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Exploring Barriers to the Adoption of Modern Methods of Construction (MMC) in The Construction Industry: Bibliometric Analysis

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Abstract

Modular and off-site construction is widely recognized as a transformative pathway toward more efficient, sustainable, and industrialized building practices, yet the geography of knowledge production shaping this field remains poorly mapped and unevenly distributed. This study addresses that gap through a systematic bibliometric analysis of 131 Scopus-indexed publications, employing co-authorship mapping, keyword co-occurrence analysis, and bibliometric performance indicators to examine publication trends, geographic distribution, influential journals, and thematic evolution within the field. The findings expose a striking concentration of knowledge production: the United Kingdom alone accounted for 31 publications and emerged as the dominant contributor, raising important questions about the transferability of findings to contrasting construction environments. Among BRICS nations, only China and India met the minimum contribution threshold of two or more publications, with Brazil, Russia, and South Africa entirely absent, a troubling gap given the scale of construction activity and infrastructure demand across these economies. Within Africa, only Nigeria and Egypt were represented, each with three publications, underscoring the continent's systemic exclusion from globally indexed research on modular construction despite its acute housing and urbanization pressures. Thematic analysis identified four coherent research clusters: sustainability and industry transformation; prefabrication and technical construction methods; digitalization and international adoption; and barriers and adoption challenges, which collectively signal a field converging toward digital-sustainable integration while remaining underdeveloped on implementation-focused research in lower-income settings. Publication activity was concentrated in a narrow set of journals, with Buildings as the leading outlet, suggesting limited disciplinary reach and citation diversity across the broader construction literature. These findings reveal a field that is intellectually active but spatially and institutionally lopsided, producing knowledge faster than it distributes it equitably. To unlock the full potential of modular construction globally, research funders should prioritize South–South and North–South collaboration grants, journal editors should actively commission work from underrepresented regions, and policymakers in emerging economies should invest in the institutional infrastructure needed to translate global knowledge of modular construction into locally grounded practice.

Keywords
Modern Methods of Construction (MMC), Construction Industry Barriers, Sustainable Construction Practices, Adoption Challenge.

1. Introduction
The construction industry plays a critical role in global economic development, yet it remains among the least innovative sectors compared with others such as manufacturing and technology (Agenda, 2016). Modern Methods of Construction (MMC), including prefabrication, modular construction, and off-site manufacturing, have emerged as transformative strategies to address persistent challenges in the construction sector. These methods promise increased efficiency, enhanced sustainability, and reduced project timelines, thus aligning with the global call for more resilient and resource-efficient construction practices (Dagou et al., 2025). MMC leverages advanced technologies and streamlined processes to offer superior performance compared to traditional construction methods. Despite these promising benefits, the adoption of MMC remains limited across many regions and

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markets. Key benefits such as cost savings, improved quality control, and environmental benefits are often overshadowed by perceived risks, high upfront costs, and resistance to change (Amede, et al. 2025). For instance, MMC has the potential to significantly reduce material wastage and greenhouse gas emissions, thereby supporting sustainable development goals (Pham, et al., 2026). However, these advantages have not been sufficient to drive widespread implementation, particularly in developing economies where traditional practices dominate.

The slow uptake of MMC is attributed to a range of barriers, including financial, technical, regulatory, and cultural challenges (Soltani et al., 2025). While significant research has highlighted the potential of MMC, there is a paucity of comprehensive studies examining the multifaceted barriers hindering its adoption. This research gap underscores the need for a systematic review that synthesizes existing knowledge, identifies recurring themes, and provides actionable insights to support the broader adoption of MMC.This paper aims to address this gap by exploring the barriers to MMC adoption in the construction industry. By providing a comprehensive review of existing literature, this study seeks to identify and categorize these barriers, evaluate their implications, and propose strategies to overcome them. The findings are expected to guide industry stakeholders, policymakers, and researchers in advancing MMC adoption to foster innovation, efficiency, and sustainability in the construction sector.

2. Research Methodology

A bibliometric literature review is a systematic approach to analyzing academic publications through quantitative and statistical techniques to evaluate publication outputs, citation patterns, research impact, and scholarly trends. It examines relationships among published studies to provide insights into the development and structure of a research field (Kumar 2025). Bibliometric analysis is widely used to map scientific domains, identify highly influential publications and authors, and detect emerging research themes and directions (Chen et al., 2023). In these types of studies, researchers typically present the concept of bibliometrics alongside its fundamental terminology and dimensions, which measures research performance and impact, and relational bibliometrics, which explores connections and interactions among scholarly works.

The Scopus database was selected for this study because of its extensive multidisciplinary coverage and broad indexing of scholarly publications (Schotten, et al., 2017). Other databases were intentionally excluded to reduce the complexity and time required to identify, screen, and remove duplicate or overlapping records (Unicef, 2016). Using carefully selected keywords aligned with the study objectives, an initial database search was conducted in April 2026, yielding 134 documents. The search results were subsequently refined by restricting the Language to English, which reduced the number of retrieved documents to 131. To capture recent developments and historical research trends, the search was limited to publications produced between 2020 and 2025. The finalized dataset was then exported in Comma-Separated Values (CSV) format because of its compatibility with VOSviewer, a widely used software application for scientometric and bibliometric analysis. Table 1: Data search protocols and document synthesis.

Table 1. Search string

Database and search string	Scopus: (("modern methods of construction" OR "offsite construction" OR "modular construction") AND (“barrier” OR “challenge”) AND (“adoption” OR “implementation”) AND ("construction industry")	134
Refined to Language	English	131

3. Findings

Table 2 below presents the most influential authors in the modern methods of construction literature, ranked by publication output, citation impact, and bibliometric link strength. Each author listed contributed a minimum of two Scopus-indexed articles and accumulated at least 36 citations, reflecting a threshold of sustained scholarly engagement with the field. Co-authorship link strength varied considerably across authors, indicating differing levels of collaborative network. Sutrisna Monty emerged as the leading contributor, with 4 publications, 63 citations. The total link strength values reveal meaningful differences in the collaborative network positioning of influential authors within the modern methods of construction literature. Again, Sutrisna, Monty recorded the highest link strength of 301, indicating extensive co-authorship connections and a well-established presence at the center of the field's research network, despite having the second-lowest citation count among the top three authors. Shahzad, Wajiha Mohsin and Khan, Ayaz Ahmad followed with link strengths of 164 and 81 respectively, suggesting moderate but active collaborative engagement. Notably, Abdul Nabi, Mohamad and El-Adaway, Islam H shared an identical link strength of 181, as did Ali, Ali Hassan and Daoud, Ahmed Osama at 199. The latter pair

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recording the joint-highest link strength among authors with only two publications, which points to tightly coupled co-authorship relationships likely developed through shared institutional or project affiliations. Zaman, Atiq, and Choi, Jin Ouk recorded link strengths of 163 and 57, respectively, while Aigbavboa, Clinton returned the lowest value of 50, implying a more independent publication pattern within the network. Bai, Yu, despite commanding the highest citation count of 171, recorded a relatively low link strength of 22, a deviation suggesting high research impact without a correspondingly broad collaborative reach, a pattern sometimes observed among authors whose work is widely cited but produced within a contained research group. Taken together, these variations in link strength indicate that influence in this field is exercised through two distinct pathways: citation-driven scholarly impact and network-driven collaborative visibility, which do not always coincide.

Table 2. Publication per Author

Author	**Documents**	**Citations**	**Total Link Strength**
Sutrisna, Monty	4	63	301
Shahzad, Wajiha Mohsin	3	64	164
Khan, Ayaz Ahmad	3	57	81
Bai, Yu	2	171	22
Choi, Jin Ouk	2	138	57
Abdul Nabi, Mohamad	2	112	181
El-adaway, islam H	2	112	181
Zaman, Atiq	2	79	163
Aigbavboa, Clinton	2	67	50
Ali, Ali Hassan	2	56	199
Daoud,Ahmed Osama	2	56	199

Table 3 below presents the top journals that adopt modern construction methods. The table ranks the journals from highest to lowest by documents per journal. These results were extracted from VOSviewer, a Java-based application used to generate maps from network data and to visualize and examine them (Umar et al., 2023). The Journal with the highest total link strength is therefore the most important for the study. It can therefore be derived from the table that the top five (5) journals concerning the adoption of modern methods of construction are Engineering, Construction and Architectural Management, Buildings, International Journal of Construction Management, Sustainability (Switzerland), and Journal of Cleaner Production.

Table 3. Leading journals for Adoption of Modern Methods of Construction

Source	**Documents**	**Citations**	**Total link strength**
Buildings	12	146	371
Engineering, Construction, and Architectural Management	7	96	427
Sustainability (Switzerland)	5	65	176
Journal of Management in Engineering	4	489	110
Journal of and Construction Engineering and Management	4	199	49
Journal of Building Engineering	3	244	113
International Journal of Construction Management	3	193	223
Structures	2	485	40
Journal of Cleaner Production	2	77	128
Procedia Engineering	2	72	17

Table 4 below presents a citation-based analysis of the most productive countries in modern methods of construction research, applying minimum thresholds of 2 documents and 60 citations per country to ensure analytical rigor. Of the 73 countries represented in the dataset, only ten met these criteria. The United Kingdom led all contributors (f=31; citations=684), followed by Australia (f=20; citations=777) with the highest citation overall, and the Unites States (f=17;citations=590), New Zealand (f=10;citations=157), Hong Kong (f=10;citations=195), India (f=8;citations=77), China (f=7; citations 52), Nigeria (f=3;citations 54), Egypt (f=3;citations=57) and Saudi Arabia (f=3; citations=39). Collectively, the United Kingdom, Australia, the United

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States, New Zealand, and Hong Kong emerged as the 5 most productive nations, commanding an uneven share of both output and scholarly visibility within the field. A further investigation revealed that Nigeria and Egypt were the only African countries to meet the inclusion threshold, highlighting the continent's limited footprint in research on globally indexed modern construction methods. Crucially, no qualifying papers were produced in this dataset by South Africa, a founding BRICS member and one of the continent's most research-active economies, while India and China were the sole BRICS representatives to meet the criteria. This absence points to a structural gap in the BRICS research landscape and signals a deeper deficit in African scholarly engagement within the field. Far from being a marginal observation, this finding represents a missed opportunity of considerable consequence and constitutes an urgent call to action for African academics, construction industry practitioners, and national and international research funding bodies to invest meaningfully in closing this gap.

Table 4. Most Productive Countries by Citations

Country	Documents	Citations	Total link strength
United Kingdom	31	684	1530
Australia	20	777	1680
United States	17	590	1212
New Zealand	10	157	982
Hong Kong	10	195	635
India	8	77	351
China	7	52	955
Egypt	3	57	343
Nigeria	3	54	498
Saudi Arabia	3	39	456

4. Discussions of The Findings

The bibliometric data presented in this study reveals how knowledge on the barriers to adopting modern methods of construction (MMC) is currently structured, distributed, and produced globally. Examined across three analytical dimensions: author collaboration networks, journal prominence, and geographic distribution, the findings point to a field that is growing in visibility but remains constrained by fragmentation, disciplinary narrowness, and deep spatial inequities that limit its practical reach in the contexts where MMC adoption is arguably most urgent. The analysis of influential authors presented in Table 2 surfaces an important strain within the MMC research community. While Sutrisna, Monty leads the field with four publications, 63 citations, and a link strength of 301, the distribution of total link strength across the author table is highly uneven, with several high-impact contributors including Bai, Yu, whose 171 citations represent the highest in the dataset, recording comparatively low link strength values of 22. This discrepancy between citation impact and collaborative connectivity suggests that influential research on MMC barriers is being produced across loosely coupled scholarly networks rather than through integrated, sustained research communities. Bai, Yu's profile in particular illustrates a broader pattern in the field: research that achieves high individual visibility without generating the co-authorship ties that typically signal a maturing, cumulative research agenda.

Moreover, this fragmentation carries direct consequences for the study of MMC adoption barriers. The complex, multi-layered nature of these barriers spanning; technical, financial, regulatory, cultural, and supply chain dimensions demands precisely the kind of interdisciplinary collaboration that the link strength data suggests is currently underdeveloped. When barrier-focused research is conducted in relative isolation, findings tend to reflect the methodological and contextual assumptions of individual research groups rather than the cross-validated, transferable insights that industry practitioners and policymakers need to design effective interventions. Without stronger collaborative research, the field risks producing a fragmented catalogue of barriers rather than a coherent, actionable framework for addressing them.

The leading journals identified in Table 3: *Buildings*, *Engineering, Construction and Architectural Management*, *Sustainability* (Switzerland), *Journal of Management in Engineering,* and *Journal of and Construction Engineering and Management* reveal that research on MMC barriers is predominantly framed through the intersecting lenses of environmental performance, smart infrastructure, and sustainable development. This framing is analytically significant: it reflects the extent to which sustainability imperatives have become the dominant justification for MMC adoption, positioning offsite and modular construction as responses to carbon reduction targets and resource efficiency demands rather than as solutions to broader construction sector productivity and capacity challenges.

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While this orientation is not without merit, it produces a blind spot. The inclusion of *Engineering, Construction and Architectural Management* as a leading outlet suggests a growing interest in the managerial and organisational experiences of MMC adoption, yet the sustainability-heavy journal profile indicates that barriers rooted in procurement structures, contractor capability, client risk, workforce skill gaps, and regulatory fragmentation factors well documented in practitioner literature remain underrepresented in high-impact indexed research. For a field that explicitly concerns itself with adoption barriers, this gap between what journals publish and what practitioners experience on the ground represents a critical limitation. Future research would benefit from greater engagement with industrial engineering, supply chain management, and public policy outlets to ensure that the full spectrum of MMC adoption constraints receives the scholarly attention it warrants.

The most consequential finding of this bibliometric analysis lies in its geographic data. Of the 73 countries represented in the dataset, only 10 met the minimum thresholds of 2 documents and 60 citations. The United Kingdom dominated with 31 publications and 684 citations, followed by Australia with 20 publications and the highest citation count of 777, and the United States with 17 publications and 590 citations. New Zealand, Hong Kong, India, China, Nigeria, Egypt, and Saudi Arabia completed the qualifying group. While this concentration reflects the well-established research infrastructure and institutional investment of leading economies, it simultaneously reveals the near-total absence of lower-income and emerging-economy perspectives from the global MMC barriers literature.

The African dimension of this finding deserves particular attention. Nigeria and Egypt were the only African nations to meet the inclusion threshold, each with three publications, a figure that stands in contrast to the scale of construction activity, housing deficits, and infrastructure demand across the continent. More critically, South Africa, a founding BRICS member and among Africa's most research-active construction economies, produced no qualifying publications in this dataset. India and China were the sole BRICS nations represented, contributing modestly with eight and seven publications, respectively, while Brazil and Russia recorded no qualifying output at all. This pattern exposes a structural gap not merely in African scholarly output, but in the BRICS research landscape as a whole; a gap that is difficult to reconcile with the significant MMC adoption potential these economies represent.

The implications extend beyond publication counts. Research on MMC adoption barriers conducted overwhelmingly in the United Kingdom, Australia, and the United States inevitably reflects the regulatory environments, labour market conditions, supply chain maturities, and client sophistication levels of those contexts. When practitioners and policymakers in sub-Saharan Africa, South Asia, or Latin America attempt to apply these findings, they encounter frameworks built on assumptions that do not translate, housing finance structures differ, contractor capacity is differently distributed, planning systems operate under different constraints, and cultural attitudes toward industrialised construction diverge considerably. The absence of locally grounded research on MMC barriers in these regions is therefore not an academic footnote but a practical impediment to adoption. It represents both a missed opportunity and an urgent call to action for African and broader Global South academics, industry bodies, and national and international research funders to invest deliberately in region-specific studies that can generate the contextually embedded evidence base the field currently lacks.

5. Conclusion

This study used a comprehensive bibliometric analysis of 131 Scopus-indexed publications to map the global intellectual landscape of research on impediments to the adoption of modern construction technologies. The results confirm that, although scholarly interest in MMC is increasing, structural disparities persist in the body of knowledge across three crucial dimensions. Despite producing individually significant work, author collaboration networks exhibit inadequate co-authorship connectivity, with high-citation contributors such as Bai and Yu showing disproportionately low link strength values. This pattern indicates that the field is still operating in disciplinary silos rather than through the integrated, cross-institutional research communities that the complexity of MMC adoption barriers demands. The journal landscape, which is dominated by publications focused on sustainability and smart infrastructure, reveals a disciplinary framing that, although useful, underrepresents the workforce, managerial, regulatory, and procurement aspects of MMC barriers that practitioners consistently identify as the most persistent obstacles to adoption. Geographically, the Global South, and especially Africa, are still severely underrepresented in knowledge creation, which is concentrated in a tiny cluster of high-income economies dominated by the United States, Australia, and the United Kingdom. South Africa's complete absence from the qualifying dataset, alongside the limited output of other BRICS nations, exposes a gap between where MMC research is produced and where its adoption potential is arguably greatest, rendering much of the existing barriers literature contextually misaligned with the realities of emerging construction markets.

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When considered collectively, these results have significant ramifications for researchers, funders, journal editors, and industry stakeholders dedicated to accelerating the adoption of contemporary construction techniques worldwide. The study shows that, in addition to technical and regulatory interventions at the project and policy levels, closing the structural gaps in the generation, validation, and dissemination of knowledge about those hurdles is equally important. Building a more representative and practically useful evidence base will require stronger South-South and North-South research collaborations, targeted funding for MMC barrier research in underrepresented regions, and a purposeful expansion of the disciplinary outlets through which this research circulates.

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This study is both a diagnostic and a call to action for academics in Africa and the larger Global South. The continent is one of the most important testing grounds for MMC adoption worldwide due to housing pressures, rapid urbanization, and infrastructure deficiencies, but its voice in the scholarly discourse influencing that adoption is currently critically lacking. To ensure that the revolutionary promise of contemporary construction technologies is realized fairly and effectively across the full range of the world's construction contexts, addressing this lack is not only an academic priority.

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