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MAPPING SMART CITY AND INDUSTRY 4.0 RESEARCH IN CONSTRUCTION-RELATED STUDIES

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Abstract. Despite its potential to increase sustainability, productivity, and efficiency, the construction industry's adoption of the Smart City and Industry 4.0 (SC&I4) concept has been considered sluggish. Previous studies have clarified that more study and development in this technology area is needed to increase its implementation in the completion of construction projects. The objective of this paper is to conduct a review of SC&I4 construction-related domains to identify the area of focus of previous studies. This study used a bibliometric approach, and the data were extracted from the Scopus database. The database was searched using keywords like "smart-city," "Industry 4.0," and "construction" to retrieve relevant documents. Based on the collected bibliographic data, a network and overlay visualisation map of the co-occurrence keywords was created using VOSviewer. The results showed that past studies prioritised SC&I4 project delivery, blockchain and sustainable development, and the Internet of Things. Additionally, the present focus of this field's research is moving toward a more digitalised application of SC&I4, particularly in blockchain technology. The results highlight a knowledge vacuum that developing nations, particularly those in South America, Asia, and Africa, might investigate to enhance the delivery of construction projects across the continent via SC&I4. This paper contributes to SC&I4 discourse, which has not received much attention in recent bibliometric and scientometric studies.

Keywords*: Smart city, Industry 4.0, construction, bibliometric, visualisation, research trend.*

INTRODUCTION

The construction industry is vital to expanding cities and the global economy in this rapidly urbanising world. It assembles the built environments for economic activity inter-alia (Odubiyi et al., 2024). Arguably, the construction industry contributes 6–13 % of the global economy and 8 % of the GDP in developing nations (Craveiroa et al., 2019; Regona et al., 2023; Fluid Construction, 2024). However, it uses most of the world's resources, contributing to the depletion of raw materials (50 %), water, energy (40–45 %), and the ozone layer (Norouzi et al., 2021; Elghaish et al., 2022; Emere et al., 2024). Similarly, it contributes to

environmental pollution in CO_2 emission (40 %) and causes a third of global waste (Liang et al., 2021; Elghaish et al., 2022). Besides, there is a significant environmental challenge to providing affordable housing and infrastructure to the world's increasing population, estimated to be about 200 000 per day (Agenda, 2016; Elghaish et al., 2022). Furthermore, the industry, especially in developing countries, is confronted with obstacles that compromise output and effectiveness, such as project delays, cost overruns, and quality issues (Emere et al., 2020; Regona et al., 2023). Adopting the SC&I4 concept – which blends modern technology and procedures with sustainable development to produce an intelligent, resource-efficient, and flexible building process –is imperative to address these issues.

Unfortunately, the construction industry is hesitant to embrace novel technologies compared to other sectors like banking, manufacturing, and retailing, which have done so to obtain a competitive edge (Osunsanmi et al., 2018; Aghimien et al., 2020). Adopting SC&I4 can improve project delivery efficiency and sustainability performance, which is desperately needed in the construction industry of developing nations. Likewise, the construction industry has received criticism for its lack of investment in research and development, and significant evidence of this is seen in developing countries (Chilipunde, 2010). For instance, there is a paucity of research relating to SC&I4, negatively impacting adoption and applicability (Aghimien et al., 2020). Furthermore, no study has used bibliometrics to objectively and methodically evaluate the scientific development of the literature on SC&I4. This research addresses this limitation by statistically analysing the scientific works published in Scopus databases between 2018 and 2024 to identify the features of the global construction-related literature on SC&I4. Similarly, this article will help the construction industry by highlighting the emphasis on SC&I4 research and encouraging areas for improvement.

1. OVERVIEW OF SMART CITY (SC)

The US Community Analysis Bureau introduced the concept of a Smart City during the 1960s and 1970s by utilising databases, aerial photography, and cluster analysis to gather information, allocate resources, publish reports, and prepare for emergencies (Montes, 2020). These early initiatives established the foundation for creating smart cities, which have subsequently developed to include cutting-edge technologies and data-driven solutions. The first SC was established in Amsterdam in 1994 when a virtual digital city was created (TWI-global, n.d.). Since then, efforts by firms like Cisco and IBM have sped up the development of smart cities, particularly in the mid-2000s (Safiullin et al., 2019). For IBM, a SC is "one that maximises the use of all the interconnected information available today to understand better and control its operations and optimise the use of limited resources" (TWI-global (n.d.), online). In other words, "it is the use of diverse information technologies or creative concepts to integrate urban systems and services to maximise urban management and services and increase resource efficiency" (Lin & Cheung, 2020, p. 2).

The definition by IBM incorporates characteristics like "instrumented", "interconnected", and "intelligent" (Harrison et al., 2010; Lin & Cheung, 2020,

p. 2). "Instrumented refers to sources of near-real-time real-world data from both physical and virtual sensors; interconnected means the integration of those data into an enterprise computing platform and the communication of such information to the various city services; intelligent refers to the inclusion of complex analytics, modelling, optimisation, and visualisation in the operational business process to make better operational decisions." (Lin & Cheung, 2020, p. 2). Safiullin et al. (2019:3) defined SC as a "new concept and a new model of urbanisation based on the 4th Industrial Revolution and the application of new technologies generated by the development of Industry 4.0 (Internet of Things, cloud computing, cyber-physical systems, big data and other technologies) for planning, construction, management, integrated industrialisation, informatisation, modernisation and sustainable development of modern cities".

Silva et al. (2018) state that SC is linked to the internet and people. Smart cities continue to evolve, integrating innovations in urban infrastructure and aiming for sustainable, efficient, and connected urban environments (Silva et al., 2018; Safiullin et al., 2019). The first-ever SC Expo World Congress was held in Barcelona in 2011, initiating an annual gathering that tracks the advancement of smart cities (Verdict, 2020; Montes, 2020). The principal elements of SC development include smart economy, smart people, smart management/smart regulation, smart mobility, smart environment, smart living, and smart infrastructure (Government UK, 2013; Safiullin et al., 2019).

2. THE INDUSTRY 4.0 (I4) CONCEPT

The phrase "industry 4.0 (I4)," or "fourth industrial revolution (4IR)," was originally used in 2011 at the Hannover Fair in Germany (Lu, 2017; Aghimien et al., 2020). I4 combines intelligent digital technology with industrial and production processes (IBM, 2024; SAP, n.d.). It involves technologies such as robotics, automation, Big Data, the Internet of Things (IoT) networks, cloud computing and analytics, artificial intelligence (AI) and machine learning (Aghimien et al., 2024; IBM, 2024). IBM ascribed I4 as synonymous with smart manufacturing, which is the realisation of the industry's digital transformation (IBM, 2024). I4 provides enhanced agility, flexibility, efficiency, and real-time decision-making to redefine how firms produce, enhance, and distribute their goods (IBM, 2024).

The name comes from the fact that the fourth industrial revolution came before the previous three. The 1700s and the middle of the 1800s saw the "first industrial revolution, during which a mechanical industry using steam and water-powered engines replaced an agrarian economy" (Aghimien et al., 2024, p. 42). Electrical energy was introduced for mass production during the Second Industrial Revolution. This revolution occurred in the early 1900s, and Henry Ford gained notoriety for his public-use automobile assembly line (Aghimien et al., 2024).

Electronics and information technology were introduced during the third industrial revolution in the late 1960s. This introduction resulted in production process optimisation and automation (Bienhaus & Haddud, 2018; Aghimien et al., 2024). Hence, I4 is a fundamental shift in industrial production that will significantly impact the city and its residents (Allam, 2019). It optimises the

traditional production cycle, allowing all phases and processes to interact (Allam, 2019; Balletto et al., 2022). In the construction context, it can be regarded as construction 4.0, "a variety of interdisciplinary technologies, methodologies and concepts that digitise, automate and integrate the construction process at all stages of the value chain" (Rendani, 2024, p. 11).

3. SMART CITY AND INDUSTRY 4.0 APPLICATION IN CONSTRUCTION

Smart city and Industry 4.0 (SC&I4) are closely related terms used simultaneously in most studies. There has been difficulty in reaching explicit definitions of the two terms (Safiullin et al., 2019; Montes, 2020). Hence, the two terms have almost the same principles that complement each other. For instance, the concept of a SC is supplemented by examining the technical advancements of I4 (Safiullin et al., 2019). The advancement of industry and technological levels determines how smart cities evolve (Lin & Cheung, 2020). The amalgamation of I4 and SC yields numerous advantages for urbanisation. SC&I4 contributes to efficiency and sustainability. For instance, I4 improves manufacturing procedures, which boosts productivity and makes better use of available resources. SC uses this efficiency to improve urban services, lower energy use, and advance sustainability (Balletto et al., 2022). With the increasing urbanisation in the world, smart cities, with digital tools, foster friendly and trustworthy relationships between social and human capital to enhance the economy and simultaneously improve building life cycles, structural integrity, and overall quality of life through appropriate resource management and governance (Gonçalves et al., 2021; Rendani, 2024). Planning and designing for new buildings are changing because of digital technologies, including cloud computing, laser scanning, building information modelling (BIM), and artificial intelligence (AI) (Rendani, 2024). Waste reduction and promotion of circular economies can be achieved through SC&I4-related technologies and initiatives (Gonçalves et al., 2021). SC&I4 encourages innovation and adaptability to the community's shifting demands to raise the quality of life (Balletto et al., 2022). Similarly, SC&I4 initiatives can lead to better public services, networked transportation, efficient infrastructure, data-driven decision-making, and increased security/safety (Balletto et al., 2022; Wolniak et al., 2023). Additionally, the coalescence of SC&I4 can improve sustainability, economic growth, and resilience (Wolniak et al., 2023). Furthermore, SC&I4 provides an avenue for the use of intelligent, networked systems (automation and data interchange) to improve infrastructure, facilitating the smooth connection between devices, sensors and services (Kaššaj & Peráček, 2024).

Although many developed nations have adopted SC&I4-related technology in many economic areas, most developing nations, especially African nations, have a different story to tell. Inadequate implementation/development is prevalent (Crnjac et al., 2017; Aghimien et al., 2020). This is a result of ongoing issues like low public awareness of the idea (Kogan & Lee, 2014), insufficient technical expertise and proficiency (Scuotto et al., 2016), high expense of IT training and skill development (Al-Nuaimi et al., 2015; Rana et al., 2019), absence of regulations and policies

(Chourabi et al., 2012), disregard for sustainability (Bibri, 2019; Rana et al., 2019), and inadequate internet connectivity (Aghimien et al., 2020). Other issues include data security and privacy, challenges with the digital divide, worker displacement, technical difficulties and high implementation costs (Pärn & Edwards, 2019; Wolniak et al., 2023). Consequently, conscientious planning and management are required to overcome the hindrances to the effective adoption of SC&I4 in research and practice.

4. RESEARCH METHODS

This study aimed to identify the primary focus areas in SC&I4 construction-related publications. Thus, a bibliometric methodology was used to map the knowledge areas and determine the research patterns. The Scopus search engine was utilised to locate pertinent publications for the investigation. Similarly, several studies have gone in this direction and claim that Scopus is effective, accurate, and exact compared to other search engines, and it can consider overlaps (Darko & Chan, 2017; Aghimien et al., 2020; Okafor et al., 2023). Because of its greater coverage of various scientific topics, Scopus has gained more recognition as a top option for literature searches, surpassing the Web of Science and other databases (Hong et al., 2012; Chadegani et al., 2013; Hosseini et al., 2018). It has also been acknowledged as a more current and rapidly expanding database (Chadegani et al., 2013; Aghimien et al., 2020).

The keywords utilised were “smart city”, “Industry 4.0”, and “construction”. The researchers intended to adopt a 10-year time frame (2014 to 2024). However, the database allowed only studies from 2018 to 2024, hence their inclusion. The search was conducted on 9th July 2024. Only conference papers and journals were considered. The idea was to highlight the most crucial information sources. Journal articles and conference papers have been recognised as reliable sources of knowledge undergoing rigorous peer review compared to other sources (Zheng et al., 2016; Aghimien et al., 2020). The initial search without any specific field produced 52 papers. However, when restricted to only construction-related fields and the English language, the search produced 28 papers. The construction-related fields considered included engineering, energy, materials science, and environmental science. Figure 1 portrays the research methodology adopted.

The extracted papers were analysed using VOSviewer software. Results are displayed according to the metrics: number of yearly publications, top cited papers, number of publications by document source, number of publications country-wise, co-occurring keyword network, and visualisation.

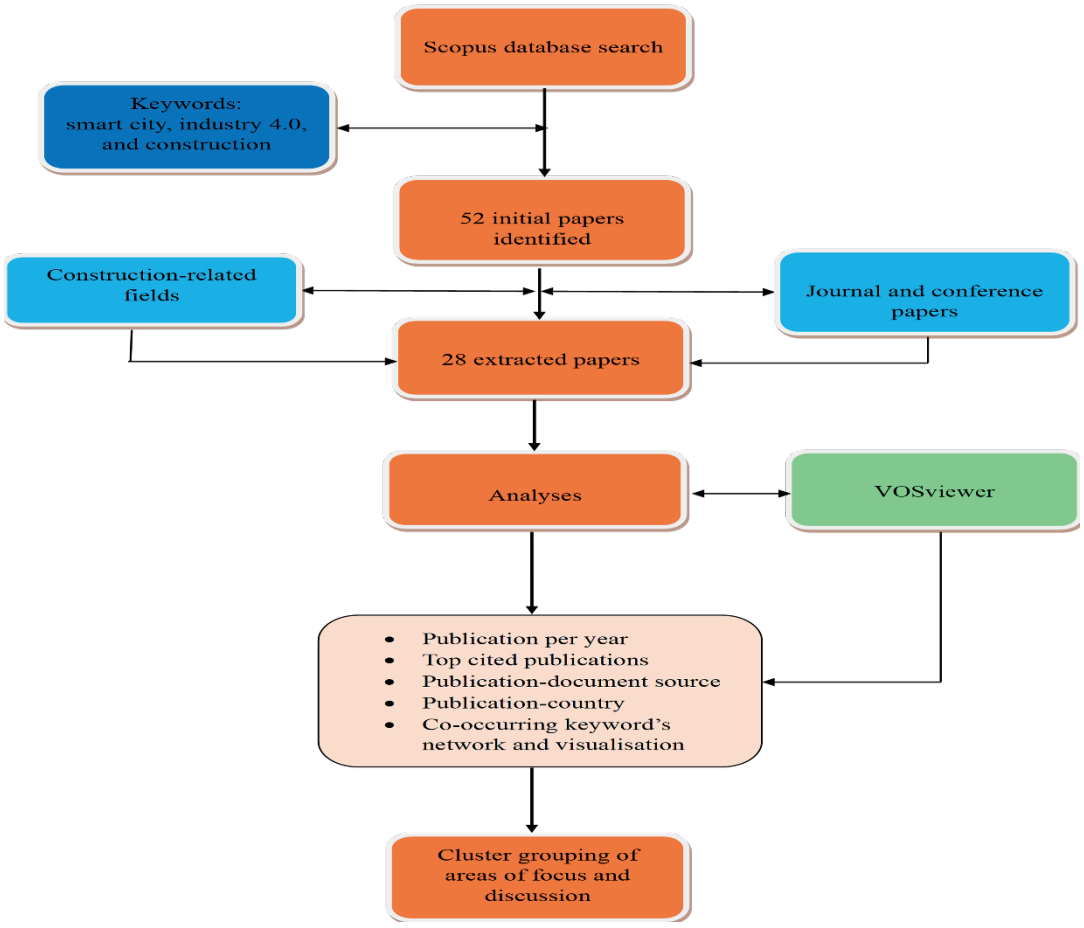

Fig. 1. Research methodology flowchart.

5. RESULTS AND DISCUSSION

5.1. Periodic Publication

A total of 28 papers on SC&I4 were obtained, thirteen of which were journal articles and fifteen of which were conference papers. Figure 2 illustrates the increase of SC&I4 articles in construction-related domains from 2018 to 2024 based on the number of publications each year, with one publication in 2018 increasing to six publications in 2020. Nevertheless, there was a decline in 2021 and a subsequent increase in 2022. The year 2022 saw the greatest number of publications (8 publications), after which a successive fall occurred from 2023 (6 publications) to 2024 (2 publications). Generally, this study's findings portray scanty research in publications regarding SC&I4 in the construction industry. This aligns with the findings of Aghimien et al. (2020) on robotics and automation studies, confirming that despite the establishment of Industry 4.0 in 2011, there had been slow adoption in the built environment. This is contrary to other industries which have embraced the concepts of SC&I4 (Crnjac et al., 2017; Balletto et al., 2022). Consequently, the

results of this study indicate that more Scopus-indexed publications are needed in construction-related fields.

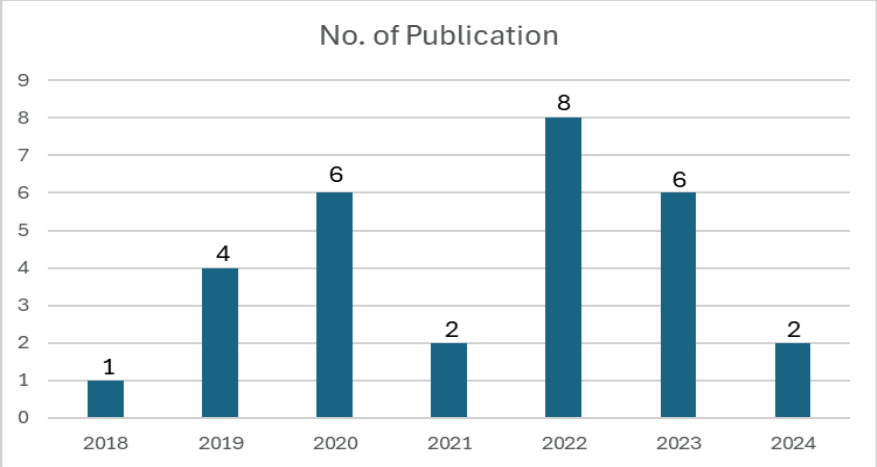

Fig. 2. Number of yearly publications.

5.2. Publications: Document Source

At a minimum threshold of "1" document and citation, the initial search results revealed 25 sources from the 28 extracted publications. However, after implementing a threshold of "10" citations, 11 document sources were extracted as the most notable sources. Table 1 indicates that the Journal of Building Engineering topped the list with two documents and 282 citations. The other top five sources included Automation in Construction (1 document; 204 citations), Journal of Management in Engineering (1 document; 88 citations), Sustainability (1 doc; 51 citations) and Smart and Sustainable Built Environment (1 document; 49 citations). Although, unsurprisingly, most of the top five sources relate to SC&14, the overall results indicate very scanty publications in these sources. Hence, more document publications indexed with Scopus are required in construction-related fields.

Table 1. Number of Documents Per Source

Source	Number of documents	Citations
Journal of Building Engineering	2	282
Automation in Construction	1	204
Journal of Management in Engineering	1	88
Sustainability (Switzerland)	1	51
Smart and Sustainable Built Environment	1	49
Construction Innovation	1	38
IOP Conference Series: Materials Science and Engineering	1	33
Materials Today Physics	1	27

Source	Number of documents	Citations
Journal of Sensors	1	20
2022 14th International Conference on Communication Systems and Networks, COMSNETS 2022	1	15
Proceedings of Institution of Civil Engineers: Management, Procurement and Law	1	11

5.3. Most Cited Publications

It was required that the retrieved articles be analysed to determine the most referenced documents and their focus areas to understand the research in SC&I4 properly. Out of 28 initially discovered documents on a threshold of 1 citation, 19 were extracted. However, a threshold of 20 citations was used to differentiate the most relevant papers. Hence, ten publications were extracted. Most of these studies focused on SC development and I4. Similarly, most of the studies were reviews and experimental, providing evidence of the concept's infancy and evolution in construction (Chen et al., 2022). The findings suggest that more empirical studies are needed. Furthermore, Table 2 indicates that none of these studies were published in 2023 or 2024. Hence, there is a need for more recent top-notch publications in the subject area.

Table 2. Top Cited Papers

Author(s)	Title	Citations	Method
Woodhead et al. (2018)	Digital construction: From point solutions to IoT ecosystem	204	Review
Norouzi et al. (2021)	Circular economy in the building and construction sector: A scientific evolution analysis	200	Review
Lin and Cheung (2020)	Developing WSN/BIM-based environmental monitoring management system for parking garages in smart cities	88	Experimental
Ozturk (2021)	Digital twin research in the AECO-FM industry	82	Review
Chen and Ying (2022)	Artificial intelligence in the construction industry: Main development trajectories and future outlook	51	Review
Aghimien et al. (2020)	A fuzzy synthetic evaluation of the challenges of smart city development in developing countries	49	Empirical
Elghaish et al. (2022)	Applications of Industry 4.0 digital technologies towards a construction circular economy: gap analysis and conceptual framework	38	Review

Author(s)	Title	Citations	Method
Safiullin et al. (2019)	Integration of Industry 4.0 technologies for "smart cities" development	33	Retrospective analysis
Luo et al. (2022)	Strong and flame-retardant wood-based triboelectric nanogenerators toward self-powered building fire protection	27	Experimental
Chew and Yan (2022)	Enhancing interpretability of data-driven fault detection and diagnosis methodology with maintainability rules in smart building management	20	Experimental

5.4. Publication: Country

Eight countries were extracted based on the two documents threshold to determine which countries have majored in the subject area from the 28 downloaded publications. This was instated to cover some overlap of articles that may exist. Table 3 indicates the revealed countries. The UK topped the list with six publications and 355 citations, seconded by China (5 publications; 80 citations) and followed by the US (4 publications; 48 citations). Australia, Greece and South Africa were bracketed with three publications, while Turkey and Egypt were bracketed with two. The results indicate the need for more Scopus-indexed publications, especially in developing nations. Only two African countries met the threshold. Hence, there is an opportunity for other countries to jump into the discourse on SC&I4 to make meaningful contributions. The findings on the UK, China, and the US align with those of Aghimien et al. (2020), who confirmed these countries as leaders in digital technologies studies. Similarly, the US was recognised as the top-listed country worldwide in digital competitiveness as of 2023 (Statista, 2024). Furthermore, the findings regarding Australia are consistent with Siu (2024), where it was enlisted as one of the world's top three smart cities.

Table 3. Publications Per Country

Source	Number of documents	Citations
United Kingdom	6	355
China	5	80
United States	4	48
Australia	3	4
Greece	3	2
South Africa	3	98
Turkey	2	82
Egypt	2	5

5.5. Area of Focus: Co-Occurrence Keywords (Author & Indexed Keywords)

A keywords co-occurrence map was produced to properly elucidate the focus topics from earlier research. The keywords included author and indexed keywords. Therefore, the 28 documents downloaded had a total of 414 keywords. Hence, there was a need to summarise the keywords into clusters. Using the default setting of 5 co-occurrences from VOSviewer, the keywords significantly decreased to 6. However, to avoid the scantiness of keywords, a 4-co-occurrence threshold was adopted, which resulted in 11 co-occurring keywords grouped in 3 clusters. Aghimien et al. (2020) earlier adopted a similar approach. The keywords are mapped in Fig. 3.

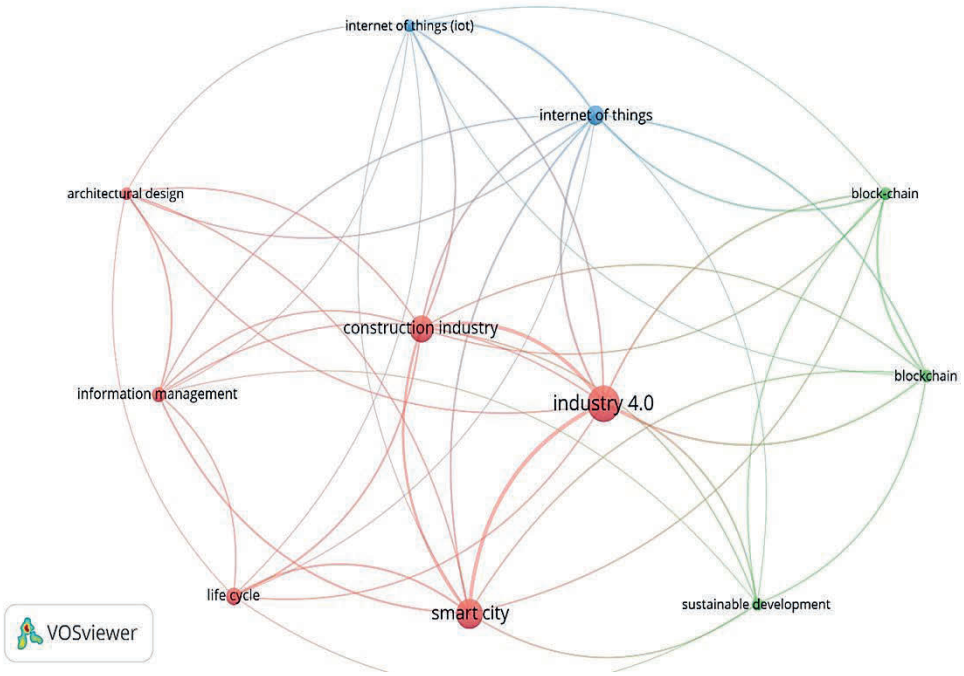

Fig. 3. Network visualisation map for co-occurring keywords.

(1) Cluster 1 – SC&I4 Project Delivery: The map's red region has six co-occurring keywords. The keywords in their descending order of total link strength include Industry 4.0, smart city, construction industry, information management, life cycle, and architectural design. This arrangement can subsequently be seen as keywords relating to SC&I4 project delivery. Given that studies are starting to point their searchlights in this area, it is evident that SC&I4 project delivery is given considerable thought. Safiullin et al. (2019) analysed integrating I4 technologies for SC development, while Jaiswal et al. (2024) reviewed incorporating Industry 4.0 in the construction sector. Jaiswal et al. (2024) highlight the technologies of execution, which include building information modelling (BIM), artificial intelligence (AI), robotics, 3D printing, the Internet of Things (IoT), and unmanned aerial vehicles (UAVs). However, Jaiswal et al. (2024) findings indicate that

adoption lags in developing countries, suggesting more research and development is needed. Aghimien et al. (2020) evaluated the challenges of smart city development in developing countries, confirming slow adoption. Incorporating SC&I4 technologies in construction project delivery aligns with Emere et al. (2024). For instance, Emere et al. (2024) affirm that BIM can be used to achieve sustainable and efficient designs in construction. Also, Fang et al. (2016) and Woodhead et al. (2018) corroborate that integrating BIM into IT infrastructure facilitates the transition from a reactive to an anticipatory approach to event control. Project efficiency can be increased by utilising smart contracts in an integrated project delivery (IPD) model (Munawat & Wang, 2023). Furthermore, processes are streamlined when BIM and hyperledger fabric are integrated (Munawat & Wang, 2023).

(2) Cluster 2 – Block Chain and Sustainable Development: Represented in green, it has three items: block-chain, blockchain, and sustainable development, which resulted in two keywords. This cluster is therefore seen to consider issues relating to the use of blockchain for sustainable development. Blockchain technology has been acknowledged as having great promise for augmenting sustainable development endeavours, fostering transparency, accountability, and decentralised decision-making (World Economic Forum, 2021). Shoker (2021) also affirms that it fosters decentralisation and trust, which has sparked innovative approaches to creating smart digital businesses, interacting with communities, and automating societies. As such, it is a classic example of a transdisciplinary technological enabler for sustainable development, possessing unique attributes like automation, decentralisation, resilience, immutability, and trust (Shoker, 2021; Mulligan et al., 2024). Blockchain began to receive increasing attention in 2017 in the built environment (Turk & Klinc, 2017; Figueiredo et al., 2022). Turk and Klinc (2017) corroborate that the collaborative nature of construction projects and the potential legal ramifications of project failure make them a suitable use case for blockchain technology.

(3) Cluster 3 – Internet of Things: Represented in blue, it has two items (Internet of Things and Internet of Things (IoT)), resulting in one keyword. Studies on the application of IoT in the construction industry are evident. For instance, Oke et al. (2022) evaluated the impact of IoT applications on the performance of construction projects. The adoption of IoT has been shown to significantly impact construction workers' productivity, safety, security, and privacy (Oke et al., 2022). Gbadamosi et al. (2019) assessed the role of IoT in delivering smart construction. Application areas include information management and communication, cyber-physical modelling, lean construction management, energy management, waste minimisation, remote inspection, offsite manufacturing, health and safety and so on (Gbadamosi et al., 2019; Arslan et al., 2019). Besides, Srivastava et al.

(2024) acknowledge that through process automation and networking, IoT can save labour expenses, shorten project repair times, and reduce material costs. Furthermore, Srivastava et al. (2024) assert that IoT alerts give insights, lower dangers and maintain the safety of construction workers' workspaces. However, the adoption of IoT has been slow, especially in most African countries, due to slow internet speed (Adepetun, 2017; Aghimien et al., 2020).

5.6. Research Focus by Year of Publication

The overlay visualisation network map for the co-occurring terms in the various publishing years is displayed in Figure 4. It was noted that, with at least four occurrences, research on the Internet of Things and its application-related problems became more noticeable between 2020 and 2021. From 2021 to 2022, emphases were given to SC&14 project delivery, life cycle, and information management. However, from late 2022 till date, more focus is on blockchain technology. Blockchain is considered a potential remedy for the sluggish, costly, and delicate transactions that plague the construction sector and are frequently linked to issues with integrity and transparency (Chaveesuk et al., 2020; Figueiredo et al., 2022). According to Ciotta et al. (2021), using smart contracts in blockchain technology might mitigate human error and enhance the dependability of decision-making processes on building/construction sites. Consequently, academics and professionals working in the construction industry are drawn to this technology because of its capacity to communicate information more swiftly, securely, and affordably (Sivula et al., 2018; Figueiredo et al., 2022). San et al. (2019) explored the integration of BIM with blockchain to address the issue of transparency throughout the lifespan of construction projects. Morena et al. (2020) recognised blockchain's potential for facilitating property management, while Guida et al. (2020) discussed its application in contract management. Lu et al. (2021) also explored its application in construction supply chain management, and Das et al. (2022) recognised its potential for electronic document management. Therefore, the focus of the study is changing in tandem with technological innovation and the growing demand for more digitally integrated construction. However, the adoption of technological changes has been slow, especially in developing countries. Some of the hindrances include a lack of expertise, inadequate mobilisation of resources to support this technological innovation, the absence of clear guidelines and resistance to adopting information technology (McKinsey & Company, 2016; Aghimien et al., 2020; Figueiredo et al., 2022; Emere et al., 2024). As further research on blockchain technology in construction emerges, these areas require careful consideration.

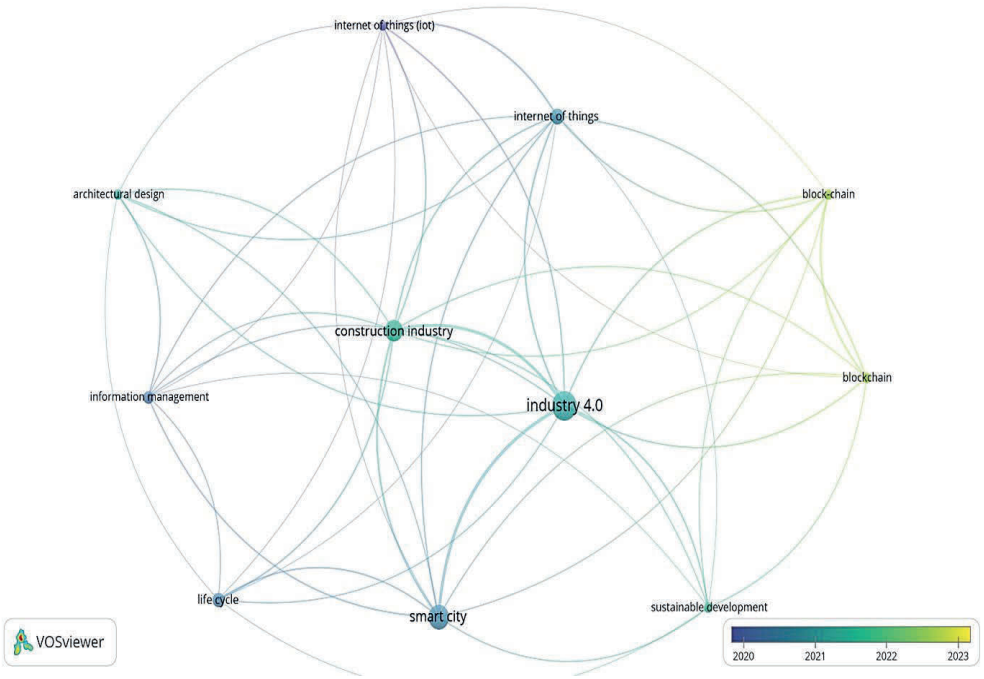

Fig. 4. Overlay visualisation map for co-occurring keywords.

CONCLUSIONS

This study used a bibliometric approach to determine the concentration of SC&I4 research among construction-related domains. The extracted papers were published over the last six years and indexed in the Scopus database. The results indicate a dearth of research articles on SC&I4, with 2022 recording the maximum number of publications at eight. This is concerning because the construction industry benefits from a comprehensive implementation of SC&I4, which calls for a thorough grasp of the idea in the built environment. With at least four publications each, the USA, China, and the UK have the most publications in SC&I4. The two African nations on the list, South Africa and Egypt, had three and two publications, respectively. None of the South American countries was enlisted, and many Asian countries were also missing. This implies that further research may be necessary to close the knowledge gap and enhance construction project delivery across the continents. Considering the identified clusters, research on SC&14 in construction-related domains has concentrated on SC&14 project delivery, blockchain and sustainable development, and the Internet of Things. Recent research in this area points toward a more digitalised use of SC&I4, especially regarding blockchain technology in the built environment.

This study adds to the body of knowledge by highlighting areas in which SC&14-related research has been focused on construction-related domains. Its conclusions have also delineated potential avenues for SC&14 research in the construction industry, especially in developing countries with a dearth of existing

literature. Although this study greatly adds to the body of knowledge already available on SC&14, caution must be exercised when extrapolating its findings because it only used data from the Scopus database. Even though there is thought to be much overlap between Scopus and other databases, more research can be done using those databases alone or in combination with other databases to compare findings and gain a more comprehensive understanding of the research topic by gathering a larger sample size than what is possible for this particular study.

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