

## Analysis of Studies on 'Disaster Management' and 'Engineering' Concepts Using VOSviewer for Bibliometric Analysis

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## ABSTRACT

In this study, the aim is to develop a bibliometric analysis map of studies on the concepts of 'Disaster Management' and 'Engineering.' Using a descriptive analysis model, specifically the general scanning model, quantitative data obtained are utilized to identify trends and gaps in studies related to disaster management and engineering concepts in the literature. The analysis is based on data from the Web of Science database. Bibliometric data from various types of works published between 1985 and 2024 (as of April 1, 2024) are taken as the unit of analysis. "When examining the distribution of 2051 works related to the concepts of 'Disaster Management' and 'Engineering' by publication years, it is observed that there is a concentration in the years 2018 (236 works), 2022 (195 works), 2021, and 2020 (with 194 works each). The most prolific authors are Juan Carlos De La Llera Martin, Kaoshan Dai, and Enşen Uzun. The predominant publication types are journal articles (1339), conference papers (702), and reviews (62). In terms of research areas, works are primarily in the fields of Civil Engineering (497), Multidisciplinary Earth Sciences (310), Environmental Sciences (263), Geological Engineering (235), Multidisciplinary Engineering (177), and Electrical and Electronic Engineering (169). The distribution of publications by countries shows leadership in publishers originating from the USA (341), People's Republic of China (315), India (222), Indonesia (144), and Japan (138). The publications are predominantly in English (2035), followed by Turkish (7) and Chinese (4). Publications indexed in SSCI-Expanded (1138), CPCI-S (687), and ESCI (181) indexes are prevalent. When examining the most frequently used keywords in publications related to Disaster Management and Engineering concepts, 'disaster management' (283 occurrences), 'resilience' (60 occurrences), 'earthquake' (40 occurrences), 'GIS' (Geographic Information Systems) (39 occurrences), 'disaster' (33 occurrences), 'remote sensing' (33 occurrences), and 'vulnerability' (33 occurrences) are the most common expressions.

## 1. Introduction

Disasters, which have always existed throughout human history, are the consequences of natural, technological, or human-induced events that deeply affect societies. These consequences manifest in various forms such as earthquakes, floods, technological accidents, and pandemics. Disasters, which can halt or disrupt the lives of communities where they occur, significantly impact the economy [20; 21]. The process of organizing, planning, coordinating and implementing existing resources by all institutions and organizations for the prevention of disaster damages is called disaster management [16; 13]. The disaster management process consists of risk management and crisis management stages, which include mitigating the effects of disasters before, during and after they occur. That is, it is the management of the risks and consequences of a disaster[20]. These phases encompass a four-step mitigation, preparedness, response, and recovery process. It is not possible to clearly distinguish between

these processes [1;14]. The disaster management cycle can be seen in Figure 1.

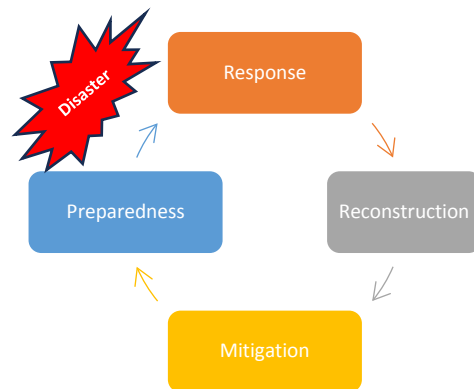


Figure 1 Disaster management cycle [20;21].

With the impact of advancing technology, there has been a focus on disaster response technologies, disaster and risk

management technologies, and technology integration to facilitate the management of disaster management processes [17;18]. Nowadays, disaster engineering studies are gaining increasing importance. The utilization of engineering studies that can address the challenges of the era allows for the design and construction of disaster-resistant structures, establishment of urban infrastructures, development of accurate disaster detection observation systems, planning of effective logistic activities, ensuring rapid interventions, establishing effective communication, implementing rapid evacuation systems, and conducting appropriate recovery efforts, all contributing to minimizing the impacts of disasters [11;12;17]. Engineering studies play an important role in increasing communities' resilience to disasters by reducing the damage caused by disasters through activities conducted before, during, and after disasters, thus enhancing communities' ability to cope with disasters [12;17].

## **2. Materials and Methods**

### **2.1 The Purpose of the Study**

This research aims to provide researchers with a comprehensive overview of the current state by examining published studies on disaster management and engineering according to bibliometric variables using a descriptive analysis model known as the general survey model. This will be based on quantitative data obtained in the field, offering a holistic perspective.

### **2.2 Research Design**

Bibliometric analysis is a formal and quantitative data collection method used to determine the current state of a field and track academic trends, distinct from systematic literature reviews. This analytical method, supported by visualization software, provides quantitative data and numerical metrics on research performance. Its primary aim is to identify productivity, strengths and weaknesses within a research field, gaps in the literature, collaboration networks, potential opportunities, and the widespread impact of produced outputs. Interpretations based on these data draw inspiration from researchers' experiences and knowledge in their fields. Bibliometrics assesses the productivity of countries, authors, universities, and journals, identifying significant trends in the literature. This method can also serve as a preliminary step in systematic literature reviews or as the initial stage in any research endeavor. Despite its limitations, bibliometrics has gained widespread interest and is recognized as an important tool among researchers [6;19]. In the study, a descriptive research model known as the general survey model has been adopted. General survey models are arrangements made to scan the entire population or a specific sample in order to make a general judgment about the population as a whole [9;10]. Bibliometrics sheds light on processes related to written communication and the development trajectory of a discipline by counting and analyzing various aspects of written communication [15]. Bibliometric analysis, a method different from systematic literature review, is a formal and quantitative data

collection method used to determine the current state of a field and track academic trends. Supported by visualization software, this analytical method provides quantitative data and numerical measurement indicators about research performance. Its primary aim is to identify productivity, strengths and weaknesses in research areas, gaps in the literature, collaboration networks, potential opportunities, and the widespread impact of produced outputs. The interpretations based on these data are inspired by researchers' experiences and knowledge in their fields. By analyzing the productivity of countries, authors, universities, and journals, bibliometrics identifies significant trends in the literature. This method, which can also be used as a preliminary stage in systematic literature reviews, can be seen as the initial step in any research. Despite its limitations, bibliometrics has gained widespread popularity and is considered an important tool among researchers [6]. (According to various practitioner groups, bibliometric analysis has diverse application areas, one of which is bibliometric analysis used as a tool for literature review [7]. In bibliometric research, some bibliometric indicators have been developed based on performance analyses using publication and citation numbers, and the performance of scientific elements has been evaluated [5]. Additionally, relationships among authors, studies, keywords, journals, institutions, countries, and citations identified through scientific mapping are examined [8]. Bibliometric analysis provides researchers with an objective perspective on the field and enables quantitative, objective, and macro-level evaluation [8;2]. In this regard, bibliometric research provides a systematic, transparent, and renewable review process for identifying the field, determining its content, and analyzing its structure and change [2;3;20].

### **2.3 Data Collection Tool**

In this study, Web of Science (WoS) database created by Clarivate Analytics was used as a data source for bibliometric data. WoS is a comprehensive research tool with broad scientific functionalities, providing large-scale datasets (Li et al., 2018). These features of WoS facilitate the monitoring of scientific activity and the examination of the current status, trends, and developments in various fields of science over time. WoS encompasses citation indexes such as SCI-Expanded (Science Citation Index-Expanded), SSCI (Social Science Citation Index), A&HCI (Arts and Humanities Citation Index), and ESCI (Emerging Sources Citation Index) [4]. Offering access to databases and citation data in 264 different disciplines, WoS includes studies in the fields of science and social sciences since 1900, arts and humanities since 1975, and books since 2005, along with their citations [4].

### **2.4 Data Collection and Analysis**

Different bibliometric analysis tools have been used in the literature. In this study, the VOS viewer (Version 1.6.19) program was preferred due to its functionality. It is considered as an important tool for researchers to explore the evolution, relationships, and new concepts in the literature. Additionally, it enables in-depth examination of

data sets by providing visualization, mapping, and multi-dimensional analysis capabilities.

In this study, the Web of Science database was utilized. Web of Science is a preferred database for various analyses, including bibliometric analyses. This preference is important in terms of the reliability of the research. Web of Science offers advanced search indicators and various control mechanisms for advanced data analysis. Additionally, it encompasses high-quality and reliable studies from the perspective of publication ethics. It provides access to a wide-ranging data collection from different disciplines.

To access academic studies in the field of disaster management and engineering concepts, an online search was conducted in the Web of Science database on April 1, 2023. By selecting 'all fields' in the WoS core collection and using the keywords 'disaster management' and 'engineering,' a total of 2051 results were obtained.

These results included various document types from different disciplines, with articles being the most prevalent (1339), followed by conference papers (702),

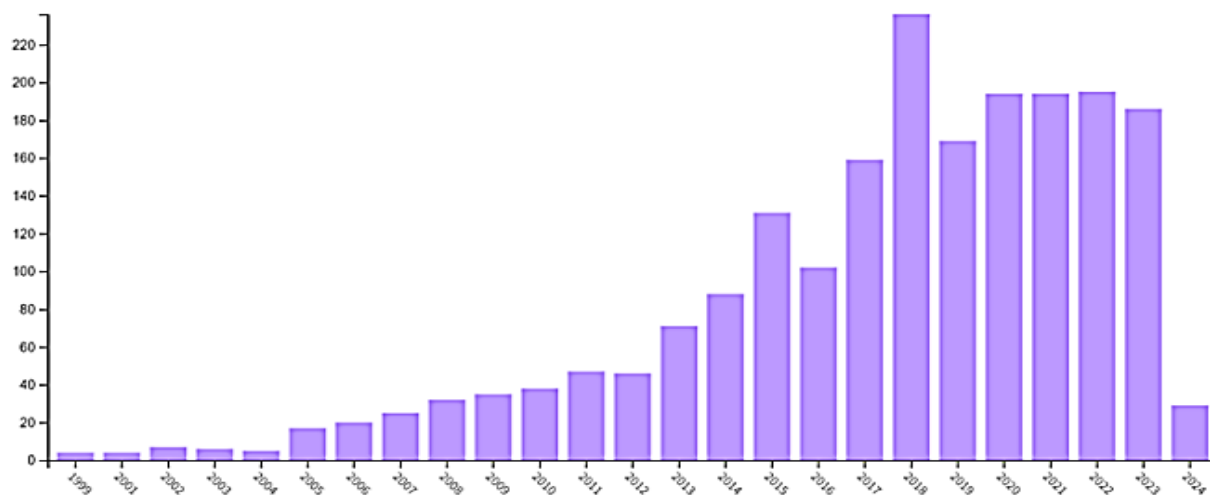
re-reviewed articles (62), early access publications (32), book chapters (16), and editorial materials (11), totaling 10 document types ranging from the oldest publication in 1985 to the most recent in 2024. As the corresponding author of the article titled 'Bibliometric Analysis of Studies on the Concepts of Disaster Management and Engineering Using VOS viewer,' I declare that scientific and ethical principles have been adhered to in this article. Furthermore, since the data for bibliometric analysis were obtained from openly accessible and published studies, ethical approval for the article was not required.

### 3. RESULTS

This section presents the findings obtained regarding the studies on the concepts of 'Disaster Management' and 'Engineering'.

#### 3.1 Distribution of Studies by Year

The distribution of studies on 'Disaster Management' and 'Engineering' published in WoS by year is illustrated in Figure 1.



**Figure 2** Numerical distribution of relevant studies by year (WoS, April 1, 2024).

Upon examining Graph 2, it is observed that the years 2018 (236 works), 2022 (195 works), 2020, and 2022 (with 194 works each) were the years with the highest number of publications in the fields of disaster management and engineering. When the graph is analyzed as a whole, it can be said that there is generally an increase in the number of articles published in the field. The reason for the low number of publications in 2024

(29 works) is attributed to the timing of the research conducted on April 1, 2024.

#### 3.2 Journals Where the Studies Were Published

In this section, the journals in which studies on "Disaster Management" and "Engineering" topics were published have been examined. Our study reveals that there are 129 journals publishing in the research field. Due to the high number of journals, Figure 3 presents the top 10 journals with the highest number of publications.



Figure 3. Top 10 journals where articles related to disaster management and engineering are published (WoS, April 1, 2024).

When examining Figure 3, it is observed that the journals with the highest number of publications in the field of disaster management and engineering are Procedia Engineering with 63 publications, followed by Engineering Structures, Environmental Engineering and Management Journal, each with 48 publications, and Bulletin of Earthquake Engineering with 41 publications.

### 3.3 Co-authorship Analysis

A network map was created based on the criteria of at least 1 publication and at least 1 citation to identify the most connected and collaborative authors in terms of co-authorship analysis. In the analysis conducted over 304 units that are interconnected, a total of 22 clusters, 11,280 connections, and a total connection strength of 1368 were identified.

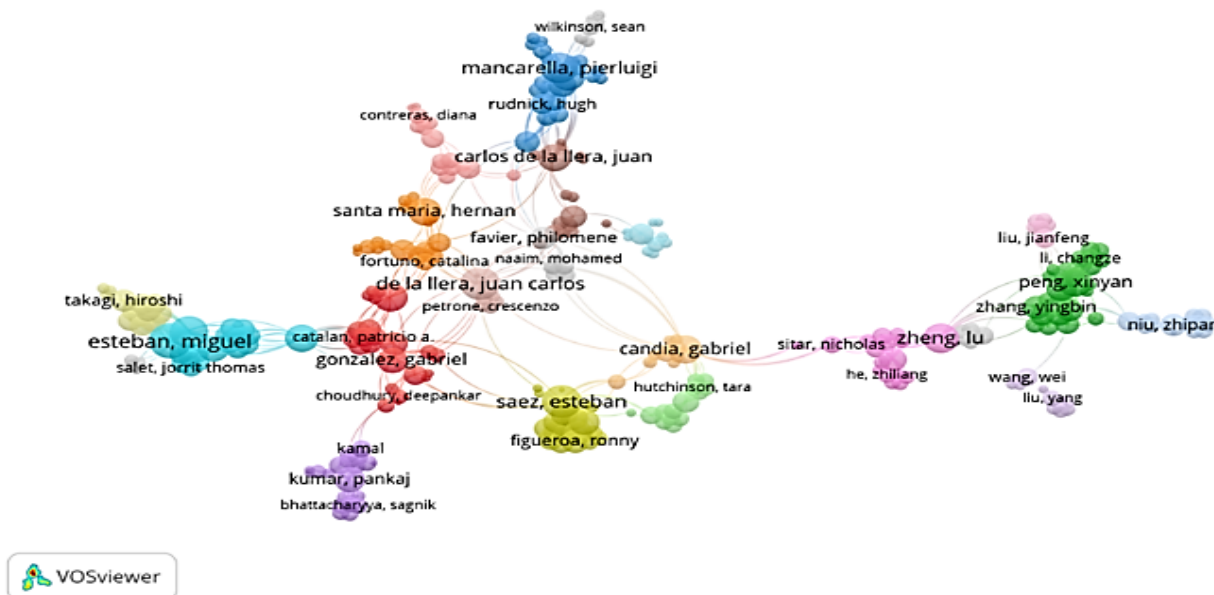


Figure 4. Co-authorship Links Showing Collaboration Among Authors.

It is observed that the authors receiving the most citations (Pierluigi Mancarella with 831 citations, Mathaios Panteli with 819 citations, and Roch H. Glietho with 640 citations) are not necessarily the authors with the strongest

connections. Similarly, authors who produce the most works (Kaoshan Dai with 19 works, Peerapong Jitsangiam with 17 works, and Alexandru Ozunu with 17 works) do not appear to be among the most connected authors

(Chayanon Hansapinyo with 69 connections, Peerapong Jitsangiam with 68 connections, and Enshen Long with 68 connections).

### 3.4 Author Citation Analysis

To identify citation networks, a network map of author citations was created with a criterion of at least 1

publication and at least 1 citation. In the analysis conducted over 498 interconnected units, a total of 23 clusters, 2455 connections, and a total connection strength of 3068 were identified.



Figure 5. Author Citation Networks.

The authors with the highest number of citations are Pierluigi Mancarella with 831 citations, Mathaios Panteli with 819 citations, and Roch H. Glitho with 640 citations. However, these three authors do not rank in the top three in terms of total connection strength, which are Tao Li

(112), Shu-Ching Chen (101), and J. C. De La Llera (92). In terms of the number of works, the ranking is as follows: Kaoshan Dai (19 works), Peerapong Jitsangiam (17 works), and Alexandru Ozunu (17 works).

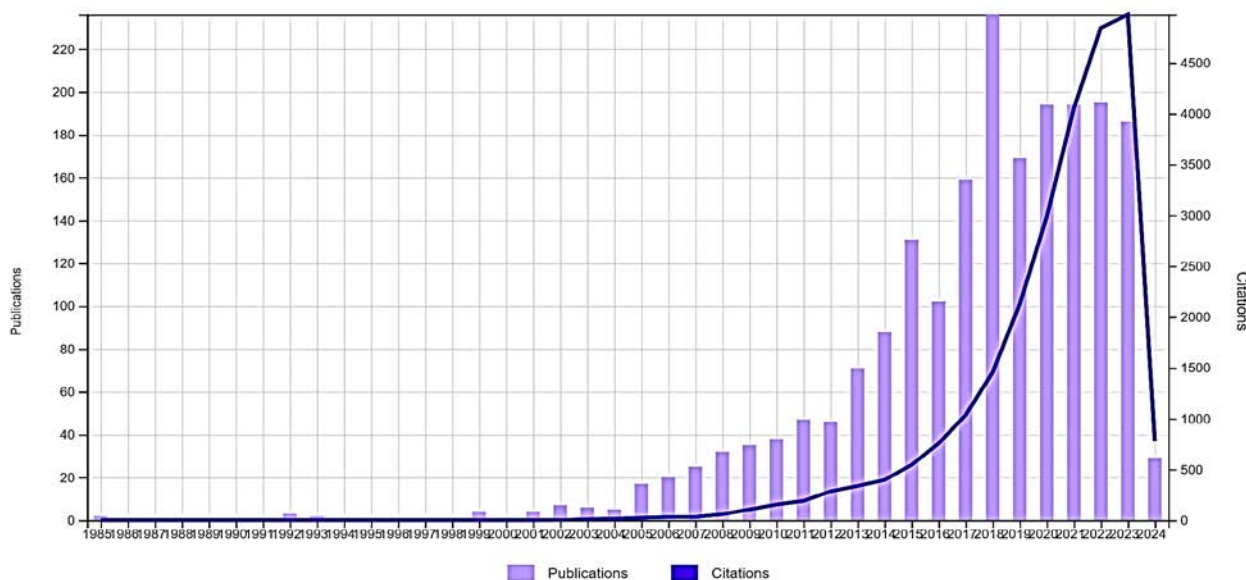


Figure 6. Citation Counts and Publications Over Time.

As a result of the analysis, it has been observed that both the number of publications and citations have significantly increased each year since 2004. Figure 6 indicates that the highest number of publications belongs to the year 2018

(236 publications), while the highest number of citations belongs to the year 2023.

### 3.5 Citation of Countries

An analysis was conducted over 62 observation units with relationships between them to create a citation network

based on the countries of origin of the publications and the citations they received. The criteria included at least 1

publication by a country and receiving at least 1 citation.

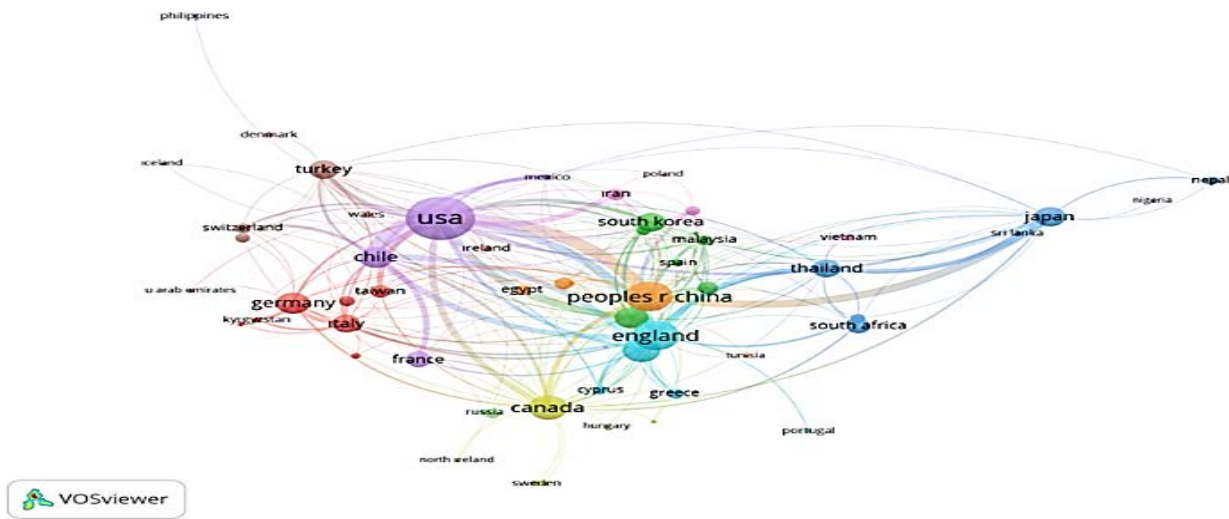


Figure 7. Citation Links of Countries

A total of 12 clusters, 278 connections, and a total connection strength of 668 were identified. The countries with the highest citations are the USA (7308 citations), People's Republic of China (3538 citations), and the United Kingdom (3481 citations). In terms of total connection strength, the USA (189), the United Kingdom (116), and Chile (99) are in the top three. In terms of the number of publications, the ranking is as follows: USA

(341 publications), People's Republic of China (315 publications), and India (221 publications)

### 3.6 Citation of Organizations

An analysis was conducted over 490 observation units with relationships between them to create a citation network based on the citations between organizations, with the criterion of at least 1 publication and 1 citation by an organization.

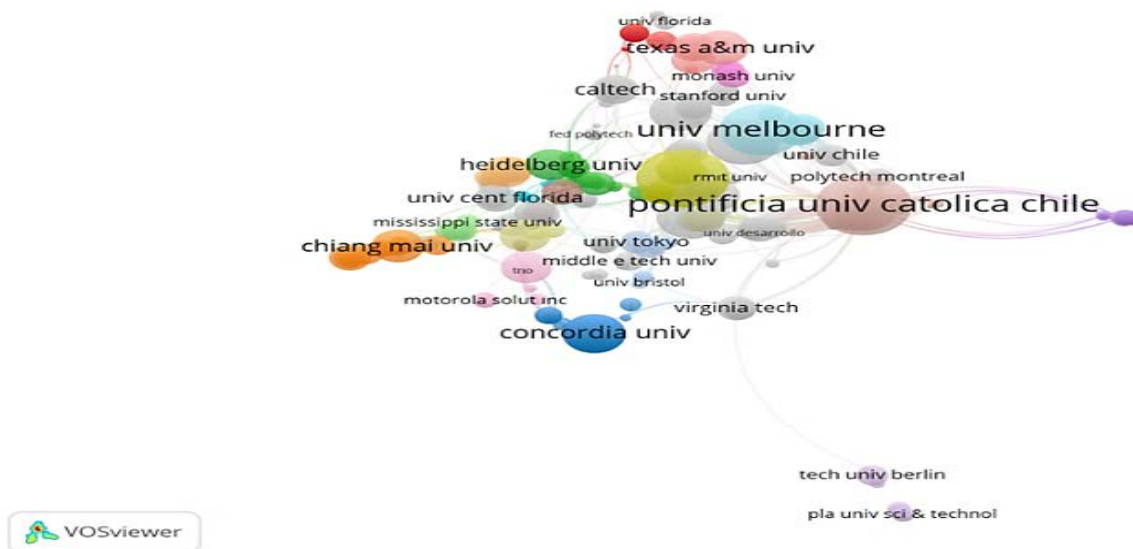


Figure 8. Citation Links of Organizations.

Sichuan University (145 publications), Istanbul Technical University (81 publications), and Pontificia University Catolica Chile (80 publications) are represented. The institutions receiving the highest number of citations are Pontificia University Catolica Chile (1473 citations),

Sichuan University (1385 citations), and Melbourne University (1097 citations). In terms of total connection strength, Pontificia University Catolica Chile (189), Nat Res Ctr Integrated Nat Disaster Man (132), and Chiang Mai University (79) are in the top three. In total, 38

clusters, 1293 connections, and a total connection strength of 1848 were identified.

### 3.7 Keyword Analysis

When examining the most frequently used keywords in publications related to post-truth, it is observed that 'Disaster Management' (283 occurrences), 'Resilience' (60

occurrences), 'Earthquake' (40 occurrences), 'GIS' (Geographic Information Systems, 95 occurrences), and 'Disaster' (33 occurrences) are the most prominent. In terms of total connection strength, the strongest keywords are 'Disaster Management,' 'Resilience,' 'Earthquake,' 'GIS,' and 'Disaster.'



Figure 9. Co-occurrence of Most Frequent Keywords.

An analysis was conducted with 4425 observation units showing at least one occurrence and relationships between them, resulting in a total of 161 clusters, 15883 connections, and a total connection strength of 16521.

### 3.8 Bibliographic Coupling Analysis of Texts

Bibliographic coupling refers to the situation where two independent sources cite a common document. An

analysis was conducted with 1149 units of works selected based on receiving at least one citation and having connections between them. This resulted in 30 clusters, 8120 connections, and a total connection strength of 13644.

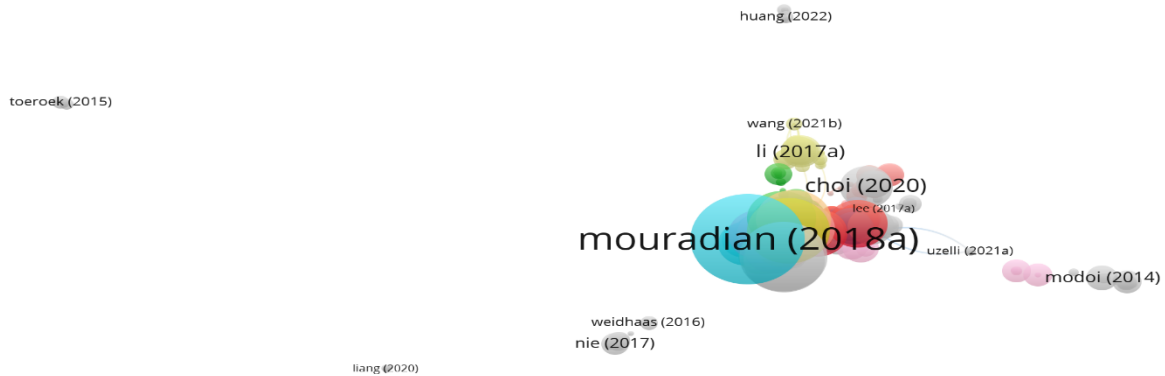


Figure 10. Bibliographic Coupling of Documents.

The publications with the highest bibliographic coupling include Mouradian (2018a) with 604 citations, Panteli (2017b) with 361 citations, and Tralli (2005) with 329 citations. The works with the highest total connection strength are Coban (2021), Wang (2018), and Maiti (2017).

### 3.9 Bibliographic Coupling Analysis of Authors

An analysis was conducted with 4303 units of works selected based on having published at least one work and

receiving at least one citation, and having connections between them. This resulted in 74 clusters, 133216 connections, and a total connection strength of 1104739. The authors with the highest bibliographic coupling include Pierluigi Mancarella with 850 citations (3152 connection strength), Mathaios Panteli, with 838 citations (2923 connection strength), and Roch H. Glitho with 652 citations (992 connection strength).

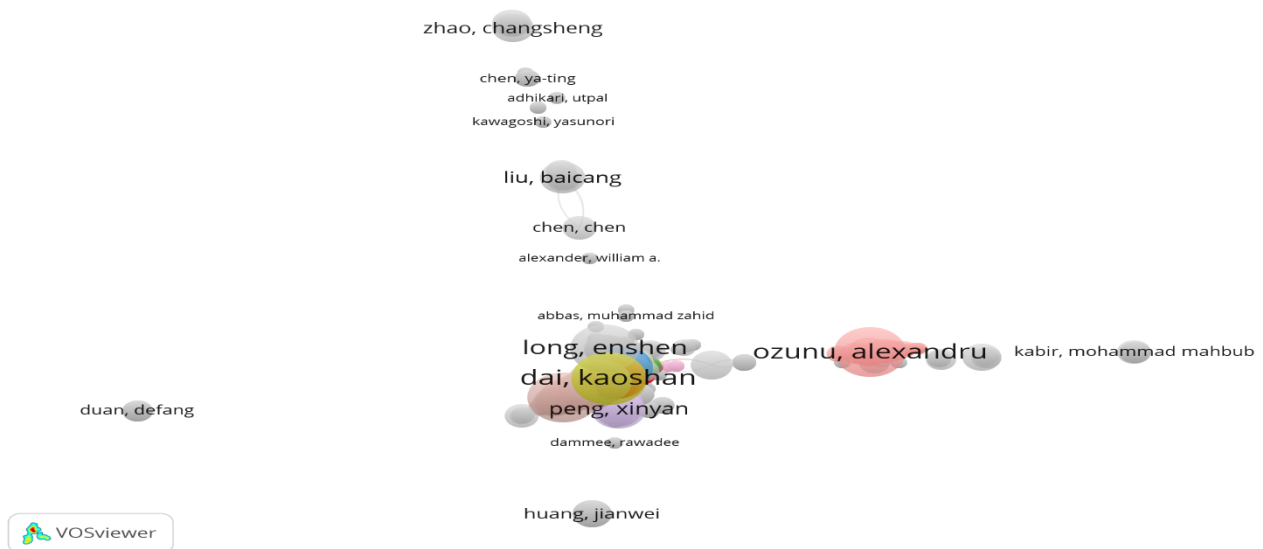


Figure 11. Bibliographic Coupling of Authors.

### 3.10 Co-citation Analysis of Co-authors

Co-citation refers to different sources cited in the same publication. An analysis was conducted with a minimum citation count of 10, resulting in 454 units analyzed. This yielded a total of 14 clusters, 10216 connections, and total

connection strength of 32068. The authors with the highest co-citation include SI Cutter (90), FEMA (78), and Mr Awual (70). The total connection strength ranks as follows: SI Cutter (781), Mr Awual (770), and Sk Nath (706)



Figure 12. Co-citation Links among Co-cited Authors.

## 4. CONCLUSION

This study aimed to map the quantitative landscape of studies related to disaster management and engineering.

In this research, data pertaining to publications on disaster management and engineering concepts were identified from the WoS database. These data were visualized



through graphs, tables, and figures to conduct bibliometric analyses. A total of 2051 articles published between 1985 and 2024 were included in the study. It was observed that the highest number of publications, 236 articles, occurred in 2018. Upon examining the distribution of articles over the years, a general increase over time was noted. It is a well-known fact that the frequency, scope, and impact of disasters have increased in the last century. Moreover, there has been a rapid increase and dissemination of scientific research. The increase in the number of publications in the fields of disaster management and engineering aimed at reducing the impact of disasters is believed to be attributed to these changes and developments.

The lower number of articles in the early years in the field of disaster management and engineering is believed to be attributed to the development of technology. Additionally, the perception of disasters as unpredictable and uncontrollable processes is also believed to influence the development of engineering studies in disaster management processes. It is thought that the increase in the number of publications in the field of disaster management and engineering, especially with the realization that disasters can be prevented and their effects mitigated, is linked to these changes and developments. It is observed that English is the most commonly used language in publications, likely due to its prominence as the language of scientific communication worldwide.

The countries with the highest number of publications in the field, such as the USA, China, and India, are believed to be attributed to their high level of development, frequent exposure to disasters, and advancements in technology. The universities with the highest number of publications in the field are Sichuan University, Istanbul Technical University, and Pontificia Universidad Catolica de Chile, indicating their focus on collaboration in disaster prevention and mitigation through engineering studies.

In terms of journals, *Procedia Engineering*, *Engineering Structures*, and *Environmental Engineering and Management Journal* are the journals with the highest number of publications, likely due to their focus on principles of design and technology. Juan Carlos de la Llera Martin, Dai Kaoshan, and Long Enshen are observed to be the authors with the highest number of publications, with each focusing on specific areas within disaster management and engineering.

In the findings obtained in the research, it is observed that the number of citations of articles published after 2005 has been increasing every year, with the highest number of citations observed in 2023. Researchers interested in the field of disaster management and engineering being familiar with studies published in high-citation years will

contribute to the development of the field and the emergence of high-quality studies. The most frequently repeated keywords in disaster management and engineering are found to be "disaster management, resilience, earthquake, GIS, and disaster," with these keywords also having the highest connection strengths, indicating a global trend towards focusing on these concepts in the field.

The study provides insights into the conceptual structure of the field, guiding researchers on future topics of interest. Researchers interested in conducting bibliometric research in the field of children's literature can explore databases such as Scopus, PubMed, Dimensions, and Lens in addition to the WoS database and analyze them using the VOS viewer package program. Periodic studies of this nature will serve to inform those interested in the subject from a scientific perspective and comprehensive overview. However, the study has some limitations, including the inclusion of only studies listed in the WoS Core Collection, excluding other sources such as TÜBİTAK Ulakbim and YÖK Thesis Archive in Turkey and international databases like Scopus and PubMed, as well as other sources not available online.

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This study adheres to the rules specified in the "Higher Education Institutions Scientific Research and Publication Ethics Directive".

This article has been scanned with plagiarism detection software.

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