Proceedings of International Structural Engineering and Construction, 12(1), 2025
Integrating Technology for Advanced Practices in Structural Engineering and Construction
Edited by Vimonsatit V., Askarinejad H., Pour M., Singh, A., and Yazdani S.

www.doi.org/10.14455/ISEC.2025.12(1).AAE-02

MAPPING SUSTAINABLE DEVELOPMENT GOALS IN CONSTRUCTION: A CO-OCCURRENCE ANALYSIS FOR STRATEGIC PRIORITIZATION

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The construction sector is closely linked to nearly all United Nations Sustainable Development Goals (SDGs), making it essential for global sustainability. However, the slow progress toward achieving these goals emphasizes a sustainability crisis and challenges in focus and prioritization. With the targets at risk of being unmet by 2030, stakeholders must identify which ones need immediate attention and where to concentrate their efforts. Strategic prioritization not only accelerates progress but also ensures the long-term sustainability of the construction sector itself. This study uses bibliometric and cluster analyses to examine the intersection of these global objectives and the construction industry, mapping the knowledge landscape and identifying gaps, trends, and actionable priorities. The research provides a structured framework to streamline efforts, tackle multifaceted challenges, and effectively target critical issues. By prioritizing targets and emphasizing interconnected goals, the framework enables stakeholders to develop focused strategies and adapt to changing regulatory and market demands. Additionally, it offers tools for benchmarking and monitoring the sector's contributions, fostering innovation, and enhancing stakeholder engagement. The findings deliver actionable insights, guiding the construction industry to align its practices with global sustainability standards and contribute meaningfully to the 2030 Agenda.

Keywords: 2030 Agenda, Building industry, SDGs, Sustainability, Systematic literature review.

1 INTRODUCTION

In response to growing global challenges, the 2030 Agenda for Sustainable Development was adopted at the 2015 UN Summit, establishing a shared vision for a sustainable future (Opoku *et al*. 2022). As outlined in “Transforming Our World: The 2030 Agenda for Sustainable Development” the framework includes 17 Sustainable Development Goals (SDGs), 169 targets, and 231 indicators to track progress (Fei *et al*. 2021). Framed as “a plan of action for people, planet, and prosperity” the SDGs call for urgent, collective action across all nations (Opoku *et al*. 2022). While the SDGs provide a clear roadmap for global sustainability (Goubran and Cucuzzella 2019), their success relies on cross-sector engagement—particularly from the construction industry, a key contributor (Fei *et al*. 2021).

As a major economic driver, the built environment remains highly resource- and energy-intensive, with continued reliance on non-renewable inputs (Alawneh *et al*. 2019). Given mounting sustainability pressures, aligning the construction sector with broader global goals has become increasingly critical—especially as several SDGs are directly tied to construction and interlinked with others through their sector-specific influence. In particular, SDG 11, “Sustainable Cities and Communities” is closely connected to other SDGs because of the construction sector’s central role in urban development. It supports SDGs 6, 7, and 9 through resilient infrastructure and energy-efficient design; advances SDGs 12 and 13 via resource efficiency and emissions reduction; and contributes to SDGs 1, 8, 10, and 15 through inclusive planning, job creation, and land conservation. These interlinkages underscore the need for integrated evaluation strategies to advance sustainable development. Given its resource intensity and sustainability challenges, the construction sector’s alignment with the SDGs warrants deeper analysis. Since the 2030 Agenda, interest in its environmental and economic impacts has grown among researchers, policymakers, and practitioners (Goubran and Cucuzzella 2019). While sustainability has long been a concern, its integration with the SDGs continues to gain momentum.

Several studies regarding the construction industry provide general guidance on sustainable practices and tools for integrating SDGs, emphasizing the need for sector-specific approaches. They also examine the construction industry’s role in achieving the 2030 Agenda (Fei *et al*. 2021). Notably, research has addressed sustainable procurement and its relevance to specific SDGs (Opoku *et al*. 2022), analytical tools for embedding SDGs in building design (Goubran and Cucuzzella 2019), and the sector’s broader connection to the UN sustainability agenda (Zhou *et al*. 2025). Although the SDGs have been widely explored in construction, the urgency of Agenda 2030 calls for sharper prioritization and more targeted action. A key gap remains in identifying the most relevant goals and how the sector can contribute effectively. To address this, the study applies bibliometric and cluster analysis to map and prioritize SDGs aligned with construction. Despite growing interest, consensus on priority goals is still lacking, highlighting the need for systematic, data-driven reviews. This study offers timely insights to support that effort.

2 RESEARCH METHODOLOGY

This study used bibliometric analysis to examine SDG-related literature in the construction sector to meet its objectives. This method provides a structured approach to mapping and visualizing research domains, highlighting relationships among disciplines, fields, and authors (Chen 2017). The process included three steps: a systematic literature review (SLR), bibliometric analysis, and cluster analysis.

2.1 Systematic Literature Review

A Systematic Literature Review (SLR) is a structured approach for identifying, evaluating, and synthesizing relevant studies and their findings (Yu *et al*. 2022). In this study, an SLR was conducted to examine and prioritize SDG-related research in the construction sector. The search protocol utilized the Web of Science (WoS) database, which includes nearly all primary research articles (Yu *et al*. 2022), and was structured as follows: “ALL FIELDS” (“construction” OR “construction industry” OR “construction sector”) AND (“sustainable development goal” OR “sustainable development goals” OR “SDG” OR “SDGs”) NOT (“infrastructure” OR “road” OR “railway” OR “asphalt” OR “pipeline”), yielding 1,433 publications. Filters (e.g., document type, language, and indexing in SCI-E, SSCI, and AHCI) were applied to records as of February 2025, reducing the dataset to 956 articles. These were exported as CSV files for bibliometric analysis.

2.2 Bibliometric Analysis

Bibliometric analysis quantitatively evaluates research publications to identify relationships within a scientific domain (Esen *et al*. 2020). To explore the SDG–construction nexus, this study used

VOSviewer for text mining and performed clustering-based analysis to examine keyword co-occurrence patterns.

3 FINDINGS

3.1 Co-occurrence-Based Keyword Clusters

A keyword co-occurrence analysis was conducted to identify major research clusters in SDG-related construction studies. Using VOSviewer v1.6.20, a network of 3,566 keywords was analyzed. Applying the software's default threshold of five, 57 keywords were grouped into ten clusters. Figure 1 shows the resulting network—259 links with a total link strength of 571. Node size indicates frequency; line thickness reflects co-occurrence strength (Van Eck and Waltman 2020). Closely related keywords appear in proximity, with lines representing their associations for intuitive interpretation.

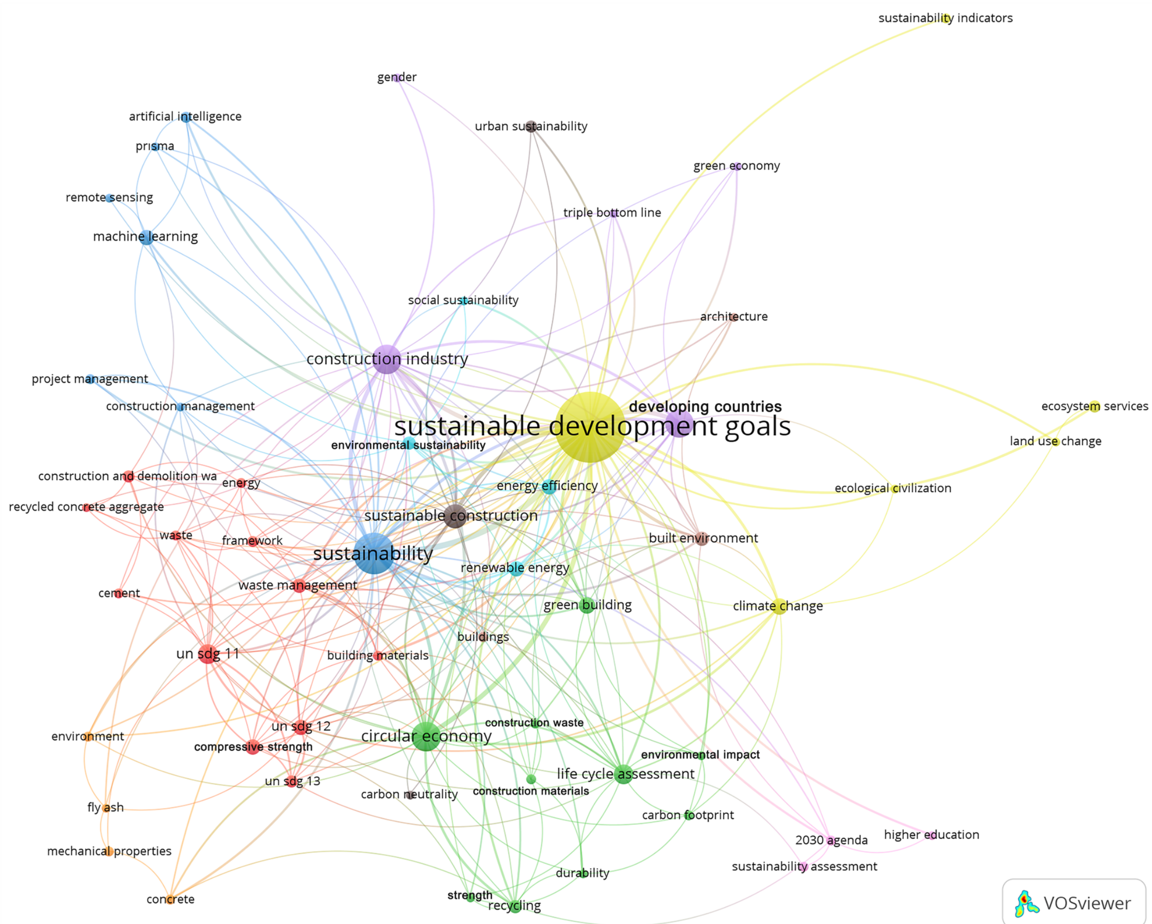

Figure 1. Co-occurrence Keyword Analysis via VOSviewer v1.6.20 (11 February 2025).

In this context, ten thematic clusters were identified through keyword co-occurrence analysis. These are as follows: **(1)** recycled construction materials, effective waste management, and resource efficiency; **(2)** circular and low-carbon construction; **(3)** data-driven approaches in sustainable construction and management; **(4)** environmental sustainability and resilience frameworks for ecological development; **(5)** inclusive development in the construction sector of the Global South; **(6)** environmental responsibility and socioeconomic sustainability; **(7)** sector-specific materials, along with their properties and impacts; **(8)** fundamental concepts that define the construction sector; **(9)** assessment for future achievements and the role of education; **(10)** carbon-neutral development in the built environment. Based on keyword frequency and co-occurrence, these clusters reveal how interconnected themes in construction literature align with the SDGs, reflecting key sub-dimensions and their interrelationships.

Cluster 1 (red) includes keywords related to "*recycled construction materials, effective waste management, and resource efficiency*", identifying key SDGs relevant to the construction sector—fundamental components aligned with the industry's sustainability priorities—such as "building materials", "cement", "compressive strength", "construction and demolition waste", "energy", "framework", "recycled concrete aggregate", "un sdg 11", "un sdg 12", "un sdg 13", "waste", and "waste management" reflecting the sector's emphasis on integrating sustainability into efficient resource management in construction. Cluster 2 (green) includes keywords related to "*circular and low-carbon construction*", emphasizing material innovation, waste reduction, and structural endurance. These keywords include "carbon footprint", "circular economy", "construction materials", "construction waste", "durability", "environmental impacts", "green building", "life cycle assessment", "recycling", and "strength". Cluster 3 (blue) includes keywords related to "*data-driven approaches in sustainable construction and management*", such as "artificial intelligence", "construction management", "machine learning", "PRISMA", "project management", "remote sensing", and "sustainability". Cluster 4 (yellow) focuses on "*environmental sustainability and resilience frameworks for ecological development*", encompassing keywords such as "climate change", "ecological civilization", "ecosystem services", "land use change", "sustainability indicators", and "Sustainable Development Goals". Cluster 5 (purple) includes keywords related to "*inclusive development in the construction sector of the Global South*", including terms such as "construction industry", "developing countries", "gender", "green economy", and "triple bottom line". Cluster 6 (turquoise) includes keywords related to "*environmental responsibility and socioeconomic sustainability*", such as "energy efficiency", "environmental sustainability", "renewable energy", and "social sustainability". Cluster 7 (orange) includes keywords related to "*sector-specific materials, along with their properties and impacts*", such as "concrete", "environment", "fly ash", and "mechanical properties". Cluster 8 (brown) includes keywords related to "*fundamental concepts that define the construction sector*", such as "architecture", "buildings", and "built environment". Cluster 9 (pink) includes keywords related to "*assessment for future achievements and the role of education*", such as "2030 Agenda", "higher education", and "sustainability assessment". Cluster 10 (grey) includes keywords related to "*carbon-neutral development in the built environment*", such as "carbon neutrality", "sustainable construction", and "urban sustainability".

On the other hand, these ten thematic clusters identified through keyword co-occurrence analysis exhibit strong conceptual interrelations, reflecting the interconnected nature of sustainability challenges in the construction sector. Clusters 1 and 2 are closely linked by their shared emphasis on resource efficiency, life cycle assessment, and material reuse—concepts also reflected in Cluster 10. Similarly, Clusters 4 and 6 converge around energy efficiency, environmental responsibility, and broader sustainability indicators. Several terms—such as "sustainability", "energy", "waste", and references to specific SDGs—appear across multiple clusters, indicating strong thematic continuity. Notably, Clusters 5 and 8 provide contextual grounding, linking sector-specific priorities with social inclusion and the fundamentals of the built environment. These inter-cluster relationships underscore the multidimensional nature of sustainable construction and reinforce the need for integrated, cross-cutting approaches that align environmental, social, and technological strategies.

4 DISCUSSIONS

With only a third of the timeline remaining until 2030, the urgency for regulation and prioritization around the SDGs has intensified. Addressing all targets at once risks inefficiency, underscoring the need to focus on high-impact priorities. This study's cluster analysis maps linkages between emerging research themes and specific SDGs, offering insights for strategic prioritization in advancing construction-sector sustainability. To ensure focus and relevance, the first five clusters—selected based on order, density, and keyword frequency—were interpreted in detail below.

First, Cluster 1 (red), defined by "recycled construction materials, effective waste management, and resource efficiency" highlights the sector's shift toward more sustainable models. As one of the largest consumers of raw materials and a major waste producer, the construction industry faces growing pressure to reduce its environmental footprint (Alawneh *et al*. 2019, Opoku *et al*. 2022). This cluster reflects increasing efforts to close material loops through reuse, recycling, and design strategies across the building lifecycle. Notably, effective construction and demolition waste management (CDWM) systems are key to reducing landfill use, conserving resources, and enhancing environmental performance (Fei *et al*. 2021). These developments signal a broader transformation in how material value is preserved within the built environment. Furthermore, Cluster 2 (green), centered on "*circular and low-carbon construction*" reflects the industry's growing focus on decarbonization and circular economy (CE) principles. As one of the most carbon-intensive sectors, construction faces rising pressure to reduce its environmental impact (Zhou *et al*. 2025). This cluster underscores a shift toward energy efficiency, emissions reduction, and circular material use through practices like material substitution, design for disassembly, and lifecycle-based decision-making. These developments mark not only technological progress but a broader transformation in how the sector approaches environmental responsibility—positioning it as a more proactive and accountable actor in addressing global challenges. Moreover, Cluster 3 (blue), anchored in "data-driven approaches in sustainable construction and management" centers on integrating artificial intelligence (AI), machine learning, and remote sensing into construction management and sustainability assessment—reflecting the industry's digital transformation. These technologies support accurate forecasting, real-time monitoring, and data-informed decisions across project lifecycles (Opoku *et al*. 2022). By improving efficiency and optimizing resource use, digital tools are enhancing project outcomes and reshaping how sustainability is embedded in construction processes (Zhou *et al*. 2025). This cluster signals a broader shift toward intelligent systems that drive innovation, automation, and long-term resilience in the built environment.

Additionally, Cluster 4 (yellow), built around "*environmental sustainability and resilience frameworks for ecological development*" places strong emphasis on adaptation to the accelerating impacts of climate change. The themes in this cluster reflect a growing focus on ecological balance, nature-based solutions, and long-term environmental adaptation within the construction and planning disciplines (Fei *et al*. 2021). By promoting resilience-oriented design and strategies that prioritize environmental stability, this cluster underscores the sector's evolving role in supporting ecological integrity and climate responsiveness (Goubran and Cucuzzella 2019). Finally, Cluster 5 (purple) is centered on "*inclusive development in the construction sector of the Global South*". This cluster reflects a growing emphasis on social equity, fair labor conditions, and the application of triple bottom line principles that integrate economic, social, and environmental dimensions (Alawneh *et al*. 2019, Goubran and Cucuzzella 2019, Opoku *et al*. 2022). These themes highlight the need for more inclusive practices within the built environment—addressing disparities in access, opportunity, and representation (Zhou *et al*. 2025). By advancing equitable development strategies, this cluster signals a shift toward socially responsible construction approaches that respond to local challenges while contributing to broader systemic transformation.

5 CONCLUSIONS

The findings underscore that core sustainability imperatives—environmental efficiency, technological innovation, and social inclusion—are closely tied to the construction sector's ongoing transformation. This alignment positions the industry as both affected by and instrumental in addressing global sustainability challenges. Cluster analysis highlights the sector's potential to accelerate meaningful progress by prioritizing strategic focus areas, reinforcing its role in driving long-term systemic change. Accordingly, this study offers evidence-based insights to guide future research, inform policy, and support targeted action at both local and global levels. As a key contribution, the study provides a systematic mapping of SDG-related research in construction through co-occurrence-based clustering—advancing strategic understanding of the sector's sustainability priorities. While the study contributes meaningful insights, its scope was limited to keyword co-occurrence and thematic clustering, without detailed evaluations of individual studies or systematic assessment of links between sector-specific barriers and SDG targets. Future research could enrich the literature by integrating mixed-method approaches, enhancing bibliometric techniques, and incorporating comparative case studies to deepen contextual understanding and practical relevance.

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