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Mapping Out Research Focus on Contemporary Technologies and Construction Cost Management: A Bibliometric Approach

Lawal, Olajumoke Mary [1*]

[1]*Department of Project Management Technology, The Federal University of Technology, Akure, Nigeria*

[*]*Corresponding author, lawaloma@futa.edu.ng*

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Abstract

Contemporary Technologies (CT) and Construction Cost Management (CCM) has been an area of focus in recent research. This study aims to conduct a review of CT & CCM with a view to revealing the area of focus of past studies. This aspect has not been given considerable attention in recent bibliometric and scientometric studies. This study, through an extensive bibliometric assessment, recognized the most active journals, most cited authors, and keywords in the studies on Contemporary Technologies and Construction Cost Management from year 2000 to 2026. Data used were gathered from the Scopus database. Keywords such as "Contemporary Technology" OR "Contemporary Technologies" OR "Emerging Technologies" OR "Technology implementation" AND "Construction Cost". VOSviewer was used to prepare co-authorship and co-occurrence map based on the bibliographic data gathered. The findings revealed that focus is placed on digital transformation in cost management, integrated digital construction management, emerging technologies and sustainability, smart technology in construction, and emerging technologies and implementation decision making. The findings of this study are limited due to the use of a single database. Despite its limitations, the findings open a knowledge gap that can be explored in developing countries particularly in Africa to improve construction cost management in the continent through the implementation of contemporary technologies.

Keywords: Contemporary, Technologies; Contemporary technologies; Cost; Construction; Construction cost; Cost management; Digitalisation

1. INTRODUCTION

The emergence and rapid advancement of digital technologies driven by the Fourth Industrial Revolution (Industry 4.0) have significantly transformed business processes and operational practices across numerous industries worldwide (Martinelli et al., 2021; Menegon Lopes & Silva Filho, 2024). This has significantly increased awareness of the potential benefits associated with the adoption of digital technologies across various aspects of human and organisational activities. As a result, many industries such as worldwide have begun integrating 4IR technologies into their operations to enhance efficiency, productivity, and innovation. However, despite these advancements, the full-scale adoption and integration of 4IR technologies remain remains a challenge and has yet to be fully achieved, particularly in developing countries where challenges

such as inadequate infrastructure, limited technical expertise, financial constraints, and resistance to change continue to hinder widespread implementation. More specifically, the construction industry has traditionally exhibited a slower pace in adopting technological innovations compared to other sectors such as banking, manufacturing, energy, e-commerce, telecommunication, and health which have been more proactive in embracing advanced technologies to enhance efficiency, productivity, and competitive advantage (Aghimien et al., 2018; Castagnino et al., 2016; Osunsanmi et al., 2018).

Conventional approaches to construction cost management primarily rely on manual quantity take-offs, 2D drawings, and independent spreadsheet systems, which are prone to inaccuracies, inefficiencies, and delays in cost reporting. As a result, construction projects in Nigeria continue to encounter persistent cost management issues, such as inaccurate cost estimates, cost overruns, budget discrepancies, inadequate cost monitoring, and ineffective cost control practices (Doloi, 2013; Ikuabe et al., 2020; Scott & Bommu, 2024; Sepasgozar et al., 2022). These repeated issues emphasise the need for more advanced and technology-driven approaches to enhance cost management performance within the construction industry. In response to the growing demand for digital transformation and improved project performance, the construction industry has embraced innovative technologies across various construction activities and processes (Akinradewo et al., 2025). One prominent area of application is construction cost management, where contemporary technologies such as Building Information Modelling (BIM), Augmented Reality (AR), Virtual Reality (VR), Artificial Intelligence (AI), and Machine Learning (ML) are increasingly reshaping construction cost management practices to enhance the accuracy of cost estimation, improve cost control mechanisms, and support more efficient decision-making throughout the project lifecycle. The integration of these technologies enhances organisational competitiveness by improving the accuracy and reliability of cost estimates, streamlining project management processes, and enabling the collection and analysis of real-time data for more effective cost monitoring and control (Smith, 2016).

Despite the inherent benefits of the adoption of contemporary technologies in construction cost management, its adoption is still very low (Ade-Ojo et al., 2025; Ern et al., 2025; Kelechi et al., 2025). The reasons allured to this poor adoption are high implementation costs (including expensive software and hardware), resistance to change, and the risk of technological obsolescence (Okorafor et al., 2025). In a similar vein, Albert et al. (2024) discovered that the limitation to their adoption include high initial implementation costs and resistance to organisational change. These limitations are likely to hinder awareness, knowledge, and understanding of the availability and practical applications of contemporary technologies in construction cost management that could benefit the construction industry, particularly in developing countries where project delivery continues to face significant challenges. Against this backdrop, the present study was undertaken to identify key research themes and trends in CT & CCM. Such an investigation is essential for advancing scholarly discourse in this area, thus fostering the wider adoption of contemporary technologies for cost management of construction projects. The aim of the study is to map out research areas in Contemporary Technologies (CT) and Construction Cost Management (CCM). The study is guided by the following objectives; to identify the number of publications per year on CT & CCM in the last 26 years; to identify the countries and authors with the highest focus on CT & CCM in the last 26 years; to identify the most cited published works and sources on CT &CCM in the last 26 years; to map out research focus in CT & CCM in the last 26 years; and to identify the research trends in CT & CCM based on year of publication.

2. METHODOLOGY

This study aims to identify the principal research themes and areas of focus in published studies on CT & CCM. To achieve this, a bibliometric analysis was employed to map existing knowledge domains and uncover

prevailing research trends. Data for the study were obtained exclusively from scholarly publications indexed in the Scopus database. Scopus is widely recognised as one of the leading multidisciplinary databases and is frequently utilised by researchers for literature retrieval (Guz & Rushchitsky, 2009). Although the Web of Science (ISI) was previously regarded as the dominant source for scientific literature, Scopus has emerged as a preferred database since its launch by Elsevier in 2004, becoming increasingly adopted in review studies (Chadegani et al., 2013; Vieira & Gomes, 2009). According to Hong et al. (2012) and Hosseini et al. (2018), Scopus offers broader coverage than many alternative databases. Furthermore, Olawumi et al. (2017) observed that there is no substantial distinction between Scopus and Web of Science, as both are widely acknowledged as the two foremost databases for scientific research and often contain overlapping records. Nevertheless, this study relied on Scopus because of its rapid growth, extensive coverage, and increasing recognition among the global research community, as highlighted by Chadegani et al. (2013). A holistic review-based approach was adopted in this study summarizing the recent research outputs (i.e. 2000-2026) on CT & CCM.

The literature search concentrated on scholarly journal articles and conference proceedings related to construction-oriented disciplines, including engineering, project management, energy, materials science, and environmental science. Journal articles were selected because they are widely regarded as credible and authoritative sources of knowledge, offering detailed, rigorous, and concise research findings compared to many other forms of publication (Ramos-Rodríguez & Ruíz-Navarro, 2004; Zheng et al., 2016). In addition, conference proceedings were incorporated due to their recognized value in providing current and reliable research insights. Webster and Watson (2002) emphasised the significance of conference papers as important sources for literature reviews, justifying their inclusion in this study. This approach is consistent with the methodology adopted by Vuksic et al. (2018) in their preliminary review of digital transformation case studies. The keywords such as “Contemporary Technology” OR “Contemporary Technologies” OR “Emerging Technologies” OR “Technology implementation” AND “Construction Cost” were the input used in searching for the documents published in Scopus. Related articles published during 2000-2026 were identified through a keyword search engine. Initially, 123 documents were found, further screening was carried out to exclude documents not published in English. After this initial screening, a total of 84 publications remained in the literature sample. Furthermore, screening based on the publication type (published journal articles and conference proceedings) was used to refine the publications. After careful refining, a total of 61 articles were extracted. Figure 1 shows the framework adopted for the research.

The findings were analysed and presented using several bibliometric indicators, including annual publication trends, country-wise distribution of publications, publications per document source, most-cited documents, co-authorship patterns, and keyword co-occurrence networks. To generate the co-occurrence network maps, VOSviewer software was employed. VOSviewer is a widely used bibliometric analysis tool designed to facilitate the visualization of scientific literature networks in a simple and effective manner. VOSviewer software visualizes large scale networks where the distance between two nodes indicates the proximity to each other (Van Eck and Waltman, 2017). Unlike traditional graph-based approaches, VOSviewer utilizes distance-based mapping techniques, enabling clearer representation and interpretation of relationships among research elements (Van Eck & Waltman, 2014).

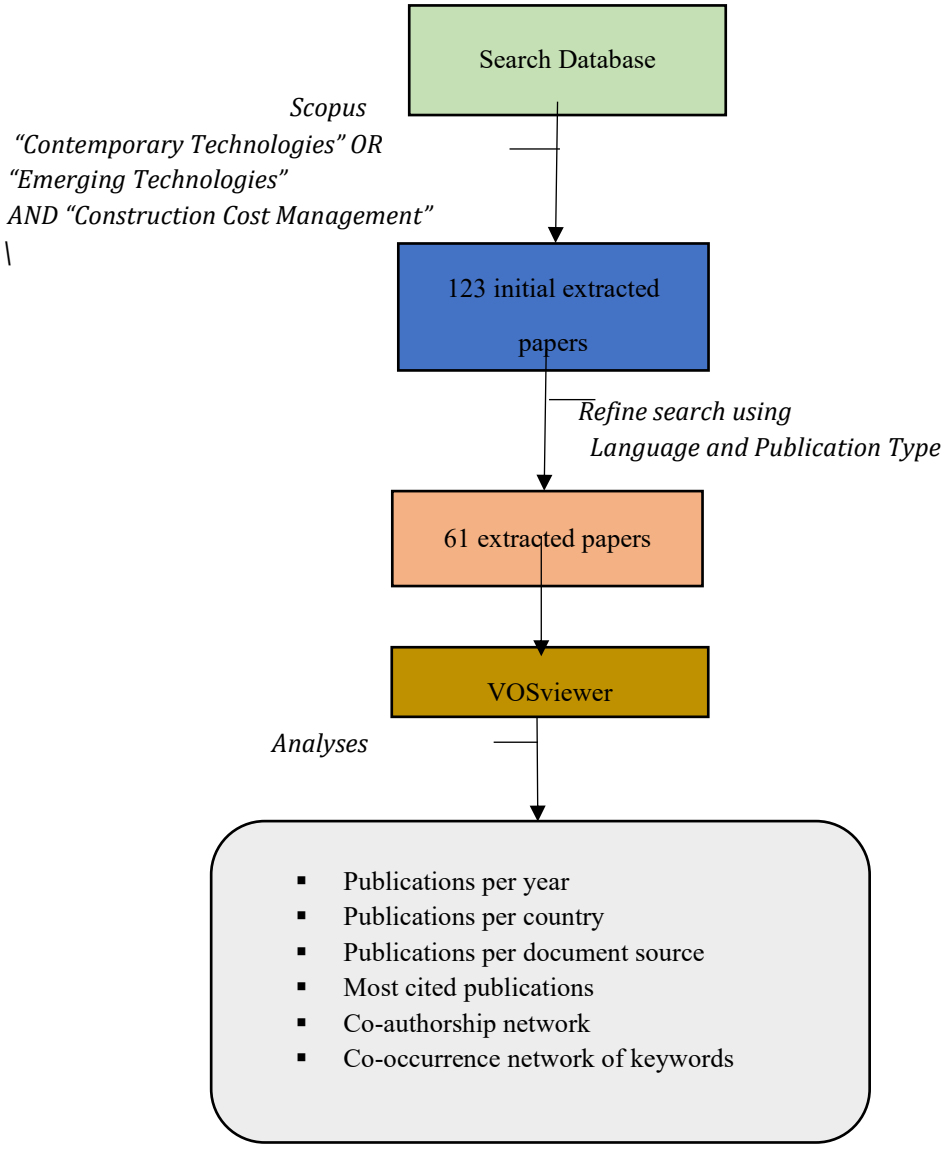

Figure 1: **Research framework**

Source: Author's compilation (2026)

3. RESULTS AND DISCUSSION

3.1 Publications per Year

A total of 61 articles on CT and CCM were extracted, 26 of which came from conferences, while the remaining 35 were journal articles. The 61 publications were first summarized based on their year of publication. Based on the number of publications per year, result in Figure 2 shows a rise in the number of publications in 2004 to 2006 with 1 publication in 2004 rising to 3 publications in 2006. However, a drop in the number of publications can be seen from 2007 through to 2008. From then on, there was a rise and fall in the number of

publications in this area with 2025 experiencing the highest number of 13 published articles. This indicates that recently, CT and CCM is having huge interests in the research community. In the upcoming years, more publications can be expected in the domain of CT and CCM research. The finding is in agreement with the findings of Wang and Guo (2022) who discovered increase in literature on digital technologies and transformation from 2018 to 2021.

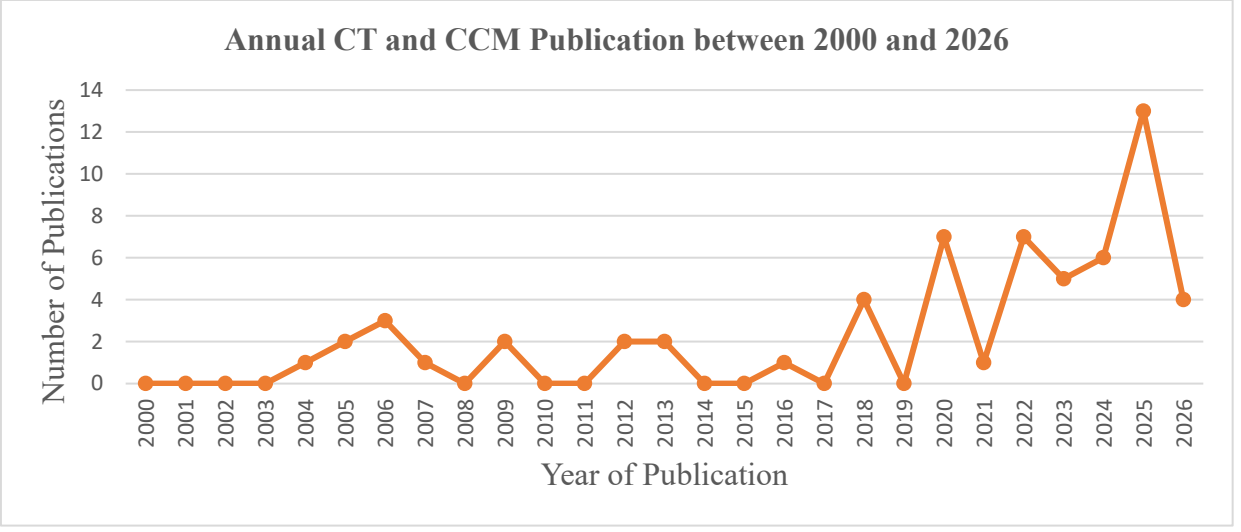

Figure 2: Number of publications per year on CT and CCM

Source: Scopus database (2026)

3.2 Publications per Country

In terms of the number of studies per country of origin, the result revealed that some articles have more than one country in their title or affiliation, hence there exist some overlap. Similarly, some countries have produced just one publication within the 26 years span and as such were eliminated based on the assumption that they might just exist as possible overlap. Thus, only countries with at least 3 documents originating from them were considered. The minimum number of documents of an author and minimum number of citations were set at 3 and 1 respectively. Out of 45 countries, 5 meet the thresholds. Table 1 and Figure 3 show that China topped the list with a total of 15 publications and 246 citations. This is followed by USA (11 papers, 204 citations), Australia (4 papers, 69 citations), Canada (4 papers, 11 citations), and India (3 papers, 16 citations). This finding is consistent with the Institute of Management Development (IMD) "world digital competitiveness" ranking which revealed that the ten most digitally competitive countries in the world are the USA, Canada, Honk Kong and other seven European countries (Institute of Management (IMD), 2018). A quick look at the Figure shows that no Africa country can be found in this area of research. This shows a knowledge gap in the area of CT and CCM in Africa.

Table 1: Geographical Distribution of CT and CCM Literature

Country	Total Publication (TP)	Total Citation (TC)	Citation per Publication (CPP)
China	15	246	16.40
United States	11	204	18.55
Australia	4	69	17.25
Canada	4	11	2.75
India	3	16	5.33

Source: Author's compilation (2026)

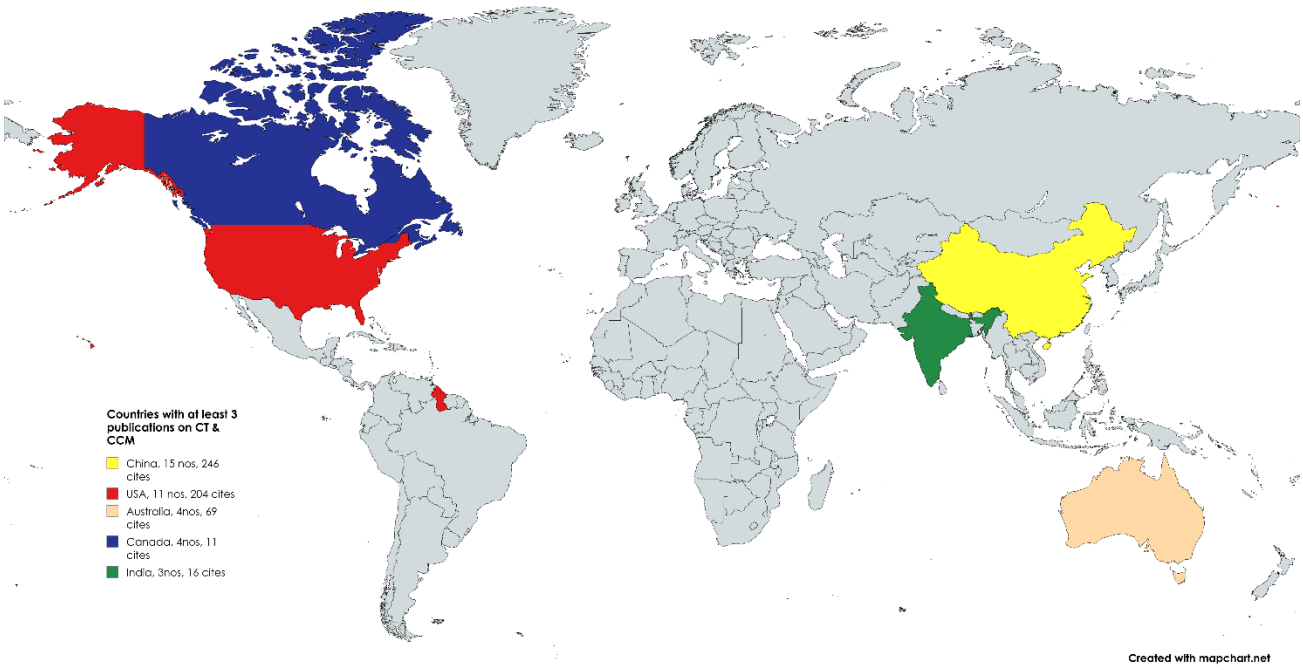

Figure 3: Number of publications per country

Source: Mapchart (2026)

3.3 Publications per Author

In terms of authorship, the extracted 61 documents had 200 authors. This include both lead authors and their collaborators. With the minimum number of documents of an author and minimum number of citations of an author set at 1 and 30 respectively, only 24 authors were revealed. Table 2 shows that the top seven authors that have written in the area of CT and CCM and are well cited are Kim, K. (1 paper, 143 citations), Kim, S. (1 paper, 143 citations), Lee, G. (1 paper, 143 citations), Yan, Y. (1 paper, 141 citations), Guo, S. (1 paper, 141 citations), Xie, D. (1 paper, 141 citations), Xu, J. (1 paper, 141 citations). The overlay visualization map for authors and co-authors on Figure 4 shows that there are seven clusters of co-authorship. The earliest authors that published their work in 2016 are shown in purple colour on the map, while authors that published their work in 2018 are shown in blue colour on the map. Authors that published their work in 2020 are shown in

green colour on the map. However, the most recent authors that published their work in 2022 till date are shown in yellow colour on the map.

Table 2: Number of Publications per Author

Author	Affiliation	Documents	Citations
Kim, K.	Dept. of Civil & Environmental Engineering, Dongguk University, Seoul, 04620, South Korea	1	143
Kim, S.	Dept. of Civil & Environmental Engineering, Dongguk University, Seoul, 04620, South Korea	1	143
Lee, G.	Dept. of Civil & Environmental Engineering, Dongguk University, Seoul, 04620, South Korea	1	143
Yan, Y.	College of Engineering, Nanjing Agricultural University, Nanjing, Jiangsu, China	1	141
Guo, S.	GXChain, Hangzhou, China	1	141
Xie, D.	Innovhope Inc. MA, United States; Walmart China, Shenzhen, China	1	141
Xu, J.	Department of Food Science and Technology, The Ohio State University, Columbus, 43210, OH, United States	1	141
Cunha, J.	ALGORITMI Centre, School of Engineering, University of Minho, Campus Azurém, Guimarães, 4800-058, Portugal	1	49
Portugal-Pereira, J.	Energy Planning Program, Graduate School of Engineering, Universidade Federal do Rio de Janeiro, Centro de Tecnologia, Bloco C, Sala 211, Cidade Universitária, Ilha do Fundão, Rio de Janeiro, 21941-972, RJ, Brazil; Centre of Environmental Policy, Imperial College London, Weeks Building 16-18 Prince's Gardens, South Kensington, SW7 1BA, London, United Kingdom	1	49
Schaeffer, R.	Energy Planning Program, Graduate School of Engineering, Universidade Federal do Rio de Janeiro, Centro de Tecnologia, Bloco C, Sala 211, Cidade Universitária, Ilha do Fundão, Rio de Janeiro, 21941-972, RJ, Brazil	1	49
Araujo, M.	ALGORITMI Centre, School of Engineering, University of Minho, Campus Azurém, Guimarães, 4800-058, Portugal	1	49
Ferreira, P.	ALGORITMI Centre, School of Engineering, University of Minho, Campus Azurém, Guimarães, 4800-058, Portugal	1	49
Szklo, A.	Energy Planning Program, Graduate School of Engineering, Universidade Federal do Rio de Janeiro, Centro de Tecnologia, Bloco C, Sala 211, Cidade Universitária, Ilha do Fundão, Rio de Janeiro, 21941-972, RJ, Brazil	1	49
Chytis, E.	Department of Accounting & Finance, University of Ioannina, Campus of Preveza, Preveza, 48100, Greece	1	37
Kitsantas, T.	Department of Accounting & Finance, University of Ioannina, Campus of Preveza, Preveza, 48100, Greece	1	37
Chileshe, N.	Construction and Project Management, UniSA STEM, Univ. of South Australia	1	35

Dayan, V.	UniSA STEM, Univ. of South Australia, City East Campus, 108 North Terrace, Adelaide, 5001, SA, Australia	1	35
Hassanli, R.	Mawson Lakes Campus, Mawson Lakes Blvd.,Mawson Lakes, Mawson Lakes, 5095, SA, Australia	1	35
Cheng, L.	School of Geography and Ocean Science, Nanjing University, Nanjing, China	1	32
Liu, D.	School of Geography and Ocean Science, Nanjing University, Nanjing, China; Jiangsu Provincial Key Laboratory of Geographic Information Science and Technology, Nanjing University, Nanjing, China; Collaborative Innovation Center for the South Sea Studies, Nanjing University, Nanjing, China; Collaborative Innovation Center of Novel Software Technology and Industrialization, Nanjing University, Nanjing, China	1	32
Hammed, R. T.	Faculty of Automatic Control and Computers, University POLITEHNICA of Bucharest, Bucharest, Romania;	1	30
Hamid, O. T.	Faculty of Automatic Control and Computers, University POLITEHNICA of Bucharest, Bucharest, Romania;	1	30
Mohamad, O. A.	Department of Computer Science, Cihan University, Erbil, Iraq	1	30
Tapus, N.	Department of Computer Science, Cihan University, Erbil, Iraq	1	30

Source: Author's compilation (2026)

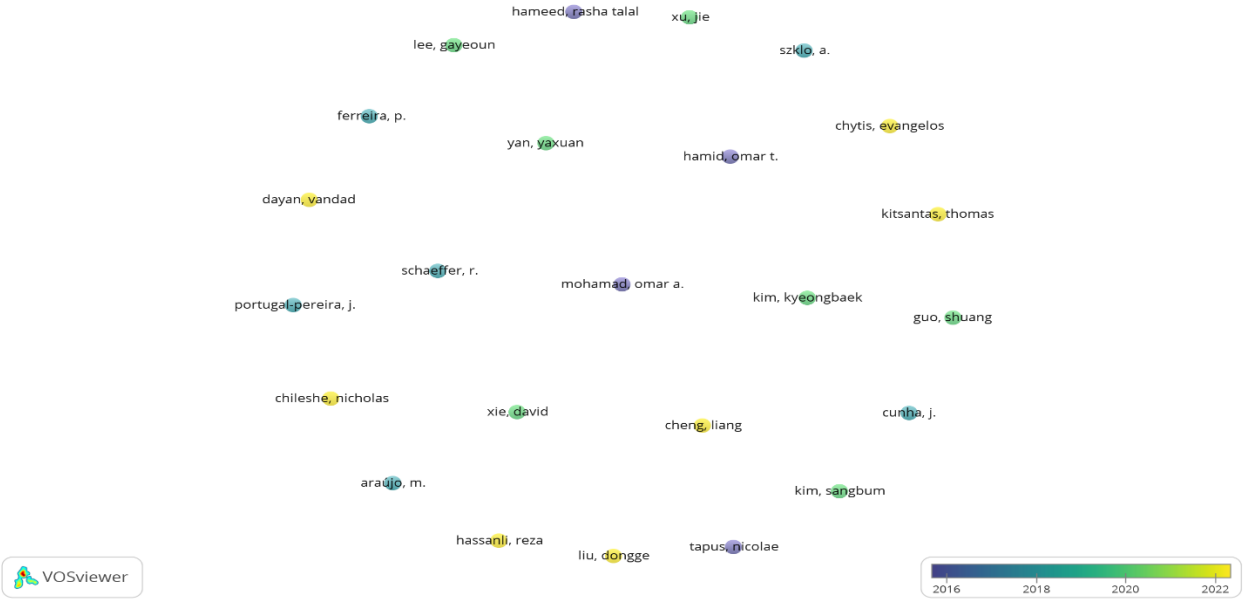

Figure 4: Overlay visualisation map for authors and co-authors

Source: VOSviewer (2026)

3.4 Most Cited Publications

To fully grasp the understanding of researches in CT and CCM, analysing the extracted papers to see the most cited documents is necessary. The minimum number of citations of a document was set at 10. Out of the 61 extracted papers, only 17 meet the threshold. Table 3 shows that the five most cited publications are from Kim et al. (2020) titled "A study on the application of blockchain technology in construction industry" (143 citations), Xu et al. (2020) titled "Blockchain: A new safeguard foreign-foods" (141 citations), Portugal-Pereira et al. (2018) titled "Better late than never, but never late is better: Risk assessment of nuclear power construction projects" (49 citations), Kitsantas and Chytis (2022) titled " Blockchain technology as an ecosystem: Trends and perspectives in accounting and management" (37 citations), and Dayan et al. (2022) titled "A scoping review of information-modeling development in bridge management systems" (35 citations).

Table 3: Top Cited Publications

Publication	Title	Citations	Publication Type
Kim et al. (2020)	A study on the application of blockchain technology in the construction industry	143	Article
Xu et al. (2020)	Blockchain: A new safeguard for agri-foods	141	Article
Portugal-Pereira et al. (2018)	Better late than never, but never late is better: Risk assessment of nuclear power construction projects	49	Article
Kitsantas and Chytis (2022)	Blockchain technology as an ecosystem: Trends and perspectives in accounting and management	37	Article
Dayan et al. (2022)	A scoping review of information-modeling development in bridge management systems	35	Article
Liu and Cheng (2024)	MAKG: A maritime accident knowledge graph for intelligent accident analysis and management	32	Article
Hammed et al (2016)	Design of e-healthcare management system based on cloud and service oriented architecture	30	Conference
Abyar and Nowrouzi (2023)	A comprehensive framework for eco-environmental impact evaluation of wastewater treatment plants: Integrating carbon footprint, energy footprint, toxicity, and economic assessments	26	Article
Munmullar et al. (2023)	Suitability of modular technology for house construction in Sri Lanka: A survey and a case Study	24	Article
Igwe et al. (2022)	Acceptance of contemporary technologies for cost management of construction projects	21	Article
Subramanya et al. (2022)	The future of highway and bridge construction: Digital project delivery using integrated advanced technologies	21	Conference
Guo et al. (2020)	Emerging technologies and methods in shared mobility systems layout optimization of campus bike-sharing parking spots	16	Article
Shi et al. (2022)	Research on a methodology for intelligent seismic performance evaluation and optimization design of buildings based on IFC and ontology	16	Article

Berlato et al. (2025)	Digital platforms for the built environment: A systematic review Across sectors and scales	16	Article
Zhang et al. (2022)	Contaminant removal and resource recovery in bioelectrochemical wastewater treatment	16	Article
Rajagopal et al. (2022)	Comparative analysis of blockchain technology and artificial intelligence and its impact on open issues of automation in workplace	13	Conference
Zheng et al. (2022)	Retraction: Application of BIM technology in prefabricated buildings based on virtual reality	12	Article

Source: Author's compilation (2026)

3.5 Publications per Document Source

The number of extracted papers per source title was evaluated. The 61 extracted publications were published in 55 different journals and conference proceedings. The minimum number of documents of a source and minimum number of citations of a source were set at 1 and i5 respectively. Out of 55 sources, 14 meet the thresholds. Table 4 shows that Buildings topped the list with 3 publications and 40 citations. Reason being that digital technologies in construction is one of the scopes of this journal. This is followed by Journal of Construction Engineering and Management (2 papers, 41 citations), KSCE Journal of Civil Engineering (1 paper, 143 citations), Artificial Intelligence in Agriculture (1 paper, 141 citations), Energy Policy (1 paper, 49 citations), Journal of Theoretical and Applied Electronic Commerce Research (1 paper, 37 citations), Ocean Engineering (1 paper, 32 citations), E-Health and Bioengineering Conference Series (EHB) (1 paper, 30 citations), Journal of Environmental Management (1 paper, 26 citations), International Conference on Transportation and Development (1 paper, 21 citations), Journal of Information Technology in Construction (1 paper, 21 citations), Current Pollution Report (1 paper, 16 citations), Journal of Advanced Transportation (1 paper, 16 citations), and Engineering Structures (1 paper, 16 citations).

Table 4: Number of Publications per Source

Publication Name	Total Publication (TP)	Total Citation (TC)	Citation per publication (CP)
Buildings	3	40	13.33
Journal of Construction Engineering and Management	2	41	20.5
KSCE Journal of Civil Engineering	1	143	143.00
Artificial Intelligence in Agriculture	1	141	143.00
Energy Policy	1	49	49.00
Journal of Theoretical and Applied Electronic Commerce Research	1	37	37.00
Ocean Engineering	1	32	32.00
E-Health and Bioengineering Conference Series (EHB)	1	30	30.00
Journal of Environmental Management	1	26	26.00
International Conference on Transportation and Development	1	21	21.00

Journal of Information Technology in Construction	1	21	21.00
Current Pollution Reports	1	16	16.00
Journal of Advanced Transportation	1	16	16.00
Engineering Structures	1	16	16.00

Source: Author's compilation (2026)

3.6 Research Focus in CT and CCM base on Co-occurring Keywords

In creating a co-occurrence map based on the bibliographic data gathered, it is crucial to set the minimum number of co-occurrences for the keywords to be extracted. It is important for proper clustering of keywords into themes that can be used to explain the areas of concentration for the past studies. The VOSviewer predefined number of co-occurring keywords as 5. However, for this current study, it is observed that adopting the default minimum of 5 will give a scanty output. Thus, a re-occurrence of 3 was adopted and full counting was used. This implies that for a keyword to be extracted, it must have at least 3 co-occurrences in the author and source indexed keywords. The analysis revealed a total of 857 keywords for all the 61 extracted publications. Out of these keywords, 37 meet the threshold. Among them, some keywords with the same semantic meanings such as "blockchain" and "block-chain", "cloud computing" and "cloud-computing" were combined and finally, 35 keywords were selected. The nodes colour divides the keywords into 5 clusters. It is important to know that the closer the keywords to each other, the higher their co-occurrence (Van Eck & Waltman, 2014). Figure 5 shows the network visualization map for the 35 co-occurring keywords and their 5 different clusters. At the centre of it is the keywords "emerging technologies" and "cost management" to which all other keywords are linked. The connection lines show the relationship between a pair of keywords.

i. **Cluster 1-** ***Digital Transformation in Cost Management*****:** This cluster is represented in red with eight keywords which are cost accounting, cost benefit analysis, cost effectiveness, cost estimating, cost reduction, digital transformation, risk assessment, and time management. The bibliometric network indicated that research in this cluster has evolved from conventional accounting and estimation techniques toward digital cost management systems. Earlier studies emphasised traditional cost accounting and cost estimating methods aimed at budgeting and financial control. However, with the advent of digital transformation, recent publications increasingly explore technologies such as building information modelling (BIM), artificial intelligence (AI), cloud computing, augmented/virtual realities, big data analytics, and digital twins as enablers of more accurate and dynamic cost management (Igwe et al., 2020; Igwe et al., 2022; Oesterreich & Teuteberg, 2016). This suggests that researchers are increasingly exploring how emerging technologies can improve cost efficiency and reduce uncertainties throughout project lifecycle (Chien et al., 2014; Choi et al., 2021). For instance, artificial intelligence and predictive analytics can be applied to forecast project risks, optimize resource allocation, and improve cost estimation accuracy; AI system can analyze large volumes of historical and real-time project data to identify patterns and predict potential disruptions before they occur (Igwe et al., 2022; Marovic et al., 2026; Rao et al., 2019). Also, in a bid to understand the application of digital technologies in construction cost management and its inherent benefits, several studies have placed focus on issues surrounding technology adoption, the different areas of its applications in cost management, and the likes (Chima & Udoekanem, 2024; Igwe et al., 2020). The benefits of applying digital technologies in construction cost management such as improved accuracy in cost estimation, enhanced budget monitoring, cost reduction, risk management,

and more effective management of design modifications has also been pinpointed by several studies (Albert et al., 2024; Kelech et al., 2025).

ii. **Cluster 2- *Integrated Digital Construction Management:*** This cluster is represented in green with seven keywords which are blockchain, building information modelling, cost management, costs, data integration, information management, and sustainable development. Cluster 2 indicates a research focus on how interconnected digital platforms can enhance project performance, cost efficiency, transparency, and sustainability across the construction lifecycle. From a bibliometric perspective, this cluster demonstrates a shift from the isolated application of digital tools toward integrated digital ecosystems that combine BIM, blockchain, information management, and cost management functions. The strong interconnections among these keywords suggest that future research is increasingly focused on developing comprehensive digital frameworks capable of supporting efficient, transparent, and sustainable construction project delivery (Haigh et al. 2026). The convergence of BIM, blockchain, data integration, information management, and sustainability principles reflect the construction industry's ongoing transition toward more collaborative, transparent, and sustainable construction practices. Hwang et al. (2020) and Larbi et al. (2024) emphasised the role of Integrated Digital Delivery (IDD) in facilitating the integration of construction workflows, project participants, and operational activities using digital technologies, thereby mitigating health and safety risks and improving productivity, collaboration, and efficiency in project delivery.

iii. **Cluster 3- *Emerging Technologies and Sustainability*:** This cluster is represented in blue with six keywords which are artificial intelligence, cloud computing, construction cost, energy, life cycle, and wastewater treatment. Cluster 3 reflects a growing research stream focused on the application of emerging technologies to enhance sustainability across construction projects. Sustainability has become a central objective in the construction industry due to increasing environmental concerns, resource scarcity, and regulatory pressures (Moshood et al., 2025). Digital technologies such as AI and cloud computing contribute to sustainable construction by enhancing resource efficiency, improving energy management, reducing waste, facilitating collaboration, and supporting lifecycle management (Adejola & Nwobodo-Anyadiegwu, 2025; Chima & Udoekanem, 2024). In a similar vein, Thomas et al. (2019) in *AICERA 2019* proceedings provided a comprehensive overview of how emerging technologies can support sustainability across multiple sectors particularly in energy systems, construction, agriculture, and environmental management. They highlighted the transformative potential of AI, IoT, cloud computing, and data analytics in driving energy efficiency, environmental protection, and smart infrastructure development. They also emphasised the need for integrated frameworks and supportive policies to facilitate the effective adoption of these technologies for sustainable development.

iv. **Cluster 4- *Smart Technology in Construction*:** This cluster is represented in yellow with seven keywords which are architectural design, construction, construction industry, construction projects, internet of things, project management, and technology. Cluster 4 represents a significant research theme centered on the application of smart technologies to improve construction processes, and project performance. The co-occurrence of these keywords suggests that researchers are increasingly focusing on how smart technologies can transform traditional construction practices into more efficient, connected, and data-driven systems (Arslan et al., 2019; Skibniewski, 2025). This cluster demonstrates that future construction management research is moving toward the development of intelligent, connected, and autonomous construction systems that leverage real-time data to improve decision-making and project outcomes. The World Academy of Research in Science and Engineering (2025) noted that smart technologies can be leveraged by construction firms for improved efficiency, cost effectiveness, and optimized overall competitiveness. Furthermore, Zhu et al. (2025) revealed

that smart technologies such as AI and IoT significantly improve the efficiency, accuracy, and productivity of project management processes by enabling real-time data-driven decision-making and providing automated data collection for progress tracking.

v. **Cluster 5-** ***Emerging Technologies and implementation Decision Making*****:** This cluster is represented in purple with seven keywords which are construction management, cost engineering, decision making, emerging technologies, investments, monitoring, and technology implementation. Cluster 5 underscores the importance of strategic decision-making in the adoption of emerging technologies in construction. It emphasises that successful digital transformation depends not only on technological availability but also on effective investment evaluation, monitoring systems, and implementation strategies that align with construction management objectives. Moslehi (2024) examined the relationship between emerging technologies and decision-making performance within the strategic management process, with particular emphasis on how digital tools support managerial efficiency and organisational outcomes. They noted that the idea of digital transformation is not merely technological but also managerial, requiring changes in how decisions are made, evaluated, and implemented within organisations. Escandon-Barbosa and Salas-Paramo (2025) further affirmed that strategic decisions, when supported by digital technologies such as artificial intelligence, machine learning, and virtual reality significantly enhance sustainable performance. They also emphasised the importance of integrating decision-making processes, implementing digital technologies, and their impact on firm performance. Furthermore, Qudrat-ullah (2025) in his book "emerging technologies and dynamic decision making" noted that organisations require adaptive decision frameworks that incorporate continuous learning, feedback mechanisms, and real-time information processing.

Table 5: Influential Keywords in CT and CCM

Author's Keywords	Occurrences
Project management	16
Cost management	12
Emerging technologies	12
Costs	11
Artificial intelligence	9
Architectural design	9
Cloud computing	8
Blockchain	7
Construction costs	7
Information management	6
Construction industry	5
Construction projects	5
Life cycle	5
Risk assessment	5
Digital transformation	4
Construction management	4
Technology	4
Cost reduction	4
Cost benefit analysis	4
Decision making	4
Building information modelling	3

Internet of things	3
Construction	3
Data integration	3
Technology implementation	3
Cost effectiveness	3
Cost engineering	3
Cost estimating	3
Cost accounting	3
Sustainable development	3
Energy	3
Investments	3
Monitoring	3
Time management	3
Wastewater treatment	3

Source: Author's compilation

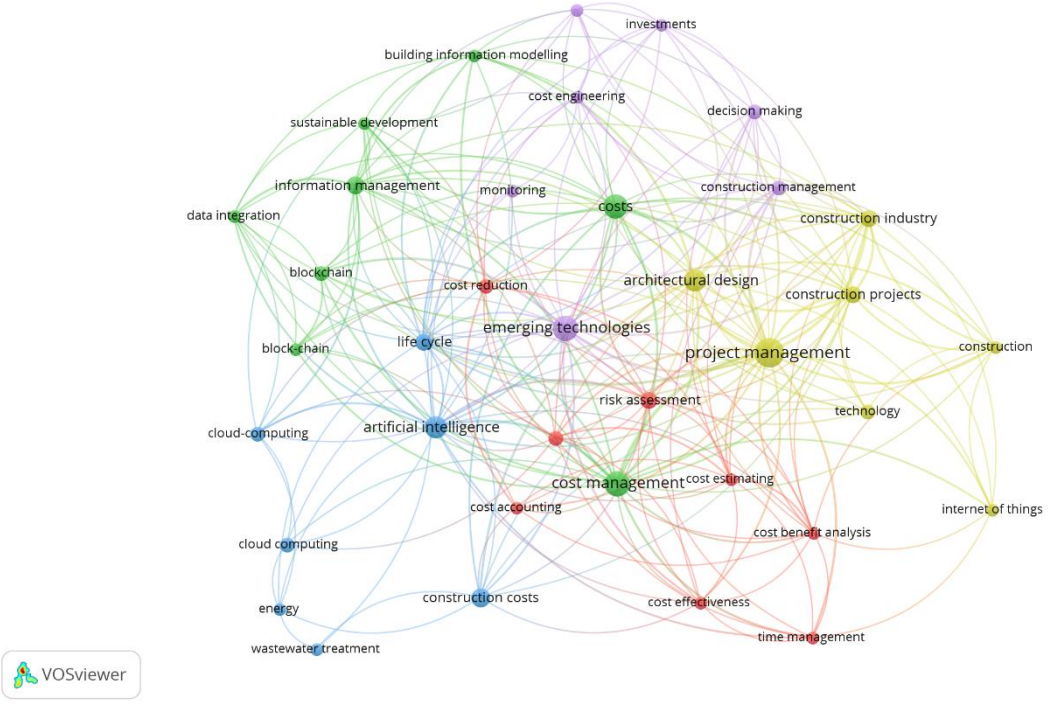

Figure 5: Network visualisation map for co-occurring keywords

Source: VOSviewer (2026)

3.7 Research Trends in CT and CCM based on Year of Publication

Figure 6 shows the overlay visualisation network map for the co-occuring keywords in the different year of publication. With a minimum of 3 occurrences, it was observed that from 2016 to 2018, the keywords evident

in this period include emerging technologies, architectural design, construction costs, technology, cost effectiveness, costs, technology implementation, risk assessment, monitoring, cost accounting, and cost engineering. These keywords are depicted in purple and blue clusters of the map. From 2018 to 2020, research focus placed emphasis on cost management, project management, construction, construction manageemnt, construction projects, cloud computing, blockchain, life cycle, sustainable development, investments, and wastewater treatment. These are indicated in green on the map. However, publications from 2021 till date has seen more focus on building information modelling, artificial intelligence, internet of things, information management, data integration, digital transformation, cost reduction, cost estimating, cost-benefit analysis, construction industry, energy, time management, and decision making. These are indicated in yellow on the map. The trend in publication can be seen in the years. Keywords with purple colour e.g. construction costs, technology, costs, technology implementaton etc. were the old areas of concentration. More recent focus lies in the yellow areas such as building information modelling, artificial intelligence, information management, cost estimating, data integration, digital transformation, energy etc. Thus, it can be deduced that as technological advancemement and the clamour for more digitalised construction increases, research focus is. A significant example is the work of Igwe et al. (2022) which focused on the acceptance of contemporary technologies for cost management of construction projects; observed that contemporary technologies enhance efficiency, accuracy, predictability in cost maangement processes, and overall project outcome. However, Ade-Ojo et al. (2025) and Albert et al. (2024) noted that issues such as high cost of purchase, expensive training, shortage of silled professionals limit the implementtation of contemporary technologies in construction. These challenges need to be given substantuial attention as studies on CT & CCM continue to emerge.

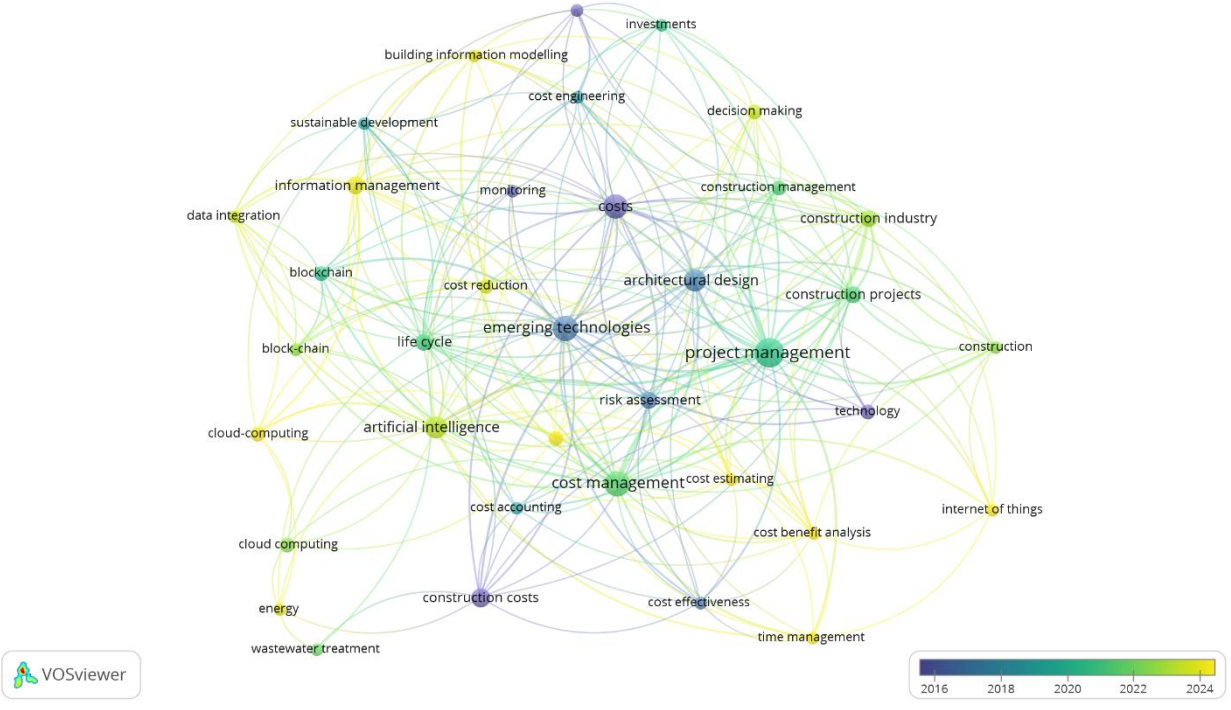

Figure 6: Overlay visualisation map for co-occurring keywords

Source: VOSviewer (2026)

4. CONCLUSION

This study sets out to identify research focus in CT & CCM through a bibliometric approach. Based on extracted studies published within a 26-year period and indexed in the Scopus database, the study has been able to identify the key area of concentration in research relating to CT & CCM. Based on the findings, it can be concluded that research publication on CT & CCM is low with 2025 experiencing the highest number of publications of 13. This is a cause for concern given the growing need for a deeper understanding CT & CCM, as well as the substantial benefits that the construction industry could derive from their comprehensive and integrated adoption. The countries with the most publications in CT & CCM are China, United States, Australia, Canada, and India with at least three publications. There is no evidence of publication in this area from Africa. This reveals a knowledge gap that can be explored in other to improve construction project delivery in the continent. Based on the different clusters extracted, research on CT & CCM have placed focus on the use of digital transformation in cost management, integrated digital construction management, emerging technologies and sustainability, smart technology in construction, and emerging technologies and implementation decision making. This study contributes to the body of knowledge as it reveals areas wherein research focus has been placed in issues relating to CT & CCM. Its findings have also mapped out possible areas for research CT & CCM, particularly in African countries were lack of literature in this regard exist. However, while this study contributes enormously to the body of existing literature on CT & CCM, caution should be exercised in generalising its results as data used were gathered from only Scopus database. Although substantial overlap exists between Scopus and other bibliographic databases, future research could incorporate additional databases or combine multiple sources to enable comparative analyses and provide a more comprehensive understanding of the research area. This approach would allow for the inclusion of a larger dataset than that used in the present study, thereby enhancing the breadth and robustness of the findings.

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