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A bibliometric analysis of safety performance in the government sector

Khairul Hafezad Abdullah[a] | Syazwan Syah Zulkifly[b] ✉ | Siti Hawa Harith[c] | Mohd Salahudin Shamsudin[c] | Nor Halim Hasan[d]

[a]Social Security Management Centre of Excellence (SoSCoE), School of Business Management, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[b]Institute for Business Competitiveness and Sustainability Initiative (IBCSI), School of Business Management, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[c]School of Business Management, Universiti Utara Malaysia, Sintok, Kedah, Malaysia.
[d]Department of Occupational Safety and Health, Seremban, Negeri Sembilan, Malaysia.

Abstract This study conducts a bibliometric analysis focusing on safety performance within the government sector, drawing on data from Scopus and Web of Science (WoS). Analyzing publication productivity, thematic areas, influential authors, leading research institutions, and prevalent keywords, our findings reveal a substantial increase in safety performance publications, particularly notable trends emerging in recent years. Key themes include "road safety," "risk management," and "safety culture," reflecting evolving priorities within governmental safety performance research. Additionally, "factor analysis" is observed alongside "safety climate" and "construction safety," suggesting a methodological shift in examining safety practices within construction-related governmental activities. Furthermore, "benchmarking" is associated with various safety domains, indicating a holistic approach to safety performance improvement. Mapping research collaboration among authors from different countries unveils distinct clusters, highlighting regional partnerships and global networks. Notably, Canada appears as an isolated cluster, while Europe demonstrates a collaborative network, and Southeast Asia and Oceania exhibit regional cooperation. East Asian countries also showcase collaboration, as do countries from different continents, emphasizing global partnerships in safety performance research. These collaborative efforts are crucial for advancing safety performance, knowledge, sharing best practices, and addressing common challenges within governmental contexts. This analysis offers valuable insights for policymakers, practitioners, and researchers interested in enhancing safety performance and fostering a culture of resilience within government entities.

Keywords: safety performance, scopus, web of science, bibliometric

1. Introduction

Safety performance within governmental sectors is a critical concern worldwide, with implications for the well-being of employees, and citizens, and for the overall functioning of governmental operations. Safety performance is defined as employees' participation in and compliance with workplace safety and health (Neal et al., 2000). Neal et al. (2000) measure safety performance based on employees' compliance with organizational safety procedures as well as their participation in helping other coworkers and promoting safety programs in the workplace. However, in a study by Bautista-Bernal et al., (2024), safety performance was measured through the total injury rate in the organization. Moreover, compared with organizations with a high injury rate, organizations with a low total injury rate are safer (Bautista-Bernal et al., 2024). Alternatively, some researchers assess safety performance by gauging decreases in injuries, accidents, property damage, and losses of goods (Chua & Wahab, 2017; Shang et al., 2011; Zulkifly et al., 2021, 2023).

Moreover, a study by Saleem and Malik (2022) reported that safety performance can be influenced by safety consciousness and safety climate. Employees with safety and health knowledge are more conscious about performing their work cautiously and ensuring that they are not trying to harm anyone else (Meng et al., 2019). As a result, a positive safety climate can be cultivated in the organization when all employees engage in work in a safe manner, adhere to safety and health procedures and attempts to prevent workplace accidents (Borgheipour et al., 2020).

Continuous engagement in safety and health work practices cultivates the organizational safety culture. Safety culture signifies the organization's commitment and obligation to practice safety and health work procedures and encourages employees to engage in collective responsibilities and accident preventive thinking (Abeje & Luo, 2023; Guldenmund, 2000). Numerous studies have highlighted the significance of safety culture factors in shaping safety performance across diverse industrial sectors, including government paramedic training institutes (Arzahan et al., 2022). The evaluation methods employed for traffic safety in local governments have garnered attention, with calls for improvements and the application of diverse accident exposure-based indicators to identify weak safety roads and clarify management responsibility (Kim & Kim, 2022).

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ISO 26000 specifically focuses on preventing occupational risk and danger, safeguarding employees' health, and customizing employees' work and working conditions (International Organization for Standardization, 2010). This objective can only be achieved when employees have high safety self-awareness and understand any issue or situation that could threaten their safety and health (Kelloway et al., 2006). Such awareness indirectly promotes accident prevention behavior and safety performance among employees and cultivates a safety-enforced environment in the workplace (Saleem & Malik, 2022).

Zero workplace accidents have become the goal of every organization to support their expansion and growth. Therefore, to support this notion, organizations need to promote safety culture in the workplace and ensure that employees behave safely while performing their work (Ahamad et al., 2022). A study by Mat Isa et al. (2021) reported that within government-linked companies, various factors, such as management commitment, safety rules and procedures, safety communication, safety training effectiveness, and safety knowledge acquisition, have been identified as crucial contributors to compliance with safety culture and organizational safety performance outcomes. This underscores the multifaceted nature of safety management within governmental entities and the need for comprehensive approaches to enhance safety performance.

Furthermore, research has emphasized the positive relationship between occupational health and safety measures and employee performance within the government sector (Kaloki & Ng'eno, 2022). This highlights the importance of improving working conditions and implementing effective safety measures to promote better performance outcomes among government employees. A study by Naji et al. (2021) reported that employees' safety performance is influenced by the safety culture practiced in the organization. Similarly, Alkhaledi et al. (2023) reported that strong safety culture practiced by employees in the public sector in Dubai and Kuwait significantly improved organizational safety performance.

This bibliometric analysis utilized the Scopus and Web of Science (WoS) databases to analyze safety performance research within the context of the government sector. In addition, ScientoPy and VOSviewer were utilized in this study to investigate the progress of the previously mentioned publication theme. Although existing studies offer valuable insights into the relationships among safety culture, occupational health and safety, and organizational performance within governmental sectors, further exploration and analysis are needed. This study aims to contribute to the literature by conducting a comprehensive bibliometric analysis focusing specifically on safety performance research within the government sector. By examining publication trends, thematic areas, influential authors, leading research institutions, and prevalent keywords, this analysis seeks to provide valuable insights for policymakers, practitioners, and researchers interested in enhancing safety performance and fostering a culture of resilience within government entities.

2. Materials and Methods

A systematic approach was adopted to conduct this bibliometric analysis of safety performance research within the government sector. First, relevant keywords related to safety performance and the government sector were used for searching and analyzing the datasets: "safety performance" OR "performance of safety" AND ("government sector" OR "public sector" OR "state sector" OR "civil service" OR "public administration" OR "municipal sector" OR "government"). These keywords were selected to ensure comprehensive coverage of relevant literature on safety performance within governmental contexts, encompassing various terms commonly associated with the government sector.

These keywords were then used to search for relevant publications in two widely used academic databases, Scopus and Web of Science (WoS). These two academic databases were utilized to retrieve relevant publications for this study. These databases are widely regarded for their comprehensive coverage of academic literature across various disciplines, making them suitable for bibliometric analyses (Abdullah, 2023). Scopus offers extensive coverage of scientific literature, including peer-reviewed journals, conference proceedings, and patents (Abdullah & Abd Aziz, 2021), while WoS provides access to high-quality scholarly content from prestigious journals and conferences. The search was conducted using Boolean operators to combine the keywords effectively. Next, the retrieved datasets were analyzed using bibliometric techniques to identify publication trends, subjects, keywords, and country analysis.

Two software tools, ScientoPy and VOSviewer, were utilized for data analysis and visualzation. ScientoPy is a Python-based bibliometric analysis tool that offers data retrieval, processing, and visualzation functionalities (Abdullah, 2023). VOSviewer is a software tool for constructing and visualizing bibliometric networks, including coauthorship networks and keyword co-occurrence maps (Abd Aziz et al., 2022). These software tools facilitated the analysis and interpretation of the datasets, enabling the identification of key trends and insights in safety performance research within the government sector.

3. Results

3.1. Preliminary Analysis

The preliminary analysis in this review involved amalgamating datasets sourced from the Scopus and Web of Science (WoS) databases. The integration process aimed to harness a comprehensive pool of scholarly information for thorough examination. Additionally, to ensure data integrity and avoid redundancy, duplicate entries were systematically removed via the ScientoPy tool. This step was crucial for refining the dataset, eliminating redundancies, and facilitating a more focused

analysis. The combined dataset from these reputable sources forms the foundation for robust analysis and insightful conclusions in this review (Sofyan et al., 2022).

Table 1 presents a detailed breakdown of the data processing steps undertaken in analyzinging papers on safety performance research within the government sector. Initially, 463 papers were identified from both the WoS and Scopus databases. Of these, 25 papers, constituting 5.40% of the initial dataset, were omitted based on document type considerations. After omitting these papers, the dataset consisted of 438 papers. Further examination revealed 109 duplicated papers, comprising 24.90% of the initial dataset. These duplicates were removed from the Scopus database, while none were removed from the WoS database. Interestingly, among the duplicated papers, 75 exhibited variations in citation counts. After removing duplicates, the dataset comprised 329 unique papers, 46.80% of which originated from WoS and 53.20% from Scopus. This comprehensive analysis underscores the meticulous approach taken to ensure the integrity and accuracy of the dataset for subsequent analysis of safety performance research within the government sector.

Table 1 Dataset amalgamation and duplicate removal.

Information	Number	Percentage
Loaded papers	463	
Omitted papers by document type	25	5.40%
Total papers after omitted papers removed	438	
Loaded papers from WoS	154	35.20%
Loaded papers from Scopus	284	64.80%
Duplicated removal results:		
Duplicated papers found	109	24.90%
Removed duplicated papers from WoS	0	0.00%
Removed duplicated papers from Scopus	109	38.40%
Duplicated documents with different cites by	75	68.80%
Total papers after removal duplicate	329	
Papers from WoS	154	46.80%
Papers from Scopus	175	53.20%

3.2. Publication Trends

The data from Figure 1 vividly illustrate a significant and sustained upward trajectory in publication trends concerning safety performance research within the government sector. The Scopus and Web of Science (WoS) databases showcase a remarkable surge in publications over the five decades since 1972, indicative of a burgeoning interest in and emphasis on this critical subject matter. While occasional fluctuations in publication rates are observed, particularly in the early 1980s and mid-1980s, the overarching trend underscores a consistent increase in research activity. Notably, recent years, particularly approximately 2021-2023, stand out as peak publication years, showcasing a heightened focus and potentially significant advancements in safety performance research within governmental contexts. This unmistakable surge reflects the growing awareness of safety concerns and underscores the evolving landscape of regulatory imperatives and societal expectations regarding safety within government organisations.

3.3. Subject Analysis

Figure 2 provides insightful data on the distribution of publications across various subjects related to safety performance research in the government sector. Engineering has emerged as the dominant subject, with 71 publications emphasizing technical aspects and engineering solutions to safety challenges within governmental contexts. The second most common health factor is public, environmental and occupational health, reflecting a significant focus on health-related aspects of safety performance, including public health interventions, occupational safety measures, and environmental health considerations. Operations Research & Management Science and Transportation also feature prominently, highlighting the importance of operational efficiency and transportation safety within government sectors. The presence of construction and building technology underscores the importance of safety in infrastructure development projects, while business and economics reflects the economic dimensions of safety performance and its implications for governmental operations. Additionally, subjects such as Environmental Sciences & Ecology, Social Sciences - Other Topics, and Science & Technology -Other Topics contribute to a multidisciplinary approach to addressing safety challenges. However, it is worth noting that certain subjects, such as Materials Science, have fewer publications, suggesting potential areas for further exploration and research in the realm of safety performance within the government sector. Overall, the diverse distribution of publications across various subjects underscores the multidimensional nature of safety performance research and the interdisciplinary collaboration necessary for effectively addressing safety challenges in governmental contexts.

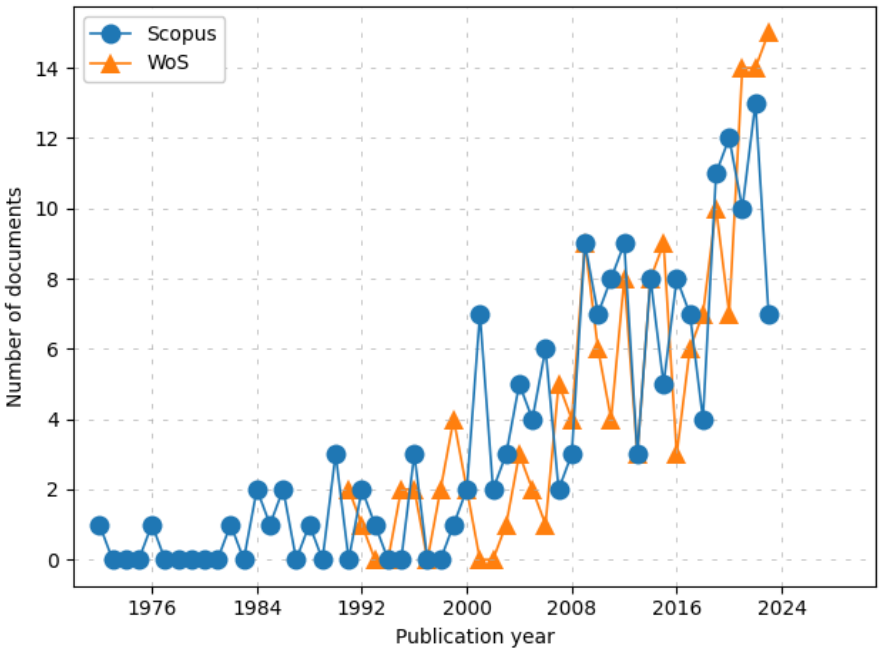


Figure 1 Trends and evolution of safety performance research in the government sector.

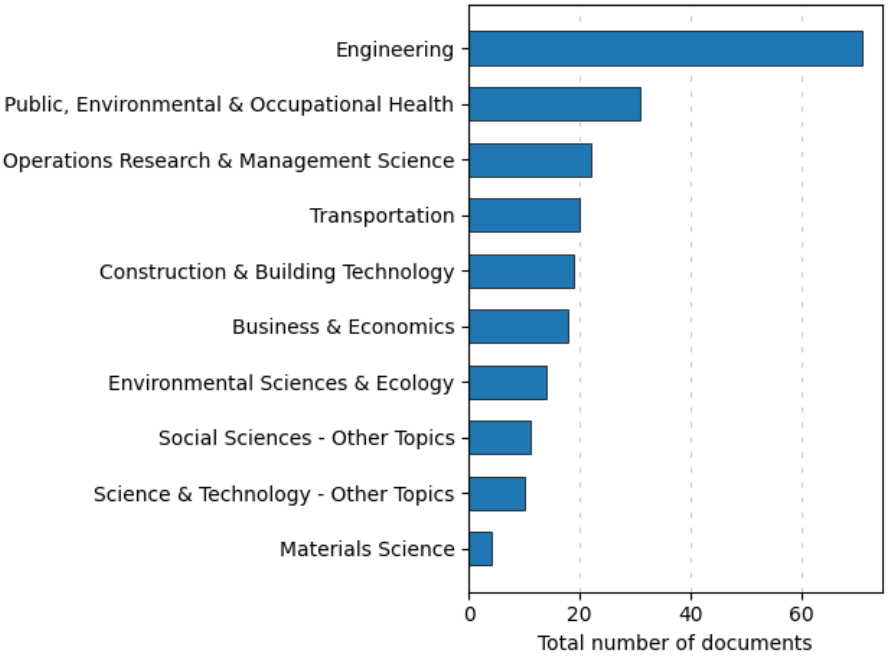


Figure 2 Subject of interest.

3.4. Keyword analysis

Figure 3 provides valuable insights into the most frequently used keywords in safety performance research within the government sector, emphasizing the most trending keywords and their significance. “Safety Performance” emerges as the most prevalent keyword, primarily focusing on evaluating and improving safety outcomes within governmental contexts. The “construction industry” closely follows, indicating a significant interest in safety within construction projects, a sector known for its inherent safety challenges. “Safety” represents a broad keyword encompassing various aspects of safety management and practices, underscoring its fundamental importance across different governmental sectors. “Safety Management” and “Occupational Health and Safety” further highlight the importance of organisational strategies and employee well-being in ensuring safety performance.

Notably, several keywords have demonstrated considerable traction in recent years, as evidenced by their high percentage of documents published in 2022 and 2023. Risk Management stands out with 44% of publications in these two years, reflecting an increased focus on identifying and mitigating risks to enhance safety outcomes. “Safety culture” follows closely with 60% of publications, indicating a growing recognition of the role of organisational culture in shaping safety practices and behaviors within governmental entities. “Benchmarking” also shows a significant uptick, suggesting an increasing emphasis on comparative analysis to drive safety improvements.

Other keywords such as “Road Safety,” “Accidents,” and “Food Safety” highlight specific safety concerns within governmental operations, underscoring the diverse range of safety challenges addressed in the research. Additionally, keywords such as “construction workers” focus on the safety of specific workforce segments, while “data envelopment analysis” reflects a methodological approach to evaluating safety performance.

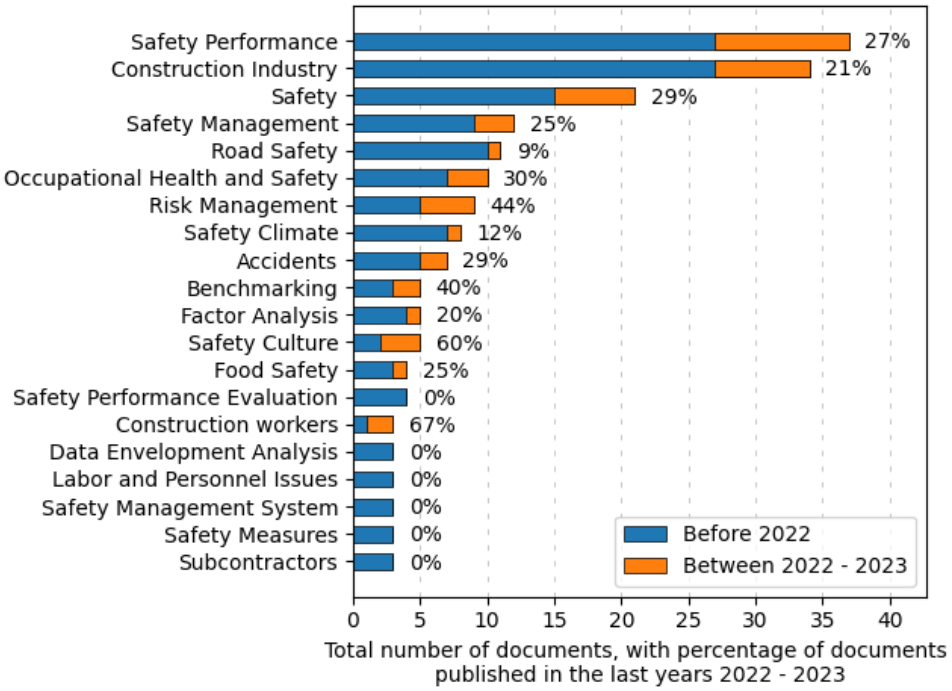


Figure 3 The 20 most related keywords previously researched.

However, despite their importance, specific keywords exhibit a lower percentage of documents published in the last two years, indicating potential areas for increased research attention. For example, “safety performance evaluation” and “safety management system” both demonstrate room for further exploration and development in recent safety performance research within the government sector. The analysis of keywords in Figure 3 provides valuable insights into the evolving landscape of safety performance research, highlighting established priorities and emerging trends within the government sector.

3.5. Country Analysis

Figure 4 provides valuable insights into the distribution of safety performance research within the government sector across different countries. The data highlight the United States as the most active country in this field, with 67 publications. While the United States leads safety performance research within the government sector, other countries, such as China, Australia, and the United Kingdom, also demonstrate significant research activity.

The United States’ focus on safety performance research in the government sector is driven by its stringent regulatory environment, necessitating continuous efforts to uphold safety standards enforced by agencies such as Occupational Safety and Health Administration (OSHA). Additionally, public accountability and the country’s commitment to ensuring the safety and well-being of its citizens and employees incentivize ongoing research to enhance safety practices within government operations. On the other hand, China is likely motivated by its rapid industrialization and urbanization, which have led to heightened safety concerns, particularly in the government sector, prompting research to identify and address safety risks.

In Australia, a strong emphasis on occupational health and safety standards and a culture of continuous improvement drive research efforts to enhance safety performance within governmental organisations. The United Kingdom’s focus on safety performance research can be attributed to its commitment to regulatory compliance and organisational excellence, with

research initiatives to foster a safety culture and risk management within the government sector. Finally, Malaysia's focus on safety performance research likely stems from its efforts to align with international safety standards and enhance the competitiveness of its government operations, necessitating research to improve safety practices and mitigate risks. Overall, the motivations driving safety performance research in these countries vary, but they share a common goal of ensuring the safety and well-being of individuals and communities impacted by governmental activities.

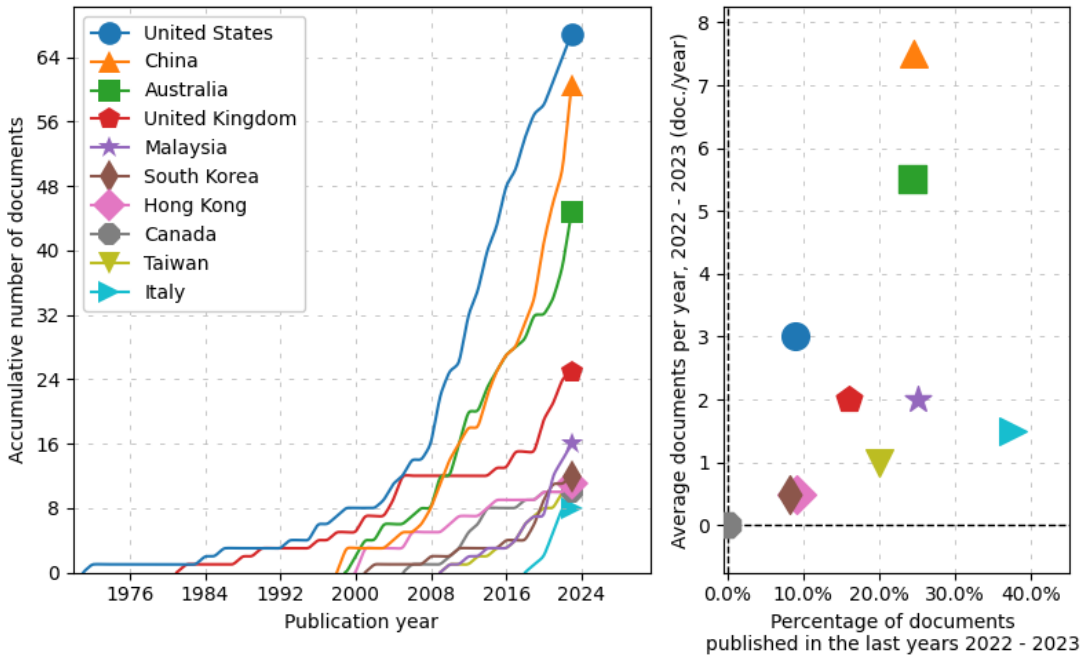


Figure 4 The top ten most active countries.

3.6. Mapping of the Co-occurrence of Authors' Keywords

The mapping of authors' keywords using VOSviewer, based on Figure 5, reveals significant clusters and associations among keywords in safety performance research within the government sector dataset. With a minimum occurrence of 5, 805 keywords were analyzed, and 17 linked keywords were identified. These linked keywords represent key themes and concepts prevalent in the literature (see Figure 5).

The mapping of authors' keywords on safety performance research within the government sector, as depicted in Figure 5, reveals several noteworthy trends and associations among keywords. Among the most trending keywords that have appeared after 2020 are "road safety," "risk management," and "safety culture." These keywords signify a heightened focus on addressing road safety issues, managing risks effectively, and fostering a safety-oriented organisational culture within governmental contexts. The emphasis on these keywords reflects evolving priorities in safety performance research, likely influenced by emerging challenges and regulatory developments in recent years.

Additionally, the keyword "factor analysis," which prominently emerged after 2014, demonstrates a strong relationship with "safety climate" and "construction safety." This association suggests that factor analysis techniques are being increasingly utilized to examine the underlying factors influencing safety climate and practices within construction-related governmental activities. The clustering of these keywords underscores the interconnectedness of concepts and methodologies in safety performance research, particularly within the construction sector.

Furthermore, the keyword "benchmarking," which gained prominence starting in 2016, is clustered together with "road safety," "risk management," and "occupational health and safety." This association suggests that benchmarking practices are being employed to compare and evaluate safety performance metrics in various domains, including road safety, occupational health and safety, and overall risk management within governmental operations. The clustering of these keywords indicates a holistic approach to safety performance improvement, incorporating benchmarking as a strategic tool for continuous enhancement and comparison against industry standards.

The mapping of authors' keywords highlights evolving research themes and methodologies in safety performance research within the government sector. These trends underscore the dynamic nature of safety management practices and the ongoing efforts to address emerging challenges and enhance safety outcomes in governmental operations. The interconnectedness of keywords reflects a multidisciplinary approach to safety performance improvement, integrating diverse concepts and methodologies to promote a culture of safety and resilience within government entities.

3.7. Mapping of Research Collaboration among Countries

Mapping research collaboration among authors from different countries using VOSviewer provides valuable insights into the global network of scholars engaged in safety performance research within the government sector. By analyzing coauthorship networks, VOSviewer enables the visulaization of collaborative relationships, the identification of key contributors, and the highlighting of patterns of international collaboration. Figure 6 depicts the network collaboration among authors affiliated with different countries.

Based on Figure 6, which depicts network collaboration among authors from different countries in safety performance research within the government sector, several key findings emerge. With a minimum number of documents set at 5, 66 countries were analyzed, with 13 countries mapped in the network collaboration visualization.

The clustering of countries into five distinct clusters reveals patterns of collaboration and cooperation among researchers from different regions. Canada stands out as an isolated cluster, denoted in purple, suggesting that Canadian researchers have a unique collaborative network within the safety performance research domain in the government sector. The largest cluster, denoted in red, comprises the Netherlands, Italy, the United Kingdom, and Germany. This cluster indicates a collaborative solid network among European countries, reflecting the close ties and partnerships in safety performance research within governmental contexts across these nations.

The yellow cluster includes Malaysia and Australia, highlighting collaborative efforts between researchers from Southeast Asia and Oceania. This cluster signifies regional cooperation and knowledge exchange in addressing safety challenges within the government sector. The green cluster, involving Hong Kong, China, and Singapore, represents collaboration among East Asian countries. This cluster underscores the importance of regional partnerships and shared expertise in advancing safety performance research within governmental organisations in this region. Finally, the blue cluster encompasses the United States, South Korea, and Iran, indicating collaborative networks spanning different continents. This cluster highlights global partnerships and knowledge sharing in safety performance research, with countries from diverse regions working together to address common safety challenges within governmental contexts.

Overall, the network collaboration visualization in Figure 6 provides valuable insights into the global landscape of safety performance research within the government sector, revealing patterns of collaboration and cooperation among researchers from different countries and regions. These collaborative networks are crucial for advancing knowledge, sharing best practices, and developing practical solutions to improve worldwide safety outcomes in governmental operations.

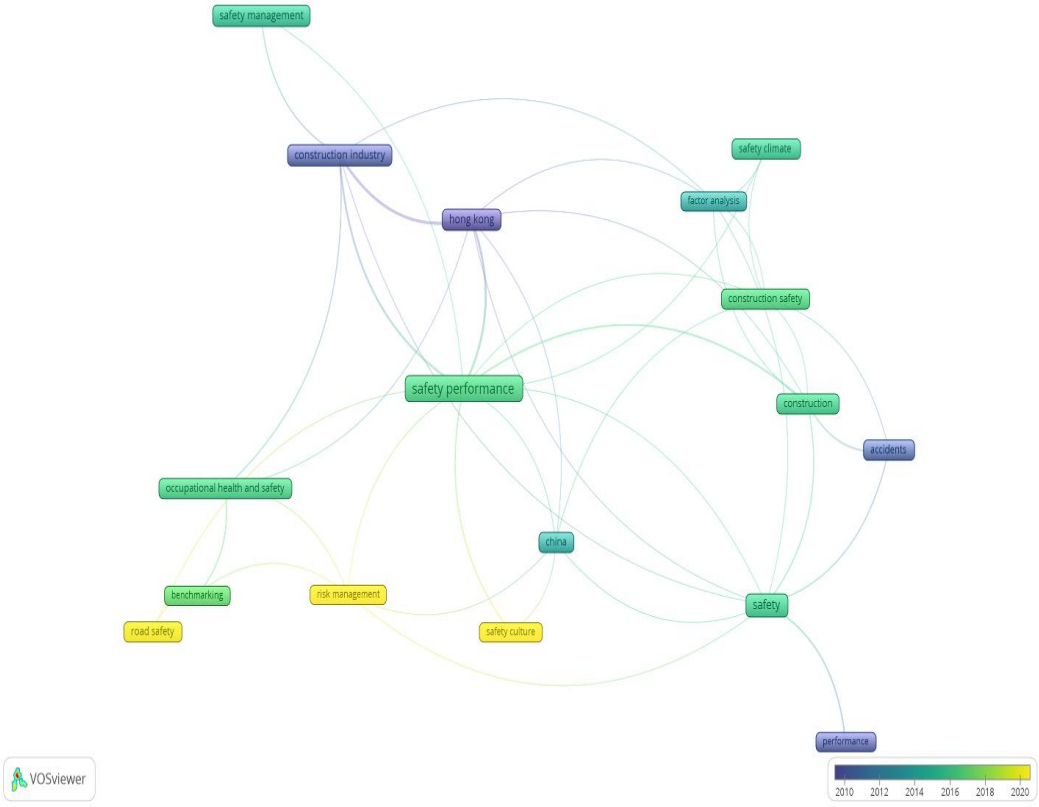


Figure 5 The overlay visualization of authors' keywords.

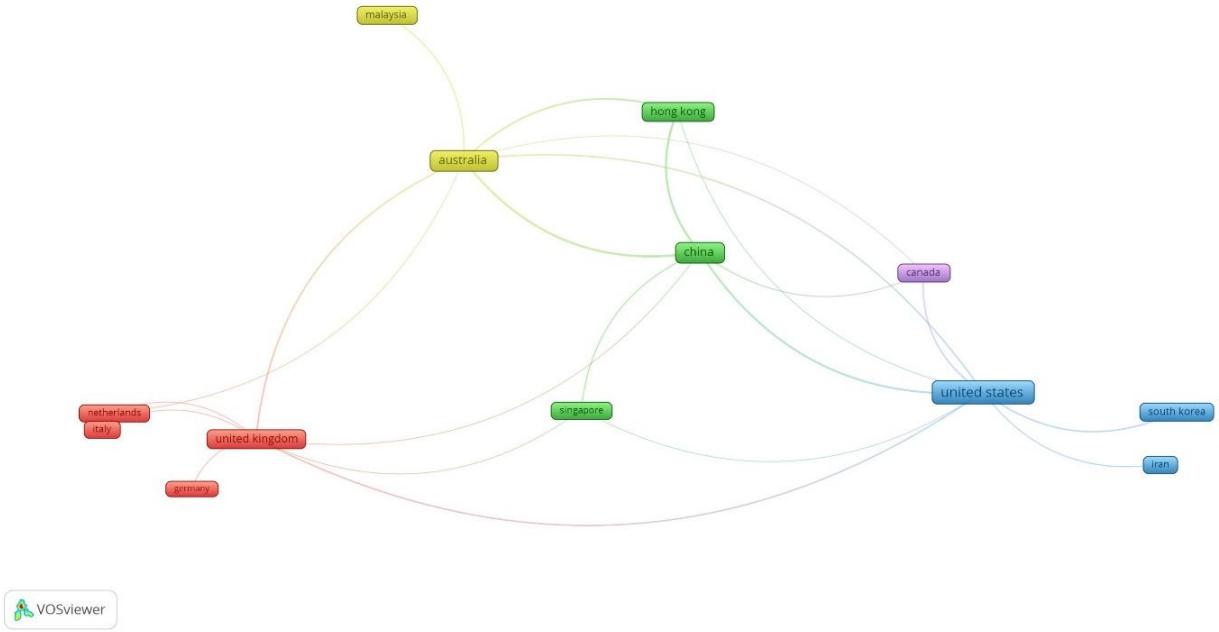


Figure 6 Collaboration among authors affiliated with different countries.

4. Discussion

The bibliometric analysis of safety performance research from 1972 to 2024 provides a thorough overview of publication trends, keyword occurrences, and the geographic distribution of research efforts. This analysis reveals significant insights into the development of safety performance research, highlighting its implications for the field and identifying areas for future investigation. Organizations and industries are increasingly recognizing the importance of fostering a positive safety culture to prevent accidents and enhance well-being (Loktionov et al., 2023). This awareness has likely been driven by new safety regulations and guidelines, prompting more focused research and initiatives aimed at improving safety practices. Major accidents and high-profile incidents have underscored the urgent need for robust safety protocols, further fuelling this research trend (Anene et al., 2023).

Safety within the construction industry has become a prominent topic, with a substantial increase in related publications. The significant growth of the construction industry globally has led to heightened research interest in worker safety (Berglund et al., 2023). Labor shortages have necessitated enhanced safety measures to protect skilled workers, and technological advancements in construction methods and equipment have introduced new safety challenges and opportunities, prompting more research to ensure worker safety (Nandan et al., 2023).

Safety performance research spans various disciplines, including engineering, public health, operations research, and transportation, reflecting the complexity of safety challenges within the government sector and the need for diverse perspectives to address them effectively (Tappura et al., 2023). The prominence of keywords such as “safety culture,” “risk management,” and “occupational health and safety” in recent publications further underscores the multifaceted nature of safety performance research.

The global nature of safety performance research is highlighted by country analysis and the mapping of research collaboration among countries. The United States leads in publication activity, likely driven by its stringent regulatory environment and commitment to public accountability. Other countries, such as China, Australia, and the United Kingdom, also demonstrate significant research activity, motivated by their unique safety challenges and regulatory frameworks. The coauthorship network shows the importance of international partnerships in advancing safety research and sharing best practices.

The keyword analysis reveals emerging trends such as an increasing focus on road safety, risk management, and safety culture. These trends indicate evolving priorities in safety performance research, likely influenced by new regulatory requirements and technological advancements (Ong et al., 2023). The growing interest in benchmarking practices and factor analysis techniques suggests a strategic approach to evaluating and improving safety performance metrics within government operations (Chang et al., 2020).

5. Final Considerations

This bibliometric study revealed that safety performance is a pivotal aspect that has been emphasized in the government sector. Notably, safety performance has been studied worldwide, and a review of the literature emphasized that this topic has

mostly been studied in East Asian and European countries. In addition, there has also been a drastic increase in the number of documents on safety performance in the governmental sector over the years, which shows that this topic is becoming a major concern among researchers. The findings of this study also reveal that there is a diverse distribution of publications on safety performance within the government sector. Engineering and public, environmental and occupational health are among the dominant subjects involved in addressing safety performance issues. However, other sectors, such as the construction sector and transportation sector, are at the top in publishing studies related to safety performance.

In short, safety performance is indeed a significant issue that is currently being studied by academicians and practitioners. This topic is expected to become one of the top research areas in the future. While this bibliometric analysis provides valuable insights into safety performance research within the government sector, certain limitations should be acknowledged. First, the analysis relies solely on data obtained from the Scopus and Web of Science (WoS) databases, potentially overlooking relevant publications indexed in other databases or gray literature sources. This limitation may result in a partial representation of the research landscape, omitting valuable contributions from nonindexed sources or emerging research platforms.

Second, the selection of keywords used in the search strategy may influence the scope and coverage of the retrieved publications. While efforts were made to employ comprehensive keywords encompassing various facets of safety performance and governmental sectors, the omission of certain terms or variations could lead to gaps in the dataset. Additionally, the exclusion of papers based on document type considerations may overlook valuable insights presented in formats such as conference proceedings or technical reports.

Furthermore, this analysis focuses primarily on quantitative metrics, such as publication counts and citation frequencies, to assess research productivity and impact. While bibliometric indicators offer valuable quantitative insights, they may not capture the qualitative aspects of research, such as the novelty of ideas, methodological rigor, or real-world applicability. Future studies could complement bibliometric analyses with qualitative assessments to provide a more comprehensive understanding of safety performance research within the government sector.

Despite these limitations, this study paves the way for several avenues for future research in the field of safety performance within governmental contexts. First, future studies could explore the impact of emerging technologies, such as artificial intelligence and the Internet of Things (IoT), on safety management practices within government organizations. Investigating how these technologies influence safety performance metrics, risk assessment methodologies, and decision-making processes could provide valuable insights for policymakers and practitioners.

Additionally, there is a need for longitudinal studies to track the evolution of safety performance research trends over time and assess the long-term effectiveness of safety interventions implemented within governmental sectors. Longitudinal analyses could help identify persistent challenges, emerging priorities, and best practices in safety management, facilitating evidence-based policymaking and strategic planning.

Moreover, given the increasing globalization of safety challenges, future research could examine cross-national comparisons of safety performance metrics and regulatory frameworks across different governmental contexts. Comparative studies could highlight variations in safety practices, regulatory enforcement mechanisms, and cultural factors influencing safety outcomes, offering valuable lessons for international collaboration and knowledge exchange.

Finally, there is a growing recognition of the importance of stakeholder engagement and participatory approaches in safety management within governmental organizations. Future research could explore the role of community involvement, employee empowerment, and multistakeholder partnerships in enhancing safety performance and fostering a culture of resilience within government entities. By addressing these avenues of future research, scholars and practitioners can contribute to advancing knowledge, informing policy decisions, and ultimately improving safety outcomes within governmental sectors globally.

Ethical considerations

Not applicable.

Conflict of interest

The authors declare no conflicts of interest.

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