia and frameworks like the National Occupational Skills Standard (NOSS) provide foundations to embed BIM competencies within industry standards. Academic institutions, including polytechnics and universities, could complement these by offering micro-credential programs or standardised BIM modules for both students and practitioners, ensuring sustainable digital capacity and accelerating adoption. Embedding such training within formal and informal pathways will ensure sustainable capacity building and accelerate BIM adoption. Therefore, organizations need to invest in continuous education and training programs. These initiatives will ensure that employees' digital competence is strengthened in relation to the latest advanced technologies.

BIM is considered an advanced technology integration in construction projects. AR and VR improve the visualisation of the model, can enhance project delivery, and affect sustainability in the construction sector (Ratana Singaram et al., 2023). Leveraging technology leads to more opportunities, better project outputs, and increased client satisfaction. This strategy will ensure that the organization will not be left behind and will maintain a competitive position in the construction sector.

Limitations

This study has a few limitations. First, the limitation of the database chosen for this article, which focuses only on the Web of Science (WoS) databases. Similarly, there is a limitation with the bibliometric analysis itself, as it is based on the occurrence of citations, which is influenced by several factors, such as the journal and institution's reputation. Although the bibliometric analysis is considered quantitative, the clusters were interpreted subjectively based on the author's deductive analysis. The interpretation of the individual clusters may be different for other authors. As a result, the citations analyzed may not fully represent global BIM adoption research, especially in under-represented regions such as Africa, the Middle East, or Latin America, which in turn limits the generalizability of the findings to broader

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global contexts where digital readiness, policy frameworks, and industry structures may differ substantially from those represented in the WoS-indexed literature.

Second, bibliometric methods inherently introduce biases related to citations. Highly cited papers disproportionately influence network structures, potentially overshadowing recent yet impactful studies that have not accumulated citations. Bibliographic coupling and co-word clustering algorithms depend on threshold selections, which may unintentionally exclude relevant documents or inflate the dominance of specific research schools. These methodological constraints can affect the robustness of cluster interpretations.

Third, the subjectivity involved in synthesizing clusters and labelling themes may produce interpretive bias. While inductive analysis was used to ensure conceptual alignment, different researchers may derive alternative interpretations. Finally, the findings may have limited generalizability to SMEs outside the contexts represented in WoS publications. Differences in policy frameworks, digital maturity, financial capability, and vendor ecosystems may cause BIM adoption patterns to vary significantly across countries.

Future Research Avenues

Publications from the WoS database were used for the bibliometric analysis. Future research could, therefore, also analyse other databases such as Scopus, Dimension and Google Scholar. Moreover, future studies should examine the digital maturity levels of SMEs across different regions by applying models such as the BIM Maturity Matrix or Digital Capability Models to better understand readiness gaps across regions. Longitudinal case studies of SMEs undergoing BIM adoption particularly within the ASEAN context could provide deeper insights into change management, stakeholder dynamics, and post-adoption challenges In terms of future research recommendations, various themes, such as the adoption and implementation of BIM in developing countries, government interventions and strategies to increase the innovative capacity of SMEs and how technology vendors support technology adoption can be further investigated. In addition, since most studies focus on large organizations, studies can be conducted on small and medium-sized construction companies and subcontractors focusing on their readiness, adoption and implementation of BIM as they are the main responsible parties for the construction works. Different approaches, such as mixed-method designs, longitudinal case studies, ethnographic observation, digital maturity assessments, and cross-regional comparative studies, should be explored to gain further valuable insights.

Conclusion

This bibliometric analysis reviews BIM adoption in SMEs. Some of the highlights include BIM awareness, the role of BIM in revolutionizing the construction industry and the barriers SMEs faced when adopting BIM. This study also identifies the key drivers and challenges of BIM adoption, providing valuable insights for other researchers. One of the critical factors in the adoption of BIM is the level of competence among employees in utilising BIM technology. It also highlights the need for development and training programs to improve employees' digital literacy. This is where technology vendor support should play a strategic and proactive role by providing structured training, hands-on guidance, continuous technical assistance, and tailored onboarding programmes that directly address SMEs' capability gaps. Vendor support acts as an external enabler, reducing learning barriers, shortening the BIM implementation curve, and ensuring that employees are not only trained but also able to apply BIM tools effectively in real project environments. By offering accessible resources, troubleshooting services, and updated

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software knowledge, vendors significantly enhance SMEs' confidence and readiness to adopt BIM at scale

A core contribution of this study lies in its integration of both bibliographic coupling and co-word analysis, offering a dual-layered understanding of the knowledge structure that few existing reviews provide. Unlike previous general BIM reviews, this study focuses exclusively on SMEs, providing a more targeted view of adoption challenges faced by small firms that dominate the global construction sector. The study extends previous literature by identifying underexplored themes such as vendor support, digital maturity, and emerging technologies (AR/VR, IoT) and by offering a consolidated framework of future research directions pertinent to SMEs and subcontractors. To summarize, this review highlights the nature of BIM adoption, which requires a holistic approach to successfully implement BIM. This paper provides insights into the adoption of BIM in SMEs, focusing on the challenges, barriers, and advances in innovative technologies.

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References

Ahmad Latiffi, A., Brahim, J., Mohd, S., & Fathi, M. S. (2014). The Malaysian government's initiative in using Building Information Modeling (BIM) in construction projects. *Proceedings of International Structural Engineering and Construction*, *1*(1), 767–772. https://doi.org/10.14455/ISEC.res.2014.82

Ahuja, R., Sawhney, A., Jain, M., Arif, M., & Rakshit, S. (2020). Factors influencing BIM adoption in emerging markets – the case of India. *International Journal of Construction Management*, *20*(1), 65–76. https://doi.org/10.1080/15623599.2018.1462445

Al-ashmori, Y. Y., Othman, I., Rahmawati, Y., & Amran, Y. H. M. (2020). Civil Engineering BIM benefits and its influence on the BIM implementation in Malaysia. *Ain Shams Engineering Journal*, *11*, 1013–1019. https://doi.org/10.1016/j.asej.2020.02.002

Al-sarafi, A. H., Alias, A. H., Shafri, H. Z. M., & Jakarni, F. M. (2022). Factors Affecting BIM Adoption in the Yemeni Construction Industry: A Structural Equation Modelling Approach. In *Buildings* (Vol. 12, Issue 12). https://doi.org/10.3390/buildings12122066

Arif, N. K., Hasmori, M. F., Deraman, R., Yasin, M. N., & Mohd Yassin, M. A. (2021). Readiness of Malaysian Small and Medium Enterprises Construction Companies for Building Information Modelling Implementation. *IOP Conference Series: Materials Science and Engineering*, *1200*(1), 012027. https://doi.org/10.1088/1757-899x/1200/1/012027

Awwad, A. (2020). *The Implementation of Building Information Modelling (BIM) Level 2 in the UK Construction Industry: The Case of Small and Medium Enterprises*. *April*.

Ayinla, K. O., & Adamu, Z. (2018). Bridging the digital divide gap in BIM technology adoption. *Engineering, Construction and Architectural Management*, *25*(10), 1398–1416. https://doi.org/10.1108/ECAM-05-2017-0091

Bretas, V. P. G., & Alon, I. (2021). Franchising research on emerging markets: Bibliometric and content analyses. *Journal of Business Research*, *133*, 51–65.

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IJEMP
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DOI: 10.35631/IJEMP.832012
Chen, Y., Lyu, J., Garcia-Sterling, Y., & Pitt, M. (2025). Decision Analysis of Institutional and Technical BIM Implementation for SMEs. *Journal of Soft Computing and Decision Analytics*, *3*(1), 171–184.

Chowdhury, M., Hosseini, M. R., Edwards, D. J., Martek, I., & Shuchi, S. (2024). Comprehensive analysis of BIM adoption: From narrow focus to holistic understanding. *Automation in Construction*, *160*, 105301. https://doi.org/https://doi.org/10.1016/j.autcon.2024.105301

Das, K., Khursheed, S., & Paul, V. K. (2025). The impact of BIM on project time and cost: insights from case studies. *Discover Materials*, *5*(1), 25.

Davila Delgado, J. M., Oyedele, L., Demian, P., & Beach, T. (2020). A research agenda for augmented and virtual reality in architecture, engineering and construction. *Advanced Engineering Informatics*, *45*, 101122. https://doi.org/https://doi.org/10.1016/j.aei.2020.101122

Delgado, J. M. D., Oyedele, L., Ajayi, A., Àkànbí, L., Akinadé, O., Bilal, M., & Owolabi, H. (2019). Robotics and automated systems in construction: Understanding industry-specific challenges for adoption. *Journal of Building Engineering*. https://doi.org/10.1016/J.JOBE.2019.100868

Demirkesen, S., & Tezel, A. (2021). Investigating major challenges for industry 4.0 adoption among construction companies. *Engineering, Construction and Architectural Management*. https://doi.org/10.1108/ECAM-12-2020-1059

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Marc, W. (2021). How to conduct a bibliometric analysis : An overview and guidelines. *Journal of Business Research*, *133*(April), 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Durdyev, S., Ashour, M., Connelly, S., & Mahdiyar, A. (2022). Barriers to the implementation of Building Information Modelling (BIM) for facility management. *Journal of Building Engineering*, *46*(October 2021), 1–12. https://doi.org/10.1016/j.jobe.2021.103736

Elhajjar, S., & Ouaida, F. (2020). An analysis of factors affecting mobile banking adoption. *International Journal of Bank Marketing*, *38*(2). https://doi.org/10.1108/IJBM-02-2019-0055

Farouk, A., Zulhisham, A., Lee, Y. S., Rajabi, M. S., & Rahman, R. A. (2023). Factors, Challenges and Strategies of Trust in BIM-Based Construction Projects: A Case Study in Malaysia. *Infrastructures*, *8*, 13. https://doi.org/10.3390/infrastructures8010013

Farrukh, M., Meng, F., Raza, A., & Tahir, M. S. (2020). Twenty-seven years of Sustainable Development Journal: A bibliometric analysis. *Sustainable Development*, *28*(6), 1725–1737.

Fauzi, M. A. (2022). E-learning in higher education institutions during COVID-19 pandemic: current and future trends through bibliometric analysis. *Heliyon*, *8*(5).

Fauzi, M. A., Nguyen, M., & Malik, A. (2023). Knowledge sharing and theory of planned behavior: a bibliometric analysis. *Journal of Knowledge Management*, *28*(2), 293–311. https://doi.org/10.1108/JKM-11-2022-0933

Georgiadou, M. C. (2019). An overview of benefits and challenges of building information modelling (BIM) adoption in UK residential projects. *Construction Innovation*, *19*. https://doi.org/10.1108/CI-04-2017-0030

Gharaibeh, L., Matarneh, S., Lantz, B., & Eriksson, K. (2024). Quantifying the influence of BIM adoption: An in-depth methodology and practical case studies in construction. *Results in Engineering*, *23*, 102555.

Ghosh, A., Edwards, D. J., & Hosseini, M. R. (2021). Patterns and trends in Internet of Things (IoT) research: future applications in the construction industry. *Engineering,*

International Journal of Entrepreneurship and Management Practices
EISSN : 2600-8750
IJEMP
Volume 8 Issue 32 (December 2025) PP. 178-192
DOI: 10.35631/IJEMP.832012

Construction and Architectural Management, *28*(2), 457–481. https://doi.org/10.1108/ECAM-04-2020-0271

Hajj, C., Martínez Montes, G., & Jawad, D. (2021). An overview of BIM adoption barriers in the Middle East and North Africa developing countries. *Engineering, Construction and Architectural Management*, *ahead-of-p*. https://doi.org/10.1108/ECAM-05-2021-0432

Hall, A. T., Durdyev, S., Koc, K., Ekmekcioglu, O., & Tupenaite, L. (2023). Multi-criteria analysis of barriers to building information modeling (BIM) adoption for SMEs in New Zealand construction industry. *Engineering, Construction and Architectural Management*, *30*(9), 3798–3816. https://doi.org/10.1108/ECAM-03-2022-0215

Hong, Y., Hammad, A. W. A., & Akbarnezhad, A. (2019). Impact of organization size and project type on BIM adoption in the Chinese construction market. *Construction Management and Economics*, *37*(11), 675–691. https://doi.org/10.1080/01446193.2019.1575515

Hosseini, M. R., Roelvink, R., Papadonikolaki, E., Edwards, D. J., & Pärn, E. (2018). Integrating BIM into facility management: Typology matrix of information handover requirements. *International Journal of Building Pathology and Adaptation*, *36*(1), 2–14. https://doi.org/10.1108/IJBPA-08-2017-0034

Ibrahim, O., Farouk, A., Chileshe, N., & Edwards, J. (2022). Modelling the relationship between Building Information Modelling (BIM) implementation barriers , usage and awareness on building project lifecycle. *Building and Environment*, *207*(PB), 108556. https://doi.org/10.1016/j.buildenv.2021.108556

Kumar, S., Pandey, N., Lim, W. M., Chatterjee, A. N., & Pandey, N. (2021). What do we know about transfer pricing? Insights from bibliometric analysis. *Journal of Business Research*, *134*, 275–287.

Li, P., Zheng, S., Si, H., & Xu, K. (2020). Critical Challenges for BIM Adoption in Small and Medium-Sized Enterprises : Evidence from China. *Advances in Civil Engineering*, *2019*.

Linnenluecke, M. K., & Marrone, M. (2020). *Conducting systematic literature reviews and bibliometric analyses*. *August 2019*. https://doi.org/10.1177/0312896219877678

M.E. Sepasgozar, S. (2020). Digital technology utilisation decisions for facilitating the implementation of Industry 4.0 technologies. *Construction Innovation*, *21*(3), 476–489. https://doi.org/10.1108/CI-02-2020-0020

M.E. Sepasgozar, S., Shirowzhan, S., & Loosemore, M. (2021). Information asymmetries between vendors and customers in the advanced construction technology diffusion process. *Construction Innovation*, *21*(4), 857–874. https://doi.org/10.1108/CI-08-2020-0140

Makabate, C. T., Musonda, I., Okoro, C. S., & Chileshe, N. (2022). Scientometric analysis of BIM adoption by SMEs in the architecture, construction and engineering sector. *Engineering, Construction and Architectural Management*, *29*(1), 179–203. https://doi.org/10.1108/ECAM-02-2020-0139

MOHAMMAD, W. N. S. B. W. (2022). DEVELOPMENT OF BUILDING INFORMATION MODELING (BIM) ADOPTION ASSESSMENT TOOL FOR BIM-BASED PROJECTS IN MALAYSIA. *Science*, *7*(1), 1–8. http://link.springer.com/10.1007/s00232-014-9701-9%0Ahttp://link.springer.com/10.1007/s00232-014-9700-x%0Ahttp://dx.doi.org/10.1016/j.jmr.2008.11.017%0Ahttp://linkinghub.elsevier.com/retrieve/pii/S1090780708003674%0Ahttp://www.ncbi.nlm.nih.gov/pubmed/1191

International Journal of Entrepreneurship and Management Practices
IJEMP
EISSN : 2600-8750
Volume 8 Issue 32 (December 2025) PP. 178-192
DOI: 10.35631/IJEMP.832012
Moradi, S., & Sormunen, P. (2023). Integrating Lean Construction with BIM and Sustainability: A Comparative Study of Challenges, Enablers, Techniques, and Benefits. *Construction Innovation*, *24*. https://doi.org/10.1108/CI-02-2023-0023

Omrani, N., Rejeb, N., Maalaoui, A., Dabic, M., & Kraus, S. (2024). Drivers of Digital Transformation in SMEs. *IEEE Transactions on Engineering Management*, *71*, 5030–5043. https://doi.org/10.1109/TEM.2022.3215727

Othman, I., Al-Ashmori, Y., Rahmawati, Y., Mugahed Amran, Y. H., Ali, M., & Al-Bared, M. (2020). *The level of Building Information Modelling (BIM) Implementation in Malaysia*. https://doi.org/10.1016/j.asej.2020.04.007

Parsamehr, M., Sachinthana Perera, U., Dodanwala, T., Kaluthantirige, P., & Ruparathna, R. (2022). A review of construction management challenges and BIM-based solutions: perspectives from the schedule, cost, quality, and safety management. *Asian Journal of Civil Engineering*, *24*. https://doi.org/10.1007/s42107-022-00501-4

Pidgeon, A., & Dawood, N. (2023). BIM adoption issues in infrastructure construction projects: analysis and solutions. *Digitalization in Construction*, 173–200.

Ratana Singaram, L., Zakaria, R., Munikanan, V., Wahi, N., Aminudin, E., Sahamir, S. R., Redzuan, A. A., Gara, J., Zulkarnaini, M. F., & Khalid, R. (2023). Pre-investigation on adaptation of construction 4.0 multi criteria business model by SME contractors in Malaysia. *Cleaner Engineering and Technology*, *15*(July), 100662. https://doi.org/10.1016/j.clet.2023.100662

Rejeb, A., Rejeb, K., & Keogh, J. G. (2022). A bibliometric analysis of humanitarian logistics. *Acta Technica Jaurinensis*, *15*(2), 74–90.

Saka, A. B., & Chan, D. W. M. (2020). Profound barriers to building information modelling (BIM) adoption in construction small and medium-sized enterprises (SMEs): An interpretive structural modelling approach. *Construction Innovation*, *20*(2), 261–284. https://doi.org/10.1108/CI-09-2019-0087

Saka, A. B., Chan, D. W. M., & Siu, F. M. F. (2020). Drivers of sustainable adoption of building information modelling (BIM) in the nigerian construction small and medium-sized enterprises (SMEs). *Sustainability (Switzerland)*, *12*(9). https://doi.org/10.3390/su12093710

Santos, R., & Aguiar Costa, A. (2017). *Information Integration and Interoperability for BIM-based Life-cycle Assessment*. https://doi.org/10.4324/9781315201863-7

Sepasgozar, S. M. E., Davis, S., Loosemore, M., & Bernold, L. (2018). An investigation of modern building equipment technology adoption in the Australian construction industry. *Engineering, Construction and Architectural Management*, *25*(8), 1075–1091. https://doi.org/10.1108/ECAM-03-2017-0052

Tran, T. Van, Tran, H. V. V., & Nguyen, T. A. (2024). A Review of Challenges and Opportunities in BIM Adoption for Construction Project Management. *Engineering Journal*, *28*(8), 79–98. https://doi.org/10.4186/ej.2024.28.8.79

Treviño-Elizondo, B. L., & García-Reyes, H. (2023). An Employee Competency Development Maturity Model for Industry 4.0 Adoption. *Sustainability (Switzerland)*, *15*(14). https://doi.org/10.3390/su151411371

Van Eck, N. J., & Waltman, L. (2014). Visualizing bibliometric networks. In *Measuring scholarly impact: Methods and practice* (pp. 285–320). Springer.

Vidalakis, C., Abanda, F. H., & Oti, A. H. (2020). BIM adoption and implementation: focusing on SMEs. *Construction Innovation*, *20*(1), 128–147. https://doi.org/10.1108/CI-09-2018-0076

Yang, Y., Chan, A. P. C., Shan, M., Gao, R., Bao, F. Y., Lyu, S. A., Zhang, Q. W., & Guan, J. F. (2021). Opportunities and Challenges for Construction Health and Safety

International Journal of Entrepreneurship and Management Practices
IJEMP
EISSN : 2600-8750
Volume 8 Issue 32 (December 2025) PP. 178-192
DOI: 10.35631/IJEMP.832012

Technologies under the COVID-19 Pandemic in Chinese Construction Projects. *INTERNATIONAL JOURNAL OF ENVIRONMENTAL RESEARCH AND PUBLIC HEALTH*, *18*(24). https://doi.org/10.3390/ijerph182413038 WE - Science Citation Index Expanded (SCI-EXPANDED) WE - Social Science Citation Index (SSCI)

Zupic, I., & Čater, T. (2015). Bibliometric methods in management and organization. *Organizational Research Methods*, *18*, 429–472. https://doi.org/10.1177/1094428114562629