

A Bibliometric Analysis of Risk Management in Road Construction Project

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ABSTRACT

Risk management in road projects is a process of controlling construction work and development that significantly affects the success of road project work. This research aims to investigate the latest developments in the world, with a specific focus on those related to risk management in road construction. The study intends to shed light on emerging trends and innovations in the field by exploring global advancements. The primary goal is to contribute valuable insights that can enhance the understanding and implementation of risk management strategies in road construction projects. These publications were obtained by scrutinizing keywords such as road construction, risk management, and construction projects. Utilizing Publish or Perish facilitated the extraction of data relevant to our research topic. Subsequently, the acquired data was transformed into a new format using Microsoft Excel. This dataset encompasses citation counts, author names, and publication years. Leveraging this information and Microsoft Excel, we constructed a chart or figure to present a comparative analysis. Additionally, VOSViewer was employed to create a visual representation illustrating relationships between research keywords.

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1. INTRODUCTION

The construction industry makes an essential contribution to a country's economy [1]. To improve the world economy, it cannot be separated from infrastructure needs [2]. The construction sector plays a vital role in infrastructure development [3]. Roads are essential for socioeconomic development by

providing access to resources, jobs, and markets [4]. The value of construction completed tends to increase yearly, indicating that construction activities in Indonesia are constantly growing [5]. This has a positive impact on economic and social aspects.

As population growth increases, so does the need for facilities and infrastructure in Indonesia [6].

This increases congestion points that require the government to build and improve transportation infrastructure and facilities, especially roads [7]. Congestion is a significant issue related to road network development, especially in urban areas [8]. Therefore, adequate road infrastructure is needed so people can comfortably carry out activities [9] [10].

Risk management is integral to the construction industry because it is instrumental in decision-making. Construction projects often risk adversely impacting the project's time, cost, and quality during its implementation [11]. According to Loosemore et al. (1993), project risk management includes technical and non-technical aspects. Technical aspects are related to work items, while non-technical aspects include the relationship between the project and the surrounding community, the project and the local government, superiors and subordinates, and so on [12]. The success of a construction implementation is also determined by its ability to manage various aspects related to construction, including risk aspects, so that the agreed-upon and determined project objectives can be achieved, significantly affecting road project work's success. Therefore, this research aims to contribute to understanding the importance of risk management in construction projects, especially road projects [13] [14].

This research illustrates how effective risk management practices can identify, measure, and manage potential risks during road project construction. It also emphasizes how risk management can help road projects achieve their primary goal: providing the community with safe, efficient, and sustainable transportation infrastructure. This research also uses Vosviewer to assist in bibliometric analysis and can help identify current trends in scientific publications.

2. LITERATURE REVIEW

2.1 Road infrastructure

This research deals in depth with aspects of highway infrastructure, detailing the various elements that affect its quality and functionality. As a foundation, this research integrates findings from previous studies focusing on highway-related issues, forming a solid knowledge base. Prior research provides valuable insights and a

deep understanding of the complexities of the highway system. Roads, in the context of this study, are recognized as vital elements that connect the movement of people and serve as critical pathways for the movement of goods. A thorough analysis of road infrastructure is essential to understanding its impact on mobility and connectivity within the Society [15].

The times have brought significant changes in the construction sector, especially in transportation, such as roads. Over time, highways have evolved from simply linking regions to a more complex and structured system. This transformation is inseparable from the contribution of technological development, which has resulted in innovations that have never existed. These innovations are designed to improve road efficiency and safety [16]. As such, these developments create more sophisticated roads and reflect a commitment to continuously improve the quality and functionality of transportation infrastructure to support society's increasingly complex needs [17] [18] [19].

Based on previous research, results from various sources have confirmed that technological development significantly affects road infrastructure's evolution. Previous studies have consistently indicated that technological advancements are crucial in developing road infrastructure and profoundly affect critical aspects such as efficiency, safety, and sustainability. With advanced technology, the development of integrated transportation systems and intelligent solutions for traffic management is increasingly becoming an essential focus in improving the quality of road networks [20]. An in-depth understanding of the linkages between technology and road infrastructure is critical to designing effective and sustainable policies to support the development of society and the economy.

2.2 Construction Safety Hazard

There must be a risk in every construction project, and road construction projects are no exception. Previous research that discusses the risks in construction activities will be a source in this research. In earlier research, it was stated that the Contractor is the only party among the stakeholders who must face some risks during the life cycle of a construction project [21]. Risk is

a consequence of uncertain conditions [22]. Even though an activity has been designed as well as possible, of course, there is a possibility that the designed activity needs to follow what is expected.

In construction projects, several risks require careful consideration, including the safety risk within the workplace [23] [24]. Safety is a severe aspect that demands special attention in a construction project. These risks can result from various factors encountered during the construction work [25]. The first factor originates from the workers, where a lack of understanding and skills in their tasks and non-compliance with safety procedures increases the likelihood of workplace accidents. Another contributing factor may arise from external elements present during construction activities. Identifying and addressing these risks promptly ensures a secure working environment. Proactive measures, such as comprehensive training and strict adherence to safety protocols, are crucial in minimizing the potential for work-related accidents.

Construction projects often ignore safety risks, and a stringent safety program is necessary. Regulations ensuring the protection of workers and the surrounding community from potential hazards become imperative [26]. With such regulations, a safe and productive working environment is hoped to be created. The implementation of safety regulations not only safeguards the workers but also contributes to the efficiency and overall sustainability of the construction project [27] [28]. Safety in a job is not only the responsibility of the Contractor itself but is a collective responsibility of all parties involved in the construction work being carried out.

2.3 Time Management

This research topic in road construction projects involves several risks that can significantly affect the project, including time. Time is one of the critical factors that can affect the project's overall time management success. Contractors need to identify, measure, and proactively manage time risks. These actions aim to minimize the possibility of delays and ensure the timely achievement of project targets by closely monitoring the schedule. The project management team can identify changes that may occur and take the necessary actions to keep the

project on track. Therefore, proactive time management efforts are crucial to successfully executing construction projects.

Factors that affect the delay of a project must be considered wisely, and one of the things that need to be considered is the natural factor of damage to the work already done. Besides natural factors, there are other factors, such as delays in material delivery. Delays in the delivery of materials needed for construction, if they are unavailable on time or experience delays, can seriously impact the project schedule. Therefore, project management needs to carefully consider and manage these two factors to mitigate the risk of project delays due to weather conditions or technical problems in the material supply chain.

Good time management also involves identifying potential risks, such as bad weather or late delivery of materials, so that preventive measures can be taken early on [29]. In addition, the use of modern technology also contributes to the efficiency of time management in the construction industry. Project planning software and integrated information systems allow project managers to quickly monitor real-time progress, identify bottlenecks, and take corrective actions. With the adoption of these technologies, construction projects can be run more efficiently, saving time and optimizing the use of resources. Overall, good time management in construction affects not only the timely completion of projects but also the quality of the results and the sustainability of the construction industry.

3. METHOD

This research aims to investigate the latest developments in the world, with a specific focus on those related to risk management in road construction. The study intends to shed light on emerging trends and innovations by exploring global advancements. The primary goal is to contribute valuable insights that can enhance the understanding and implementation of risk management strategies in road construction projects. Ultimately, this research seeks to provide a comprehensive perspective on the current state of risk management in road infrastructure development. This research was carried out with a systematic literature review using bibliometric analysis using VOS Viewer and published or perished.

4. RESULT AND DISCUSSION

These publications were obtained by scrutinizing keywords such as road construction, risk management, and construction projects. Utilizing Publish or Perish facilitated the extraction of data relevant to our research topic. Subsequently, the acquired data was transformed into a new format using Microsoft Excel. This dataset encompasses citation counts, author names, and publication years. Leveraging this information and Microsoft Excel, we constructed a chart or figure to present a comparative analysis. Additionally, VOSViewer was employed to create a visual representation illustrating relationships between research keywords.

4.1 Network Visualization Based on Keywords

The network visualization, presented through the VOS viewer in Figure 1, illustrates the connections among the visualized terms. In this depiction, the figure provides a visual representation of the most frequently used keywords derived from an analysis of 1000 articles. The visualization is a valuable tool for understanding the relationships and patterns within the network of terms.

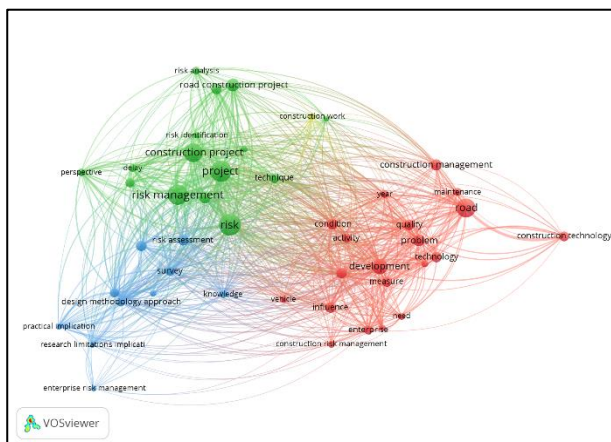


Figure 1. Keyword Trends (2000-2023).

The figure shows that the most frequently used keywords include "risk management," "construction project," and "road construction." The visualization allows for easy identification of these key terms and provides a clear overview of their prevalence within the analyzed data.

4.2 Density visualization based on keywords

The result of the review using the VOSviewer application is the density between research keywords. This result visualizes the keywords entered and selected to create Figure 3.

The visualization results from (figure 3) reveal the presence of 34 keywords associated with the risk management of road construction projects. These keywords offer valuable insights into the specific focus areas within the context of risk management for such projects. The visualization enhances our understanding by highlighting and organizing the relevant terms related to this critical aspect of road construction.

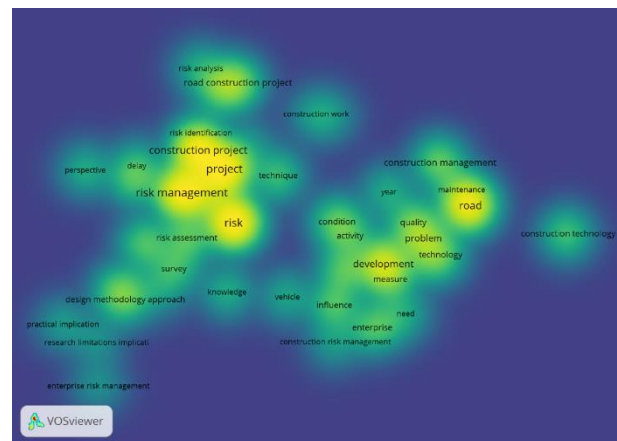


Figure 3. Density Visualization based on keywords (2000-2023).

4.1 Publication types

We observe the publication types using publish and perish. Figure 2 describes the publication types most relevant to this article.

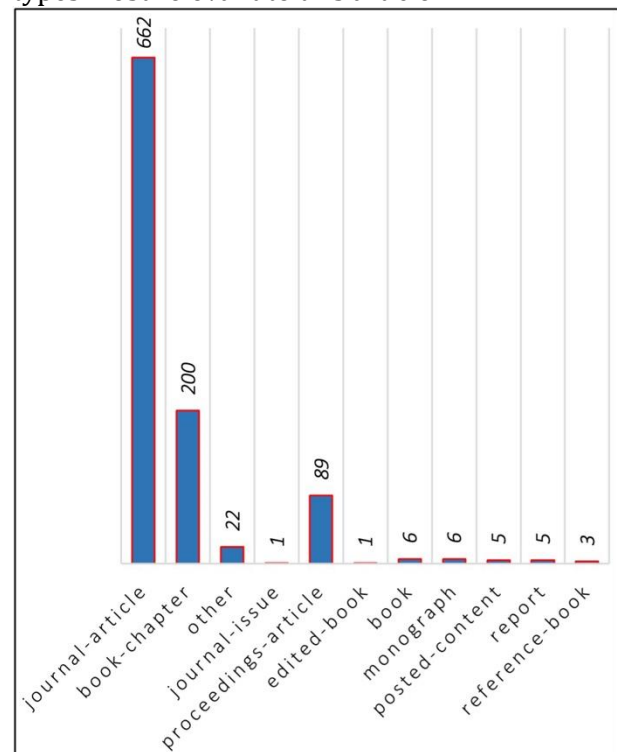


Figure 2. Publication Types.

The Figure shows that most publications related to this article are from journal articles and book chapters.

4.3 Publication of research by year

The Publish or Perish application's database reveals the distribution of research years, which is processed in Microsoft Excel to create the depicted graph (Figure 4). The graph visually represents the predominant research years related to the topic and offers an observation of the evolution of research within the time frame from 2001.

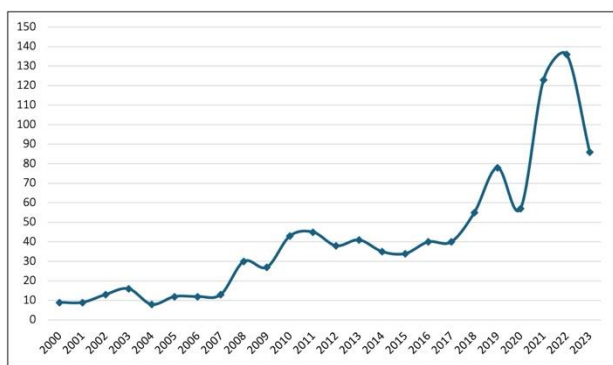


Figure 4. Authors Visualization by VOSViewer.

Figure 4 identified the most frequently published research related to this topic in 2022, followed by 2021. Figure 4 also shows that 2004 saw the fewest publications related to this topic.

4.4 Influential Authors

The Publish or Perish application's database reveals the distribution of research years, which is processed in Microsoft Excel to create the depicted graph (Figure 4).

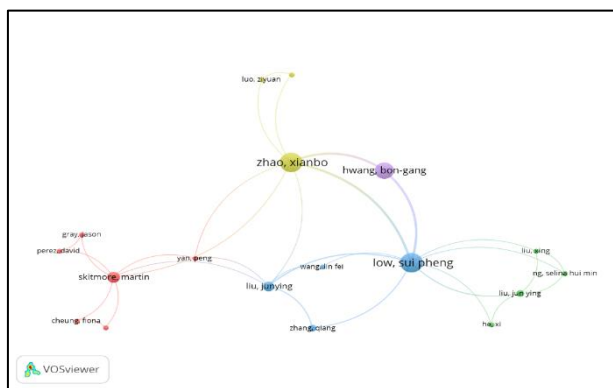


Figure 5. Influential authors generated by using VOSViewer.

The graph visually represents the predominant research years related to the topic. It offers observation of the evolution of research within the time frame from 2000 to 2023.

Table 1. Prominent authors by documents.

Rank	Name	Document
1	Low, sui pheng	15
2	Zhao, shian bo	15
3	Hwang, bon-gang	11
4	Dey, Prasanta Kumar	8
5	Ohtsu, hiroyasu	8
6	Yashina, marina v	5
7	Karelina, maria yu	5
8	Mahamid, Ibrahim	4
9	Chileshe, Nicholas	4
10	Haruna, Mamoru	4

Table 1 shows the authors with documents related to this topic: Low, Sui Pheng, Zhao, and Shian Bo, which have 15 documents. Hwang, bon-gang follows by 11 documents.

5. CONCLUSION

This research analyzes the risk management of road construction projects. This research shows that the most frequently used keywords include "risk management," "construction project," and "road construction." Journal articles are the most published and dominant research. This research reveals the presence of 34 keywords associated with the risk management of road construction projects. The most frequent research related to this topic was published in 2022 and followed in 2021. The influential authors show the relation between the authors. So, the conclusion is that this topic is still increasing and developing yearly.

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