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Maritime Transportation Accidents: A Bibliometric Analysis

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ABSTRACT

Purpose:
The article aims to highlight the concept of risk management in maritime transportation accidents in the specialized literature on the Web of Sciences database through existing materials.

Design/methodology/ approach:
The keyword study identifies several keywords as they have been set in this study and as they appear in the Web of Science database. Using VOSviewer our main concern is to identify and highlight the most essential and questioned words associated with the "maritime accidents" and "other issues related with maritime accidents" concept. We extracted 456 articles, underlined 259 keywords with the similar meaning to the keywords we have selected in the previous stage.

Findings:
We found that the maritime transportation accidents (MTA) topic has limited expansion in the literature. The gaps are considerably big leaving space for further research. The analysis of the keywords proves an interconnection between the MTA, the risk models, safety, management organization and more.

Research limitations/implementations:
Although there has been an increased interest in this field especially among countries with the shipping sector highly developed (maritime universities in China, London Poland, etc.), we have noticed that the related studies are still at the beginning, especially if we consider the accounting side of this subject.

Originality value:
The present article can only be the beginning of a set of studies in MTA, given that the issue has an increasing interest in academia. For future research, we can consider using a larger sample, more keywords, and additional databases.

1. Introduction

The examination of scientific publications can be approached from various perspectives such as subject matter, time, and scientific metrics. Bibliometric analysis is the primary technique used to evaluate research outcomes in the scientific community. It involves quantifying data related to scientific publications and their authors as a means of measuring scientific accomplishments (Norton, 2001). These publications can be collected from databases, for example Scopus and/or Web of Sciences (WoS).

The main objective of this research is to analyze the factors behind a maritime transportation accident (MTA). A bibliometric analysis of the scientific literature on this issue has been used to identify the evolution and future research trend in this topic which is extremely important in shipping as an indicator for wage packages and risk premiums. The term bibliometric analysis introduced by Pritchard (1969) was quickly used to assess the number of publications on several publications by researchers every time they were searching on existing literature for certain topics. Since then, many authors have undertaken the task of defining and analysing bibliometric techniques (Norton, 2001; Polanco, 1995; Stefaniak, 2008; Nowak, 2006).

Bibliometric analysis uses quantitative statistical data analysis based on published literature, from the sources selected by the author (usually Scopus and Web of Sciences) to study publication patterns within a scientific field (De Bellis, 2009), in our case the maritime transport accidents (MTA). The bibliometric analysis involves a set of quantitative measures, techniques, indices, metrics, and tools to analyze references in the scientific literature (Donthu et al., 2021).

The rationale for selecting Scopus and/or WoS databases is that they are reputable, globally recognized databases of academic publications, which compile a vast array of bibliometric indicators and cover a diverse range of fields

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spanning the sciences, technology, social sciences, humanities, medicine, and arts. The databases collectively index content from over 45,000 scientific journals and conference proceedings and are highly ranked in terms of citation counts. Using additional databases could lead to redundant data and integration issues.

From a bibliometric perspective, there is currently a knowledge gap regarding maritime transport accidents (MTA), which prompts several general questions such as: What is the conceptual and thematic structure of MTA? What are the main internal factors and sub-factors that underpin this topic? How has research in this field developed over time? And what are the emerging research areas and challenges for the future?

Using bibliometric analysis, the researcher identifies the key elements of the research such as the author(s), the affiliation, links and citations, the country of publication, the year of publication, JEL codes, and keywords.

2. Review of Literature

It is widely accepted that human error is responsible for approximately 80% of sea accidents. Despite numerous studies on the human factor and maritime safety, certain issues require further investigation. Crew fatigue caused by strict schedules, understaffing, poor management, low wages, inadequate equipment or technology, and the safety culture and recruitment policies of shipping companies are factors that adversely affect crew safety.

However, these organizational factors are often acknowledged but seldom researched. Additionally, it is essential to examine how multiculturalism in ship operations can lead to problems caused by multinational crews and how such problems can be prevented in the future.

The growing concern for maritime safety has led to an increased demand for research on the competencies of crews operating at sea, particularly in high-risk areas. Chen et al. (2013) have explored the human and organizational factors contributing to marine casualties.

They illustrated an accident in a multiple-levels why-because graph and identified how the human factors are involved in an accident amongst factors. A drawback of this method is that the analyser should have substantial knowledge on the maritime accidents and operational environments.

Chauvin et al. (2013) evaluated the relationship between human factors and maritime safety in the Human Factor Analysis and Classification System (HFACS). They examined the human factors in 5 causal categories and further divided human failures into perception and decision. They suggested to use psychological experiments to train people for a higher level of safety in the maritime field. Although the cause-and-effect relationship between human factors and maritime accidents is yet to be defined, she provided that the human factors is a critical factor of maritime accidents.

Analysing maritime accidents can be a dope way to find out what caused the mess and how different factors are linked. Pristrom et al. (2015; 2016) peeped the Global Integrated Shipping Information System (GISIS) database to figure out how likely a ship might get hijacked. Zhang et al. (2016b) checked out past accidents from 2008 to 2013 in Tianjin port to predict what might happen in the future.

Zampeta & Chondrokoukis (2022) have conducted a thorough analysis of maritime transportation accidents, focusing on internal factors that contribute to such accidents. Their study sheds light on the essential elements and activities that lead to maritime accidents, which can be addressed to enhance workers' occupational health, especially during the challenging pandemic and post-pandemic times. The study employs various advanced econometric techniques, yielding robust estimates that strengthen the existing findings in this field.

In a related study, Zampeta & Chondrokoukis (2023) have demonstrated that different work activities can result in injuries to different body parts. The location of work-related injuries varies across different groups of body parts. The study also reveals strong connections between work activities, work location, rank, nationality, and body injuries, utilizing robust econometric methodology and Gaussian and Mixed-Markov graphical models.

This research has analysed the existing literature in maritime transportation accidents (MTA) to determine the importance of MTA and how it is distributed among authors, countries and citation complexity using bibliometric analysis.

According to Liu et al. (2019), bibliometric studies involve a quantitative analysis of publications that focus on a particular phenomenon. This method is widely used to examine scientific discourse and understand the emergence and development of a research field (Ellegaard & Wallin, 2015) and is an effective procedure for understanding how a field of research emerges and develops (van Raan, 2005; Zhang et al., 2016a).

Norton (2001) argues that bibliometric analysis measures the literature used by researchers to study a topic, while Stefaniak (2008) defines it as the use of quantitative methods to analyze the state and development of a research topic in the literature. Polanco (1995) describes bibliometric analysis as a way to track the evolution of research in a topic using quantitative criteria, and Nowak (2006) presents it as a tool to describe and explain scientific phenomena. The use of bibliometric analysis allows researchers to understand the interest of other users in a particular research topic.

Bocken et al. (2014), Czakon (2011), Cook et al. (1997), Hart (1998), Mulrow (1994), and Tranfield et al. (2003) have identified three stages of bibliometric analysis: research planning, research implementation, and reporting.

In the present study, the research area focused on maritime transport accidents (MTA), and the data source selected was the Web of Science (WoS) scientific database. The analysis was limited to the period between 2010 and 2022, and key bibliographic criteria, such as the number, type, country, language, and research areas of the publications, were used for the analysis. Excel and VOSviewer were used to analyze the resulting data sets, and the findings of the bibliometric analysis were reported in the publication.

3. Methodology

The continuous growth of maritime transportation accidents (MTA) that could impact the efficiency of the sector has increased our interest to evaluate and review different articles regarding maritime transportation accidents, using a statistical method such as the bibliometric analysis. We collected data from the Web of Science (WoS) Core Collection, one of the highest qualitative research information sources. The WoS information network contains some of the most vigorously verified academic papers, so we created our database using this source of information. The outcome of our database was achieved using terms such as: maritime accidents, human casualties in maritime transportation, risk models, maritime safety, probability models and more.

3.1 Keywords Review

The keyword study identifies several keywords as they have been set in this study. The identified keywords appeared during the analysis illustrate the most used elements in the Web of Science database. In the first stage the main concern is to identify and highlight the most essential and questioned words associated with the "maritime accidents" and "other issues related with maritime accidents" concept. Using the Web of Science database we extracted 456 articles, by using (VOSviewer), underlined 259 keywords with the similar meaning to the keywords we have selected in the previous stage.

Figure 1 presents an interconnected link diagram with the elements through the links between them. Depending on the size of the dots in the diagram the occurrence of the keywords was identified together in the same article. The lines represent the connection between the keywords, and the thicker a line, the more those keywords were identified together in the same article.

The strength of the connection is shown by the distance between the dots. If the difference between the two dots is slight, then the connection within the concepts (keywords) is more substantial. Ultimately, it is vital to observe that each color marks a different group (cluster) of keywords generated by the software.

For the visualization of the bibliometric network, the words whose minimum repetition frequency is at least 3 were taken into account. Therefore, 259 keywords meet the condition that they are grouped into six clusters (Figure 1).

The most frequent words were model (85), safety (75), maritime accidents (68), maritime safety (67), Bayesian network (51) and so on. It is possible that the works on this subject are oriented to the search of statistical models with Bayesian and mathematical approaches that minimize maritime accidents. Other trends in this domain of knowledge are in the implementation of a management system for maritime safety and that are in accordance with development and climate care.

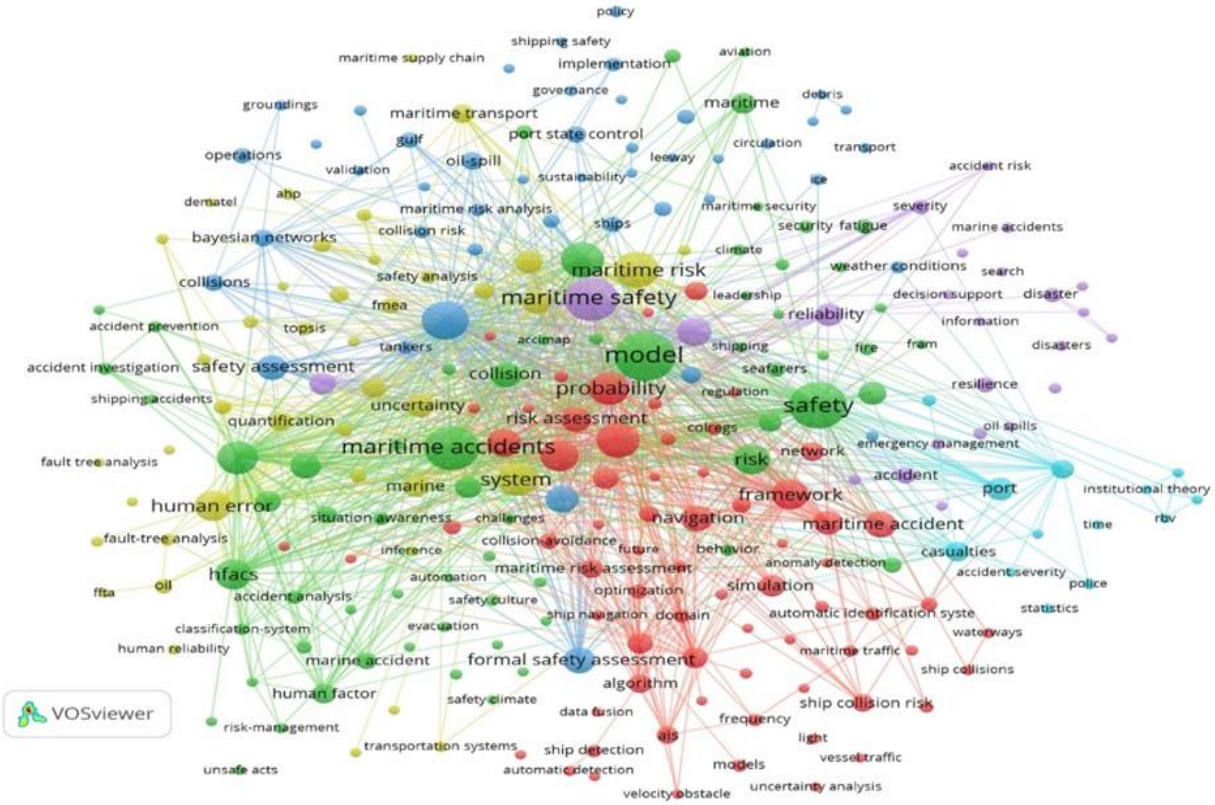

Figure 1: Co-occurrence map of keywords regarding maritime transportation accidents
Source: (Author's construct, 2023)

The VOSviewer visualization network has returned six clusters using a rate of 3 occurrences of the keywords. Table 1 portrays the six clusters; each is represented by the top ten significant keywords placed in descending order based on their frequency.

Table 1: Clusters of keywords

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
(Red)	(Green)	(Blue)	(Yellow)	(Purple)	(Skyblue)
Risk-Assessment	Model	Bayesian Network	Maritime Risk	Maritime Safety	Port
Probability	Safety	Sea	System	Transportation	Casualties
Accidents	Maritime Accidents	Formal Safety Assessment	Decision-Making	Reliability	Determinants
Framework	Management	Safety Assessment	Systems	Ship	Seaport
Risk Analysis	Organizational-Factors	Oil-Spill	Uncertainty	Accident	Statistics
Maritime Accident	Risk	Bayesian Networks	Marine	Resilience	Time
Navigation	Hfacs	Collisions	Methodology	Information	Police
Risk Assessment	Human Error	Port State Control	Quantification	Validity	Institutional Theory
Ais Data	Classification	Prediction	Maritime Transport	Search	Accidente Severuty
Simulation	Collision	Gulf	Fuzzy	Search And Rescue	Vessel Accidents

Source: (Author's construct, 2023)

3.2 Overlay Map Review

Regarding the overlay map, the words are shown according to the average year of publication. The terms in yellow are found in documents that were from the year 2020 which are model, maritime accidents, maritime safety, risk-assessment, Bayesian network, organizational facts. Among the most current terms are e-navigation, optimization, domain, machine learning, safety climate, risk, among others (Figure 2).

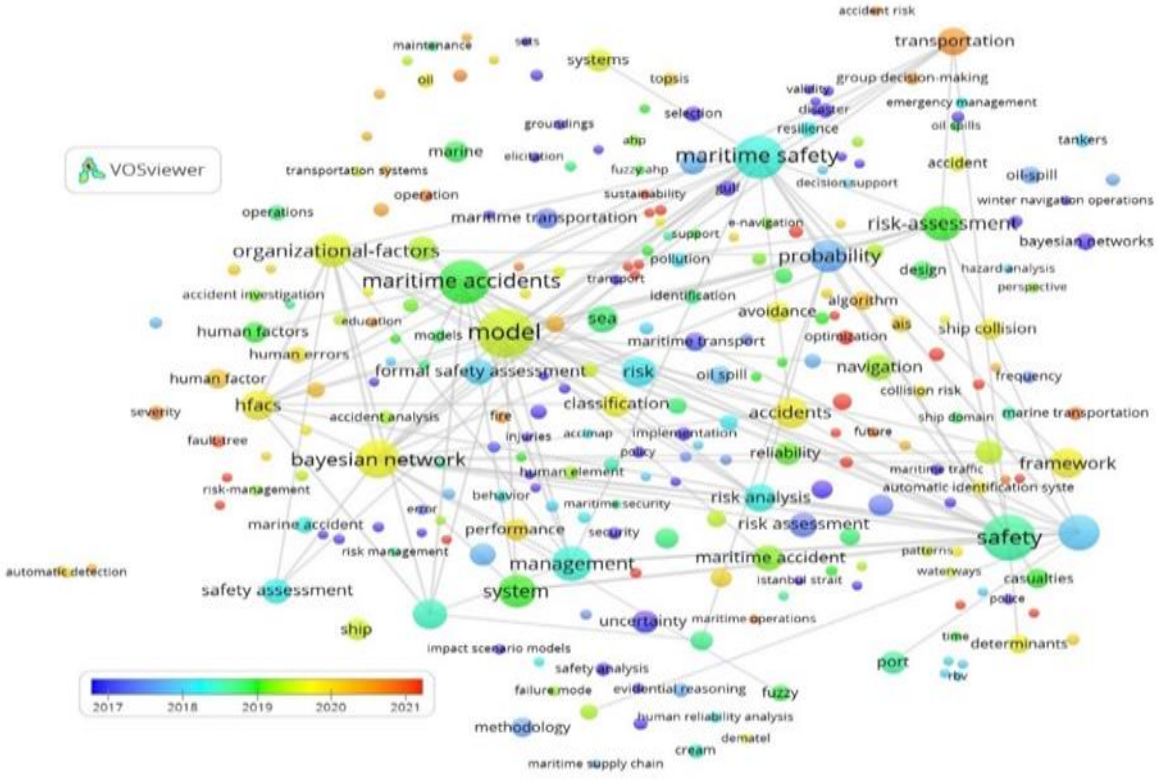

Figure 2: Overlay map according to the average year of publication.
Source: (Author's construct, 2023)

3.3 Overlay Map According to the Country of Publication

During the second part of this study, we imposed a minimum of one published document per country. The program selected from the database (499 articles) 44 countries that met the requirements. The research teams from different countries have built a stable collaboration network, creating the foundation for future research on the "maritime accidents" topic.

Figure 3 presents the overlay of countries in different links (marked with different color) and dots (different in size). Some dots are more significant than others because some countries have published more papers on this subject, showing a greater interest in it. The density of each line is a sign of qualitative cooperation among researchers. Table 2 shows the cluster of references per country.

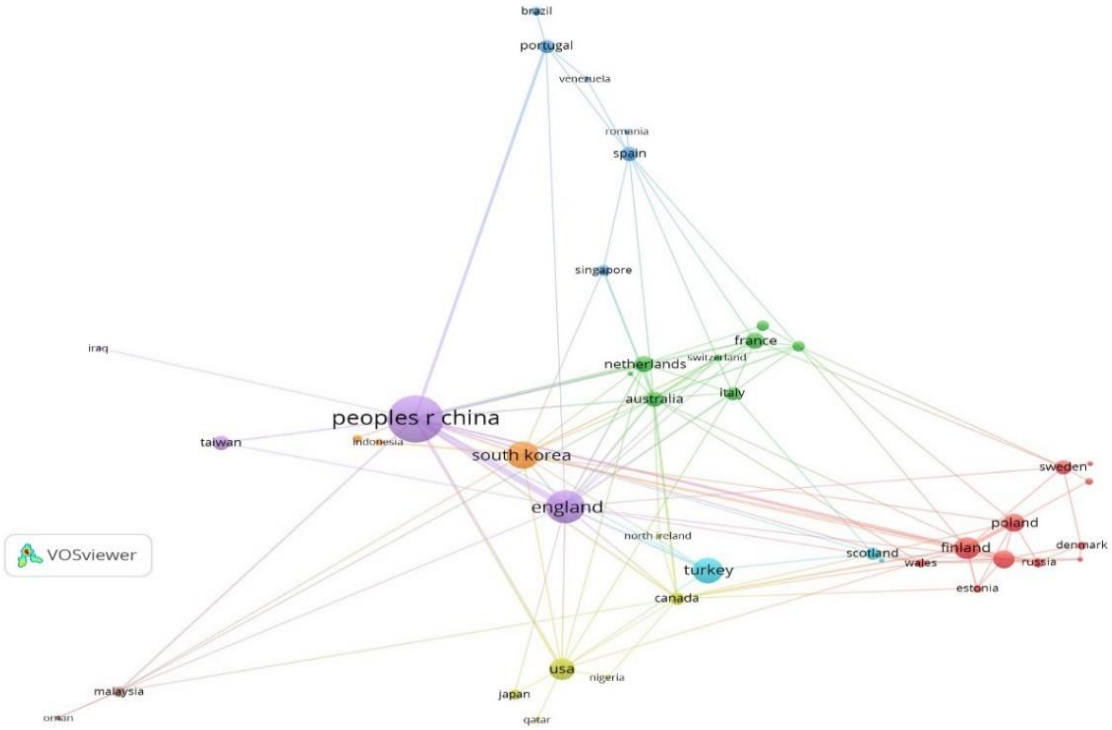

Figure 3: Overlay map according to the country of publication.
Source: (Author's construct, 2023)

Table 2: Clusters of references per country

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
(Red)	(Green)	(Blue)	(Yellow)	(Purple)	(Skyblue)
France	Turkey	USA	Peoples R	South Korea	Malaysia
Netherlands	Finland	Taiwan	China	New Zealand	Oman
Australia	Poland	Canada	England	Indonesia	United Arab Emirates
Croatia	Norway	Japan	Taiwan		
Spain	Sweden	North Ireland	Iraq		
Italy	Scotland	Nigeria			
Portugal	Russia	Qatar			
Germany	Denmark				
Greece	Estonia				
Singapore	Slovenia				

Source: (Author's construct, 2023)

Following Table 2 we established the top 6 countries with the greatest interest on the topic of "maritime transportation accidents and related issues" where the study subject has been highly disputed, France, Turkey, USA, Peoples Republic of China, South Korea and Malaysia, following by The Netherlands, Finland, Taiwan, England, New Zealand and Oman. Greece is in the lowest position with Estonia, Singapore, and Slovenia. The subject of this study "maritime transportation accidents" has not been examined extensively, although Greece has one of the biggest fleets in the world and this is the reason behind our decision to work on this.

3.4 Author Co-Citation Network Review

Figure 4 shows the organization of co-authorship where we can distinguish nine clusters as shown in Table 3. Each one is represented by a different color. Table 3 is represented by the top ten most quoted universities, where researchers have shown interest in the trends of maritime transportation risk management topics.

Among the top 10 universities with the greatest number of citations in MTA are the Wuhan Technical University of the Peoples Republic of China, followed by the Liverpool John Moores University, Dallian Maritime University, Shanghai Maritime University, Aalto University, Gdynia Maritime University, Delft Technical University, Hong Kong Polytechnic University, Istanbul Technical University, and National Taiwan Ocean University.

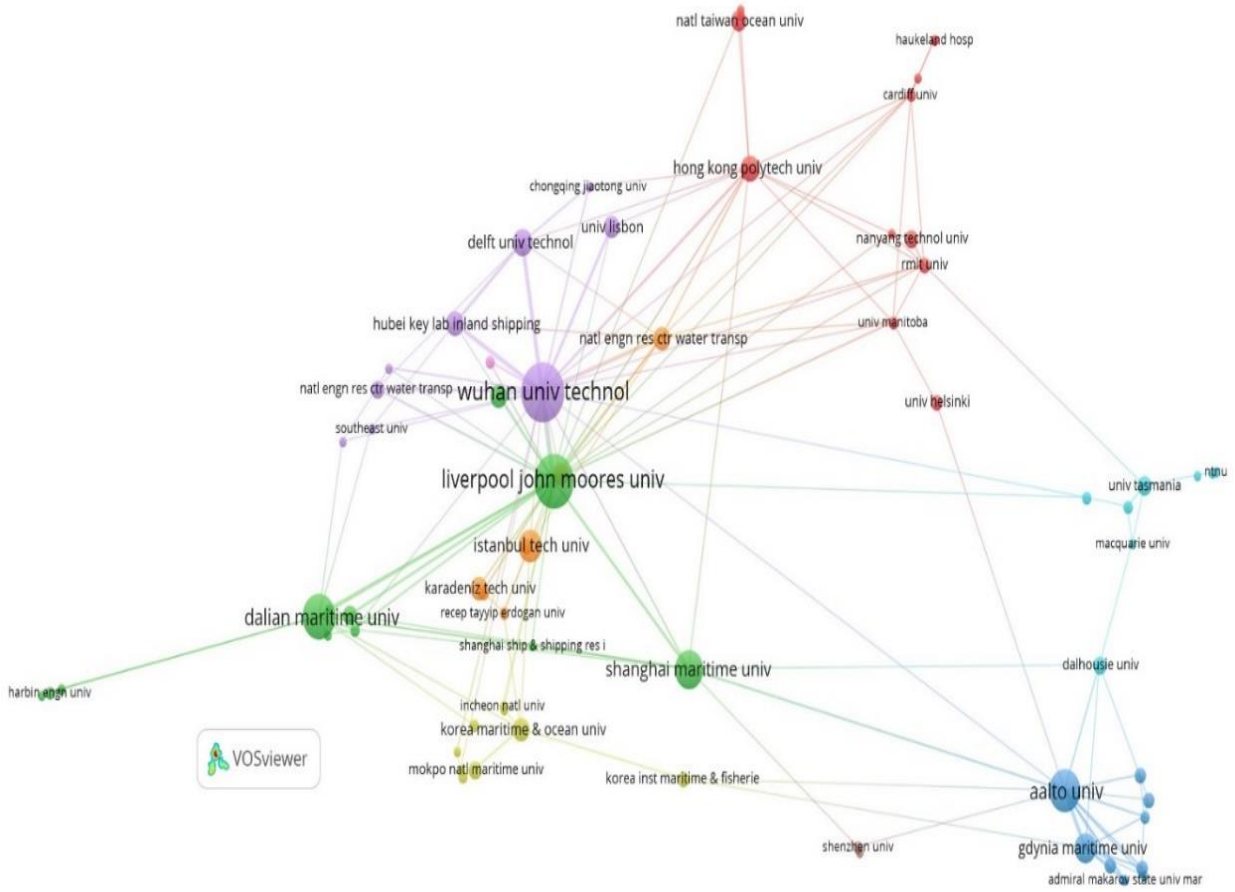

Figure 4: Organization of co-authorship
Source: (Author's construct, 2023)

Table 3: Author co-citation overlay map regarding MTA

Cluster 1 (Red)	Cluster 2 (Green)	Cluster 3 (Blue)	Cluster 4 (Yellow)	Cluster 5 (Purple)	Cluster 6 (Skyblue)	Cluster 7 (Orange)	Cluster 8 (Brown)	Cluster 9 (Skypurple)
Nanyang Technol Univ	China Univ Petr	Aalto Univ	Incheon Natl	Chongqing	Dalhousie Univ	Istanbul Tech	China Univ Geosci	Most
Hong Kong Polytech Univ	Chinese Acad Sci	Admiral Makrov	Korea Inst Maritime	Delft Univ	Macquarie Univ	Karadeniz Tech	Shenzhen Univ	
Rmit Univ	Dalian Maritime Univ	Finnish Geospatial	Korea Inst Ocean	Hubei Key Lab	Men Univ	Natl Engn Res		
Chung Ang Univ	Dalian Univ Technol	Gdansk Univ Tech	Korea Maritime & Ocean	Natl Engn	Ntnu	Ordu Univ		
Natl Sun Yat Sen Univ	Guangdong Ocean Univ	Maritime Univ	Korea Maritime Inst	Shenzhen Tech	Texas A&M Univ	Piri Reis		
Natl Cheng Kung Univ	Harbin Engn Univ	Napa	Mokpo	Southeast Univ	Univ South Eastern	Recep Tayip		
Cardiff Univ	Key Lab Nav	Norwegian Univ	Shandong Jiatong	Univ Lisbon	Univ Tasmania	Univ Strathclyde		

	Safety Guara		Univ					
Russian Acad Sci	Liverpool John Moores	Tallin Univ Tech	Univ Malaysia	Univ California	Western Norway			
Haukeland Hosp	Peking Univ	Waterbone Transport	Wuhan Inst Technol	Wuhan Univ				
Swansea Univ	Shanghai Jiao Tong Univ							

Source: (Author's construct, 2023)

4. Results and Conclusions

The analysis above is based on all articles (from the economy, management, and business finance) published between 2000 and 2022. The sample consists of 456 articles. The bibliometric visualization network was created using the free VOSviewer, establishing a study based on keywords (keywords that arise under the abstract), quotations, geographical representation, and authorship. Through this evaluation, we should be able to identify the nature of the connection between the writers and the research subject by assessing occurrences and co-citations.

While using VOSviewer, it was crucial to understanding the software's terminology. Each constructed map comprises items. For example, items can be identified as researchers or publications representing the object of interest. The connection between items is outlined through different types of links. These links are bibliographic coupling links for published papers, researchers' co-authorship links, and terms' co-occurrence links.

When the association is strong, every link is symbolized by its force, defined by a specific mathematical value. With their links, items can be classified into different clusters (groups). It may occur when not all items on the chart are grouped into clusters, which means those elements do not relate to any defined clusters. The clusters are marked with a different color, while each element has assigned a specific feature. We might notice that the program uses attributes such as "score" or "weight." The purpose of these attributes is to classify the elements as essential or less significant depending on the attribute received; for example, an increased score stands for more extensive meaning than a decreased score.

Analyzing the results of this study, we found that the MTA topic has limited expansion in the literature. The gaps are considerably big leaving space for further research. The analysis of the keywords proves an interconnection between the MTA, the risk models, safety, management organization and more. The MTA is an important issue in Shipping because it can be used for the determination of the compensation packages of the sea workers as well as for the insurance premiums and the P&I clubs associated with different type of shipping.

The internal factors of MTA should be an issue for further research, and this is actually the main aim of this research. For successful performance, the company must consider the changes and recommendations brought by the two areas. Shipping risk management for the prevention of maritime transportation accidents must consider an important topic in today's turbulent times where Environment Society and Sustainability (ESG) is the new strategy to be followed.

Therefore, although the database provided by WoS consists of numerous scientific research and scientific papers, there is enough space for future research. This article aims to highlight the concept of risk management in maritime transportation in the specialized literature on the Web of Sciences database through existing materials. Although there has been an increased interest in this field especially among countries with the shipping sector highly developed (maritime Universities in China, London Poland, etc), we have noticed that the related studies are still at the beginning, especially if we consider the accounting side of this subject.

The aim of this research is thus embodied in the identification of the conceptual frameworks offered by the specialized literature, thus laying the foundations for future research.

This article makes a valuable contribution to the limited research on the topic of MTA, highlighting the need for further discussion and investigation in the field. However, due to the reliance on the Web of Science database, the study is subject to limitations, including a small number of articles.

In light of this, future research could expand on this study by using a larger sample size, incorporating more keywords and databases. Additionally, future research could involve developing a more comprehensive bibliometric analysis that includes internal factors of MTA, to be used in both qualitative and quantitative statistical analysis and an econometric model. One of the authors is currently working on a doctoral dissertation on the factors influencing MTA.

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