



Bibliometric Analysis on Digital Tools for Project Delivery in Construction Management

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Abstract

In recent years, the construction industry has undergone a significant transformation, primarily driven by the adoption of digital tools to enhance project delivery and efficiency and ensure sustainability. This study conducts a bibliometric analysis of literature from 2015 to 2025 on digital tools used for project delivery in construction management to discover publication trends, identify key contributors, and highlight existing research gaps. A total of 382 relevant publications were retrieved from the Web of Science (WoS) database, and VOSviewer software was used for the network analysis. Various influential authors, institutions, journals, and countries contributing to the field were identified from the network analysis, with Building Information Modeling (BIM), artificial intelligence (AI), drones, virtual and augmented reality, and cloud computing emerging as the most prominent technologies. Furthermore, four main thematic clusters were identified: BIM and sustainability frameworks, digital tools in Education, innovations in construction management, and simulation-based design optimization. The findings reveal that while nations such as China, the United States, and Australia lead in research output, regions such as Africa, particularly Nigeria, remain underrepresented in this area. The bibliometric analysis revealed gaps in existing literature, including the need for integrated digital frameworks, enhancing digital literacy among construction professionals, and greater regional participation. These insights contribute to the ongoing dissertation on digital transformation in the construction industry and offer a basis for research and policy development in emerging economies of the future.

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Keywords

Construction management; Construction project; Construction project delivery; Digital tools; BIM; Information management; Construction industry; Lean construction; MS Project.

1. Introduction

Over the years, the construction industry has expanded rapidly due to population growth and urbanization. Urbanization is one of the key drivers of modernization and socioeconomic development (Wang et al., 2018). This rapid increase has led to the need for the timely delivery of construction projects. To achieve this, it is essential for

construction projects to integrate digital technology into construction projects to enable fast, quality, and affordable delivery of projects. Most of these construction projects require systematic planning, a large workforce, more time, and precise execution to achieve the project's objectives. The construction sector must actively utilize data and technology to support strategic expansion and improve project execution and delivery to achieve the project's objectives and competitive advantages (Aliu et al., 2023).

Digital technologies have transformed how projects are managed across various industries, and the construction industry is not exempt. With increasing project complexities, cost pressures, and sustainability demands, the use of technology/digital tools in construction project management, such as Building Information Modelling (BIM), Primavera P6, Microsoft Project, Procore, etc., has become important in ensuring timely and cost-effective project delivery (Opoku et al., 2021). These digital tools facilitate planning, scheduling, cost management, quality management, procurement management, scope management, monitoring, collaboration, risk management, and communication management, essential functions or frameworks for successful project execution. Despite global advancements, the adoption and impact of digital tools for project management in construction in developing countries such as Nigeria remain under explored, necessitating a bibliometric analysis to uncover trends and knowledge gaps. Bibliometric analysis enables the systematic mapping of research trends, intellectual structures, and thematic evolution within a research field. This study seeks to fill that gap by using bibliometric methods to analyze existing literature on digital tools for project delivery in construction project management.

Aliu et al. (2023) put bibliometric analysis as a quantitative method used to analyze, evaluate, and visualize patterns in scholarly literature, such as publication trends, research themes, and collaborations, primarily through statistical and network methods. According to Van Eck and Waltman (2010) and Akrama et al. (2019), bibliometric analysis uses science mapping tools for visualizing physical aspects of scientific research and domains, and describing the structure of their disciplines. In recent years, bibliometric analysis has become an increasingly important tool in evaluating and mapping the structure of academic research. This quantitative method is used to analyze patterns in scientific publications, which has enabled researchers to understand research trends, collaboration networks, and influential contributions across disciplines. Bibliometric analysis efficiently distills large volumes of data into meaningful insights through the exponential increase of scholarly outputs, particularly in digital and open-access formats (Zuo & Tian, 2025).

The VOSviewer is one of the widely adopted tools for bibliometric analysis. It is software developed by researchers at Leiden University. The VOSviewer is known for its ability to create detailed visualizations of networks, co-authorship, co-citation, and keyword co-occurrence maps. It is accessible to novice and experienced researchers due to its user-friendly interface and interactive features, allowing in-depth exploration of publication trends and intellectual structures in scientific literature (Zhang et al., 2025).

Several digital technologies/tools and software are being used to complete the required level of digital transformation in construction project management. These include digital tools such as Building Information Modelling (BIM), Virtual, augmented, and mixed reality, Internet of Things (IoT) and intelligent sensors, Mobile technologies and cloud computing, Drones, Artificial Intelligence (AI) and Machine Learning, etc. (Parusheva & Aleksandrova, 2021). Digital tools for construction management, such as BIM (Building Information Modeling) and other digital tools that use drones, have been widely used to increase or improve construction (Sinaga et al., 2024).

Management determines and executes ways and methods for efficiently and effectively utilizing human and non-human resources to support defined goals (Bryde, 2003). The managerial process of organizing a building or a structure is construction project management. In building technology, civil engineering, and architecture, physically assembling an infrastructure or building is a construction project management process. Construction project management plays an important role in many developing countries' economies. Radujković and Sjekavica (2017) explain that an effectively achieved construction project meets the project objectives safely, within the schedule, cost, and quality criteria.

While previous bibliometric studies have examined digital technologies in construction management, most focus on isolated tools or general project management trends. This study extends existing literature by integrating thematic evolution, keyword co-occurrence, co-citation, and collaboration network analyses to expose not only dominant

digital tools but also weakly connected themes and geographical gaps. In addition, the study uniquely identifies digital education as a standalone thematic cluster and the under representation of African countries, particularly Nigeria, within global research outputs.

2. Aim

In this study, the aim is to carry out a bibliometric analysis of literature on digital tools for project delivery in construction management, with a view to identifying publication trends on digital tools in project delivery in the construction industry.

3. Research Objectives

To identify the most influential authors, sources, and institutions contributing to the literature on digital tools for project delivery in construction management.

To analyze the evolution and trends of literature on digital tools for project delivery in construction management.

To identify the geographical distribution of research outputs on digital tools for project delivery in construction management.

To identify research gaps and propose future research directions by observing weakly connected keywords, isolated clusters, and limited integration between major themes.

3.1. Research Questions

1. Who are the most influential authors, sources, and institutions contributing to the body of knowledge on digital tools for project delivery in construction management based on citation and publication metrics?
2. How has research on digital tools for project delivery in construction management evolved over the years, and what are the current and emerging trends in this study?
3. What is the geographical distribution of research outputs on digital tools for project delivery in construction management, and which countries or regions are leading or underrepresented in this study?
4. By observing weakly connected keywords, isolated clusters, and limited integration between major themes, what research gaps exist in the current literature on digital tools for project delivery in construction management, and what areas warrant further investigation?

4. Review of Related Literature

In their research, Sinaga et al. (2024) suggest that productivity tools used in project management in construction are constantly growing and are expected to further proliferate globally in the coming years, contributing to scientific progress.

Using a systematic review following PRISMA guidelines, bibliometric analysis (Scopus, WoS), and bibliometric mapping, Olaonipekun et al. (2024) identified nine key ICT technology groups with BIM as a central hub. They also identified technologies like reality tech, drones, AI, and wearable technologies that significantly impact safety, coordination, and data management, and challenges, which include high costs, awareness gaps, and security issues. Furthermore, Aliu et al. (2023) carried out a bibliometric study of project management literature from 2010 to 2023 and identified an increasing emphasis on technologies such as AI, IoT, BIM, automation, and data analytics in project management research. This study indicates a paradigm shift towards digital, knowledge-driven, and technology-enabled project management. Therefore, specialized training, interdisciplinary approaches, and lifelong learning are crucial for preparing future project managers. Parusheva and Aleksandrova, (2021) using literature review and synthesis of recent industry and academic insights supported by secondary data from research reports and publication, they looked at key digital tools such as the building information modeling (BIM), virtual and augmented reality, mobile technology, cloud computing, drones, IoT sensors, and how AI and machine learning help gather all construction data to make better decisions in construction project management. Among them, they found that building

information modelling stands out in the first place, establishing BIM as a leading standard for highly efficient construction. They also pointed out that people are just as important as technology to successfully digitize and transform the construction industry. In their studies, Delgado et al. (2020) stated that one of the benefits of adopting digital tools and AR and VR technologies is that they can improve the delivery of construction projects. Construction industries recognize that AR and VR can improve communication and collaboration, improve project understanding, improve productivity, and reduce spending on projects.

Despite global advancements, the adoption and impact of digital tools for project management in construction in developing countries such as Nigeria remain under explored, necessitating bibliometric analysis to uncover trends and knowledge gaps.

5. Methodology

The WoS is an organized, selective, and well-balanced source with comprehensive citation links and improved data for various purposes (Birkle, 2020). The search for literature for this study was on the WoS data source indexes: WoS Core collection (Science Citation Index Expanded and Conference Proceedings Citation Index from January 1st 2015, to August 31st 2025). Search fields in Topic, Title, Abstract, Author keywords, and Keyword plus. The search focused on Conference proceedings, journals, book chapters, and books. Search words as follows were used; “digital tools”, “digital technology”, “BIM”, “construction project” “construction management”, “project delivery”, and “project management”. The key words used as follows, TS = (“digital tools” OR “digital technology” OR “BIM” OR “construction project” OR “construction management” OR “project delivery” OR “project management” OR “information management” OR “construction industry” OR “lean construction” OR “Procore” OR “Primavera” OR “MS Project”). These were used to search in categories such as titles, abstracts, and keywords to get 23,971 articles from the data source. These articles were further filtered and screened based on the document type, Conference proceedings and Journals, Language type as English only, Open access, and the final stage of publication. Duplicate records were removed using DOI and Title. Records not primarily about digital tools applied to construction project delivery or construction management were removed based on Title and Abstract. Studies that address digital tools/ technologies and their application or evaluation in construction project delivery, management, planning, education, simulation, or performance were included. Editorial notes, non-research opinions, pure software descriptions without application to construction projects, and non-English articles were excluded, summing up to a total of 382 articles for final bibliometric analysis. These articles were further extracted, downloaded in tab-delimited file format, and analyzed using the Vosviewer software.

In this study, the bibliometric analysis was carried out using VOSviewer (version 1.6.20) to discover characteristics of the literature on digital tools for project delivery in construction management. Analysis type includes Co-authorship (authors), Co-occurrence (keywords), Co-citation (references), and bibliographic coupling (sources). Full counting method was used, Association strength normalization, and the Minimum thresholds for Authors: Minimum documents = 3, Sources (journals/conferences): Minimum documents = 5, Institutions: Minimum documents = 4, Countries: Minimum documents = 10, Keywords: Minimum occurrences = 10. The VOSviewer is a software used to analyze bibliometric data. VOSviewer is very useful in the context of research and scientific studies. This software is very famous among researchers because it offers insight into the structure and progress of scientific literature (Arifin, 2025). The choice of the bibliometric research design is to systematically examine the intellectual structure, thematic evolution, and research gaps in scholarly literature on digital tools for project delivery in construction management. Bibliometric analysis was selected due to its ability to provide an objective, reproducible, and quantitative assessment of large volumes of academic publications, enabling the identification of research patterns, trends, and underexplored areas within the field. The findings were generated using a combination of keyword co-occurrence analysis, thematic evolution analysis, thematic mapping, co-citation analysis, and collaboration network analysis. Keyword co-occurrence, thematic evolution, and thematic mapping analyses were employed to identify dominant themes, emerging research areas, and underdeveloped topics. In addition, co-citation analysis was used to reveal the intellectual structure and theoretical gaps within the literature, while collaboration network analysis helped uncover geographical and institutional disparities in research contributions. Together, these methods enabled the systematic identification of research gaps and informed the formulation of future research directions. The methodological

approach follows established bibliometric procedures and aligns with best practices widely adopted in construction management and built environment research.

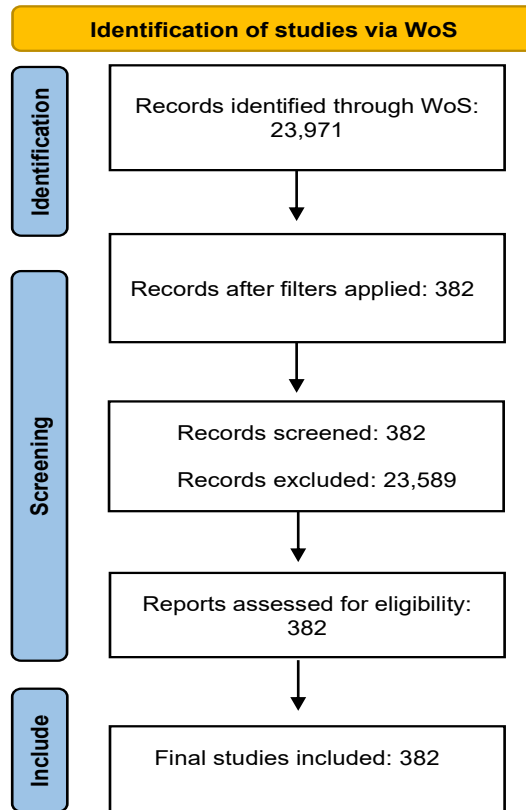


Figure 1. PRISMA flow diagram.

Source. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews.

"PRISMA" stands for Preferred Reporting Items for Systematic Reviews and Meta-Analyses. It is an evidence-based minimum set of items for reporting in systematic reviews and meta-analyses. **Figure 1** followed the PRISMA 2020 guidelines. The process comprised four stages: identification, screening, eligibility assessment, and inclusion. From an initial 23,971 WoS records, filtering and screening steps led to the selection of 382 publications for final analysis.

5.1. Robustness Check and Justification for Clustering Parameters

To ensure the reliability and validity of the bibliometric clusters produced in VOSviewer, some considerations guided the selection of minimum thresholds and normalization settings.

Minimum Occurrence/Document Thresholds: The thresholds applied to authors (min. 3 documents), sources (min. 5 documents), institutions (min. 4 documents), countries (min. 10 documents), and keywords (min. 10 occurrences) were chosen to balance network density and noise reduction. These thresholds are consistent with bibliometric best practices recommended by Van Eck and Waltman (2010), which emphasize excluding very low-frequency nodes to avoid division and unstable cluster formation.

Full Counting Method: Full counting was used because it ensures that every occurrence of a keyword or author is fully recognized, which is suitable for relatively moderate datasets such as those in this study's 382 publications. Full counting, therefore, preserved thematic diversity without distorting influence patterns.

Association Strength Normalization: The association strength method was selected because it is the standard and most widely validated normalization technique in VOSviewer for co-occurrence and bibliographic coupling networks. It helps correct for scale differences across items and prevents large, general keywords such as "construction" from dominating the map.

Stability of Cluster Output: Multiple runs were performed with slight variations in thresholds and layout parameters. The core clusters BIM/sustainability, education-related digital tools, construction management innovation, and simulation/optimization consistently reappeared across all model runs. This consistency indicates strong cluster stability and confirms that the identified thematic structures are not pieces of specific parameter settings.

Alignment with prior Bibliometric Studies: The chosen parameters align with thresholds commonly used in bibliometric studies within construction management, such as Aliu *et al.* (2023) and Sinaga *et al.* (2024). The recurrence of similar cluster themes in prior studies further supports the robustness of the clustering outcomes.

6. Results and Discussion

The study’s results reveal that the scholarly focus on digital tools in construction project management has been increasing, with particular attention to technologies such as Building Information Modeling (BIM), virtual and augmented reality, drones, IoT, AI, digital twin, and cloud computing. By analyzing a dataset of 382 publications retrieved from Web of Science (WoS), the study identified influential authors, journals, and institutions contributing significantly to the body of knowledge on digital tools for project delivery in construction management based on citation metrics, highlighting the growing research productivity and collaboration networks.

6.1. Authors, Sources, and Institutions Contributing to Literature on Digital Tools for Project Delivery in Construction Management.

Table 1 identified 8 authors out of 1,241 authors who have a minimum of 3 documents and a minimum of 10 citations, **Table 2** identified 14 sources out of 175 with a minimum of 5 documents per source, and **Table 3** identified 10 institutions out of 587 institutions with a minimum of 4 documents per institution in digital tools for project delivery in construction management. Minimum thresholds for the number of documents and citations were applied in VOSviewer to reduce network complexity and enhance interpretability. This approach ensured that only authors, sources, and institutions with sustained scholarly contributions and sufficient citation impact were included, thereby improving the strength of network relationships and cluster structures.

Table 1. Top 8 Authors contributing to the literature on digital tools for project delivery in construction management. Source: VOSviewer analysis (2025)

Authors	Documents	Citations	Authors ranked globally
Skitmore, Martin	5	210	1
Blismas, Nick	3	173	2
Wakefield, Ron	3	173	2
Chan, Greg	3	147	4
Li, Heng	3	147	4
Xia, Bo3	3	133	6
Wibowo, M. Agung	3	99	7
Xu, Jiuping	3	14	8

Table 1 identifies the top 8 authors contributing to the literature on digital tools for project delivery in construction management, with Skitmore, Martin, and emerging as the most prolific and highly cited author, followed by Blismas, Nick, and Wakefield, Ron. These authors have made significant contributions, with Skitmore’s work accumulating 5 documents and 210 citations, indicating influence within the scholarly community.

Findings from existing bibliometric studies, such as Zhang *et al.* (2025), had a similar pattern where these prolific authors dominated the field. Researchers like Skitmore have extensively contributed to construction innovation and digitalization research, including BIM and project management technologies. Additionally, the importance of authors like Blismas and Wakefield indicates their contributions to exploring the incorporation of digital tools with

sustainable and innovative construction practices. Their work aligns with the broader shift toward understanding how digital technologies influence project efficiency, safety, and collaboration. Identifying these authors confirms these key authors’ consistency across bibliometric analyses. Their influence shows the importance of their research outputs in setting plans for future studies, such as exploring barriers to digital adoption or developing new frameworks for BIM implementation.

6.2. Sources Contributing to the Literature on Digital Tools for Project Delivery in Construction Management

Table 2 identifies the top 14 sources contributing to the literature on digital tools for project delivery in construction management, revealing that journals such as the *Journal of Civil Engineering and Management and Automation in Construction* are the leading outlets, with 17 publications, 296 citations, and 5 publications, 283 citations, respectively. These sources collectively contain a large portion of influential research, as evidenced by their high citation counts. Existing bibliometric analyses, such as those by Zhang et al. (2025), reveal a consistent pattern where reputable, high-impact journals serve as primary distribution channels for advancements in construction digitalization. Moreover, studies such as those of Giang et al. (2021) emphasize the importance of specialized journals in fostering a cohesive research community focused on innovation and digital transformation within construction management. These sources enable the distribution of research on emerging trends like digital twins, IoT, and data analytics, reflecting the journal’s role in shaping the field’s intellectual structure. Additionally, **Table 2** indicates that conference proceedings such as the “Creative Construction Conference” contribute a high volume of publications but attract comparatively fewer citations than leading journals. This pattern suggests that such conferences primarily serve as platforms for novel ideas and early-stage research, which subsequently mature and gain higher scholarly impact when published in these leading journals.

Generally, the position across bibliometric studies indicates that these key sources play key roles in advancing scientific understanding and community engagement around digital tools in construction project delivery. Their high citation metrics and frequent publication of influential papers confirm their status as core outlets shaping research plans, informing practice, and setting standards for digital innovations in construction management.

Table 2. Top 14 Sources contributing to the literature on digital tools for project delivery in construction management. Source: VOSviewer analysis (2025).

Sources	Documents	Citations	Sources ranked globally
Journal of Civil Engineering and Management	17	296	1
Automation in Construction	5	283	2
Creative Construction Conference 2015, selected papers	18	276	3
Engineering, Construction, and Architectural Management	5	152	4
Civil Engineering Innovation for a Sustainable	6	141	5
Sustainability	28	125	6
Buildings	39	122	7
Archives of Civil Engineering	8	58	8
KSCE Journal of Civil Engineering	5	47	9
Applied Sciences-Basel	10	19	10
Education Sciences	7	6	11
Frontiers in Education	9	3	12
Cogent Education	5	2	13
Frontiers in the Built Environment	8	1	14

6.3. Top 10 Institutions Contributing to Literature on Digital Tools for Project Delivery in Construction Management

Table 3 identifies the top 10 institutions contributing to the literature on digital tools for project delivery in construction management, highlighting the leading organizations actively advancing this research area. The study identified Delft University of Technology as the top institution with 4 documents and 280 citations, followed by Heriot-Watt University and Hong Kong Polytechnic University, which are among the most prolific contributors with 4 documents and 206 citations and 6 documents and 171 citations, respectively. Previous studies by Zhang *et al.* (2025) discovered that these institutions are recognized globally for their research excellence and innovation in construction digitalization. Delft University of Technology is frequently identified as a key player in BIM and construction automation research, aligning with its significant publication output. In conclusion, the importance of these institutions aligns with the broader scholarly landscape. It signifies their pivotal roles in advancing knowledge, developing innovative solutions, and fostering international collaboration in digital tools for construction project delivery.

Table 3. Top 10 Institutions contributing to literature on digital tools for project delivery in construction management. Source. VOSviewer analysis (2025).

Institutions	Documents	Citations	Institutions ranked globally
Delft University of Technology	4	280	1
Heriot-Watt University	4	206	2
Hong Kong Polytechnic University	6	171	3
Islamic Azad University	4	117	4
Poznan University of Technology	4	83	5
Queensland University of Technology (QUT)	6	76	6
RMIT University	4	53	7
University of Johannesburg	6	48	8
Universitat Politècnica de València	9	7	9
Warsaw University of Technology	5	2	10

6.4. Research Trends on Digital Tools for Project Delivery in Construction Management

To identify the research trends on digital tools for project delivery in construction management based on the number of keyword occurrences in the literature. **Table 4**, 24 keywords out of 1,992 keywords, and a minimum of 10 occurrences were identified across the 382 papers. These 24 keywords reveal the central themes and focus areas within the research area. These keywords were divided into four (4) thematic clusters, indicating interconnected research areas.

Table 4 identified 24 keywords, with Construction management being the most frequent keyword with 40 occurrences. The 24 keywords were further divided into four thematic clusters: BIM-related, education-related, construction-related, and design-related.

Cluster 1 (BIM and Sustainability Frameworks): This cluster, as shown in **Figure 1**, comprises six (6) co-occurring keywords, which include BIM, Construction Industry, Framework, Model, Performance, and Sustainability. This cluster centers around BIM, which is part of the construction industry, highlighting the development of frameworks and models to enhance performance and sustainability. BIM is extensively explored to standardize data exchange and collaboration, as seen in studies by Azhar et al. (2012), highlighting the importance of BIM standards for improved project coordination. Also, as discussed by Sacks et al. (2018), BIM integration involves optimizing schedules, cost,

and resource management. The relationship between BIM and Sustainability is also well-documented, as identified by Darwish et al. (2020), demonstrating how BIM can support sustainable design and construction practices.

Cluster 2 (Digital tools in Education): This is the second cluster in the digital tool cluster, as shown in the visualization map (see **Figure 2**). It is related to education and comprises five (5) co-occurring keywords: Digital tools, Education, Impact, Students, and Technology. This cluster emphasizes the educational and knowledge-dissemination aspects of digital tools in construction. Recent studies, such as Oyesode et al. (2023), focus on the educational impact of integrating BIM and other digital tools in engineering curricula, such as how higher education institutions serve as hubs for cultivating digital literacy among students to meet industry demands. The impact of digital tools on developing competencies, as highlighted by research on teaching BIM in universities such as Du (2017) and Giang et al. (2021), enhances students' readiness for the transformation of digital technology in the industry.

Cluster 3 (Innovations in Construction processes and Management): This cluster comprises four (4) co-occurring keywords, which include Construction processes, Construction management, Innovation, and Project management. This cluster revolves around applying digital tools within the broader scope of construction project management. Existing studies, such as those by Samuelson and Stehn (2023), reveal ongoing innovations in project management practices driven by digital tools, such as project scheduling software and AI-based risk management. Integrating digital innovations improves management efficiency, enhances collaboration, and reduces delays, as supported by research from Mutoni (2025). Emphasizes how digital tools support project outcomes, quality control, and management of complex construction projects.

Cluster 4 (Simulation-based Design Optimization): In this cluster, five (5) co-occurring keywords were identified, including Design, Optimization, Simulation, and System integration. This cluster focuses on the technical application of digital tools like simulation and optimization in construction design and systems management. Simulation technologies, including virtual reality (VR) and augmented reality (AR), are studied extensively for visualizing and optimizing construction sequences such as those of Delgado *et al.* (2020). Digital optimization models employ algorithms to improve project scheduling, resource allocation, and cost management (Nabeel, 2024). This system method integrates various digital tools to facilitate holistic project planning and control, with literature emphasizing integrated systems for scheduling, design, and construction workflows, such as Lee et al. (2010) and Chen and Tang (2019).

Addressing research gaps within these clusters, such as developing unified frameworks, enhancing digital literacy, and integrating advanced simulation tools, remains critical for progressing digital transformation in construction. The regular appearance of terms like “construction management”, “performance”, and “model” highlights the emphasis on optimizing construction processes and project outcomes through digital tools like BIM and simulation technologies. The current trends in using digital technologies for managing construction projects include widespread adoption of Building Information Modeling (BIM), virtual and augmented reality, drones, Internet of Things (IoT), artificial intelligence (AI), digital twin, machine learning, cloud computing, and mobile technologies. These tools enhance safety, coordination, data management, planning, scheduling, cost control, quality assurance, and collaboration throughout the project lifecycle. This study strongly emphasizes BIM as a central technology, with digital twin, AI, drones, and reality technology also playing vital roles in improving construction processes and project oversight. Furthermore, research has evolved from foundational technological explorations to sophisticated, integrated applications to transform construction project delivery. Future studies will likely focus on enhancing digital literacy, expanding digital transformation in underrepresented regions, and developing comprehensive frameworks for digital integration.

Table 4. Top 24 keywords with a minimum of 10 occurrences identified in the literature on digital tools for project delivery in construction management.
Source. VOSviewer analysis (2025).

Keywords	Occurrences	Keywords ranked globally
Construction management	40	1
Performance	33	2
Construction	27	3
Model	26	4
Design	22	5
Management	22	6
Technology	19	7
Framework	18	8
BIM	17	9
Construction industry	17	10
Construction project	17	11
Education	17	12
Innovation	15	13
Digital tools	13	14
Optimization	13	15

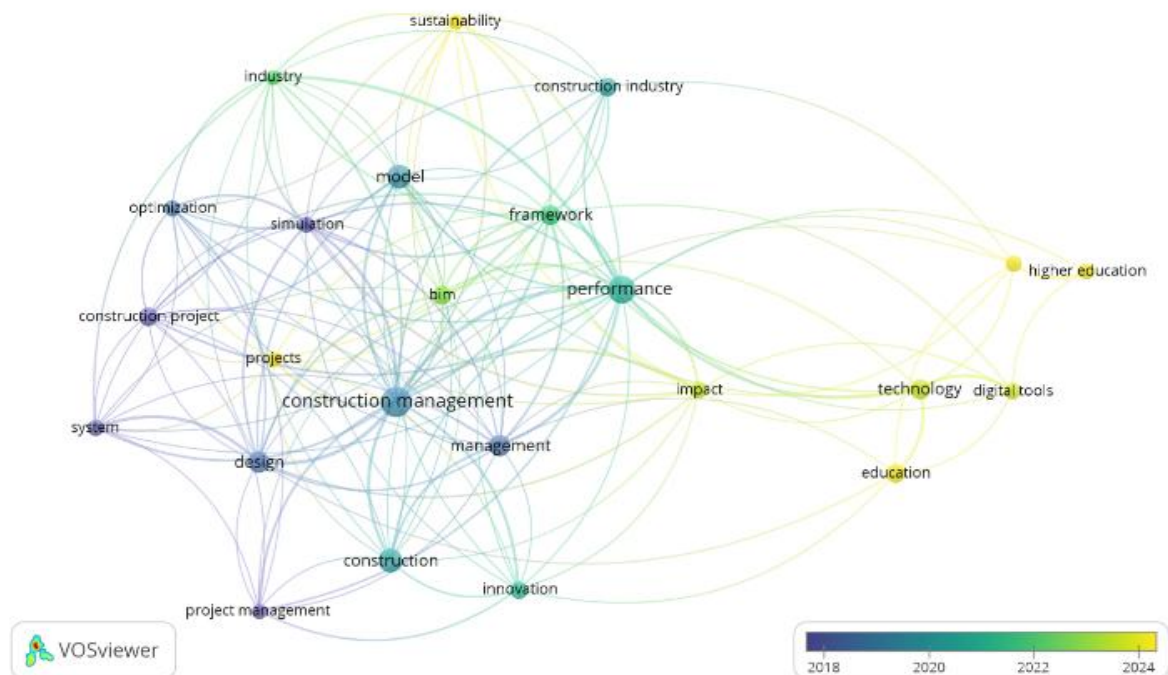


Figure 2. Overlay Visualization analysis of research keywords in the literature on digital tools for project delivery in construction management.
Source. VOSviewer (2025).

6.5. Geographical Distribution of Research Outputs on Digital Tools for Project Delivery in Construction Management

To identify the geographical distribution of research outputs and countries or regions leading or under-represented on digital tools for project delivery in construction management. **Table 5** identifies 11 out of 82 countries, and each of these 11 countries has a minimum of 10 documents.

6.6. Top 11 Countries Contributing to the Literature on Digital Tools for Project Delivery in Construction Management

Table 5 identifies that the People’s Republic of China leads significantly in the number of documents (49), while Australia leads in citations (520). The USA and England also contribute significantly to the literature. This distribution indicates a diverse global engagement, with significant contributions from Asia (China and South Korea), Europe (including Poland, England, and Germany), and Oceania (Australia). China’s leading position in publication volume and impactful citations underscores its central role in advancing research on digital tools in construction management. Overall, the data reflect both the prolific research activity and the regional strengths in the field, with countries like Australia and Indonesia standing out in citations despite fewer publications, suggesting high-impact contributions from these regions. This analysis revealed that regions like Africa are under-represented in the global research, with only South Africa actively contributing with 10 documents and 80 citations among the top countries contributing to the literature on digital tools for project delivery in construction management. Supporting this, Mutoni (2025) identified a distinct lack of studies focusing on the use of digital project management tools in Sub-Saharan Africa or other developing regions. Hence, there is a need for increased engagement from other African countries, particularly Nigeria, to participate more fully and contribute globally to this field of study.

Table 5. Top 11 countries contributing to literature on digital tools for project delivery in construction management. Source: VOSviewer analysis (2025).

Countries	Number of Documents	Citations	Documents ranked globally	Citation ranked globally
People’s Republic of China	49	434	1	3
USA	34	444	2	2
England	28	328	3	5
Spain	28	185	3	6
Poland	27	398	5	4
Australia	26	520	6	1
Italy	18	44	7	11
South Korea	13	153	8	7
Germany	13	62	8	10
Indonesia	10	150	10	8
South Africa	10	80	11	9

6.7. Research Gaps Identified

The research gaps identified in this study are derived from the bibliometric findings rather than from speculative assumptions. The gaps emerge from observed thematic patterns in the keywords co-occurrence analysis (**Table 4**), uneven geographical distribution of research outputs (**Table 5**), and source analysis (**Table 2**). These patterns indicate areas warranting further investigation, as follows:

Need for integrated digital frameworks for project delivery. The keyword co-occurrence analysis (**Table 4, Figure 1, Figure 2**) reveals that research on digital tools for project delivery in construction management is organized into four thematic clusters: BIM and sustainability frameworks, Digital tools in education, Innovations in construction

management, and Simulation-based design optimization. The limited interconnections among them indicate a fragmented research landscape. Notably, advanced technologies such as artificial intelligence, simulation, and optimization appear in separate clusters rather than being examined together within unified project delivery frameworks. This thematic separation suggests that existing studies focus on individual technologies or applications in isolation, with limited emphasis on integrated digital systems that combine BIM, AI, management processes, and education. Consequently, there is a research gap in the development and validation of holistic digital frameworks that integrate multiple digital tools to support end-to-end construction project delivery.

Addressing the need to improve digital literacy among construction professionals and stakeholders to facilitate digital tool implementation and the current use of digital tools. The separation of education-related keywords into a different cluster in **Table 4** shows a gap between digital skills development and practical application in project delivery. This pattern indicates that while digital tools are increasingly discussed in educational contexts, fewer studies examine how these translate into professional practice and improved project delivery outcomes. Therefore, a gap exists in research that bridges digital education, workforce capability development, and real-world construction project performance.

Investigating ways to improve BIM implementation, integration, and utilization, construction project management can be improved to maximize its benefits throughout the project lifecycle. The co-occurrence network (**Table 4**) shows a strong dominance of BIM within the literature; emerging technologies such as Artificial Intelligence, Augmented Reality/Virtual Reality/Mixed-Reality, and Digital Twins exhibit lower occurrence within the network. This imbalance suggests that although BIM is well known and adopted, other advanced digital technologies remain under explored in integrated construction project delivery. As a result, there is a research gap in empirical and applied studies that have examined the combined use of BIM with advanced digital technologies to enhance decision-making, risk management, and project optimization throughout the project lifecycle.

Need for regional participation, especially in Africa, specifically Nigeria. The geographical analysis (**Table 5**) reveals limited research output from Africa, with Nigeria absent among the leading contributors on digital tools for project delivery. The research output is heavily concentrated in developed and technologically advanced countries, including China, the United States, Australia, and several European nations. But African countries are underrepresented, with only South Africa appearing among the top contributing countries, and Nigeria absent from the leading contributors.

These identified gaps highlight significant areas where further research can improve construction project management practices through digitalization, ultimately aiming to reduce processes, increase adoption, and maximize technological benefits in Nigeria and Africa.

7. Conclusion

In conclusion, the study presents a bibliometric analysis of 382 Web of Science-indexed publications (2015–2025) on digital tools for project delivery in construction management, using VOSviewer to examine authorship, sources, keyword co-occurrences, and geographical distribution. The findings confirm a sustained increase in scholarly output, reflecting growing academic interest in construction digitalization.

The results show that research output and citation impact are concentrated among a limited number of authors, institutions, and journals. Authors such as Skitmore, Blismas, and Wakefield, institutions including Delft University of Technology and Hong Kong Polytechnic University, and journals such as *Journal of Civil Engineering and Management and Automation in Construction* play central roles in shaping the intellectual structure of the field. Conference proceedings, notably the Creative Construction Conference, contribute a high volume of publications but attract lower citation impact, indicating their role in disseminating emerging research rather than consolidating mature knowledge.

Keyword co-occurrence analysis identifies four dominant thematic clusters: BIM and sustainability frameworks, digital tools in education, innovations in construction management, and simulation-based design optimization. BIM emerges as the most established and extensively studied digital technology, while advanced tools such as artificial intelligence, simulation, and optimization appear less frequently and remain weakly integrated within project delivery

research. The presence of a distinct education-related cluster highlights increasing attention to digital skills development, although its separation from project delivery themes indicates limited integration between education-focused research and industry application.

Geographical analysis reveals a strong concentration of research in developed economies, particularly China, the United States, Australia, and Europe. African countries remain underrepresented, with South Africa as the only African contributor among the leading countries and Nigeria absent from the top-ranked outputs. These contributions provide a clearer understanding of the field and support evidence-based directions for future research, practice, and policy development.

Supplementary Materials

The supplementary materials include:

Web of Science exported data files (tab-delimited format)

VOSviewer project files for co-authorship and keyword co-occurrence analyses

Screenshots of the bibliometric network and overlay visualizations

Additional datasets generated or analyzed during this study are available from the corresponding author upon reasonable request.

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Ethics approval

Not applicable.

Conflict of interest

The author(s) declare(s) that there is no competing interest.

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8. Appendices

Appendix A. Full list of all authors meeting thresholds documents (min. 3 documents)

ID	Author	Documents	Citations	Total link strength
996	Skitmore, Martin	5	210	0
129	Blismas, Nick	3	173	2
1125	Wakefield, Ron	3	173	2
177	Chan, Greg	3	147	0
588	Li, Heng	3	147	0
1165	Xia, Bo	3	133	0
1145	Wibowo, M. Agung	3	99	0
1171	Xu, Jiuping	3	14	0

Appendix B. Complete list of all contributing sources, journals & Conferences (min. 5 documents)

ID	Source	Documents	Citations	Total link strength
23	Automation in construction	5	283	0
62	Engineering, Construction, and Architectural Management	5	152	0
120	KSCE journal of civil engineering	5	47	0
35	Cogent education	5	2	0
31	Civil engineering innovation for a sustainable	6	141	0
53	Education sciences	7	6	0
20	Archives of Civil Engineering	8	58	1
65	Frontiers in the built environment	8	1	0
66	Frontiers in education	9	3	0
17	Applied sciences-basel	10	19	0
100	Journal of civil engineering and management	17	296	3
43	creative construction conference 2015, selected Papers	18	276	0
162	Sustainability	28	125	1
26	Buildings	39	122	1

Appendix C. Complete list of all countries in the dataset, including publication and citation counts (min. 10 documents)

ID	Country	Documents	Citations	Total link strength
29	Indonesia	10	150	0
64	South Africa	10	80	0
65	South Korea	13	153	0
23	Germany	13	62	0
34	Italy	18	44	0
3	Australia	26	520	2
55	Poland	27	398	0
20	England	28	328	2
66	Spain	28	185	0
77	USA	34	444	3
52	People's Republic of China	49	434	3