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A COMPREHENSIVE BIBLIOMETRIC ANALYSIS OF SCIENTIFIC RESEARCH (1975-2023) ON FACTORS INFLUENCING SAFETY PERFORMANCE IN THE CONSTRUCTION INDUSTRY

Alaa AA Elkaseh[1], Siti Mazzuana Shamsudin[2], Rozana Zakaria[3], Vikneswaran Munikanan[4], Anees Ahmed[5]

[1,5]*Faculty of Civil Engineering,*
UNIVERSITI TEKNOLOGI MALAYSIA, SKUDAI, JOHOR
[2]*School of Construction and Quantity Surveying,*
College of Built Environment (CBE),
UNIVERSITI TEKNOLOGI MARA, 40450 SHAH ALAM, SELANGOR
[3]*Faculty of Artificial Intelligence,*
UNIVERSITI TEKNOLOGI MALAYSIA, KUALA LUMPUR
[4]*Department of Civil Engineering, Faculty of Engineering,*
NATIONAL DEFENSE UNIVERSITY OF MALAYSIA

Abstract

This extensive bibliometric analysis delves into the dynamic and evolving landscape of research on safety performance factors within the construction industry. This study examines 468 academic articles to monitor the progression of research trends in the construction industry. There is a significant rise in academic endeavours that align with the swift advancements in technology in this domain. Notably, this analysis highlights the pivotal role of influential publication sources as primary repositories of knowledge dissemination. Furthermore, recurring keywords such as “construction industry” and “safety performance” illuminate the multifaceted nature of safety research, emphasising its holistic approach. High-impact works, especially those exploring safety culture and climate, have a strong influence on shaping the discussion and directing industry practices in the field. Academic institutions have also made substantial contributions, actively participating in shaping the conversation on safety performance. Hence, the in-depth analysis offers valuable insights for stakeholders committed to advancing safety practices in the industry, underscoring the sector’s steadfast dedication to fostering safer, more resilient, and socially responsible construction endeavours.

Keywords: Bibliometrics, Safety Performance, Citation Analysis, Knowledge Mapping, Safety Factors.

[1] PhD Candidate Email: a1976@graduate.utm.my

INTRODUCTION

Safety performance is a critical aspect in various industries, playing a vital role in safeguarding the well-being of workers and ensuring the overall success of organisations. Gaining insight into the variables that impact safety performance is crucial for efficient safety administration and the mitigation of workplace accidents. The factors that influence safety performance are crucial areas that require continuous attention and meticulous management to sustain a safe working environment (Buniya et al., 2023; Y. Li et al., 2018; Tezel et al., 2021).

In contemporary project management, determining the critical measures that guarantee successful safety performance for all stakeholders is a significant challenge (Sultana et al., 2019). It is essential to identify the factors that influence safety performance and develop strategies to measure, monitor, and improve safety outcomes (Lu et al., 2020; Nævestad et al., 2018, 2021). This article provides a comprehensive bibliometric analysis of scientific research conducted between 2012 and 2022 to contribute to the knowledge and advancement of research on factors influencing safety performance. The analysis is specifically focused on factors affecting safety performance and aims to identify research trends, collaboration networks, and gaps in the existing literature.

This study intends to employ bibliometric analysis to analyse the research landscape, assess the distribution and effect of publications, identify significant contributors, and research clusters, and track the evolution of research trends over time. Using the Scopus Database as the primary source of data, this study employs statistical and content analysis techniques, including the use of VOSviewer software, Excel sheets, and the WordArt website, to examine and evaluate relevant publications. The analysis will delve into various aspects, such as the publication output, most influential authors and institutions, citation patterns, co-authorship networks, and the thematic content of the publications.

LITERATURE REVIEW

Concepts of Factors Affecting Safety Performance in the Construction Industry

Safety performance pertains to an organisation's capacity to proficiently handle and reduce hazards to guarantee the welfare and security of its personnel, stakeholders, and the surrounding environment. It encompasses the implementation of strategies, policies, procedures, and practices aimed at preventing accidents, injuries, and occupational hazards within the workplace (Ghosh, 2021; Jääskeläinen et al., 2022a; Safety Management International Collaboration Group, 2013). Factors affecting safety performance in the context of safety performance are specific elements or factors that significantly influence the success or failure of safety initiatives within an organisation (Machfudiyanto

et al., 2019a). These variables are crucial for developing a strong safety culture, enhancing safety outcomes, and attaining organisational safety objectives (Buniya et al., 2023; Y. Li et al., 2018).

Bibliometric Study on the Factors Affecting Safety Performance in the Construction Industry

Between 2012 and 2023, there have been comprehensive bibliometric studies on the construction industry found in the Scopus database. These studies (Akram et al., 2019; Chellappa et al., 2021; Ghaleb et al., 2022; J. Li et al., 2022; X. Liu et al., 2023; Malakoutikhah et al., 2022; Management, 2021; Newaz et al., 2023; Tao et al., 2020; Wang et al., 2019) all explored the landscape of scientific research on safety performance in the construction industry. They examined prominent publications, research patterns, and discoveries pertaining to the various aspects that impact safety performance.

The studies' findings have provided valuable insights on safety performance, emphasising the necessity for further investigation in this field which emphasise the importance of exploring factors affecting safety performance in the construction industry. Such research would not only augment the scientific knowledge repository but also yield practical implications, enabling the formulation of evidence-based approaches to increase safety performance within organisations. By addressing the factors affecting safety performance, organisations can better understand and implement measures that promote a safer work environment and prevent accidents and injuries.

Research Gap

Several review-based studies have explored various facets of construction safety management (CSM), such as advanced technologies, construction equipment safety, safety culture, and accident causation models (Chen, K. 2020; Guo et al., 2017; Levitt & Samelson, 1993; Liang et al., 2020; Park & Kim, 2013). Nonetheless, there is a significant lack of research that specifically examines the elements that influence safety performance in the construction industry (Bhagwat & Delhi, 2022; Haupt et al., 2019; Kazan, 2013).

Existing studies have primarily concentrated on specific factors influencing safety performance within individual projects, with limited attention given to synthesising the broader body of knowledge or adopting a comprehensive approach (Clarke, 2006; Griffin & Neal, 2000; Jääskeläinen et al., 2022a, 2022b; Y. Li et al., 2018; Machfudiyanto et al., 2019b; Nævestad et al., 2018, 2021). As a result, there is a dearth of thorough comprehension of the aspects that have a substantial influence on safety performance in building projects. Hence, it is imperative to conduct a comprehensive review that

systematically explores and analyses the factors affecting safety performance in the construction industry, considering various dimensions and contexts.

RESEARCH METHODOLOGY

This study employs a qualitative methodology that is well-suited for investigating open-ended inquiries, unexplored areas, and unknown frontiers (Aspers & Corte, 2019; Ensslin & Vianna, 2008; Kaiser, 2014). It is highly suitable for addressing problems that involve multiple stakeholders, settings, and processes, making it an advanced approach that transcends the limitations of purely qualitative or quantitative methods. This approach proves particularly useful in exploratory studies where initial knowledge of the problem and its boundaries is limited.

This study sequentially employs a science mapping approach from the bibliometrics to examine the elements that influence safety performance in the construction industry. The process has three primary stages: conducting a bibliometric search, performing scientometric analysis, and conducting content analysis. The objective is to create visual networks that depict research domains associated with safety performance. This approach improves understanding and contributes to evidence-based interventions for enhanced safety outcomes in the industry.

Bibliometrics, as described by Amadeu Dutra Moresi et al. (2021) and Donthu et al. (2021), applies mathematical and statistical methods to analyse literary works and measure texts and information. Common methods include citation and content analysis (Alryalat et al., 2019; Ninkov et al., 2022). For bibliometric analysis, the user-friendly VOSviewer software was employed to explore uncharted domains of knowledge, enabling researchers to visualise knowledge networks, uncover hidden connections, and identify trends (Shah et al., 2020; Xie et al., 2020). The VOSviewer software that is crucial for creating and displaying bibliometric maps and creating two types of mapping: bibliographic and textual data (Caputo & Kargina, 2022; Kirby, 2023). This software highlights several aspects, demonstrating the interaction between publications, authors, keywords, and citations. The analysed data was arranged by the co-occurrence and frequency of a minimum of 85 keywords, which accounted for 51% of all instances.

ANALYSIS AND DISCUSSION

To perform the analysis efficiently, a sequential method is crucial. Initially, the process commences by establishing the parameters of the population and subsequently choosing an appropriate sample. Following the process of data codification, a comprehensive analysis and interpretation of the results. This systematic approach ensures that the necessary stages are methodically executed to attain the desired outcomes.

Rigorous filters were applied to curate documents that aligned with the research objectives. This involved setting a publication year range (1975–2023), which yielded 773 documents. To maintain relevance, non-engineering materials were excluded, leaving 607 pertinent documents. Emphasis on specific document types, such as articles and conference papers, resulted in 568 selections, while book chapters and reviews were excluded. Further filtering for final-stage publications generated 558 documents. Incorporating keywords like "safety performance," "construction industry," "construction safety," and "safety factors" retained 497 documents. Diverse source types were included without specific exclusions, totalling 476 documents. The final selection only considered English-language documents, resulting in a dataset of 468 documents after the exclusion of nine documents in other languages. These stringent criteria ensured a focused dataset that aligned with the research objectives, as detailed in Table 4.

Table 4: Selection and Exclusion Criteria Findings

Criteria	Selection Criteria	Exclusion Criteria	No of document found
Publication Year	1975– 2023	No Exclusion	773
Subject Area	Engineering	No relationship with the engineering field	607
Document Type	Articles, Conference papers	Book chapters, Reviews Conference reviews	568
Publication Stage	Only the final stage	Articles in press	558
Keywords: Safety performance, construction industry, construction safety, safety factors	Presence of or some proximity with safety performance, construction industry, and factors	No relationship with safety performance, construction industry, and factors	497
Source type	Journals, Conference proceedings	Book series, Trade journals, Undefined	476
Language	English Language Only	Chinese, Japanese, Italian, Lithuanian	468

Analysis

Following a thorough examination of the titles, keywords, and abstracts of individual studies, 468 articles that had been published in prominent international journals were chosen for inclusion in the proposed bibliographic review for this study. In the context of safety performance factors, content analysis extended its application to delve into a myriad of elements influencing safety performance within the construction industry. Numerous authors in specialised literature have explored this subject across various thematic areas. On the other hand, a comprehensive review of major journals dedicated to research on safety

performance within the construction industry was systematically conducted. The primary aim was to identify the key factors that exert an influence on safety performance. A total of 468 research articles were identified, collectively encapsulating the principal viewpoints of several authors on the factors that shape safety performance.

Based on the findings of this bibliometric analysis, it appears that studies on safety performance factors in construction have been published since 1983. As these factors evolved and gained prominence over the years, the number of studies has continued to grow steadily. While there were relatively few studies in the 1990s, the research area garnered significant attention in the last decade, resulting in a noticeable upward trend in the number of research studies, as illustrated in Figure 1. This increasing trend can be attributed to the concurrent development and adoption of technologies in the construction industry. In total, the bibliometric analysis included 468 documents. Most of these documents consisted of articles (341), with conference and proceedings papers (127) being the next most common type.

Prominent individuals in the academic study field are perfect examples of knowledge and intellectual competence. A thorough and comprehensive examination of the Scopus database reveals a definitive list of the top 10 luminaries working in this extremely specialised study field (as depicted in Figure 2). Chan, A.P.C., distinguishes himself from other experts with an impressive collection of 22 scholarly documents. In addition, A.J. Al-Bayati has produced 14 notable contributions to this field, garnering significant attention. Similarly, Chen, Y., and McCabe, B., have individually authored 11 notable articles that demonstrate their academic relevance.

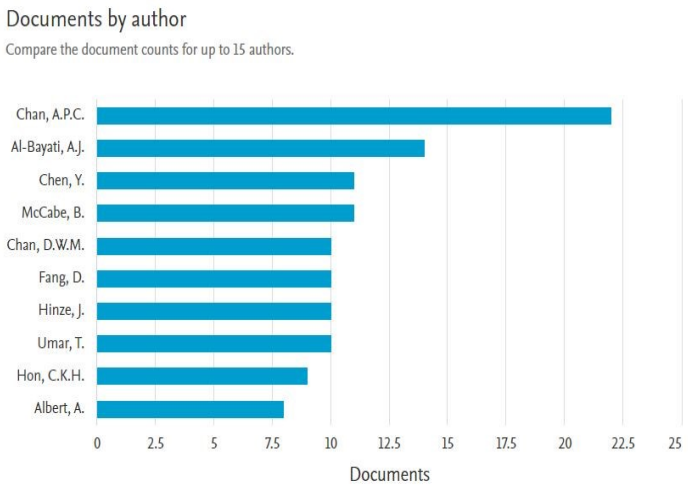

Figure 3: Documents by Author

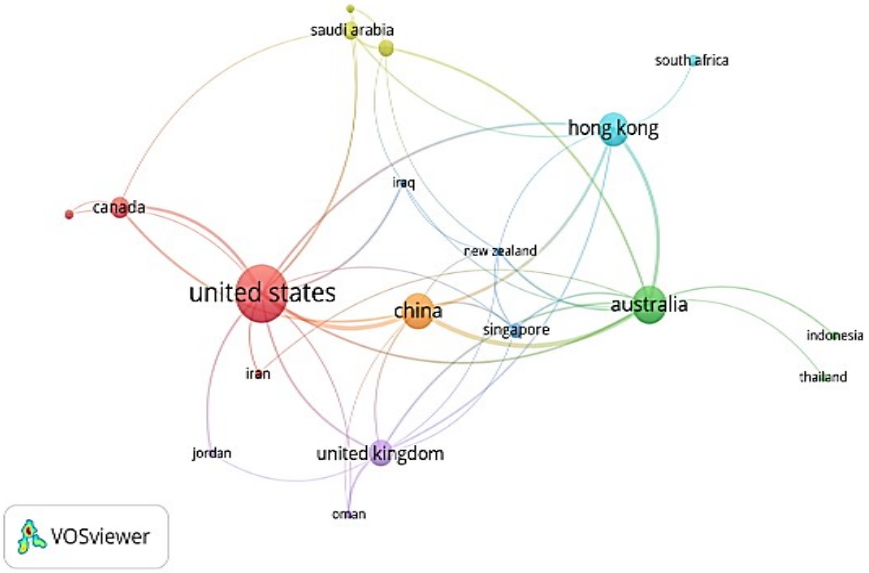

Figure 3: VOSViewer Analysis of Countries

Apart from that, Figure 3 above indicates the bibliometric analysis of countries, which is divided into seven distinct clusters, each represented by a unique colour. The colour-coded map further elucidates this by showcasing the volume of scholarly documents generated by each country. Collaborative links between countries are depicted by the overlapping of the two colours between the respective elements. Together, this analysis provides a comprehensive and illuminating perspective on the intricate relationships and research contributions among countries, offering valuable insights into the dynamics of the global research landscape.

Discussion

This bibliometric analysis revealed the evolving research patterns concerning safety performance variables in the construction industry, indicating the sector's ability to adapt to emerging issues.

The identification of prominent publication sources, including the Journal of Construction Engineering and Management, Safety Science, and Construction Management and Economics, underscores the critical role of specialised platforms in knowledge dissemination. These journals serve as repositories of evidence-based practices, facilitating the exchange of ideas and insights among researchers, practitioners, and policymakers. Their influence extends beyond academic boundaries, shaping industry practices and regulatory

frameworks. As these sources continue to thrive, they are poised to play an instrumental role in shaping the future discourse on safety performance factors.

The highly cited research documents identified in this analysis represent the cornerstone of safety performance research. These studies have made substantial contributions to theoretical frameworks and have also offered practical insights that are relevant to the industry's stakeholders. For instance, the seminal work by Choudhry et al. (2007) on safety culture serves as a roadmap for organisations seeking to cultivate a safety-centric culture. Siu et al.'s (2004) exploration of safety climate and psychological strains offers valuable perspectives on the psychological aspects of safety performance. Aksorn and Hadikusumo's (2008) study on critical success factors provides actionable insights for project managers and stakeholders, emphasising the role of employee involvement and management commitment. The impact of these documents extends beyond academia, permeating the construction industry and influencing decision-making processes.

Although this bibliometric analysis provides valuable insights, it is crucial to acknowledge its limitations. The dependence on existing literature restricts the exploration of emerging issues and gaps in empirical research. Potential areas for future research could involve a more thorough investigation of emerging technologies, such as the Internet of Things (IoT) and artificial intelligence, and their impact on safety performance. The integration of these technologies into construction processes offers opportunities for real-time monitoring, predictive analytics, and proactive risk management. Furthermore, comparative studies that assess safety practices and outcomes across different regions and construction contexts can contribute to the development of context-specific strategies.

In short, this bibliometric analysis serves as a foundational resource for researchers, practitioners, and policymakers invested in enhancing safety performance in the construction industry. As the construction industry continues to evolve, embracing technological innovations and sustainability imperatives, safety performance research remains an essential compass, guiding the sector towards safer, more resilient, and more socially responsible practices.

CONCLUSION

In the realm of construction industry safety, the comprehensive bibliometric analysis conducted herein has offered a valuable lens through which to scrutinise the multifaceted terrain of safety performance research. The trajectory of safety performance research has, over the years, revealed the sector's remarkable adaptability and resilience in the face of evolving challenges. It thus illuminates the profound commitment of both academic and industrial stakeholders to proactively address safety concerns.

In synthesis, this bibliometric analysis stands as an invaluable resource, catering to the needs of researchers, practitioners, and policymakers who are highly committed to improving safety performance within the construction industry. It serves as an illuminating guidepost, charting the evolutionary trajectory of safety research, delineating the dominant agents of influence, and elucidating the significance of international collaboration. As the construction industry continues its evolutionary trajectory, marked by the assimilation of technological innovations and the embrace of sustainability imperatives, safety performance research remains an indispensable compass—a guiding light steering the sector towards practices that are inherently safer, more resilient, and imbued with social responsibility.

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