Risk Management of High-Rise Buildings in Coastal Areas: A Bibliometric Review Using Vosviewer

Rahmat Hermawan[1], Andri Irfan Rifai[2], Mulia Pamadi[3], Susanty Handayani[4]
Universitas Internasional Batam[1,2,3], Indonesia
Institut Transportasi dan Logistik Trisakti[4], Indonesia
rahmat.hrmwn14@gmail.com, andri.irfan@uib.ac.id, mulia@uib.ac.id,
susantyhandayani@gmail.com

ABSTRACT

The research aims to provide a comprehensive and quantitative analysis of the existing literature on risk management of high-rise buildings in coastal areas, identify research trends, and evaluate the impact of scientific publications in this field. This research focuses on the importance of risk management in high-rise buildings located in coastal areas, considering the increasing sea levels, extreme weather events, and high population density. This research uses bibliometric analysis, specifically VOSviewer software, to analyze data from 1000 publications with keywords such as Risk Management, Coastal Area, High-rise building, and Environmental Risk from 2000 to 2023. The research involves extensive bibliometric data analysis, including keyword frequency analysis, time trends, and relationships between authors and journals. The research results are expected to provide valuable insights for researchers and practitioners in developing practical and sustainable risk management strategies for high-rise buildings in coastal areas. The conclusion of this study is that the research trend on risk management of high-rise buildings in coastal areas is still an interesting topic around the world and will continue to develop continuously.

Keywords : coastal area, risk management, high rise building, bibliometric analysis, environmental risk

INTRODUCTION

The issue of risk management is now a concern on the agenda, mainly due to the growing worries about climate change. In construction projects, risk management plays a role in identifying and addressing risks and uncertainties by analyzing their impact and implementing suitable responses (Apriliyani, 2020). Risk management involves examining all risks and evaluating uncertainties to ensure effective management (Yoe, 2019). Given the rise in sea level, the increased occurrence of weather events, and the high population density in coastal areas, it has become vital to prioritize risk management for tall buildings along coastlines. This international necessity highlights the significance of understanding and focusing on regional risk management. Through this process, project objectives can be achieved. Limitations can be assessed to determine their impact on the project scope (Willumsen, Oehmen, Stingl, & Geraldi, 2019).

The construction of buildings is increasing rapidly in various parts of the world due to the ongoing process of global urbanization (Okolelova, Shibaeva, & Shalnev, 2018). With the advancement of technology and urban development, it has become common to see buildings near coastal areas. General construction activities, especially the construction of high-rise buildings, have a variety of risks (Raamkumar & Indhu, 2022). However, managing risks associated with these buildings becomes more complex when they are located in different regions. These buildings are exposed to risks related to their

interaction with the environment, such as extreme weather conditions, floods, and damage caused by ocean waves. Therefore, it is essential to consider safety and health principles when developing this category of high-rise buildings to address the risks posed by occupational accidents (Ratnaningsih, Arifin, Suyoso, Trisiana, & Yusuf, 2019).

It is worth mentioning that managing risks in areas is not just a concern for local communities but has also gained global attention. Construction projects face increased risks due to construction practices and working conditions (Chatterjee, Zavadskas, Tamošaitienė, Adhikary, & Kar, 2018). The safety of buildings in coastal regions relies on effective risk management. Coastal areas are particularly susceptible to risks caused by natural disasters and environmental fluctuations. Thus, it is crucial to develop a risk management strategy that considers the challenges of coastal environments.

Bibliometric analysis is an approach that involves using a variety of methods to measure, track, and examine literature in a specific field. It can be done quantitatively or qualitatively using techniques (Hakim, 2020; Rojas-Sánchez, Palos-Sánchez, & Folgado-Fernández, 2023). This research will analyze articles from different sources to identify key themes, research gaps, and emerging trends in the field. The insights gained from this review can help guide future research and policy development related to risk management for high-rise buildings in coastal areas. To conduct the analysis, the viewer was utilized to examine and visualize the research network based on information sources such as journal articles and conferences.

Managing risks in construction projects along the coast is essential to recognizing and addressing factors that could lead to unexpected challenges. For instance, unpredictable occurrences like elevations surpassing planned levels can necessitate adjustments in design and implementation strategies (Ismiyati, Sanggawuri, & Handajani, 2020). In this research endeavor, the author aims to offer a quantitative analysis of the existing literature on risk management for high-rise buildings in coastal regions. By utilizing tools such as Publish or Perish and VOSviewer, the research will identify trends in research, examine patterns among researchers, and assess the impact of scientific publications within this domain. The ultimate goal is to provide insights that can assist both researchers and practitioners in developing practical and sustainable risk management approaches for high-rise construction along coastal areas.

Literature Review

Risk management

Risk management in civil engineering projects can be defined as a systematic approach to identifying, analyzing, and controlling risks in construction activities (Nawaz, Waqar, Shah, Sajid, & Khalid, 2019). Efficient risk management is essential to project success and allows parameters such as time, cost, quality, safety, and environmental compliance to be monitored (Björnsdóttir, Jensson, de Boer, & Thorsteinsson, 2022). Risk management in construction projects also involves responding to unforeseen risks during the project process. It is not feasible to eliminate risks associated with a particular project, and the best that can be achieved is allocating risks to various groups along with appropriate risk management (Idris, Adnan, Baharuddin, Zaki, & Ismail, 2022). Therefore, analyzing and managing risks is essential to decision-making procedures in the construction industry.

Based on previous studies, it has been found that risk management is a crucial topic in minimizing risks in construction projects, including high-rise buildings in coastal areas. To estimate the likelihood and impact of potential hazards. Studies have shown that there are several methods used in risk management for construction projects, such as

probabilistic risk assessment, hazard identification, and risk mitigation (Junjia, Alias, Haron, & Abu Bakar, 2023). In addition, several factors affect risk management in construction projects, such as geographic conditions, weather conditions, and environmental conditions.

It is widely used as a practical approach to predict potential hazards in many engineering projects, including architectural construction projects (Yu Ting He & Atangana Njock, 2023). These structures face several unique risks and challenges, mainly due to their exposure to natural threats such as storms, tides, and rising sea levels. Managing these risks effectively is crucial to ensuring the safety and sustainability of tall buildings in coastal areas.

The construction industry will increasingly focus on sustainability and resilience in architectural design and construction practices. Building safety and sustainability requires the consideration of risk management. A comprehensive construction risk assessment should consider climate change, extreme weather, resource scarcity, and social impacts (Junjia et al., 2023). Therefore, it is essential to consider these factors in the risk management strategy for high-rise buildings in coastal areas.

High-Rise Buildings in Coastal Area

According to 'Peraturan Menteri Pekerjaan Umum Nomor 24 tahun 2008 tentang pedoman pemeliharaan bangunan gedung', A building is a physical form that is integrated with a site created by construction work, exists partially or entirely above ground, underground, or underwater, and is used as a place for human activities such as housing, commerce, and social and cultural activities, and others. The definition of high-rise buildings varies across different countries and regions. However, generally speaking, high-rise buildings are multi-story structures that require elevators to reach the upper floors (Satır & Topraklı, 2020). High-rise buildings are complex structures requiring high stability for safety and design purposes. This structure is more complicated than low-rise buildings and requires special attention to wind and seismic activity (Shakir, Jasim, & Weli, 2021).

High-rise buildings in coastal areas have become a global trend in recent decades. One of the advantages of these buildings is the beautiful view they offer. However, high-rise buildings in coastal areas also face several challenges, including strong winds, floods, and erosion. They can significantly alter the wind patterns in the coastal region. This can cause an increase in wind speed and turbulence, which can damage buildings and infrastructure (Zhang, Xiong, Chen, & Wang, 2022). Coastal areas are already vulnerable to flooding, and high-rise buildings can exacerbate this problem. Increased development density in coastal areas can lead to increased runoff, which can flood drainage and water channels.

Previous research has shown that it is essential to understand the effects of wind on tall buildings in coastal areas. The Influence of Wind and Tall Building Morphology in Macau by (Jialun He, Chen, Zheng, & Zheng, 2023) examined wind fields and the morphological effects of high-rise buildings in Macau using computer simulation techniques. Using computer simulation techniques, this research looked into wind fields and the morphological effects of Macau's high-rise buildings. The writers examined the wind loads that resulted from the wind flow around the buildings. The research results show that tall buildings must consider several design elements, including building width and depth, city integration, wind direction, economics, sunlight, and lighting.

Therefore, wind loads significantly affect the risk of high-rise building construction in coastal areas. This is proven by (Wang et al., 2019) research which discusses wind

characteristics on three adjacent high-rises during Typhoon Meranti. In coastal areas with stronger winds than inland areas, high-rise buildings must undoubtedly pay more attention to the risk of wind loads. Particular attention should be paid to the dangerous vibrations caused by storms in high-rise buildings to ensure structural safety and occupant comfort.

Sea Level Rise

The increase in sea level has become a global issue, and it poses scalability for coastal areas with high-rise buildings. Coastal areas are highly vulnerable to the impacts of rising sea levels (Griggs & Reguero, 2021). This issue has gained worldwide attention due to the accelerated rate at which global sea levels rise in the 21st century (Affandi & Din, 2022). The elevation of the international mean sea level has predominantly arisen from the thermal expansion of the upper ocean and the melting of glacial and ice sheets (Durand et al., 2022). This research outlines the impacts of rising sea levels, such as flooding, erosion, salinization, and the potential sinking of coastal areas. It also highlights the importance of understanding the extent and pace of future sea level change and the corresponding necessity for appropriate and feasible mitigation and adaptation strategies in coastal areas.

Coastal lowland areas are particularly vulnerable to rising sea levels exacerbated by subsidence of the natural land surface (Scardino et al., 2022). These areas are home to nearly 1 billion people and face various risks and impacts, including frequent and intense coastal flooding, environmental degradation/loss/degradation, habitat/ecosystem, coastal erosion, shoreline change, and surface and groundwater salinization (Khojasteh et al., 2023). A study on the implications of climate change-induced sea level rise for communities has found that approximately 80% of those at risk reside in the Asia-Pacific region, highlighting the area's high vulnerability to flooding. In addition, the loss of coastal ecosystem functions such as sandy beaches, salt marshes, tidal flats, and mangrove forests will also have severe consequences due to rising sea levels, affecting communities and the environment.

Robert J. Nicholls explained the inadequate public awareness of sea-level rise in his journal article, which discusses Scientific developments concerning sea-level rise between 1990 and 2021. The article highlights that most of the 85 million poor people living in low-lying rural and coastal areas live in 20 developing countries, which include Indonesia, Mozambique, Pakistan, Cambodia, Senegal, and the Philippines. However, these countries' contribution to SLR research from 1990 to 2021 is less than 1%. His journal also highlights the vulnerability of coastal areas and populations in Small Island Developing States (SIDS) and delta regions, emphasizing the need to involve local experts in studying coastal systems in detail and developing appropriate adaptation strategies.

A consequence of the increasingly evident global climate change is rising sea levels. Scientific literature is deeply concerned about its impact on infrastructure, particularly buildings. The rise in sea levels poses a significant threat to buildings in coastal areas (Nazarnia, Nazarnia, Sarmasti, & Wills, 2020). It increases the risk of coastal flooding and soil erosion, putting extra pressure on building foundations (Smith et al., 2019). Additional pressure on a building's foundation due to rising sea levels can cause cracks, fractures, or collapse. This can result in a leaning or even collapsing building. Appropriate adaptation strategies are necessary to mitigate the impact of rising sea levels on buildings. The right adaptation strategy will depend on the specific conditions in each coastal area.

Therefore, a thorough analysis is required to determine the most effective adaptation strategy.

RESEARCH METHOD

This research will use a method of mapping various journal literature sources worldwide. It relies on bibliometric data from scientific sources related to management in high-rise buildings in coastal areas. The data for this research was collected using software such as Publish or Perish and VOSviewer. To find data, they may use tools such as Publish or Perish and VOSviewer, which utilize Google Scholar's data. Researchers often use Google Scholar as a source for publishing their research. It is important to note that Google Scholar should be used cautiously, as it may only sometimes provide accurate or comprehensive results. Additionally, verifying the credibility of sources found through Google Scholar is recommended (Rahayu, Liddini, & Maarif, 2022).

This research was developed based on the entire process of data collection and filtering. The primary analysis method used in this research was the VOSviewer software for bibliometric review. Bibliometrics is the application of statistical methods as one of the options for presenting the results of article reviews on information retrieval.   The publication was categorized and reviewed through a literature review (Suharso, Setyowati, & Arifah, 2021). The bibliometric data generated is used to visualize trends, relationships between concepts, and the development of research in high-rise building risk management in coastal areas. This analysis includes creating author, journal, and keyword rankings and a visual network model of the relationships between articles in the data source.

The research involved extensive bibliometric data analysis, including analysis of keyword frequencies, time trends, and relationships between authors and journals; the researcher searched 1000 journal publications with the keywords Risk Management, Coastal Area, High-rise building, and Environmental Risk from 2000 to 2023, The review was initialized as data in Research Information Systems (RIS) format which will be exported into VOSviewer for further analysis, The information collected included author name, document source, year of publication, publication title, country, journal, field of science, and publication type.

RESULT AND DISCUSSION

The author used Vosviewer, a software tool for creating and visualizing bibliometric networks in this research. The author used version 1.6.19 of Vosviewer. This is the latest version of Vosviewer, which was released in 2022. Additionally, the author used the Publish or Perish software version 8.9.4538.8589 to obtain raw data on academic journals and papers. This software provides a bibliometric analysis platform similar to Google Scholar. Scopus or Crossref can be used to track the number of citations, journal impact factor, and other criteria commonly used to evaluate the quality and impact of publications.

The selection of appropriate keywords is a critical aspect that will affect the research output. In this research, the authors chose four keywords that have been carefully selected to ensure that this research will get the output as expected; keywords in the form of "Risk Management; Coastal Area; High-rise Building; Construction Management" will be entered into the Publish or Perish software which is then used to search for 1000 journals related to these keywords from 2000 to 2023, The database obtained from Publish or Perish is then saved with the Research Information Systems (RIS) file type,

The database that has been accepted will then be processed using Vosviewer to create visualization and concept network analysis results.

Linkage of Research Keyword

Based on the data processing results using Vosviewer, the network of interrelationships between keywords in this research can be identified, as shown in Figure 1. This network visualization is obtained from data processing on Vosviewer, where the database has been pulled from Publish or Perish with the selection of keywords based on events and the level of relevance associated with the process. Therefore, this affects the network size displayed in the visualization results, determining how large or small the number of entities seen is.
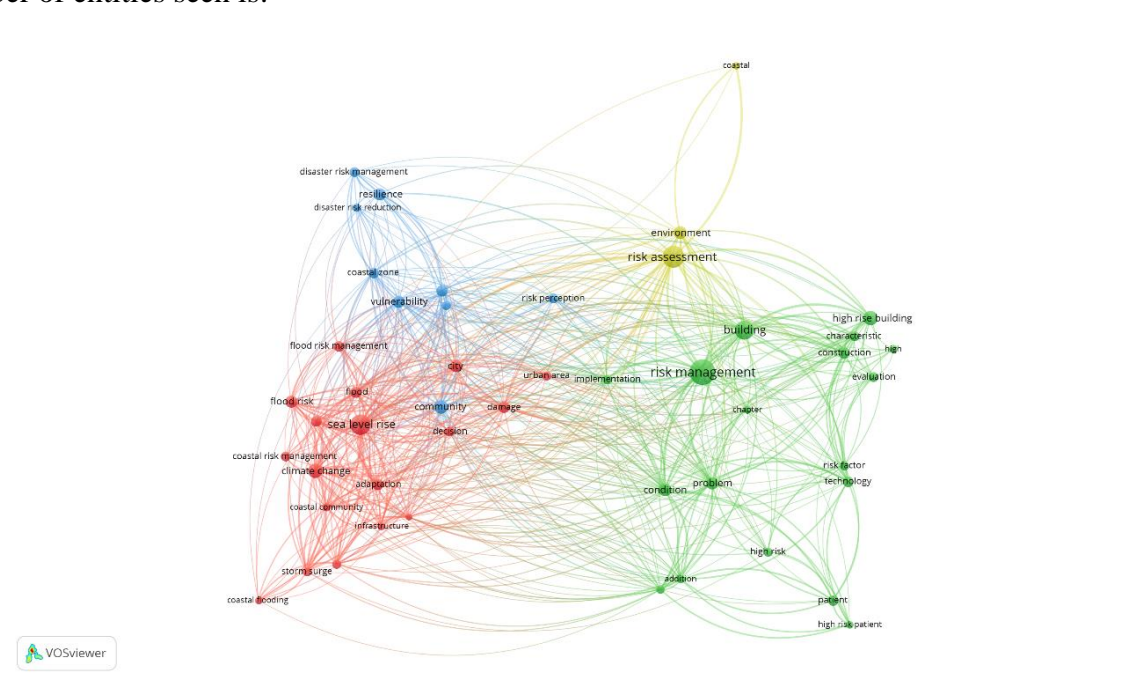

Figure 1. Linkage of Research Keyword
Source: Personal Processed Results by Vosviewer; 2023.

Based on the visualization results shown in Figure 1, the keyword "Risk Management" has the most significant relationship with other keywords. Followed by Risk Assessment, and then Sea Level Rise is the next keyword that has a relationship with other large networks. The keywords in Figure 1 are connected according to the color of the keyword nets.

Density of Research Keywords

Research keyword density is one of the mapping depictions in the VOSviewer application. Each field on this map will be divided based on its popularity in searches, and each point field has a color that depends on the element's density at that time. This shows that the color of a point on the map depends on how many elements are connected to other elements (Nurdin, Hutagalung, Kurniawan, & Hermawan, 2021). Visualization of the research keyword map density with the theme Risk Management of High-Rise Buildings in Coastal Areas can be seen in the following figure:
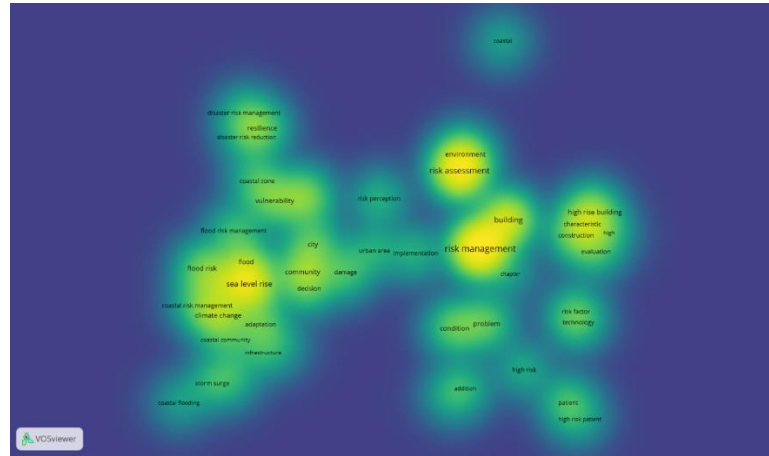
Figure 2. Density Visualization of Research
Source: Personal Processed Results by Vosviewer; 2023.

Figure 2 shows that the Risk Management keyword index has a reasonably large density, followed by several other keywords, namely Sea Level Rise, Risk Assessment, and High-rise Building. Some keywords that have started to have density have begun to have much research intersecting with the topic, while those away indicate that the topic still needs to be widely researched.

Keyword	Total Research
Risk Management	218
Sea Level Rise	95
Risk Assessment	89
High-rise Buildings	77
Total	**479 (47;9%)**

Figure 3. Density of Research Keywords
Source: Personal Processed Results; 2023.

Of the 1000 studies, 479 focused on the four dominant keywords, representing a significant percentage of 47.9% of the total studies, although there were associations with other keywords. However, their intensity was relatively lower compared to the dominant keywords. Detailed information regarding the prevalent keywords can be found in the visual representation of the density data.

Publication Statistics per Year

One of the results of the analysis conducted with VOSviewer includes the aspect of the research year as a dimension of analysis. This database is then processed to track the accumulated research publications worldwide each year. Cumulative calculations were performed on selected research journals from around the world, and the results were presented as graphical visualizations to facilitate understanding. Figure 4 illustrates the annual data processing results regarding the number of research publications.
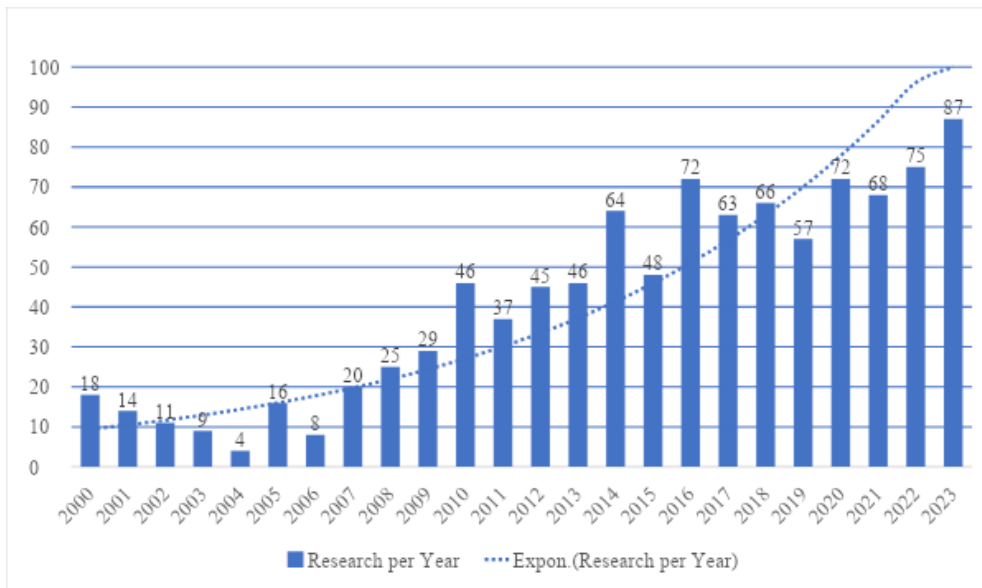
Figure 4. The global trend of publications
Source: Personal Processed Results; 2023.

The graphical visualization in Figure 4 displays the number of studies conducted from 2000 to 2023. The data analysis reveals a relatively small decline in the early period, specifically from 2002 to 2006. Subsequently, there was a consistent increase for the following 12 years, from 2007 to 2018. In 2019, there was a slight decrease followed by an increase in the next years, reaching its peak in 2023 with 87 studies. Therefore, the trend in risk management research for high-rise buildings in coastal areas is increasing yearly. Although the research trend fluctuates, the graph shows an overall increase as its cumulative value tends to be stable and continuously rising.

Publication Sources and Types

Overall, 1000 papers have been published through 177 journals and conferences, indicating the interrelatedness of the sources based on how often they cite each other (Mugabushaka, van Eck, & Waltman, 2022). After screening, the five most dominant publishers were selected based on their citation count. These top 5 journals indicate the strength of the journal's links with other journals, as shown in Figure 5.

Journals	Published documents	Citations	Cites per Year	Scopus Quartile
Elsevier BV	194	3816	3,52	Q1
Wiley	82	785	1,32	Q1
Informa UK Limited	49	548	1,03	Q2
Springer Science and Business Media LLC	21	482	2,82	Q1
Coastal Education and Research Foundation	23	140	2,51	Q3

Figure 5. Top 5 Publishers According to Citations
Source: Personal Processed Results; 2023.

This data is essential to analyze because it can provide an overview of the types of documents found in this research. Despite the diversity of research publishers, various types of research have been analyzed to obtain data on these types of research. This data is essential to explore because it can provide an overview of the types of documents found in this research. This data is essential to explore because it can give an overview of the

types of documents in this research. Information on various types of research can be found in Figure 6, presented below.
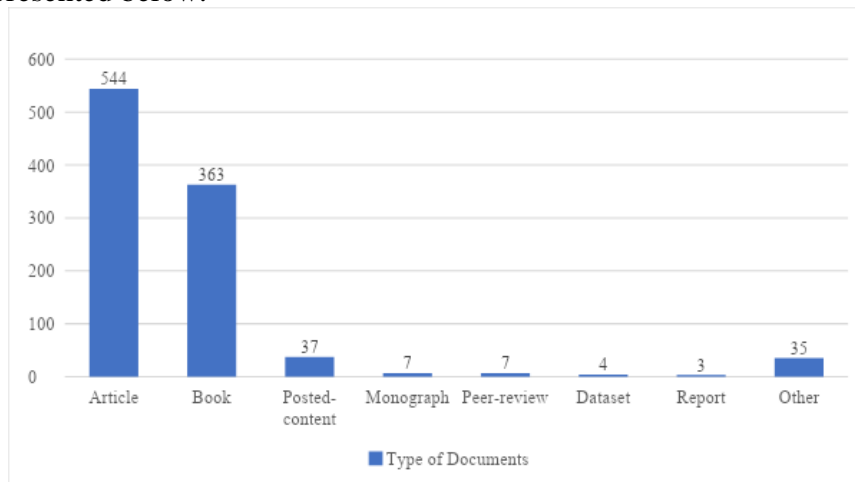

Figure 6. **Type of Documents Publication**
Source: Personal Processed Results; 2023.

The graphical visualization in Figure 6 indicates that the article is the most commonly published research document on risk management in high-rise buildings in coastal areas, with a total of 544 papers. This suggests that academic researchers in universities or institutions conduct more research on risk management in high-rise buildings in coastal areas. Another widely published research document is the book, with 363 papers. This is followed by posted content with 37 papers, monographs with seven papers, peer-reviewed articles with seven papers, datasets with four papers, reports with three papers, and other types with 35 papers, for a total of 1000.

Case Studies Based on Research Origin

The diversity of research produced through networking can also be seen in the countries where the research originates. This diversity of countries indicates that research is not only conducted in one country but in various countries around the world. Based on the analysis using VOSviewer software, the continent of origin of the research can be grouped as shown in the figure below.
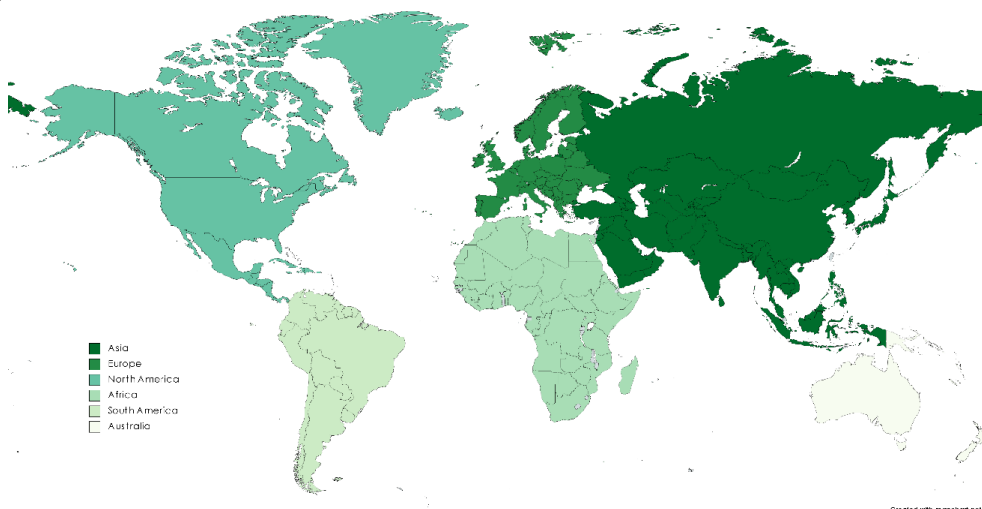

Figure 7. Continental Mapping of Research Origin
Source: Personal Processed Results by Mapchart; 2023.

Based on the analysis of case studies from various countries, Figure 7 shows the distribution of case studies grouped by continent. The darker the color of the data distribution, the more research topics related to risk management of high-rise buildings in coastal areas in the region. As seen in Figure 5, the darkest color is located on the Asian Continent. This topic has been discussed by as many as 221 case studies, followed by the European Continent with 162 case studies, the North American Continent with 123 case studies, the African Continent with 22 case studies, the South American Continent with 11 case studies, and also the Australian Continent with 10 case studies.

In addition, the author also analyzes the classification regarding the country of origin of the research case studies. This analysis was conducted to learn more about which countries researched the continent. Data processing was done by analyzing each journal individually to find out the possible origin of the case study country. The top ten countries of origin were classified as shown in Figure 8 below.

Country	Total Research
United States of America (USA)	112
China	73
England	47
Germany	42
Bangladesh	27
Indonesia	25
South Korea	21
India	20
Netherlands	11
Singapore	10

Figure 8. Country Origin of Data
Source: Personal Processed Results by Mapchart; 2023.

The data processing results in Figure 8 show the ten countries that discuss the most topics related to risk management of high-rise buildings in coastal areas. The United States of America occupies the first rank with 112 studies, followed by China with 73 studies, England with 47 studies, Germany with 42 studies, Bangladesh with 27 studies, Indonesia with 25 studies, South Korea with 21 studies, India with 20 studies, Netherlands with 11 studies, and Singapore with ten studies. In addition to these top ten countries, many others still contribute concretely to this research topic, but the number is less significant.

CONCLUSION

The research on risk management in high-rise buildings in coastal areas uses bibliometric methods to analyze scientific literature. This research has identified key themes, research gaps, and emerging trends in the field. This research uses Publish or Perish software to obtain 1000 scientific articles published from 2000 to 2023. Documents that have been produced include 554 scientific articles, 363 books, 37 content posts, seven monographs, seven peer reviews, 4 data sets, three reports, and 35 others. Based on the analysis results using Vosviewer software, the keywords most frequently appearing are Risk Management, Sea Level Rise, Risk Assessment, and High-rise Buildings. In addition, the development of research year publications from 2000 to 2023 was also obtained, with a peak publication of 87 articles in 2023. This research trend is also analyzed to find out which continent is the most dominant in related research topics, so it appears that the Asian Continent has the most research, namely 221 case studies, followed by the European Continent with 162 case studies, the North American Continent

with 123 case studies, the African Continent with 22 case studies, the South American Continent with 11 case studies, and also the Australian Continent with 10 case studies. So, the research trend on risk management of high-rise buildings in coastal areas is still an exciting topic worldwide and will continue to grow continuously.

REFERENCES

Affandi, Muhammad Luqman Ahmad, & Din, Ami Hassan Md. (2022). A Short Review on Causes of Sea Level Rise for Climate Monitoring. *IOP Conference Series: Earth and Environmental Science*, *1051*(1), 12003. IOP Publishing.

Apriliyani, Merlina Ayu. (2020). Analisa Keterlambatan Berbasis Manajemen Risiko Pada Proyek Warehouse Lazada Tahap 2. *Rekayasa Sipil*, *8*(2), 326487.

Björnsdóttir, Svana Helen, Jensson, Páll, de Boer, Robert J., & Thorsteinsson, Saemundur E. (2022). The importance of risk management: what is missing in ISO standards? *Risk Analysis*, *42*(4), 659–691.

Chatterjee, Kajal, Zavadskas, Edmundas Kazimieras, Tamošaitienė, Jolanta, Adhikary, Krishnendu, & Kar, Samarjit. (2018). A hybrid MCDM technique for risk management in construction projects. *Symmetry*, *10*(2), 46.

Durand, Gaël, van den Broeke, Michiel R., Le Cozannet, Goneri, Edwards, Tamsin L., Holland, Paul R., Jourdain, Nicolas C., Marzeion, Ben, Mottram, Ruth, Nicholls, Robert J., & Pattyn, Frank. (2022). Sea-level rise: From global perspectives to local services. *Frontiers in Marine Science*, *8*, 709595.

Griggs, G., & Reguero, B. G. (2021). *Coastal Adaptation to Climate Change and Sea-Level Rise. Water, 13, 2151*.

Hakim, Lukmanul. (2020). Analisis Bibliometrik penelitian inkubator bisnis pada publikasi ilmiah terindeks Scopus. *Procuratio: Jurnal Ilmiah Manajemen*, *8*(2), 176–189.

He, Jialun, Chen, Yile, Zheng, Liang, & Zheng, Jianyi. (2023). Research on Wind Environment and Morphological Effects of High-Rise Buildings in Macau: An Example from the New Reclamation Area around Areia Preta. *International Journal of Environmental Research and Public Health*, *20*(5), 4143.

He, Yu Ting, & Atangana Njock, Pierre Guy. (2023). An analysis approach for building collapse accident using system thinking approach and SEA model. *Smart Construction and Sustainable Cities*, *1*(1), 11.

Idris, Muhammad Hafizuddin, Adnan, Hamimah, Baharuddin, Har Einur Azrin, Zaki, Zulkhairy Affandy Mohd, & Ismail, Wan Norizan Wan. (2022). Risk Factors on Civil Engineering Projects. *IOP Conference Series: Earth and Environmental Science*, *1067*(1), 12064. IOP Publishing.

Ismiyati, Ismiyati, Sanggawuri, Ranggi, & Handajani, Mudjiastuti. (2020). Penerapan Manajemen Resiko pada Pembangunan Proyek Perpanjangan Dermaga log (Studi Kasus: Pelabuhan DalamTanjung Emas Semarang). *Media Komunikasi Teknik Sipil*, *25*(2), 209–220.

Junjia, Yin, Alias, Aidi Hizami, Haron, Nuzul Azam, & Abu Bakar, Nabilah. (2023). A Bibliometric Review on Safety Risk Assessment of Construction Based on CiteSpace Software and WoS Database. *Sustainability*, *15*(15), 11803.

Khojasteh, Danial, Haghani, Milad, Nicholls, Robert J., Moftakhari, Hamed, Sadat-Noori, Mahmood, Mach, Katharine J., Fagherazzi, Sergio, Vafeidis, Athanasios T., Barbier, Edward, & Shamsipour, Abbas. (2023). The evolving landscape of sea-level rise science from 1990 to 2021. *Communications earth & environment*, *4*(1), 257.

Mugabushaka, Alexis Michel, van Eck, Nees Jan, & Waltman, Ludo. (2022). Funding Covid-19 research: Insights from an exploratory analysis using open data infrastructures. *Quantitative Science Studies*, *3*(3), 560–582.

Nawaz, Ahsan, Waqar, Ahsan, Shah, Syyed Adnan Raheel, Sajid, Muhammad, & Khalid, Muhammad Irslan. (2019). An innovative framework for risk management in

construction projects in developing countries: evidence from Pakistan. *Risks*, *7*(1), 24.

Nazarnia, Hadi, Nazarnia, Mohammad, Sarmasti, Hadi, & Wills, W. Olivia. (2020). A systematic review of civil and environmental infrastructures for coastal adaptation to sea level rise. *Civil engineering journal*, *6*(7), 1375–1399.

Nurdin, Bartoven Vivit, Hutagalung, Simon Sumanjoyo, Kurniawan, Robi Cahyadi, & Hermawan, Dedy. (2021). Bibliometric analysis on governance index topics using scopus database and vosviewer. *Journal of Physics: Conference Series*, *1933*(1), 12047. IOP Publishing.

Okolelova, Ella, Shibaeva, Marina, & Shalnev, Oleg. (2018). Development of innovative methods for risk assessment in high-rise construction based on clustering of risk factors. *E3S Web of Conferences*, *33*, 3015. EDP Sciences.

Raamkumar, J. S., & Indhu, B. (2022). A Study on the Assessment of Risk Management in High-Rise Buildings. In *Advances in Construction Management: Select Proceedings of ACMM 2021* (bll 47–56). Springer.

Rahayu, Nindi Sri, Liddini, Uswatun Hasanah, & Maarif, Samsul. (2022). Berpikir Kreatif Matematis: Sebuah Pemetaan Literatur dengan Analisis Bibliometri Menggunakan Vos Viewer. *Mosharafa: Jurnal Pendidikan Matematika*, *11*(2), 179–190.

Ratnaningsih, Anik, Arifin, Syamsul, Suyoso, Hernu, Trisiana, Anita, & Yusuf, Nizam Azkha. (2019). Risk assessment on occupational accident of apartment building structural work with Failure Mode and Effect Analysis (FMEA) method. *MATEC Web of Conferences*, *276*, 2016. EDP Sciences.

Rojas-Sánchez, Mario A., Palos-Sánchez, Pedro R., & Folgado-Fernández, José A. (2023). Systematic literature review and bibliometric analysis on virtual reality and education. *Education and Information Technologies*, *28*(1), 155–192.

Satır, Muhsin Selçuk, & Topraklı, Abdurrahman Yağmur. (2020). A review of evacuation of high-rise buildings. *Gazi University Journal of Science Part B: Art Humanities Design and Planning*, *8*(1).

Scardino, Giovanni, Anzidei, Marco, Petio, Paolo, Serpelloni, Enrico, De Santis, Vincenzo, Rizzo, Angela, Liso, Serena Isabella, Zingaro, Marina, Capolongo, Domenico, & Vecchio, Antonio. (2022). The impact of future sea-level rise on low-lying subsiding coasts: a case study of Tavoliere Delle Puglie (Southern Italy). *Remote Sensing*, *14*(19), 4936.

Shakir, Imad, Jasim, Mohammed Ahmed, & Weli, Sardasht S. (2021). High Rise Buildings: Design, Analysis, and Safety: An Overview. *International Journal of Architectural Engineering Technology*, *8*, 1–13.

Smith, David E., Barlow, Natasha L. M., Bradley, Sarah L., Firth, Callum R., Jordan, Jason T., & David, LONG. (2019). Quaternary sea level change in Scotland. *Earth and Environmental Science Transactions of the Royal Society of Edinburgh*, *110*(1–2), 219–256.

Suharso, Putut, Setyowati, Lis, & Arifah, Mufida Nur. (2021). Bibliometric Analysis Related to Mathematical Research through Database Dimensions. *Journal of Physics: Conference Series*, *1776*(1), 12055. IOP Publishing.

Wang, Chequan, Li, Zhengnong, Luo, Qizhi, Hu, Lan, Zhao, Zhefei, Hu, Jiaxing, & Zhang, Xuewen. (2019). Wind characteristics investigation on the roofs of three adjacent high-rise buildings in a coastal area during Typhoon Meranti. *Applied Sciences*, *9*(3), 367.

Willumsen, Pelle, Oehmen, Josef, Stingl, Verena, & Geraldi, Joana. (2019). Value creation through project risk management. *International Journal of Project Management*, *37*(5), 731–749.

Yoe, Charles. (2019). *Principles of risk analysis: decision making under uncertainty*. CRC press.

Zhang, Hua, Xiong, Minghui, Chen, Bing, & Wang, Yanfeng. (2022). Influence of tropical cyclones on outdoor wind environment in high-rise residential areas in Zhejiang province, China. *Sustainability*, *14*(7), 3932.