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THE KNOWLEDGE STRUCTURE AND RESEARCH TRENDS OF CIRCULAR ECONOMY IN CONSTRUCTION: A GLOBAL BIBLIOMETRIC REVIEW

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Abstract

Purpose: This study investigates the developmental trajectory, knowledge architecture, and worldwide distribution of circular economy (CE) scholarship in the construction sector. It seeks to systematically trace publication patterns, reveal dominant research streams, and identify emerging directions within a fast-growing and multidisciplinary field. **Design/methodology/approach:** A bibliometric review structured around the PRISMA framework was undertaken using records retrieved from the Scopus database. From an initial pool of 5,005 documents, screening procedures produced a final sample of 3,512 peer-reviewed articles published in the last decade (2015-2026). Bibliometric techniques, including performance analysis, citation analysis and keyword co-occurrence network mapping using VOSviewer, were applied to evaluate research growth patterns, influential contributors and thematic structures. **Findings:** The results reveal sustained and accelerated growth in CE research in construction, particularly after 2020, indicating increasing conceptual consolidation and a shift toward application-oriented studies. The research landscape is characterised by a structured and collaborative network of authors, institutions and countries, with the United Kingdom, Italy, Australia and China leading in productivity and citation impact. Four major thematic clusters are identified: construction and demolition waste management, lifecycle sustainability and environmental assessment, digital circularity enabled by emerging technologies, and circular supply chains and business models. Despite increasing participation from developing regions, research influence remains concentrated within established research systems. **Originality/value:** The research delivers a broad bibliometric overview of CE research in construction and contributes fresh insight into the field's intellectual foundations, thematic progression, and global knowledge networks.

Keywords: Circular Economy, Construction Industry, Bibliometric Analysis, Sustainable Construction, Digital Circularity and Construction and Demolition Waste.

INTRODUCTION

The construction sector is generally regarded as a resource-demanding segments of the global economy and remains highly influential in determining environmental sustainability outcomes across the built environment (Benachio et al., 2020). Accelerated urban growth and continuous infrastructure development have substantially increased demand for construction materials, energy resources and land, generating significant environmental pressures throughout building life cycles. Current estimates suggest that the global construction industry is responsible for nearly one-third of material use, alongside a considerable share of greenhouse-gas emissions and solid waste generation (Adams et al., 2017; Jayakodi et al., 2024). These pressures have intensified calls for fundamental changes in how built assets are conceived, delivered and managed. In this context, the CE has evolved as a transformative sustainability solution aimed at replacing the conventional linear system with regenerative approaches that encourage

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resource circulation, waste minimisation and prolonged material value retention (Ghisellini et al., 2016; Kirchherr et al., 2017). Within construction, CE principles promote procedures such as material reuse, design for disassembly and lifecycle resource optimisation, thereby supporting the transition toward more sustainable built environment systems (Akanbi et al., 2019; Illankoon and Vithanage, 2023). Recent empirical investigations also highlight policy mechanisms and implementation pathways that can accelerate circular transitions in construction (Bello et al., 2026; Lamperti Tornaghi, 2026).

During the past decade, CE thinking has become a major theme within construction management and sustainability scholarship, driven by growing global concern regarding climate change mitigation and efficient resource use. International sustainability agendas, including the UNs Sustainable Development Goals, together with national CE strategies, have further stimulated scholarly attention toward circular construction systems and sustainable material management (Meseguer-Sánchez et al., 2021; Jayakodi et al., 2024). Researchers have examined several dimensions of circular construction, including construction and demolition waste management, circular building design, lifecycle assessment and sustainable construction supply chains (Illankoon and Vithanage, 2023; Guerra et al., 2021). Recent studies further demonstrate the capacity of circular strategies to lower embodied carbon emissions, improve resource productivity and generate long-term economic value within the built environment (Padilla-Rivera et al., 2020). In addition, emerging scholarship increasingly emphasises the essentiality of digital technologies like BIM, digital twins and material passports in enabling circular material traceability and lifecycle optimisation across construction systems (Guerra et al., 2021; Belkhiri et al., 2026).

Despite these developments, implementing CE principles within the construction industry remains challenging due to structural and institutional characteristics of the sector. Construction projects are typically delivered through fragmented networks involving multiple stakeholders, including contractors, designers, suppliers and regulators, which complicates coordination across project phases and supply chains (Pomponi and Moncaster, 2017). In addition, many construction practices remain strongly influenced by short-term cost considerations rather than lifecycle sustainability performance, limiting incentives for adopting circular design and material recovery strategies (Illankoon and Vithanage, 2023). Recent studies identify several barriers to circular construction adoption, including limited technological infrastructure, insufficient regulatory support, low stakeholder awareness and weak collaboration across supply chains (Guerra et al., 2021; Benachio et al., 2020). These challenges suggest that transitioning toward circular construction requires not only technological innovation but also a deeper understanding of how knowledge in this field is evolving within the academic literature.

In response to such constraints, scholars have explored CE strategies across multiple stages of the construction lifecycle, including building design, material production, on-site operations and end-of-life asset management. Lifecycle-oriented design strategies like modular construction and design for disassembly allow buildings to be dismantled and reused instead of demolished, thereby extending material service life and reducing waste generation (Adams

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et al., 2017). Likewise, digital material passports have been proposed as innovative mechanisms for recording material composition and facilitating future reuse in subsequent projects (Belkhiri et al., 2026). Other studies underline the relevance of circular business models and sustainable supply-chain arrangements that support resource recirculation throughout the built environment (Jayakodi et al., 2024). Collectively, these contributions demonstrate the interdisciplinary character of CE research in construction, combining engineering solutions, managerial approaches and policy interventions to advance sustainable infrastructure development.

As literature on CE in construction continues to expand, synthesising and structure the knowledge in the field has become essential. Bibliometric analysis has emerged as a valuable methodological tool for examining research productivity, collaboration networks, citation influence and thematic evolution within rapidly developing scientific domains (Aria and Cuccurullo, 2017; Donthu et al., 2021). Through systematic analysis of large publication datasets, bibliometric methods enable researchers to identify influential authors, leading journals and dominant themes shaping the growth of academic disciplines (Zupic and Čater, 2015; Donthu et al., 2021). Within sustainability studies, bibliometric mapping has been widely used to analyse the progress of CE scholarship, revealing strong growth in publication outputs and increasing interdisciplinary collaboration across environmental science, engineering and management research (Meseguer-Sánchez et al., 2021). In construction studies, bibliometric approaches provide valuable insights into sustainability research trajectories while helping to identify emerging knowledge clusters and unresolved research gaps in the built environment domain.

Although several studies have reviewed CE applications within the construction sector, relatively limited research has systematically mapped the global knowledge structure and research trajectories associated with this rapidly expanding field. Existing reviews often focus on specific themes such as construction waste recycling, lifecycle assessment or circular building materials without examining the broader intellectual landscape of CE research in construction (Benachio et al., 2020; Illankoon and Vithanage, 2023). Consequently, scholars and practitioners often lack a comprehensive understanding of how CE scholarship in construction has evolved in terms of publication trends, influential authors and geographical patterns of knowledge production. Furthermore, limited attention has been given to identifying research clusters, collaboration networks and emerging thematic directions within this domain. Addressing these knowledge gaps is essential for guiding future research and supporting evidence-based policy and industry strategies aimed at accelerating the transition toward circular construction.

Understanding the intellectual progression of CE research on construction is especially significant considering growing global priorities surrounding sustainable infrastructure delivery and climate change mitigation. Governments, international agencies and industry actors increasingly view CE strategies as essential instruments for reducing the sustainability challenges in construction activities while enhancing resource efficiency across the built environment (Geissdoerfer et al., 2017; Kirchherr et al., 2017; Jayakodi et al., 2024).

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Nevertheless, the successful attainment of these sustainability goals depends on a clear appreciation of how scholarly knowledge in this domain is developing and where important research deficiencies persist. A systematic examination of the worldwide research landscape of circular construction can therefore generate valuable insight into emerging technological advances, interdisciplinary partnerships and policy-relevant directions that can strengthen sustainable infrastructure development.

Stemming from the forgoing, this study seeks to systematically investigate the knowledge structure and research trends of CE scholarship in the construction industry through a comprehensive global bibliometric review. More specifically, the study analyses publication trends over time to understand the growth path of circular construction research and pinpoint the most prolific researchers, leading institutions and influential nations steering knowledge production in this area. In addition, bibliometric network techniques are applied to examine keyword co-occurrence patterns, co-citation linkages and collaborative research networks to examine the intellectual foundations of the domain. These analyses facilitate the clustering of key research themes influencing the evolution of CE scholarship in construction. By combining multiple bibliometric indicators, this research gives an extensive review of the development of CE research within built environment literature. The findings contribute to existing scholarship by identifying dominant thematic areas, mapping global knowledge networks and highlighting emerging research frontiers requiring further investigation. These insights provide valuable guidance for researchers seeking to position future studies within the evolving knowledge landscape of circular construction. Moreover, the results present valuable considerations for policy authorities and industry participants interested in advancing CE strategies and promoting sustainable resource management across the construction sector.

LITERATURE REVIEW

Conceptual Foundations of the CE in Construction

The CE paradigm has attracted substantial scholarly and policy attention as a sustainable departure from the conventional linear economic system usually represented by a linear production–consumption–waste cycle patterns of resource use. Unlike linear production models, CE frameworks seek to keep materials and products in productive use at their highest value for as long as feasible period through reuse, recycling, remanufacturing and regenerative resource management practices (Kirchherr et al., 2017; Geissdoerfer et al., 2017). CE is now widely acknowledged as a critical means of attaining sustainable development and enhancing resource efficiency across diverse industrial sectors. Within the built environment, CE principles place strong emphasis on lifecycle thinking, closed-loop material systems and the optimisation of resource use throughout the entire construction lifecycle (Ghisellini et al., 2016; Wang et al., 2025).

The global construction sector represents a particularly significant context for CE implementation because of its considerable environmental footprint. Buildings and infrastructure consume substantial quantities of raw materials such as steel, concrete, timber and aggregates, while construction processes generate large volumes of waste during both

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development and demolition stages (Benachio et al., 2020; Olatunde et al., 2025). Extant literature on the conceptual foundations of CE in construction further emphasise material innovation, the advancement of lifecycle assessment methods and barriers constraining circular adoption in construction systems (Naghibalsadati et al., 2025; da Silva et al., 2026; Mohandes et al., 2026). Construction and demolition waste alone constitutes a notable share of global solid waste streams, making circular resource management essential for sustainable infrastructure project delivery (Akanbi et al., 2019; Awodele et al., 2025). Consequently, circular construction principles such as material recovery, adaptive reuse and design for disassembly have received growing attention within recent academic discourse.

Recent literature indicates that CE implementation in construction extends beyond waste recycling to include wider systemic changes in the conception, production and management of physical assets (Nureni et al., 2025). Jayakodi et al. (2024) note that circular construction requires a lifecycle-based approach integrating material efficiency, renewable energy utilisation and sustainable supply chains within infrastructure systems. In a similar vein, Padilla-Rivera et al. (2020) contend that progress toward circular construction depends on shifting from product-oriented thinking to service-oriented and lifecycle-driven economic models. These conceptual advances suggest that CE scholarship in construction has progressed from a limited focus on waste management toward a broader framework incorporating resource efficiency, environmental sustainability and circular business models. However, the growing diversity of themes has also introduced fragmentation within the literature, underscoring the need for systematic synthesis of existing knowledge structures.

Circular Construction Practices and Sustainable Material Management

Circular construction describes the operationalisation of CE principles across the full lifecycle of built assets, including building design, material fabrication, construction, and demolition-built environment (Awodele et al., 2025). Within this perspective, circular construction strategies seek to enhance resource efficiency while reducing waste; it is a practical process to increasing the reuse, recovery and recycling of construction materials (Pomponi and Moncaster, 2017; Benachio et al., 2020). Among the most extensively researched domain in circular construction is the construction waste management, which remains a topical environmental concern within the sector. Existing studies indicate that the adoption of circular sustainable waste handling practices like recycling, reuse and material recovery can substantially lessen the environmental impacts linked to construction operations (Akanbi et al., 2019; Illankoon and Vithanage, 2023).

A number of studies have also explored how innovative construction methods can enhance circular resource flows across the built environment. For instance, modular construction and prefabrication approaches allow building components to be produced off-site and subsequently reused in future developments, thereby lowering material waste and improving resource efficiency (Adams et al., 2017). Likewise, design for disassembly (DfD) has been advanced as a strategy that enables building elements to be easily dismantled and reused at the conclusion of their service life (Pomponi and Moncaster, 2017). Such approaches encourage closed-loop material cycles throughout the construction domain and support the advancement of circular

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building systems. Beyond technical interventions, the literature also underscores the significance of organisational and institutional conditions in enabling circular construction practices. Research demonstrates that collaboration among stakeholders, enabling regulatory frameworks and appropriate market incentives are critical for advancing circular resource management within the construction industry (Jayakodi et al., 2024). Nevertheless, despite increasing attention to circular construction strategies, several barriers continue to restrict broader implementation. These challenges include limited awareness among construction professionals, inadequate technological infrastructure and uncertainty regarding the economic feasibility of circular building systems (Guerra et al., 2021; Benachio et al., 2020). Consequently, further investigation is needed to determine effective pathways for embedding CE principles into infrastructure development processes.

Digital Technologies and the Emergence of Digital Circularity in Construction

The fast-paced development of digital technologies has opened new possibilities for applying circular economy principles within the construction industry. Digital tools such as building information modelling (BIM), digital twins, blockchain systems and Internet of Things platforms allow more effective tracking, management and optimisation of material flows throughout building life cycles (Akanbi et al., 2019; Guerra et al., 2021; Jayarathna et al., 2025). These innovations underpin the idea of digital circularity, which describes the integration of digital information systems with circular resource management strategies across the built environment. One of the most influential digital advances supporting circular construction is BIM-based lifecycle management. BIM platforms make it possible to create detailed digital representations of buildings and infrastructure assets, enabling stakeholders to monitor material composition, environmental impacts and lifecycle performance of construction systems (Akanbi et al., 2019). By embedding CE principles into BIM models, studies have shown strong potential for improving material reuse, supporting design for disassembly and optimising resource flows across construction projects (Belkhiri et al., 2026). Digital material passports constitute another emerging innovation within circular construction research. These digital records contain data relating to the constituents, source and future reuse potential of building materials, thereby supporting more efficient resource recovery at termination of project lifecycle (Akanbi et al., 2019). In this line with this, Guerra et al., (2021) opined that traceability and transparency can be enhanced within the circular supply chain with secure data exchange among stakeholders through blockchain technology. Collectively, these digital developments demonstrate how technological progress is reshaping CE practices with the construction domain.

In spite of the forgoing advancements, the integration of digital technologies with CE principles remains comparatively underdeveloped in many construction settings. Scholars emphasise the importance of interdisciplinary collaboration among engineers, construction managers and information technology specialists so that the benefits of digital circularity in the construction industry could be accessed (Jayakodi et al., 2024; Belkhiri et al., 2026). Consequently, understanding how research on digital circularity is evolving within the wider circular construction literature represents an important priority for future investigation.

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Circular Supply Chains and Business Model Innovation in Construction

Circular supply chains constitute another significant dimension of CE implementation in the construction industry. Conventional construction supply chains generally operate through linear material flows, where raw resources are extracted, processed, utilised in projects and ultimately disposed of as waste. By contrast, circular supply chains seek to close material loops through the reuse, recycling and remanufacturing of construction materials (Padilla-Rivera et al., 2020; Meseguer-Sánchez et al., 2021). Recent studies stress the importance of embedding circular economy principles into construction supply chain management to improve resource efficiency and environmental performance.

For instance, reverse logistics systems facilitate the recovery and redistribution of construction materials following demolition or renovation works, thereby extending material lifecycles and reducing waste generation (Jayakodi et al., 2024). In the same way, circular procurement practices encourage construction organisations to prioritise sustainable materials and resource-efficient technologies throughout project delivery processes.

Business model innovation is also central to the successful development of circular construction systems. Existing research indicates that the adoption of service-oriented business models, product-as-a-service strategies and collaborative consumption approaches can assist construction firms in transitioning toward circular economic practices (Meseguer-Sánchez et al., 2021). Nevertheless, implementing such business models often requires substantial organisational transformation and new forms of stakeholder collaboration across construction ecosystems.

Bibliometric Approaches to Mapping CE Research

Given the rapid growth of CE scholarship within the construction industry, bibliometric analysis has become an important methodology for synthesising and assessing the evolution of this research field. Bibliometric methods provide quantitative tools for examining scientific publications, citation relationships and collaboration networks to identify knowledge structures, as well as the evolving research trends (Zupic and Čater, 2015; Donthu et al., 2021). These approaches are particularly effective for investigating large and interdisciplinary domains such as CE studies. Recent bibliometric investigations of CE research indicate substantial growth in scholarly output since the mid-2010s, reflecting heightened global concern regarding sustainability and resource-efficiency challenges (Meseguer-Sánchez et al., 2021). Bibliometric analyses have also been applied to pinpoint leading authors, institutions and nations playing pivotal role CE scholarship, as well as the principal thematic clusters within the literature. For instance, several studies have highlighted research themes associated with waste management and sustainable production systems as dominant areas within CE research (Padilla-Rivera et al., 2020; Jayakodi et al., 2024).

Within the construction domain, bibliometric approaches have been employed to map research trends linked to sustainable construction materials, green building technologies and circular construction practices. These analyses generate valuable insight into the intellectual structure of circular construction scholarship while drawing attention to research frontiers such as digital

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circularity, lifecycle sustainability assessment and circular supply chains (Illankoon and Vithanage, 2023). Nevertheless, many existing bibliometric studies concentrate on broader sustainability themes, and comparatively few investigations specifically explore the global knowledge structure of CE research within the construction industry.

Research Gaps and the Need for a Comprehensive Bibliometric Investigation

Despite increasing scholarly attention to CE research within the construction domain, several important knowledge gaps remain in the existing literature. First, the interdisciplinary character of circular construction research has produced fragmented knowledge structures distributed across multiple academic fields, including engineering, environmental science, management and policy studies. Second, relatively limited attention has been devoted to identifying global collaborative networks and the spatial distribution patterns of knowledge production within circular construction scholarship. Third, there is still inadequate understanding of how research themes associated with circular construction are changing over time and which emerging topics are set to define the future direction of the field.

Addressing these gaps requires a comprehensive bibliometric investigation capable of systematically examining publication trends, citation relationships and thematic clusters within circular construction research. By mapping the intellectual structure of the field, bibliometric analysis can generate valuable insights into influential authors, leading countries and dominant research themes that drive the evolution of CE scholarship in construction. Such evidence is essential for informing future research agendas and supporting evidence-based strategies aimed at advancing circular construction practices.

METHODOLOGY

This study employs a structured bibliometric review to methodically investigate the epistemic framework, research evolution and global knowledge dynamics of CE scholarship within the construction industry. The methodological framework follows a transparent and replicable procedure aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework, which is generally known for strengthening methodological rigour, reproducibility and clarity in evidence-based reviews across construction management and sustainability research (Page et al., 2021; Olatunde et al., 2026). A bibliometric approach is particularly suitable for this investigation because CE research in construction represents a rapidly growing and interdisciplinary field spanning engineering, environmental science and built environment management. Accordingly, quantitative mapping techniques provide a robust means of synthesising large bodies of scholarly output while identifying underlying knowledge structures, thematic clusters and research trajectories. Complementary analytical methods such as material flow analysis and Bayesian modelling have also been adopted in recent CE studies to improve data-driven insight generation (Li et al., 2026; Liao et al., 2025).

The dataset for this study was sourced from the Scopus database, a leading and highly reliable indexing platform for peer-reviewed research in engineering and environmental fields. The choice of Scopus as the sole data source was informed by its extensive journal coverage,

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consistent metadata structure and strong citation indexing capacity, all of which are necessary for rigorous bibliometric analysis and network mapping. Scholarly evidence shows that Scopus captures a more comprehensive scope of construction and sustainability publications than several alternative databases, thereby supporting comparative bibliometric evaluation (Falagas et al., 2008; Mongeon and Paul-Hus, 2016). The sole use of Scopus database also helps to reduce duplication errors, indexing inconsistencies and methodological bias that are common experience where multiple sources are combined. A comprehensive search strategy was developed using Boolean operators and carefully selected keywords to capture the full scope of CE research within the construction domain. The search string combined terms such as "circular economy", "circular construction", "circular built environment", "closed-loop economy", "industrial symbiosis", "industrial ecology", "cradle to cradle" and "resource efficiency" with construction-related expressions including "construction industry", "built environment", "construction sector", "building industry", "construction materials" and "construction waste". This formulation ensured the inclusion of both conceptual and application-oriented studies, reflecting the terminological diversity evident within CE literature. The database search was conducted on 9 March 2026, ensuring that all retrieved records represented the most current existing body of research at the time of analysis. The initial search produced 5,005 documents across all years, representing the full body of potentially relevant literature prior to screening.

To ensure analytical relevance and maintain focus on contemporary developments, the dataset was refined through a sequence of inclusion and exclusion criteria. First, the time horizon was restricted to publications issued between 2015 and 2026, reflecting the period in which CE research experienced substantial conceptual expansion and policy relevance within the construction sector. This step reduced the dataset to 3,581 documents. The selection of this period is consistent with prior studies noting the post-2015 acceleration of CE discourse driven by global sustainability agendas and technological innovation in the built environment. Second, subject-area filtering retained only studies classified within engineering and environmental disciplines, thereby excluding peripheral work from unrelated areas while preserving interdisciplinary relevance. Third, document-type filtering limited the sample to peer-reviewed journal articles, conference papers and book chapters, which represent validated and academically rigorous channels of knowledge dissemination in construction research.

Additional refinement was undertaken based on language to ensure coherence and consistency in interpretation and analysis. Although the preliminary dataset contained publications in several languages, including German, Spanish, Italian and Chinese, only English-language records were retained for detailed analysis. This process reduced the sample from 3,581 to 3,512 documents, forming the final corpus for bibliometric evaluation. The exclusion of non-English studies is consistent with established bibliometric practice and improves methodological coherence, although it is acknowledged as a limitation in capturing region-specific contributions. Following finalisation of the dataset, bibliometric analysis was undertaken using a combination of performance indicators, and bibliometric and scientometric mapping techniques to interrogate publication trends, identify influential contributors and knowledge structures. Descriptive performance analysis was first conducted to assess annual

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publication output, enabling identification of growth patterns and research maturity over time. This was complemented by citation analysis to evaluate scholarly influence and identify high-impact authors, institutions and countries playing frontal role on CE research in construction. Threshold criteria were introduced to ensure analytical robustness and focus on influential contributors within the dataset. Specifically, authors were required to have a minimum of 10 publications and 10 citations, organisations required at least 5 publications and 25 citations, while countries were included using thresholds of at least 80 publications and 200 citations. These thresholds were selected to balance inclusivity with analytical clarity, ensuring that the resulting networks reflected meaningful scholarly contributions rather than isolated outputs.

To further explore the intellectual structure of the field, science mapping techniques were applied using VOSviewer software, which is widely used for visualising bibliometric networks and identifying thematic relationships within large datasets. Keyword co-occurrence analysis was employed to examine conceptual linkages among research topics and to identify dominant thematic clusters shaping CE scholarship in construction. This method is particularly effective for revealing how research themes evolve and interact over time, thereby offering insight into emerging research directions and conceptual convergence. Co-authorship and collaboration network analysis were also undertaken to examine relationships among authors, institutions and nationality, highlighting patterns of knowledge production and global research collaboration. In addition, co-citation analysis was used to identify the intellectual foundations of the field by examining frequently co-cited references within the dataset. This approach facilitates identification of seminal studies and theoretical frameworks underpinning contemporary research in circular construction. Bibliographic coupling was further applied to detect emerging research clusters by analysing shared reference patterns among recent publications.

Collectively, these complementary techniques present a holistic analysis of both the historical development and current research frontiers of CE scholarship in the construction industry. To improve the reliability and interpretability of the bibliometric networks, data cleaning and standardisation procedures were undertaken prior to analysis. Variations in author names, institutional affiliations and keyword terminology were harmonised to minimise fragmentation and strengthen network coherence. This process is essential in bibliometric studies, as inconsistencies in metadata can distort analytical outcomes and obscure genuine relationships within the dataset (Van Eck and Waltman, 2010). The application of standardisation procedures therefore ensured that the resulting visualisations accurately represented the underlying knowledge structure of the field. The synthesis of findings was undertaken through an integrated quantitative bibliometric approach with qualitative interpretation of thematic patterns. While bibliometric methods provide objective measures of research productivity and influence, interpretive analysis is required to contextualise these findings within broader developments in CE and construction research. Accordingly, identified clusters and trends were examined in relation to key themes such as circular material management, lifecycle design, digital circularity and sustainable construction practices. This combined approach enhances the depth and relevance of the analysis, ensuring that the study delivers both empirical insight and conceptual understanding of the field.

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RESULTS

Figure 1 illustrates the temporal evolution of CE research within the construction industry between 2015 and 2026, reflecting a sustained upward trend in scholarly output. The early phase of the period reflects a comparatively low volume of publications, implying the emerging and exploratory nature of CE discourse within construction research. During this stage, studies were largely conceptual, focusing on defining CE principles and exploring their applicability to construction systems. From approximately 2018 onwards, a noticeable increase in publication volume is observed, indicating growing academic and industry interest in sustainable resource management and circular construction practices. This acceleration aligns with increased global attention to sustainability agendas, including policy frameworks promoting resource efficiency and waste reduction in the built environment.

The most significant growth occurs after 2020, marking a transition from conceptual exploration to more application-driven and technologically integrated research. This period reflects the consolidation of CE research within mainstream construction scholarship, with increasing emphasis on lifecycle optimisation, material circularity, and digital-enabled resource tracking. The upward trend demonstrated in Figure 1 suggests that CE research has moved beyond a niche topic to become a central theme within construction management and sustainability studies. Notably, increased publication output reflects growing academic attention rather than full-scale industry implementation. Like trends observed in other emerging domains, scholarly expansion may outpace practical adoption due to institutional, economic, and technological barriers within the construction sector.

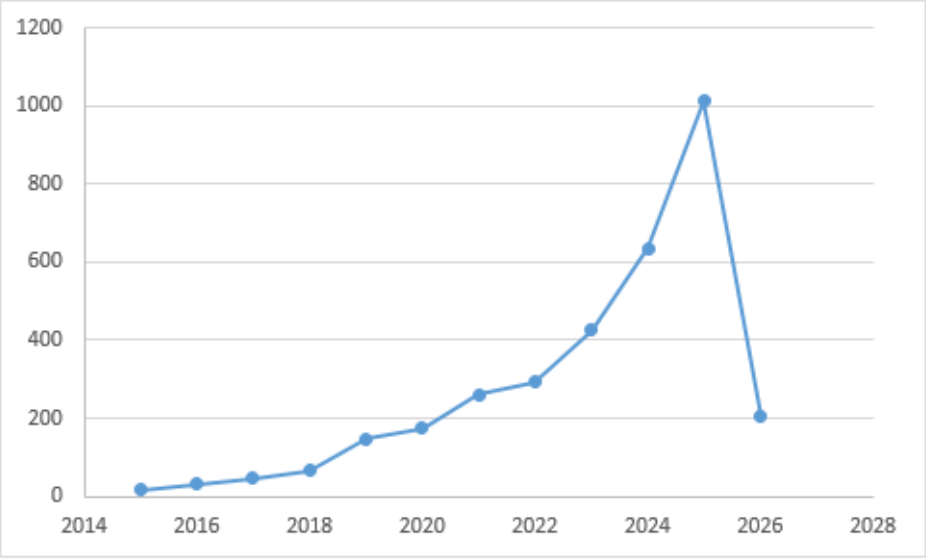

Figure 1: Number of publications per year

Table 1 depicts the result for countries with a minimum threshold of 85 publications, offering insight into the geographical distribution and global concentration of CE research in

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construction. The results indicate a highly structured and geographically concentrated knowledge production landscape. The United Kingdom emerges as the leading contributor, with the highest number of publications and citations, indicating both strong research productivity and significant scholarly influence. Italy and Australia follow closely, demonstrating substantial contributions in both output and citation impact. China also ranks prominently, reflecting its growing investment in sustainability research and infrastructure development. European countries dominate the upper tier of the table, with Spain, the Netherlands, Germany, and Portugal all demonstrating high publication volumes and strong citation performance. This pattern suggests that CE research in construction is strongly embedded within European sustainability and policy frameworks, where regulatory support and research funding have accelerated academic output. The presence of countries such as Switzerland, Belgium, Austria, and Sweden further reinforces the role of Europe as a central hub for circular construction research.

In contrast, while countries such as India and Brazil demonstrate notable publication output, their citation counts are comparatively lower, indicating differences in research influence and global visibility. The United States, despite having fewer publications than some European countries, records a relatively high citation count, suggesting strong research impact and international recognition. Overall, Table 1 highlights a geographically concentrated yet gradually diversifying research landscape, where developed economies continue to dominate both productivity and influence, while emerging economies are increasingly contributing to knowledge production.

Table1: Countries with Minimum of 85 Documents

Country	Documents	Citations	Total link strength
United Kingdom	368	10888	241
Italy	308	5623	157
Australia	281	5750	98
China	247	6209	155
Spain	238	4657	176
India	231	2246	45
United States	229	5432	118
Netherlands	207	5757	133
Germany	190	3536	107
Portugal	167	2251	144
Switzerland	116	2413	92
Brazil	112	1742	38
Belgium	111	2835	103
Austria	108	3080	95
Canada	107	1410	62
Sweden	97	2499	72
Denmark	96	2790	87
France	94	1985	59
Turkey	90	956	78
Poland	85	760	42

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Table 2 provides an overview of authors with a minimum of 10 publications, revealing patterns of scholarly productivity and citation influence within CE research in construction. The results indicate a relatively concentrated group of leading contributors, although no single author overwhelmingly dominates the field. De Wolf, Catherine emerges as the most prolific author, with the highest number of publications and a substantial citation count, indicating both productivity and influence. Other highly productive authors, including Hebert, Karaca, and Tanikawa, demonstrate strong publication output, although their citation impact varies significantly.

A key observation from Table 2 is the divergence between publication volume and citation influence. For instance, some authors with fewer publications achieve higher citation counts, suggesting that research impact is driven by thematic alignment, methodological rigour, and journal prominence than by productivity only. Authors such as Lu, Weisheng and Birkved, Morten exhibit particularly high citation counts relative to their publication numbers, implying consolidated scholarly niche within the field. On the contrary, many authors with comparately high publication counts record lower citation impact, highlighting variability in research visibility and dissemination. The distribution of authorship suggests that CE research in construction displays temporal stability but not overly centralised network of contributors. The presence of multiple authors with comparable publication outputs indicates a collaborative and distributed research environment, rather than dominance by a small group of elite scholars. This pattern reflects CE research is interdisciplinary in nature, which integrates perspectives from engineering, environmental science, and construction management.

Table 2: Authors with Minimum of 10 Documents

Author	Documents	Citations	Total link strength
De Wolf, Catherine	21	768	11
Hebert, Guillaume	18	343	0
Karaca, Ferhat	18	388	20
Tanikawa, Hiroki	18	733	2
Braganca, Luís	17	219	20
Perera, B.A.K.S.	16	59	0
Shooshtarian, Salman	16	167	15
Agyekum, Kofi	15	168	1
Haas, Carl	15	505	2
Maqsood, Tayyab	15	167	15
Schiller, Georg	15	471	0
Lu, Weisheng	14	1074	1
Aigbavboa, Clinton	13	31	8
Askar, Rand	13	60	26
Birkved, Morten	13	810	0
Gruis, Vincent	13	623	2
Fishman, Tomer	12	536	3
Pineda-Martos, Rocío	12	141	22
Abadi, Mohamed	11	61	0
Honic, Meliha	11	572	10
Lavagna, Monica	11	443	1

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Liu, Gang	11	543	1
Ng, S. Thomas	11	522	0
Adekunle, Peter	10	42	8
Iyer-Raniga, Usha	10	55	0
Udawatta, Nilupa	10	13	0

The organisational analysis presented in Table 3 further reinforces the clustered nature of knowledge production within CE research in construction. Institutions meeting the threshold of at least five publications demonstrate that research output is concentrated within specialised departments focused on construction management, built environment studies, and sustainability research. The Department of Building Economics at the University of Moratuwa emerges as the most productive organisation, indicating strong research activity in circular construction within this institution. Similarly, institutions such as the Kwame Nkrumah University of Science and Technology and RMIT University demonstrate notable contributions, reflecting the global spread of research activity across both developed and developing regions. European institutions, particularly Delft University of Technology, exhibit high citation counts relative to their publication output, suggesting strong research influence and international collaboration. The presence of institutions from Asia and Africa highlights the growing global engagement with CE research, although citation disparities indicate differences in research visibility and impact. These findings suggest that institutional influence is shaped not only by publication output but also by factors such as research quality, collaboration networks, and journal placement.

Table 3: organisations with Minimum of 5 Documents

Organization	Documents	Citations	Total link strength
Department of Building Economics, University of Moratuwa, Sri Lanka	31	149	0
Department of Construction Technology and Management, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana	16	224	4
School of Property, Construction and Project Management, RMIT University, Melbourne, Australia	13	123	12
Department of Management in the Built Environment, Faculty of Architecture and the Built Environment, Delft University of Technology, Delft, Netherlands	21	561	5
Graduate School of Environmental Studies, Nagoya University, Nagoya, Japan	10	353	0
Department of Architecture, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana	7	111	8
Department of Civil Engineering, Hacettepe University, Ankara, Turkey	7	59	0
Isise, Arise, Department of Civil Engineering, University of Minho, Guimarães, Portugal	7	31	2
Amsterdam Institute for Advanced Metropolitan Solutions (AMS), Amsterdam, Netherlands	6	179	5
Delft University of Technology, Netherlands	6	25	0
Department of Architecture and Civil Engineering,	6	82	0

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Chalmers University of Technology, Gothenburg, Sweden			
Department of Civil Engineering, School of Engineering, University of Birmingham, Edgbaston, Birmingham, B15 2TT, United Kingdom	6	49	0
Institute of Environmental Sciences (CML), Leiden University, Leiden, Netherlands	6	48	0
School of Engineering and Built Environment, Griffith University, Brisbane, Australia	6	133	11
Cities Research Institute, Griffith University, Brisbane, Australia	5	98	10
Commonwealth Scientific and Industrial Research Organisation, Canberra, Australia	5	199	0
Department of Civil Engineering, the University of Hong Kong, Pokfulam, Hong Kong	5	232	0
Department of Construction Technology and Management, Building Science, Engineering and Materials Research Team, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana	5	57	6
Department of Real Estate and Construction, Faculty of Architecture, the University of Hong Kong, Pokfulam, Hong Kong	5	188	0
Faculty of Architecture and the Built Environment, Delft university of Technology, Delft, Netherlands	5	103	0
Laboratory of Building Construction and Building Physics, Department of Civil Engineering, Aristotle University of Thessaloniki, Thessaloniki, Greece	5	26	2
School of Design and the Built Environment, Curtin University, Perth, Australia	5	69	5

Figure 2 illustrates the keyword co-occurrence network, offering valuable insight into the conceptual structure and thematic development of CE research within the construction industry. The network displays several interconnected clusters that represent the dominant areas of scholarly attention. One major cluster is centred on construction and demolition waste management, underscoring the continued significance of waste reduction, recycling and material recovery within circular construction research. Keywords grouped within this cluster indicate a strong research focus on resource efficiency and waste minimisation strategies, reflecting the sector's substantial contribution to global waste generation. A second cluster concentrates on lifecycle thinking and sustainable construction practices, incorporating concepts such as lifecycle assessment, environmental impact and sustainable building design. This cluster demonstrates how CE principles are increasingly embedded within broader sustainability frameworks, emphasising the need to assess environmental performance across the full lifecycle of construction projects. The prominence of lifecycle-related keywords suggests a transition from isolated waste management strategies toward more comprehensive approaches to resource optimisation. Another important cluster highlights the contribution of digital technologies to CE implementation. Keywords associated with BIM, digital twins and material passports indicate growing scholarly interest in digital circularity and data-driven

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resource management. This cluster reflects increasing recognition that technological innovation is essential in enabling material traceability, lifecycle optimisation and circular supply chain management within the construction sector. A further cluster focuses on circular business models and supply chain integration, linking concepts such as circular procurement, reverse logistics, and industrial symbiosis. This indicates that CE research in construction extends beyond technical solutions to include organisational and economic dimensions. The prominence of these keywords indicates that researchers are increasingly exploring how business models and supply chain structures can support circular resource flows within the built environment. The overall structure of the keyword network demonstrates a well-developed and interconnected research landscape, where multiple thematic areas are linked through shared concepts and methodologies. The density of connections between clusters indicates increasing conceptual convergence, suggesting that CE research in construction is evolving toward a more integrated and interdisciplinary framework. At the same time, the presence of smaller and less connected nodes indicates emerging research areas that have not yet reached full maturity, highlighting opportunities for future investigation.

Taken together, the results demonstrate that CE research in construction has experienced rapid growth, increased conceptual consolidation, and expanded global participation. The combination of temporal trends, geographical distribution, authorship patterns, and thematic clustering provides a comprehensive overview of the field's intellectual structure. While research activity remains concentrated within developed regions and leading institutions, the growing contribution of emerging economies and the integration of digital technologies indicate a dynamic and evolving research landscape.

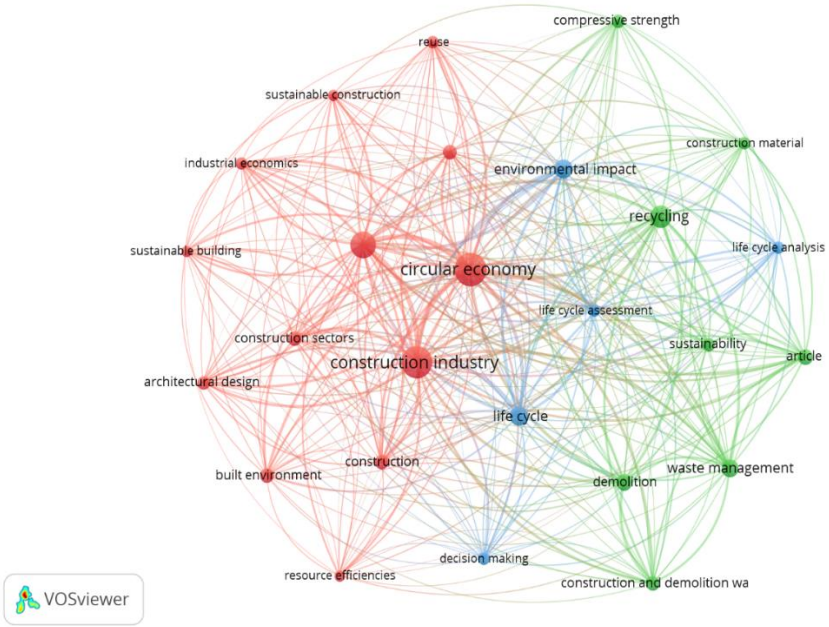

Figure 2: Indexed keywords network visualization

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DISCUSSION OF FINDINGS

From a theoretical perspective, this study contributes to CE scholarship in construction by empirically clarifying the intellectual structure and conceptual progression of the field. The findings show that CE research in construction has moved from a fragmented and exploratory domain into a more organised and thematically coherent body of knowledge. The keyword co-occurrence network (Figure 2) identifies several interconnected clusters covering construction and demolition waste management, lifecycle sustainability assessment, digital circularity and circular supply chain systems, indicating that the field is no longer limited to isolated themes but is developing into an integrated and multidimensional framework. This supports earlier conceptual arguments that CE thinking in construction has shifted from a narrow concentration on waste management toward a broader systems-oriented paradigm encompassing lifecycle thinking, resource optimisation and regenerative design (Kirchherr et al., 2017; Geissdoerfer et al., 2017). Recent studies further emphasise decision-support systems, consumer perception and sustainable material performance as important drivers of circular construction implementation (Buzatu et al., 2026; Gurtner and Starovicova, 2026; Kumar et al., 2025; Dahish et al., 2025).

The prominence of lifecycle-related and sustainability-oriented concepts within the keyword clusters reinforces the theoretical positioning of circular construction as a lifecycle-based system rather than a collection of isolated technical interventions. This is consistent with previous studies arguing that CE implementation in the built environment requires integration across design, construction, operation and end-of-life stages (Ghisellini et al., 2016; Pomponi and Moncaster, 2017). In addition, the appearance of digital technology-related keywords such as BIM, digital twins and material passports suggests conceptual convergence between CE and digital transformation research in construction. This convergence implies that CE theory in construction is increasingly being operationalised through data-driven and digitally enabled systems, reinforcing the argument that digitalisation is a key enabler of circular resource flows and lifecycle optimisation (Akanbi et al., 2019; Guerra et al., 2021).

The co-occurrence of technical, environmental and managerial concepts within the network also demonstrates the interdisciplinary nature of CE research in construction. Unlike earlier sustainability frameworks that were often discipline-specific, the results indicate that CE scholarship integrates engineering innovation, environmental assessment approaches and organisational strategies within a unified analytical framework. This supports the view that circular construction represents a socio-technical transition requiring alignment among technological capabilities, institutional structures and stakeholder behaviours (Kirchherr et al., 2017; Jayakodi et al., 2024). The observed thematic convergence therefore provides empirical evidence of theoretical consolidation, suggesting that CE research in construction is maturing into a coherent and integrative research field.

This study advances the methodological frontier in bibliometric practice within construction management and sustainability research by demonstrating the value of combining performance indicators with science mapping techniques to analyse complex and rapidly evolving research domains. The integration of publication trends, citation analysis and keyword network mapping

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provides a multidimensional perspective on the development of CE scholarship. The temporal growth trend shown in Figure 1 confirms that CE research in construction has expanded rapidly, particularly after 2020, reflecting increasing global concern for sustainability, climate change mitigation and resource efficiency. This pattern is in consonance with broader bibliometric evidence showing that CE scholarship has accelerated in alignment with global policy frameworks such as the United Nations Sustainable Development Goals (Meseguer-Sánchez et al., 2021). Importantly, the findings show that publication growth has been accompanied by increasing conceptual consolidation rather than simple expansion in volume. The cluster structure in Figure 2 indicates that research themes are becoming more interconnected, suggesting both methodological and conceptual convergence across studies. This supports arguments that bibliometric analysis can be used not only to describe research productivity but also to assess disciplinary maturity and intellectual coherence (Donthu et al., 2021; Zupic and Čater, 2015). The use of threshold-based performance indicators in Tables 1 to 3 further strengthens methodological rigour by ensuring that the analysis focuses on influential contributors rather than fragmented or low-impact outputs.

The geographical and institutional analyses provide further methodological insight by revealing structural patterns in global knowledge production. The dominance of European countries in Table 1 reflects the close relationship between CE research and European sustainability policies, particularly those encouraging resource efficiency and circular material use within the built environment (Geissdoerfer et al., 2017). In the same vein, the growing contributions of countries such as China, India and Brazil indicate a gradual diversification of research participation, although citation disparities imply that epistemic influence is still clustered around established research institutions. These findings reinforce methodological arguments that bibliometric studies should combine both productivity and impact indicators to capture the full complexity of global research dynamics (Donthu et al., 2021).

From an industry and policy perspective, the findings provide important insight into how CE principles are being translated into construction practice. The prominence of waste management and material recovery themes within the keyword network reflects the continued prioritisation of construction and demolition waste reduction as a key entry point for CE implementation. This aligns with industry evidence suggesting that waste management remains one of the most immediate and measurable dimensions of circular construction (Akanbi et al., 2019; Illankoon and Vithanage, 2023). However, the simultaneous prominence of lifecycle assessment and design-related concepts suggests that the field is progressing beyond reactive waste management toward proactive design strategies that enable circularity from the earliest stages of project development.

The emergence of digital technologies as a major research cluster also carries significant managerial implications. The integration of BIM, digital twins and material passports within circular construction scholarship indicates that digital tools are increasingly regarded as essential enablers of CE implementation. These technologies support material tracking, lifecycle analysis and resource optimisation, thereby addressing important barriers associated with information fragmentation and supply chain coordination in construction projects (Guerra

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et al., 2021; Belkhiri et al., 2026). For construction firms, this suggests that successful adoption of CE practices depends not only on technical innovation but also on sustained investment in digital infrastructure and data management capabilities.

At a strategic level, the fact that research output is abundant in specific nations and institutions highlights the importance of national innovation systems and research ecosystems in shaping CE development. Countries with strong policy support, research funding and institutional capacity tend to demonstrate higher levels of both productivity and impact. Conversely, regions with weaker infrastructure and less developed research ecosystems exhibit lower citation influence despite increasing participation. This suggests that achieving global progress toward circular construction requires targeted policy interventions, capacity-building initiatives and international collaboration to address structural inequalities in research and innovation (Jayakodi et al., 2024).

The findings also reveal important gaps between academic research and practical industry implementation. Although the rapid rise in publication output indicates strong scholarly interest, previous studies suggest that real-world adoption of CE principles in construction remains constrained by organisational, economic and regulatory barriers (Benachio et al., 2020; Guerra et al., 2021). These barriers include fragmented supply chains, limited stakeholder awareness and insufficient incentives for lifecycle-based decision-making. Accordingly, the observed bibliometric growth should be interpreted as evidence of conceptual and academic maturity rather than full-scale industry transformation. In addition, the convergence of CE with digital technologies introduces important governance and ethical considerations. The use of digital tools for material tracking and lifecycle analysis requires robust data governance frameworks, interoperability standards and clear accountability mechanisms. Without such safeguards, the benefits of digital circularity may be weakened by data fragmentation, privacy concerns and system integration challenges (Guerra et al., 2021; Belkhiri et al., 2026).

CONCLUSION

This study provides a comprehensive bibliometric assessment of CE research within the construction industry, offering a structured understanding of its intellectual development, thematic evolution, and global knowledge distribution. The findings demonstrate that CE scholarship in construction has experienced sustained and accelerated growth between 2015 and 2026, reflecting its increasing importance within sustainability and built environment research. The temporal analysis indicates a clear transition from early conceptual exploration to a more mature and application-oriented research phase, particularly after 2020, where studies increasingly emphasise lifecycle optimisation, material circularity, and digital-enabled resource management. The study further reveals that CE research in construction is characterised by a relatively structured and interconnected intellectual domain. The keyword co-occurrence network highlights four dominant thematic areas: construction and demolition waste management, lifecycle sustainability and environmental assessment, digital circularity enabled by emerging technologies, and circular supply chains and business models. These clusters confirm that the field has evolved beyond isolated waste management approaches

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toward a holistic, systems-based framework integrating technical, environmental, and managerial dimensions. This progression reflects broader theoretical developments within the CE paradigm, which emphasise regenerative resource flows, lifecycle thinking, and systemic transformation of production and consumption systems.

Geographical and institutional analyses reveal that knowledge production in circular construction research remains concentrated within developed economies, particularly in Europe, although emerging economies are increasingly contributing to the field. Countries such as the United Kingdom, Italy, and Australia demonstrate strong research productivity and citation impact, while China and other developing regions show growing participation. However, disparities in citation influence highlight persistent inequalities in global research visibility and capacity. Similarly, authorship and institutional analyses indicate a distributed but structured research network, where productivity and scholarly influence are not concentrated within a single group but shared across multiple contributors and institutions.

From a practical perspective, the findings confirm that CE research is closely aligned with key industry challenges, particularly waste reduction, resource efficiency, and lifecycle sustainability. The growing prominence of digital technologies such as BIM, digital twins, and material passports suggests that the future of circular construction will be increasingly driven by data-enabled systems and integrated digital platforms. However, the study also highlights a significant gap between academic research and real-world implementation, with adoption constrained by organisational, technological, and regulatory barriers within the construction sector.

Based on these findings, several recommendations were proposed. First, construction organisations should prioritise the integration of CE principles into early-stage design processes, particularly through lifecycle-oriented approaches such as design for disassembly and modular construction. Second, investment in digital infrastructure and data management systems is essential to enable effective implementation of circular practices, especially in relation to material tracking and lifecycle optimisation. Third, policymakers should develop supportive regulatory frameworks and incentives that encourage circular procurement, material reuse, and sustainable supply chain practices. In addition, international collaboration and knowledge-sharing platforms should be strengthened to bridge the gap between developed and developing regions and promote more inclusive global research participation.

Some of the limitations associated with this study despite its contributions includes the fact that the use of a single database may not include all relevant publications, especially those indexed in alternative databases or regional repositories. Second, the analysis of only English-language publications might have exclude some significant studies in other languages. Furthermore, while bibliometric analysis offers valuable insight into research trends and knowledge structures, it does not directly evaluate the practical effectiveness or real-world application of CE strategies within the construction industry. Future research could bridge these gaps by incorporating multiple databases and widening the scope to include non-English publications, thereby offering a more comprehensive global perspective. In addition, there is a clear need for empirical investigations that assess the actual implementation of CE principles on construction

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projects. Further studies should also examine the integration of digital technologies with CE practices, with particular emphasis on interoperable systems and scalable solutions suitable for industry adoption. Moreover, future scholarship should explore the influence of policy, governance and stakeholder collaboration in accelerating the transition toward circular construction systems.

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