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MAPPING ARTIFICIAL INTELLIGENCE RESEARCH IN CONSTRUCTION SAFETY: A BIBLIOMETRIC ANALYSIS OF TRENDS, THEMES AND EMERGING RESEARCH FRONTS

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Abstract

This study conducts a comprehensive bibliometric analysis of research on artificial intelligence (AI) applications in construction safety, focusing on publications from 2022 to 2026. Utilizing the Web of Science Core Collection as the primary data source, relevant documents were identified and analyzed to map recent trends, thematic developments, and emerging research fronts. The methodology included quantitative assessment of annual publication output, article types, and research area distribution, as well as co-occurrence analysis of keywords. The results reveal a rapid growth in scholarly output during this five-year period, with research articles dominating the publication landscape, supplemented by review papers and conference proceedings. The interdisciplinary nature of the field is evident through substantial contributions from engineering, computer science, and construction technology domains. Keyword analysis highlights prevailing themes such as machine learning, risk assessment, and real-time monitoring, alongside the emergence of topics like computer vision and predictive analytics. The findings underline the accelerating evolution of AI-driven safety research and the increasing integration of advanced computational tools in construction practice. This analysis offers valuable insights for researchers, industry practitioners, and policymakers aiming to enhance construction safety through artificial intelligence.

Keywords: Artificial Intelligence; Bibliometric Analysis; Construction Safety; Emerging Themes; Risk Assessment; Web of Science.

1. INTRODUCTION

The construction industry is globally recognized for its high-risk working environments, accounting for a disproportionate share of occupational injuries and fatalities (Zhou et al., 2015). Despite significant advances in safety regulations and management systems, the sector continues to face persistent challenges in mitigating hazards, ensuring worker protection, and achieving sustainable safety outcomes (Li et al., 2021). In response, researchers and practitioners have increasingly turned to artificial intelligence (AI) as a transformative tool for enhancing construction safety performance.

AI technologies including machine learning, computer vision, and data-driven analytics offer novel capabilities for real-time hazard identification, predictive risk assessment, and proactive safety management (Fang et al., 2022). Recent years have witnessed a surge in research exploring the integration of AI into construction safety practices, reflecting both technological advancements and the urgent need for innovation in safety management (Kim et al., 2023). Applications of AI range from automated monitoring of personal protective equipment compliance and detection of unsafe behaviors to intelligent risk prediction models and

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interactive safety training platforms. This growing body of literature signals a shift from traditional, reactive approaches to safety towards more data-centric and anticipatory paradigms (Nasirzadeh et al., 2023).

However, the rapid evolution and interdisciplinary nature of AI-driven safety research have resulted in a fragmented knowledge base, with studies dispersed across engineering, computer science, and construction management domains (Li et al., 2021). To date, there has been limited systematic synthesis of recent research trends, thematic developments, and emerging fronts in this dynamic area. Bibliometric analysis offers a robust approach to address this gap, enabling quantitative mapping of publication patterns, research areas, and intellectual structures within the field (Fang et al., 2022).

This study aims to provide a comprehensive bibliometric overview of AI research in construction safety, focusing on articles published between 2022 and 2026 in the Web of Science Core Collection. By analyzing publication trends, article types, research areas, and key thematic clusters, this paper seeks to elucidate the trajectory of AI adoption in construction safety and identify emerging research priorities. The findings intend to inform researchers, practitioners, and policymakers striving to harness AI for safer and more resilient construction environments.

2. LITERATURE REVIEW

The last decade has witnessed a surge in the application of artificial intelligence (AI) within construction safety management, reflecting both technological advancements and the sector's ongoing struggle to reduce incidents and fatalities (Teizer et al., 2017; Zhang et al., 2022). Early research primarily explored the use of automated decision support and sensor-based hazard detection, laying the groundwork for more sophisticated AI-driven interventions (Behzadan et al., 2018). Recent developments in deep learning and data analytics have enabled new capabilities, including real-time surveillance, predictive risk modeling, and automated safety compliance monitoring (Li et al., 2022; Park & Kim, 2022).

Recent studies demonstrate that AI-powered computer vision systems can accurately identify unsafe acts and conditions on construction sites, often surpassing the detection accuracy of traditional methods (Park & Kim, 2022). Additionally, natural language processing techniques have been utilized to systematically analyze safety reports and incident logs, extracting actionable insights for both preventative strategies and training (Song et al., 2023). Integration of AI with building information modeling (BIM) has also been shown to facilitate proactive safety planning and resource allocation (Zhang et al., 2022). Despite these promising advances, challenges persist. The literature frequently cites issues surrounding data quality, interoperability, and the limited scalability of AI solutions in diverse construction settings (Behzadan et al., 2018; Teizer et al., 2017). Furthermore, there is a recognized need for more empirical studies assessing the real-world impact of AI tools on accident reduction, as well as broader adoption across small- and medium-sized enterprises. Interdisciplinary collaboration is increasingly emphasized as essential for the next phase of AI research in construction safety, with contributions from civil engineering, computer science, occupational health, and

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management science (Song et al., 2023). Given the rapid expansion and fragmentation of the field, bibliometric analysis presents an effective approach for mapping knowledge structures, identifying emerging research fronts, and guiding future investigations (Zhang et al., 2022).

3. METHODOLOGY

3.1 Research Design

This study employed a bibliometric analysis to map the development of research on artificial intelligence (AI) in construction safety. The analysis focused on publication trends, document characteristics, disciplinary distribution, influential contributors, collaboration patterns, thematic clusters, and emerging research fronts. Bibliometric analysis is appropriate for examining a rapidly expanding field because it applies quantitative techniques to bibliographic metadata in order to identify the intellectual, conceptual, and social structure of a body of literature. It can therefore reveal how AI-enabled construction-safety research has developed over time, which disciplines contribute to it, and which topics are receiving increasing scholarly attention. The study was guided by the objective of mapping research trends, themes, and emerging fronts in AI applications for construction safety. Accordingly, the review combined descriptive performance analysis with science-mapping analysis. Performance analysis was used to assess publication output, document types, research areas, sources, authors, institutions, countries, and citations. Science mapping was used to examine relationships among authors, institutions, countries, publications, and keywords, thereby identifying collaboration patterns, intellectual foundations, thematic groupings, and potential emerging research directions.

3.2 Data Source and Search Date

Bibliographic data were retrieved from the Web of Science Core Collection on 16 August 2026. Web of Science Core Collection was selected because it provides curated multidisciplinary bibliographic records, citation-linkage information, and structured metadata suitable for bibliometric analysis. The database includes data on document titles, abstracts, keywords, authors, affiliations, publication sources, citations, document types, and research-area classifications. These features support both descriptive statistical analysis and network-based bibliometric mapping. The search date is important because Web of Science is continuously updated as new documents are indexed, early-access publications are assigned to formal issues, and citation records change. Consequently, the results of this study reflect the content indexed in the database as of 16 August 2026. Publications for 2026 should therefore be interpreted as provisional because the full publication and indexing cycle for that year had not yet been completed.

3.3 Search Strategy

A structured Topic search was undertaken in the Web of Science Core Collection. The Topic field was used because it searches for specified terms in publication titles, abstracts, author keywords, and Keywords Plus. The search strategy combined terminology relating to AI with terms related to the construction industry and occupational or project safety.

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The following search string was used:

TS = (("artificial intelligence" OR AI OR "machine learning" OR "deep learning" OR "computer vision" OR "neural network" OR "intelligent system*") AND (construction OR "construction industry" OR "construction site*" OR "construction project*") AND (safety OR "occupational safety" OR "workplace safety" OR "construction safety" OR "accident prevention" OR "injury prevention"))*

The search period was limited to publications issued between 2022 and 2026. This period was selected to capture the recent expansion of AI-focused construction-safety research. The search was limited to English-language publications where this restriction was applied. The database was also refined according to the document types selected for inclusion in the study.

3.4 Eligibility Criteria and Screening

The retrieved records were screened to ensure that only publications directly relevant to AI research in construction safety were retained. The screening process involved reviewing titles, abstracts, keywords, and available bibliographic information. Publications were included where they explicitly addressed the use, application, development, evaluation, adoption, or review of AI-related methods, tools, systems, or techniques in construction-safety contexts.

Criterion	Inclusion criteria	Exclusion criteria
Research focus	AI-related research directly relevant to construction safety	Studies unrelated to AI, construction, or safety
Industrial context	Construction industry, construction projects, construction sites, or built-environment safety contexts	Manufacturing, healthcare, mining, transport, or other non-construction contexts, unless construction-specific findings were separately reported
Publication period	Documents published from 2022 to 2026	Documents published before 2022 or after 2026
Language	English-language records, where language filtering was applied	Non-English records, where excluded
Record quality	Records with sufficient bibliographic metadata for analysis	Duplicate, incomplete, or unanalysable records
Relevance screening	Records retained after title, abstract, and keyword screening	Records judged irrelevant during screening

Following the search, refinement, and screening procedures, 56 publications were retained as the final dataset. The selected documents consisted of 33 original research articles, 22 review articles, and one early-access publication. Original articles were retained because they contribute empirical, technical, conceptual, and applied evidence. Review articles were included because they synthesise existing knowledge, identify methodological and practical gaps, and signal increasing maturity in an emerging research field.

The early-access publication was retained because it represents current research available online before formal allocation to a final journal issue. Web of Science categorises records by document type, enabling this form of refinement and analysis.

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3.5 Data Extraction and Analysis

The final dataset was exported from Web of Science Core Collection with full records and cited references. The extracted bibliographic information included publication titles, authors, affiliations, countries, journals, publication years, abstracts, author keywords, Keywords Plus, cited references, document types, research areas, and citation counts. Exporting full bibliographic records with cited references facilitates both descriptive bibliometric analysis and network-based science mapping.

3.6 Descriptive Profile of Dataset

The final dataset shows a marked increase in scholarly output over the study period. Annual scientific production increased from one publication in 2022 to six in 2023, followed by 15 publications in 2024 and a peak of 18 publications in 2025. As of the database search date, 14 publications had been indexed for 2026. Of the 56 records, 47 publications (83.9%) were published between 2024 and 2026.

This demonstrates that AI research in construction safety is a recent and rapidly expanding domain. However, the 2026 total should not be interpreted as a decline because data were collected on 16 August 2026, before the completion of the 2026 publication year.

Document-type analysis shows that original articles represent the majority of the literature, with 33 publications (58.9%). Review articles account for 22 publications (39.3%), while one record (1.8%) was classified as early access. The substantial proportion of review articles suggests that scholars are actively consolidating a growing knowledge base, assessing existing AI applications, identifying research gaps, and proposing future research directions.

The Web of Science research-area analysis indicates that the literature is concentrated in Engineering Civil (n = 26; 46.4%) and Construction Building Technology (n = 22; 39.3%). Other relevant areas include engineering multidisciplinary (n = 6; 10.7%); computer science, artificial intelligence; industrial engineering; environmental sciences; environmental studies; green and sustainable science and technology; and multidisciplinary sciences (each n = 4; 7.1%); and management (n = 3; 5.4%).

A record can be assigned to multiple Web of Science research areas. Therefore, the cumulative frequency across research areas exceeds the final sample size of 56 publications. This pattern reflects the interdisciplinary nature of AI-enabled construction-safety research, which integrates technical, computational, environmental, sustainability, and management perspectives.

3.7 Ethical Considerations

The study used publicly accessible bibliographic metadata retrieved from the Web of Science Core Collection. It did not involve human participants, personal data, interviews, surveys, interventions, or experimental procedures. Therefore, formal ethical approval was not required. To strengthen transparency and reproducibility, the study documents the database, search date, search strategy, screening process, eligibility criteria, analytical procedures, and final sample size.

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4. DESCRIPTIVE ANALYSIS OF PUBLICATION TRENDS AND RESEARCH CHARACTERISTICS

This section presents a descriptive bibliometric overview of the 56 documents included in the study. The analysis examines annual scientific production, document types, and Web of Science research areas to establish the temporal development, publication profile, and disciplinary orientation of the research field. These results provide an initial understanding of the growth and structure of the literature before the subsequent analyses of sources, authors, countries, institutions, citations, and research themes.

4.1 Document Types

The document-type analysis provides insight into the nature and maturity of the publications included in the bibliometric dataset. As illustrated in Figure 1, the dataset consists of 56 documents, comprising 33 articles, 22 review articles, and one early-access publication. Original research articles represent the largest share of the dataset, accounting for 58.9% of all publications. Review articles constitute a substantial 39.3%, while the early-access document represents 1.8% of the total records.

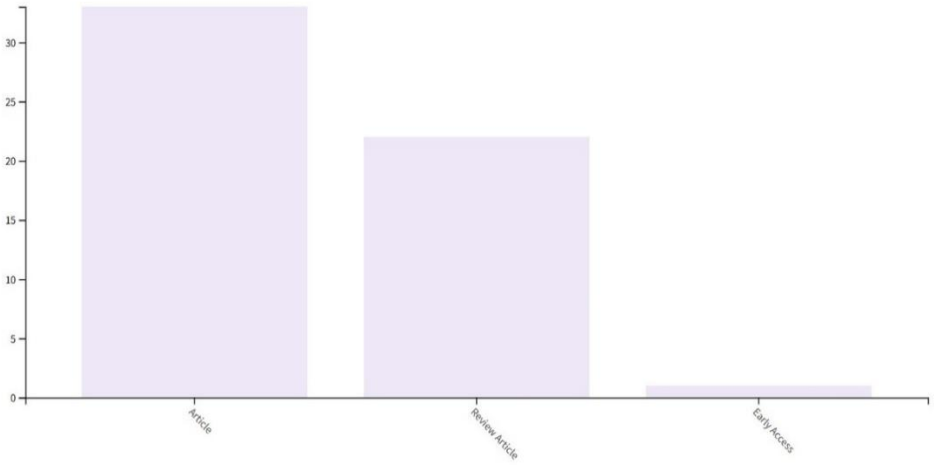

Figure 1: Document Types

Source: Authors' analysis based on Web of Science Core Collection data

The dominance of original research articles indicates that the field is supported primarily by studies that generate new empirical, technical, conceptual, or applied knowledge. Depending on the scope of the review, these articles may include investigations into construction processes, engineering applications, safety management practices, emerging technologies, data-driven approaches, or implementation challenges. The prominence of articles therefore suggests that researchers are actively producing evidence and testing approaches relevant to the development of the field.A particularly notable finding is the high proportion of review articles.With 22 review papers, nearly two-fifths of the dataset consists of literature reviews,

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systematic reviews, scoping reviews, bibliometric reviews, or other forms of evidence synthesis. This is important because review articles commonly emerge when a research domain begins to expand rapidly and researchers need to consolidate fragmented knowledge. Their presence suggests that scholars are seeking to identify dominant concepts, research clusters, methodological patterns, theoretical foundations, practical applications, and persisting research gaps.

The combination of a high proportion of articles and review papers indicates that the field is developing along two complementary directions. On the one hand, original studies are extending the evidence base through the production of new findings. On the other hand, review studies are organising and synthesising the existing knowledge base. This pattern may be interpreted as an indication of an emerging but increasingly structured field: research activity is sufficiently extensive to warrant synthesis, yet the continued dominance of original articles shows that substantial opportunities remain for further empirical investigation and practical application.

The single early-access publication reflects the ongoing and current nature of research activity in the field. Early-access articles are papers that have been made available online before being assigned to a final issue, volume, or page range. Its inclusion indicates that new work is still entering the scholarly publication pipeline and may be indexed before formal issue publication.

Overall, the document-type distribution shows that the knowledge base is dominated by original research while being strongly supported by review-based scholarship. This profile suggests a rapidly evolving research domain in which scholars are simultaneously generating new knowledge and attempting to consolidate existing evidence. The substantial presence of review articles also highlights the value of the present bibliometric study, as it can provide a broader quantitative mapping of publication patterns, disciplinary contributions, influential sources, collaboration networks, and emerging thematic directions that may not be fully captured through conventional narrative or systematic reviews.

4.2 Research Areas

The research-area analysis was conducted to identify the disciplinary orientation of the publications included in the dataset. As shown in Figure 2, the 56 retrieved documents are predominantly classified within engineering- and construction-related research areas. This finding confirms that the research topic is principally embedded in the built-environment domain, while also drawing on knowledge from artificial intelligence, environmental sustainability, industrial engineering, and management.

It is important to note that the research-area counts are not mutually exclusive. A single publication may be allocated to more than one Web of Science research area because the source journal or publication can be indexed across multiple subject categories. Consequently, the total number of research-area occurrences exceeds the 56 documents included in the dataset. This overlap should be regarded as an indication of interdisciplinarity rather than a duplication error. Web of Science applies research-area classifications across its databases, and source publications may carry multiple subject-category assignments.

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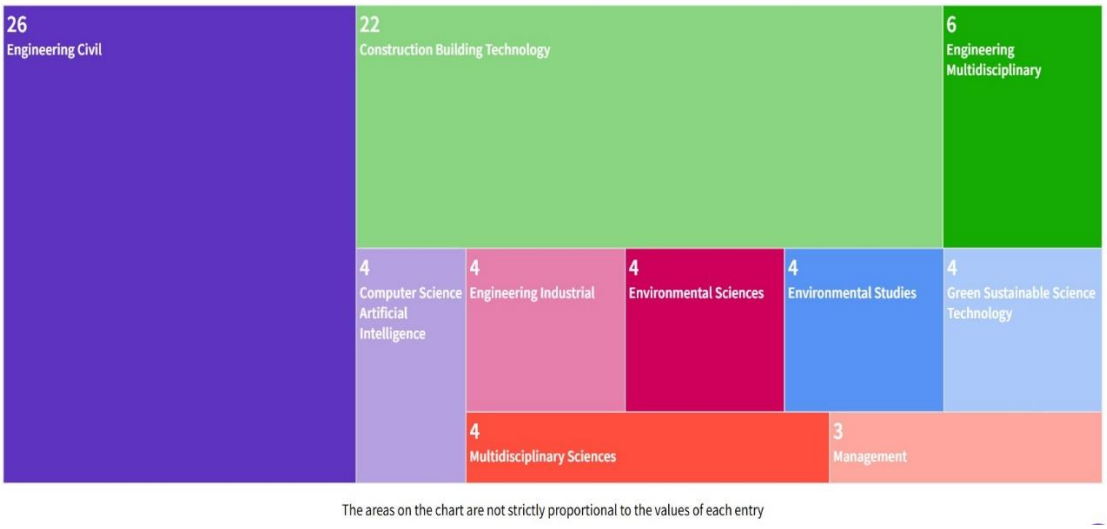

Figure 2: Research-Area Distribution of the Retrieved Publications

Source: Authors' analysis based on data retrieved from the Web of Science Core Collection.

Civil engineering is the most prominent research area, with 26 publications, representing 46.4% of the dataset. This result indicates that the research topic is strongly connected to civil-engineering applications, including the planning, design, delivery, management, maintenance, performance, and safety of infrastructure and construction projects.

The prominence of civil engineering also suggests that the field is concerned with practical industry challenges rather than being limited to purely theoretical or conceptual discussions.

Construction and building technology is the second-largest research area, accounting for 22 publications or 39.3% of the dataset. Its strong representation reinforces the centrality of the construction sector to the research field.

This category generally reflects research concerned with construction methods, building processes, project implementation, construction technologies, productivity, safety, digitalisation, and innovation in the delivery of built assets. Together, civil engineering and construction/building technology constitute the core disciplinary foundation of the literature.

The presence of engineering multidisciplinary, represented by six publications (10.7%), further indicates that the topic crosses conventional engineering boundaries. This may reflect the integration of knowledge from different technical disciplines, such as civil, industrial, environmental, and digital engineering. Such integration is particularly relevant where research problems are complex and require combined technical, operational, and managerial solutions.

Several research areas each account for four publications, representing 7.1% of the dataset. These include computer science, artificial intelligence; industrial engineering; environmental sciences; environmental studies; green and sustainable science and technology; and multidisciplinary sciences.

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The inclusion of computer science and artificial intelligence suggests that computational methods, intelligent systems, machine learning, automation, predictive analytics, or other digital technologies are becoming relevant within the field. This may point to an emerging technological orientation in which construction and engineering challenges are addressed through data-driven and AI-enabled approaches.

The representation of environmental sciences, environmental studies, and green and sustainable science and technology demonstrate that the field is also connected to sustainability-related concerns. These may include environmental performance, resource efficiency, waste reduction, climate resilience, sustainable construction practices, and the environmental implications of engineering decisions.

The coexistence of technical engineering categories with sustainability-oriented categories suggests that the literature increasingly recognises the need to balance project, operational, safety, and technological objectives with environmental responsibility.

Management is represented by three publications, equivalent to 5.4% of the dataset. Although this category has a smaller presence than the engineering and technical areas, it is significant because it signals attention to organisational and managerial issues. These may include technology adoption, decision-making, leadership, policy, risk governance, stakeholder engagement, skills development, and implementation barriers.

The comparatively limited number of publications within management may indicate a potential gap in the literature. Future studies could therefore examine how technical and digital innovations are adopted, governed, and sustained within construction organisations and project environments.

Overall, the research-area distribution shows that the field is primarily anchored in civil engineering and construction/building technology, but it is clearly interdisciplinary in character.

The results demonstrate the convergence of engineering, construction technology, artificial intelligence, environmental sustainability, and management perspectives. This interdisciplinary profile suggests that addressing the topic effectively requires not only technical solutions, but also consideration of environmental impacts, organisational readiness, managerial capabilities, and implementation conditions

4.3 Annual Scientific Production

The annual scientific production analysis demonstrates a strong upward trajectory in publication output over the period 2022–2026. As shown in Figure 3, the dataset comprises 56 publications, with annual output increasing from only one document in 2022 to a peak of 18 documents in 2025. This pattern indicates that the field has received growing scholarly attention and has developed rapidly over the review period.

Publication activity was limited in 2022, when only one document was recorded. However, the output increased to six publications in 2023, representing the beginning of sustained academic interest in the topic.

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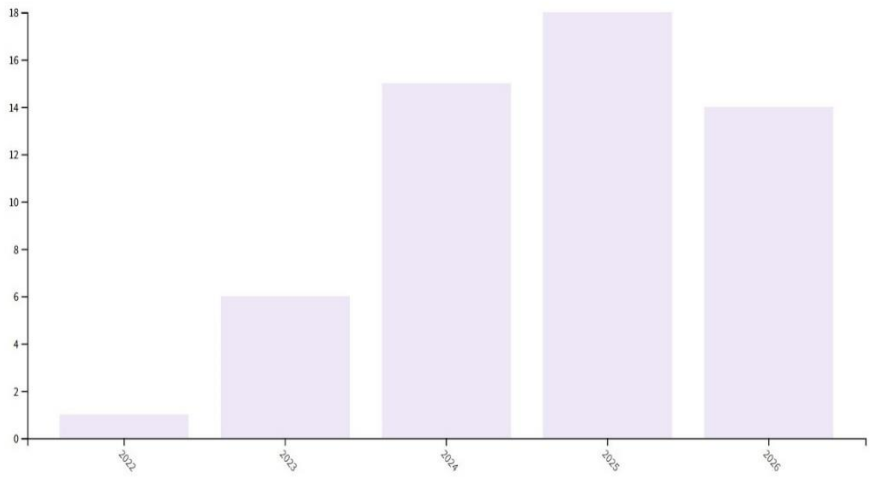

Figure 3: Annual Scientific Production of Publications from 2022 to 2026

Source: Authors' analysis based on data retrieved from the Web of Science Core Collection.

The number of publications increased substantially in 2024, reaching 15 documents, before attaining its highest level in 2025 with 18 publications. The increase from six publications in 2023 to 18 publications in 2025 represents a threefold rise within two years, illustrating the accelerated development of the research area.

Although 14 publications were recorded for 2026, compared with 18 in 2025, this apparent decline should be interpreted with caution. The 2026 figure may not represent a complete publication year because the bibliometric search was undertaken before the end of the year. Publications may still be under review, in press, indexed as early access, or awaiting assignment to a final journal issue. Therefore, the 2026 output should not necessarily be interpreted as evidence of reduced research interest.

A key observation is that 47 of the 56 publications, equivalent to 83.9% of the dataset, were published between 2024 and 2026. This concentration of publications in the most recent years confirms that the topic is contemporary and rapidly emerging. The trend suggests that researchers, practitioners, and policymakers are increasingly recognising the relevance of the topic, resulting in growing scholarly engagement and publication activity.

Overall, the annual scientific production pattern indicates that the field is at an expansion stage. The progression from a very small number of publications in 2022 to consistently high publication output from 2024 onwards suggests that the subject has transitioned from an emerging area of inquiry towards a more established, though still developing, research stream. Continued growth can be expected as further empirical studies, technological developments, review papers, and practical applications contribute to the expansion of the knowledge base.

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5. DISCUSSION

This study mapped the development of artificial intelligence (AI) research in construction safety using a bibliometric dataset of 56 publications indexed in the Web of Science Core Collection between 2022 and 16 August 2026. Overall, the findings indicate that AI in construction safety is a recent, rapidly expanding, and interdisciplinary field. The evidence shows increasing scholarly attention to the use of AI to shift construction safety management from reactive incident response towards proactive hazard identification, real-time monitoring, risk prediction, and preventive decision-making.

5.1 Rapid Growth of the Field

Annual scientific production increased from one publication in 2022 to six in 2023, 15 in 2024, and a peak of 18 publications in 2025. A further 14 documents had already been indexed for 2026 by the search date. Importantly, 47 of the 56 publications, representing 83.9% of the dataset, were published between 2024 and 2026. This pattern demonstrates that AI-enabled construction-safety research has moved quickly from a relatively limited area of inquiry to an increasingly visible research stream.

The rise in publication output can be linked to the growing availability of digital technologies and data-driven approaches in construction. AI tools such as machine learning, deep learning, computer vision, predictive analytics, wearable sensing, drones, robotics, and Building Information Modelling (BIM) create opportunities to identify unsafe behaviours, monitor personal protective equipment, detect hazardous conditions, predict accident risks, and support safety-related decision-making. Recent reviews similarly identify vision-based monitoring, predictive hazard detection, and automated risk assessment as central AI application areas in construction health and safety. The apparent reduction from 18 publications in 2025 to 14 documents in 2026 should not be interpreted as a decline in scholarly interest. The dataset was retrieved on 16 August 2026, before the end of the publication year. Additional documents may still be published, indexed, or moved from early-access status into final journal issues. The 2026 results should therefore be treated as provisional.

5.2 Maturing Knowledge Base

The document-type distribution provides further insight into the development of the field. Original research articles constituted 58.9% of the dataset, while review articles accounted for 39.3%. The predominance of original articles indicates continued development of new AI models, systems, datasets, technical applications, and practical safety interventions. At the same time, the substantial proportion of review articles indicates that scholars are increasingly consolidating the available evidence, comparing methods, identifying conceptual and methodological gaps, and proposing future research priorities. This combination is characteristic of a field that is expanding but not yet fully mature. AI in construction safety has generated sufficient research activity to warrant systematic and bibliometric reviews; however, the high proportion of original articles confirms that substantial empirical, technological, organisational, and implementation questions remain unresolved. The present bibliometric study therefore contributes by complementing existing reviews with a structured assessment of

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publication patterns, disciplinary orientation, and emerging research directions.

5.3 Interdisciplinary Orientation

The research-area results show that the field is principally rooted in civil engineering (46.4%) and construction and building technology (39.3%). This concentration is expected because construction safety problems arise directly from project activities, site conditions, equipment use, workforce behaviour, and the operational complexity of construction processes. It also confirms that AI is being investigated primarily as an applied solution to industry-based safety challenges. However, the presence of multidisciplinary engineering, computer science and artificial intelligence, industrial engineering, environmental sciences, sustainability, and management categories demonstrates that construction-safety research cannot be addressed through a purely technical lens. Effective AI implementation requires suitable algorithms and data, but it also depends on management commitment, digital infrastructure, workforce acceptance, organisational readiness, policy guidance, data governance, and ethical safeguards.

The relatively small representation of management (5.4%) highlights an important gap. Most current research appears to focus on technological development and technical application, while fewer studies explicitly address adoption strategies, leadership, skills development, organisational culture, procurement, governance, and the integration of AI tools into daily safety-management workflows. This is significant because even technically accurate AI systems may fail to improve safety if they are not trusted, adopted, integrated, and acted upon by site managers, safety officers, supervisors, and workers.

5.4 Key Research Implications

The results suggest that AI research in construction safety is becoming increasingly oriented towards proactive and predictive safety management. Rather than relying only on post-incident reporting, inspections, and manual observation, AI can support continuous monitoring and earlier identification of unsafe conditions. Computer vision may be used to detect the use of personal protective equipment or proximity to hazardous zones; machine-learning models may estimate accident risk from historical and real-time data; and wearable devices may provide information on worker location, movement, fatigue, or exposure to hazardous conditions. However, the transition from experimental AI applications to widespread industry adoption remains constrained by several challenges. Current research identifies data quality, limited availability of labelled construction-site datasets, weak generalisability across diverse projects, algorithmic opacity, privacy concerns, fragmented digital systems, and organisational resistance as significant implementation barriers. Construction sites differ substantially by project type, layout, work activities, weather conditions, workforce composition, and safety culture. Consequently, an AI model that performs well on one project may not necessarily deliver accurate results in another setting.

Future research should prioritise real-world validation of AI systems across diverse construction contexts, longitudinal evaluation of safety outcomes, explainable AI, ethical data governance, worker-centred system design, and practical implementation frameworks. Greater attention is also needed on management and organisational issues, including safety culture,

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leadership, training, technology acceptance, implementation costs, and policy frameworks. In the South African context, future studies should further investigate how data-driven safety practices and AI-enabled injury-prevention methods can be adapted to local construction conditions, institutional capacity, and workforce needs (Nkosi and Emuze, 2026). Similarly, the responsible implementation of AI requires ethical planning, stakeholder collaboration, and attention to worker health and well-being (Nkosi, Emuze and Windapo, 2025).

Addressing these technical, organisational, and governance issues will be necessary to convert AI from a promising technological capability into a trusted, scalable, and effective component of construction safety management.

6. CONCLUSION

This bibliometric analysis mapped research on artificial intelligence in construction safety using 56 Web of Science Core Collection publications published from 2022 to 16 August 2026. The findings show that the field has experienced rapid growth, with publication output rising from one document in 2022 to a peak of 18 documents in 2025. The concentration of 83.9% of publications between 2024 and 2026 confirms that AI in construction safety is a contemporary and expanding area of scholarship.

The literature is dominated by original research articles, supported by a substantial body of review articles. This profile shows that the field is simultaneously generating new technical and empirical knowledge while consolidating its conceptual foundations and identifying research gaps. Civil engineering and construction/building technology constitute the dominant research areas, confirming the strong practical relevance of AI applications to construction operations and site safety. The representation of computer science, AI, industrial engineering, sustainability, environmental studies, and management also demonstrates the field's interdisciplinary nature. The results indicate that emerging research is increasingly concerned with AI-enabled safety monitoring, predictive risk assessment, automated hazard detection, computer vision, machine learning, data analytics, wearables, drones, and digital construction technologies. These approaches have the potential to improve construction safety by enabling earlier detection of risks and better-informed preventive action. Nevertheless, the field remains constrained by shortcomings in data availability and quality, limited model generalisability, explainability challenges, integration difficulties, organisational resistance, privacy concerns, and insufficient governance arrangements.

Future research should prioritise real-world validation of AI systems across different construction contexts, longitudinal evaluation of safety outcomes, explainable and transparent AI, ethical data governance, worker-centred system design, and practical implementation frameworks. Greater attention is also needed on management and organisational issues, including safety culture, leadership, training, technology acceptance, implementation costs, and policy frameworks. Addressing these issues will be necessary to convert AI from a promising technical capability into a trusted, scalable, and effective component of construction safety management.

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