The Relationship between Ports and Regional Development - a Bibliometric and Visualization Analysis

Odnos između luka i regionalnog razvoja – bibliometrijska i vizualizacijska analiza

Alen Jugović
University of Rijeka
Faculty of Maritime Studies
E-mail: alen.jugovic@pfri.uniri.hr

Helga Pavlić Skender
University of Rijeka
Faculty of Economics and Business
E-mail: helga.pavlic.skender@efri.uniri.hr

Goran Kolarić
Ministry of Science and Education
of the Republic of Croatia
E-mail: glavnotajnistvo@mzo.hr

Petra Adelajda Zaninović*
University of Rijeka
Faculty of Economics and Businesse
E-mail: petra.adelajda.zaninovic@efri.uniri.hr

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Abstract

Interest in ports and their impact on regional development can be traced back to the early days of industrialization and world trade, but has become more important in recent decades due to changes in global economic patterns, technological advances and the increasing importance of sustainable development. Although the economic impact of ports has been explored in the literature, there is a lack of studies dedicated to analyzing the popularity of this topic in academic papers. This research aims to fill this gap by employing a bibliometric analysis to capture the evolution of academic work on the relationship between ports and regional development and to identify research patterns and emerging areas of interest. Bibliometric analysis and visualization tools are used for the analysis. Based on the Web of Science Core Collection database, the most important research areas, journals and author keywords are identified. The results of the analysis are visualized with the VOSviewer software. The findings show that the topic is popular and that there is a growing trend in publications on the relationship between ports and regional development. Authors from port countries dominate the field. In addition, major publishers such as Elsevier and Taylor & Francis publish the most on this topic. The results of the co-occurrence analysis show the dominance of the keywords ports, management, port performance, logistics, which indicates that these keywords are of central importance for the research area under investigation.

KEY WORDS

ports
seaports
regional development
bibliometric analysis
VOSviewer

Sažetak

Interes za luke i njihov utjecaj na regionalni razvoj može se pratiti još od početaka industrijalizacije i svjetske trgovine. Međutim, u posljednjim desetljećima ovaj je interes postao značajniji uslijed promjena u globalnim ekonomskim strukturama, tehnološkom napretku te radi sve veće važnosti održivog razvoja. Iako je gospodarski utjecaj luka istražen u literaturi, nedostaju istraživanja posvećena analizi popularnosti ove teme u znanstvenim radovima. Cilj je ovoga rada primijeniti bibliometrijsku analizu kako bi se prikazao tijek znanstvenih istraživanja o odnosu između luka i regionalnog razvoja. Nadalje, u radu se nastoje identificirati ključni istraživački obrasci i nova područja interesa. U analizi koriste se bibliometrijski alati i alati za vizualizaciju podataka. Na temelju baze podataka Web of Science Core Collection identificirana su najvažnija istraživačka područja, časopisi i ključne riječi autora. Rezultati analize, prikazani s pomoću softverskog alata VOSviewer, ukazuju na visoku popularnost teme i rastući trend u objavama koje se tiču odnosa između luka i regionalnog razvoja. Autori iz lučkih zemalja prednjače u ovom području, dok vodeći izdavači poput Elseviera i Taylor & Francisa objavljuju najviše radova o spomenutoj temi. Rezultati analize supojavnosti ističu dominaciju ključnih riječi poput „luka", „upravljanja", „performansi luka" i „logistike", što ukazuje na iznimnu važnost tih termina za istraživano područje.

KLJUČNE RIJEČI

luke
morske luke
regionalni razvoj
bibliometrijska analiza
VOSviewer

1. INTRODUCTION / *Uvod*

Due to their crucial role in international trade, logistics and transportation, the contribution of ports to economic development has received increasing attention in academic literature. Ports serve both as important nodes in the supply chain and as catalysts for local and national economic expansion. Given the complex interactions between infrastructure, policy, and market dynamics, understanding the intricate

* Corresponding author

relationship between seaports and economic development is critical for both academic studies and practical applications. However, despite much academic attention, there is still a lack of systematic identification of research trends, patterns and emerging areas of interest in this field. This research aims to fill this gap by employing a bibliometric analysis, that is, the co-authorship analysis, the co-occurrence analysis, the co-citation analysis and the bibliographic coupling, to capture the evolution of scholarly work on the relationship between ports and regional development. Bibliometric analysis, a method of quantitatively examining the structure, growth and influence of the academic literature, provides a comprehensive overview of the major research topics, methods and collaborations in the field. By analysing a variety of published studies, this research provides insights into the evolution of the discourse on ports and regional development over time and identifies burgeoning areas of research that could influence future policy and academic research. This research contributes to a deeper understanding of the relationship between seaports and regional development and pushes the boundaries of research by identifying new areas for exploration. By expanding our knowledge of research patterns, emerging trends, and critical gaps in the literature, this study serves as a foundation for future empirical research and policy decisions aimed at realizing the full potential of seaports to promote economic prosperity.

This paper consists of six interconnected parts and is organized as follows. Following the introduction, the literature review presents the current state of knowledge on the relationship between ports, port infrastructure and economic growth and development. The third part, Methodology, describes the methodology used in this study. The fourth part presents the results of the bibliometric analysis, while the fifth part discusses the main findings. Finally, the sixth part, the conclusion, contains the main conclusions, the limitations of the research and suggestions for further research.

2. LITERATURE REVIEW / *Pregled literature*

The economic role of ports has been researched topic for centuries. The majority of published articles agree that ports positively affect economic growth and development. For example, ports are an important economic factor in coastal regions and the development of ports brings many economic benefits [1]. Ports play a crucial role in complex supply chains as logistical hubs that influence supply chain patterns and processes. The functioning of supply chains and logistics is highly dependent on ports. Ports are among the many nodes that make up global supply chains and are critical to ensuring that transportation can continue between supply chain participants [2]. According to Panayides and Song [3], ports are evolving beyond their usual role of loading and unloading cargo to become links in a branched logistics chain and thus part of an international distribution network. Ports attract new industries and create the conditions for the growth of surrounding businesses [4]. The higher the annual freight and passenger volume, the more infrastructure, deliveries and associated services are required. These bring benefits to the economy and the country to varying degrees. Given their historical role as hubs of trade and global prosperity, ports are often cited in economic literature as important drivers of economic growth [5]. However, while policymakers see infrastructure investment as a driver of economic growth, some scholars disagree on the overall economic impact of ports, and question whether it makes sense to invest so much funds in transportation infrastructure rather than in other, potentially more profitable sectors [6]. The investment in the port indirectly contributes to economic growth, but operation of the container port has a positive effect on regional economic growth [3]. Ports are also important in supporting economic activities in the hinterland as they provide an important link between sea and land transportation. According to Bottasso et al [1]. ports tend to increase the GDP of the place where they are located and have a spillover effect on the GDP of neighboring regions. According to Mudronja, Jugović and Škalamera-Alilović [7], the operation of seaports contributes to the economic development of their respective regions and usually increases the GDP per capita in the area surrounding the seaport. As providers of jobs, ports not only fulfil an economic function, but also a social one. In terms of cargo transported, sea transportation is the cheapest and most effective transportation system compared to other systems. Industry needs a safe and cheap means of exporting finished goods and importing raw materials. Therefore, most of the world's industries are located in the coastal regions near the major ports. These industries in turn affect the lives of workers and indirect beneficiaries [8]. With increasing concerns about environmental issues, Agarwala and Saengsupavanich [9] highlight the important role of seaports as economic gateways while also addressing the environmental degradation they can cause. Although there are a large number of academic papers analysing the relationship between ports and economic growth and development [10, 11, 12, 13, 14, 15, 16, 17], to our knowledge there is a gap in the literature regarding the bibliometric analysis of these publications, i.e. the identification of academic papers on the links between ports and regional development. Several publications have conducted the bibliometric analysis on port-related topics, such as sustainable development goals in the maritime industry and port sector [18], digitalization in maritime transport and seaports [19], maritime security policy [20], port choice and sustainable decision-making in container liner shipping [21], and trends towards achieving sustainability in transport [22]. However, a bibliometric analysis of the relationship between ports and regional development is lacking. This article aims to fill this gap and provide insights into the development, trends, influence, collaboration and future direction of the research. The remainder of the article explains the methodology used to conduct the bibliometric analysis on this topic and presents the main findings of the research.

3. METHODOLOGY / *Metodologija rada*

In this paper, a bibliometric analysis is used as a research method. Bibliometric analysis is a relatively new but popular and rigorous method for examining and analysing large amounts of scientific data. Its popularity is due to the "advancement, availability and accessibility of bibliometric software such as VOSviewer and scientific databases such as Web of Science or Scopus" [23]. The reason for choosing bibliometric analysis is to examine the bibliographic material, to identify the most important research publications, publishers and fields, and to link these publications to each other. A complex and multifaceted topic like the effects of ports on regional development, using bibliometric methods allows to systematically map the existing body of research.

By analysing the number of publications, citation counts, co-authorship networks, and keyword occurrences, patterns, trends, and influential works can be identified that have shaped the research on the relationship between ports and regional development. This ensures that is considered wide range of sources and gain an overview of the major contributions to the field. Bibliometric and visualization analysis is well-suited for this research because it allows for a systematic, objective, and comprehensive examination of the academic literature, helping to identify key trends, influential researchers, and major topics in the research related to the effects of ports on regional development. Visualization tools (e.g., co-citation networks and co-authorship networks) can help reveal the central themes and topics, such as the impact of ports on economic growth, logistics, infrastructure, and trade, thus offering insight into what is most relevant and important in area of research. However, there is a scarce on the bibliometric research on the relationship between ports and regional development and this research aims to fill this gap. The Figure 1. presents the steps of the bibliometric research process that is used in this research-

The study is conducted in four phases. In the first phase, a comprehensive literature search is carried out in the Web of Science Core Collection. The search queries (terms) used are: Ports, Seaports AND Regional development, as we wanted to limit the search to literature dealing with the topic of ports (seaports) in the context of regional development. The database search was also limited to journal articles published in English from 2008 till March 2025. From 2003 till 2008 there was a gap in the data so we decided to include years for which we have available data. In addition, the search was limited to the Web of Science categories: Transportation Economics, Operational Research, Management Science, Management, Business, Urban Studies, Business Finance and Social Science interdisciplinary as we wanted to limit the search to studies related to economics and business. We also limited our research to papers indexed in Social Science Citation Index (SSCI), Science Citation Index Expanded (SCI-EXPANDED), Emerging Sources Citation Index (ESCI), Conference Proceedings Citation Index – Science (CPSI-S), Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH) and Arts & Humanities Citation Index (A&HCI). We have chosen only open-source papers in English language. Our final results were 2,238 publications in the Web of Science Core Collection. From the Web of Science results, we were able to identify the annual publications, the number of publications per category, the number of publications per country, the main journals in the field and the main publishers in the field. This type of research offers the possibility of analysing the popularity and relevance of a particular topic at the different levels of research.

Using the VOSviewer software, an analysis of the co-occurrence of keywords was carried out in the second phase of the study. VOSviewer software was used for the co-occurrence of keywords analysis and network visual presentation [25]. We extracted 57 of the most often keywords from our study (table 7). The keywords were coloured in the network visualization according to the clusters to which they belong and the average year of publication was used to colour the keyword nodes [26]. The nodes in the constructed bibliometric network represent keywords while the weight (size) of the node indicates how often the respective keyword occurs. Depending on the number of articles in which a

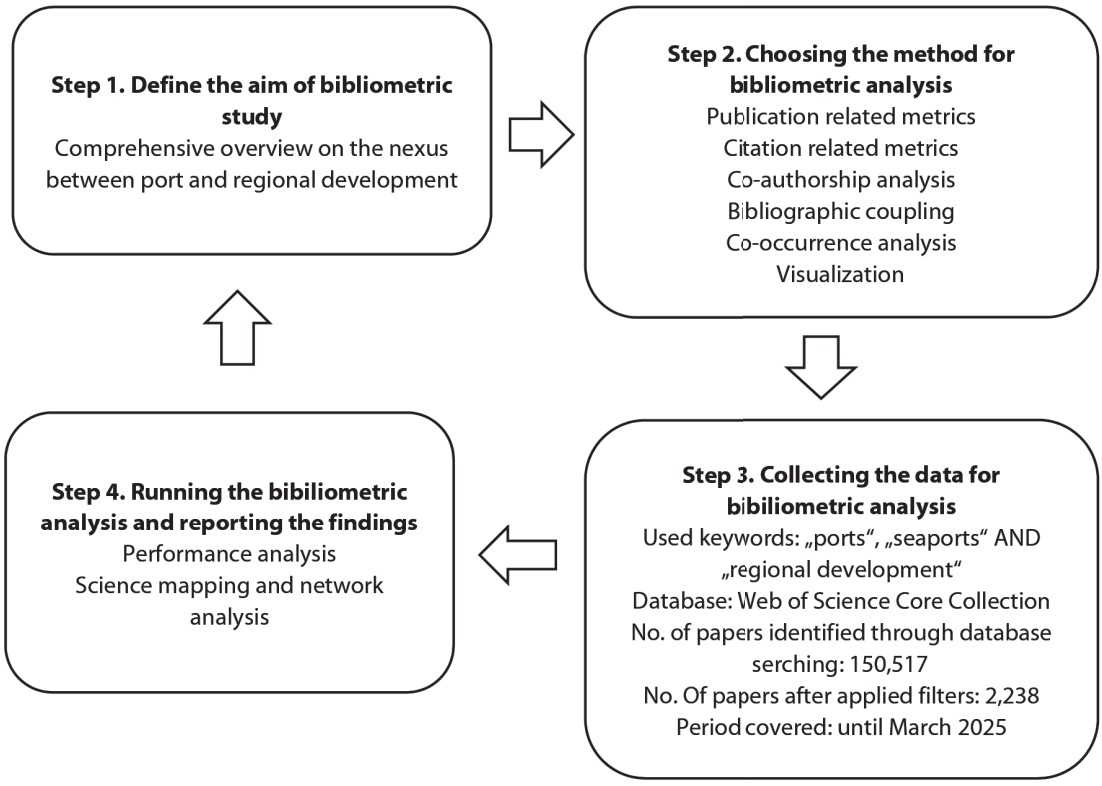

Figure 1 Steps of the bibliometric research process
Slika 1. Faze bibliometrijskog istraživačkog procesa

Source: Authors based on [23, 24]

node appears with another, the links (edges) show the relationships between the nodes [23]. This analysis has helped us to recognise the relationships between the different terms in the field and the development of the field of research in general.

4. RESULTS / *Rezultati*

The relevance and popularity of the role of ports in regional economic development can be seen from the number of publications on this topic. Figure 1 shows the annual number of publications dealing with the role of ports in regional development and similar topics. The analysis covers the period from 2008 to the last available data in 2025. The significant growth in publication is evident, from only 19 publications in 2008 to the peak of 270 publication in 2021 and slight decrease in the last years. In the last observed year, 2025, there is only 10 publications, but as the data is only available till March 2025, we expect more publications by the end of the year.

Table 1 shows the number of publications on the search terms "ports", "seaports" and "regional development" according to the Web of Science category. Most publications, namely 1361 articles, were published in the Transportation category, followed by the Operational research management science category with 491 articles. The lowest number of publications can be found in the Business category, namely 256 publications. Some articles can be classified in several categories, which is why the total number of articles in Table 2 is greater than the total results we obtained, namely 583 articles.

Most of the articles found are listed in the Social Science Citation Index (SSCI), which shows that this topic is recognized in the higher ranked and cited journals and in the academic world in general. Table 2 shows the distribution of the articles found published in the journals by the Web of Science indices.

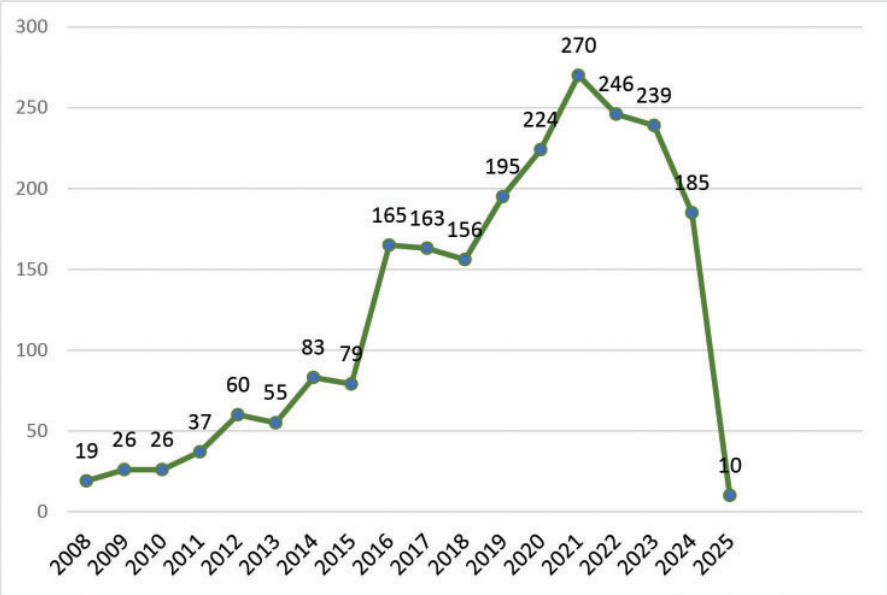

Figure 2 Annual number of publications on the ports and regional development
Slika 2. Godišnji broj publikacija o lukama i regionalnom razvoju

Source: Author's elaboration based on [27]

Table 1 Number of articles published by the Web of Science Categories
Tablica 1. Broj objavljenih članaka prema kategorijama Web of Science

Transportation	Economics	Operational research management science	Management	Business
1361	305	491	469	256

Source: Author's elaboration based on [27]

Table 2 Number of articles by the Web of Science indices
Tablica 2. Broj članaka prema indeksima Web of Science

Social Science Citation Index (SSCI)	Science Citation Index Expanded (SCI-EXPANDED)	Emerging Sources Citation Index (ESCI)	Conference Proceedings Citation Index Science (CPSI-S)	Conference Proceedings Citation Index – Social Science & Humanities (CPCI-SSH)	Arts & Humanities Citation Index (A&HCI)
910	555	835	210	251	12

Source: Author's elaboration based on [27]

The five most important journals in which articles on port economics and regional development are most frequently published are presented in Table 3. The Asian Journal of Shipping and Logistics is a multidisciplinary journal focusing on shipping and logistics. The impact factor is 3.98 (2023) and is in the Q2 category, i.e. between 25% and 50% of journals in this field. The journal is published by Elsevier. Maritime Policy Management is published by Taylor & Francis, has an impact factor of 3.83 (2022) and is in the top quartile of Q1 CiteScore, meaning it is in the top 25% of journals in its field. Both journals publish articles in open access [28, 29].

The leading publishers in the field of port economics, in particular the relationship between ports and regional development, are Elsevier and Taylor & Francis, which are among the leading publishers in the field of economics in general. This is also a confirmation of the relevance of this topic, which is recognized by the best publishers.

Table 5 below lists the five most frequently cited authors according to the Web of Science Core Collection metrics who make a significant contribution to the body of knowledge in the fields of transportation, ports and ports economics and management.

The five leading countries, i.e. their researchers in the field of port economics and regional development, are mainly from China, but also from the USA, England, Spain and the Netherlands. This is not surprising, as these are the countries with the largest transhipment ports in the world. China has 22 of the 60 largest container ports in the world, the USA has five of the 60 largest container ports in the world, while England with the Port of London, the Port of Felixstowe and the Port of Southampton, Spain with the Port of Barcelona, the Port of Algeciras and the Port of Valencia and the Netherlands with the Port of Rotterdam are important ports that contribute significantly to European and global trade [30].

Table 3 Top five journals in the field
Tablica 3. Pet najboljih časopisa u području

The Asian Journal of Shipping and Logistics	Maritime Policy Management	Maritime Business Review	Transportation Research Procedia	Pomorstvo Scientific Journal of Maritime Research
163	104	89	88	75

Source: Author's elaboration based on [27]

Table 4 Top five publishers in the field
Tablica 4. Pet najboljih izdavača u području

Elsevier	Taylor & Francis	Springer Nature	Emerald Group Publishing	University of Rijeka Faculty of Maritime studies
1090	186	156	122	75

Source: Author's elaboration based on [27]

Table 5 Top five cited authors in the field
Tablica 5. Pet najcitiranijih autora u području

Author / Institution	H-index	No. of citation	No. of publications
Wang, Shuni / Hong Kong Polytechnic University	56	13,114	389
Yang, Zaili /Liverpool John Moores University	54	9,299	293
Notteboom, Theo / Ghent University – Maritime Inst	40	5,035	134
Ducruet, Cesar / Centre National de la Recherche Scientifique (CNRS)	28	2,728	76
Yeo, Gi-Tae / Incheon National UniversityGrad Sch Logist	23	1,696	77

Source: Author's elaboration based on [27]

Table 6 Top five countries that published work in the field
Tablica 6. Pet najboljih zemalja koje su objavile rad u području

China	USA	England	Spain	Netherlands
351	210	227	148	173

Source: Author's elaboration based on [27]

The following figures show the clustered networks of the co-authorship analysis, the co-occurrence analysis, the co-citation analysis and the bibliographic coupling. The figures, i.e. visualization was performed with the VOSviewer software. Co-authorship analysis examines the interactions between the most important authors in a research area [23]. It usually provides insights into their mutual collaboration by determining which factors contributed to this collaboration. Using authors as the unit of analysis and assessing their individual performance and influence refers to the tactical level [31]. The results of the co-authorship analysis are shown in Figure 2. The threshold for inclusion was set at a minimum of five documents per author to ensure a focus on significant contributions to the field. Of the 96 items identified in the dataset, 71 are linked, indicating a high level of collaboration and shared research interests among scholars in the field. 71 elements in 15 clusters make up the clustered network. Each of the 15 clusters represents a specific thematic sub-area within the broader field of port and regional development. Each of the clusters is shown in a different colour. The large number of links (136) and total link strength (347) indicates the strong links between authors and suggest that the research community in this field is highly engaged in collaborative knowledge production.

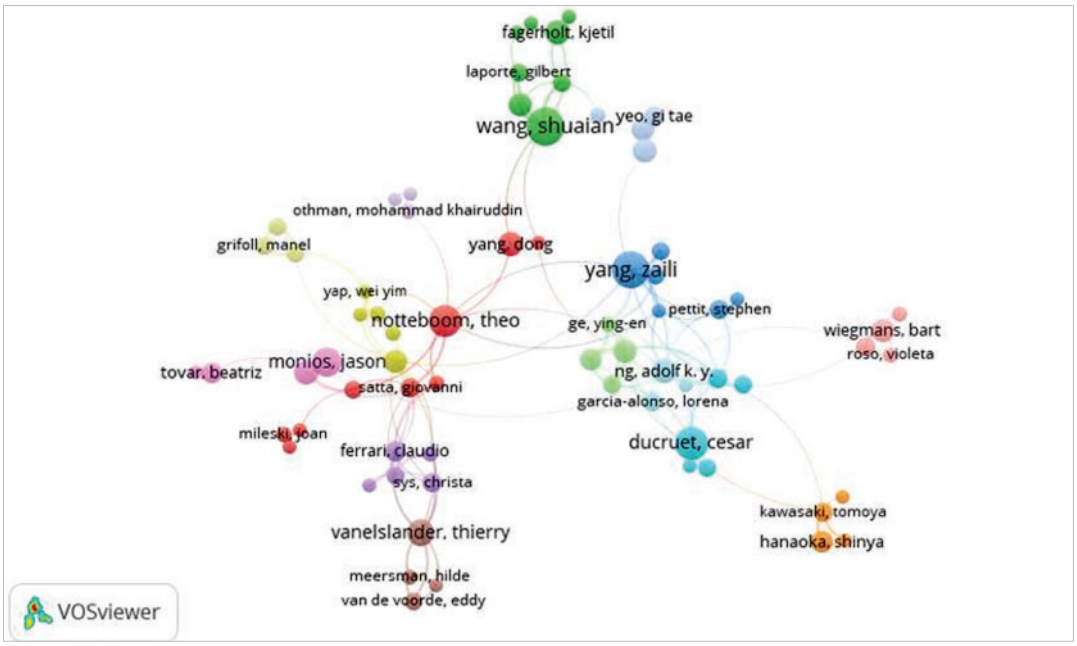

Figure 2 Clustered network of cited authors based on co-authorship analysis
Slika 2. Klasterirana mreža citiranih autora temeljena na analizi suautorstva

Source: Author's elaboration based on [27]

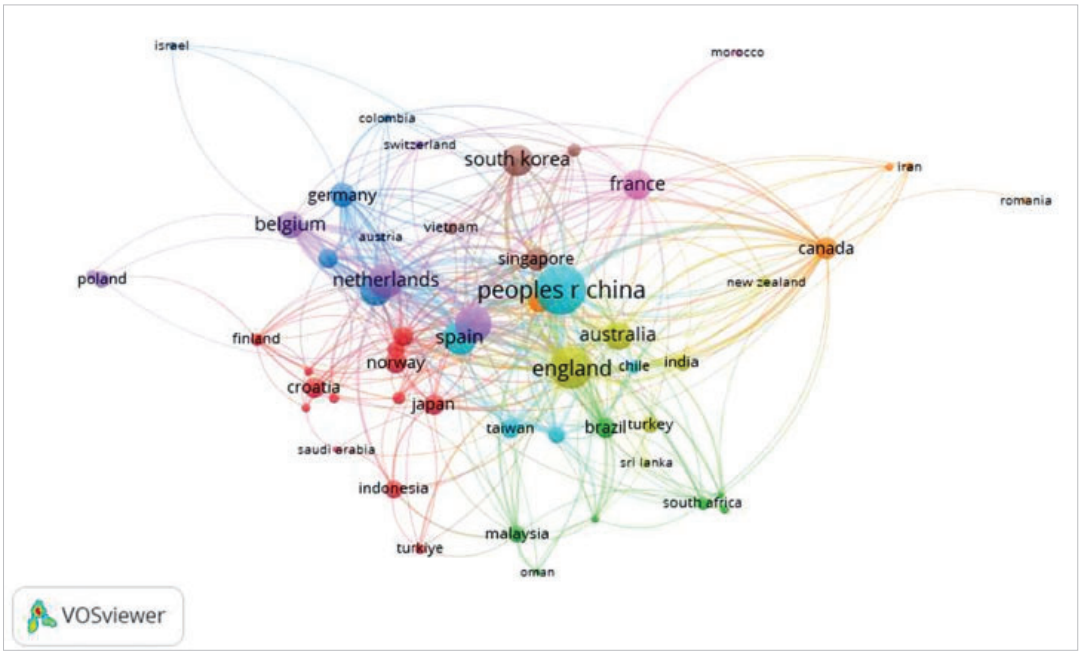

Figure 3 Clustered network of countries based on co-authorship analysis
Slika 3. Klasterirana mreža zemalja temeljena na analizi suautorstva

Source: Author's elaboration based on [27]

Figure 3 shows a clustered network of countries based on a co-authorship analysis. The result of a clustered network divides these countries into nine different clusters. Each node in the figure represents a country, and the countries from each cluster have the same colour. The size of the node indicates how strong a country's collaboration with others in that research field is (i.e. the larger the node, the higher the number of relationships with other countries). The strength of the links between two countries indicates the strength of their mutual cooperation. There are 54 countries in our sample with 371 links and 1054 link strength. The central nodes are the countries that are also the leading port countries with the highest cargo throughput, i.e. countries with hub ports, while the other, smaller nodes are countries with smaller ports. From this we conclude that the researchers are interested in exploring their environment and in making policy and business recommendations.

Figure 4 show clustered network of keywords based on the co-occurence analysis. Co-occurrence analysis is a bibliometric analysis based on the actual content of a publication [23]. It uses the keywords of the publications as the unit of analysis. If these keywords are not known, other words from the title, abstract or full text of the publication can be used [24]. The co-occurrence analysis assumes that the more frequently two words occur together, the greater the link between publications containing these words. The results of the co-occurrence analysis of the author keywords are shown in Figure 4 and Figure 5. The minimum number of occurrences was set at 15. The total number of 3,795 linkages with a total linkage strength of 9,073 underlines the high degree of interconnectedness between these core themes and indicates a cohesive body of research in which related concepts are explored together. The co-occurrence analysis led to the identification of five clusters of keywords. The co-occurrence network shows that the keywords "port"", "performance"", "logistics"", "impact" and "optimization" occupy central positions in the network. The size of the circles representing these keywords is an indication of their frequency, and their dominant presence in the analysis underlines their importance as core concepts in the field.

Figure 5 present clustered network of cited sources based on the co-citation analysis. Co-citation analysis is the most widely used and validated bibliometric method, as it examines the intellectual structure of a research field by identifying the most influential publications or authors and their knowledge base. Co-citation analysis is based on the assumption that the more two entities (in our case journals) are cited together, the more likely it is that their contents are related in some way [32]. Since this method is based on the number of citations, it is biased towards highly cited publications and usually omits the less cited ones [24]. Furthermore, since the entire publication process changes over time, the analysis of co-citations focuses on the past state of a research field rather than the current situation or possible changes in the future [32]. In this clustered network, each node represents a publication that has been cited by another publication in our sample, while the size of the node indicates how many times it has been cited (i.e., the larger the node, the higher the number of citations). We set the number of citations of the cited publications to at least 20. The result is 365 items clustered into six clusters with 35326 links and a total link strength of 664306.

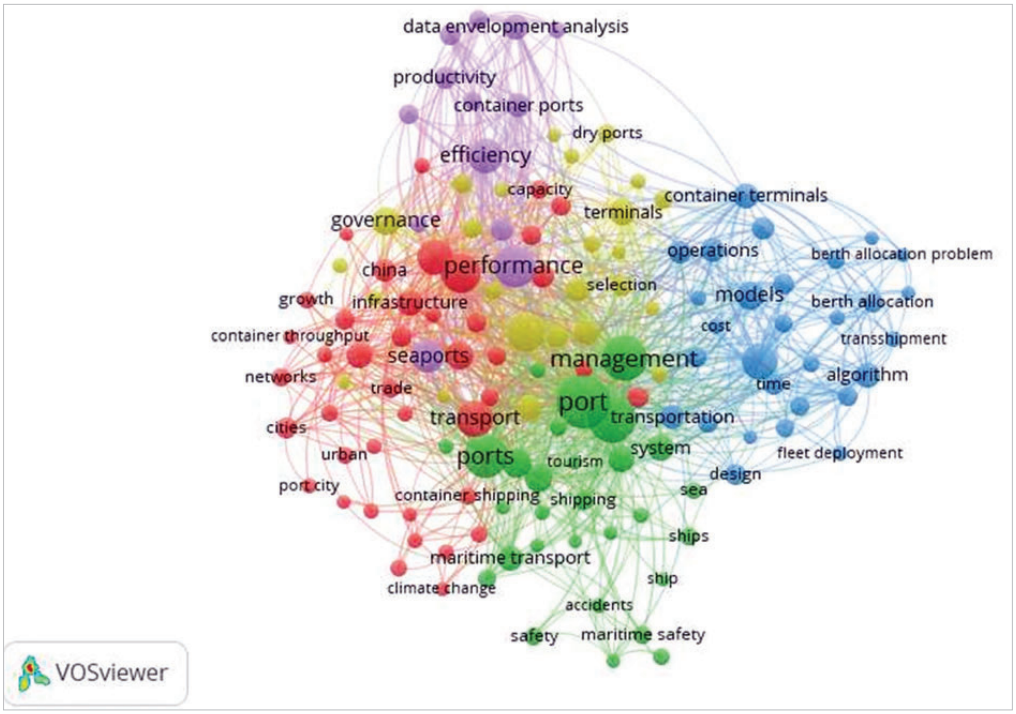

Figure 4 Clustered network of keywords based on the co-occurence analysis
Slika 4. Klasterirana mreža ključnih riječi na temelju analize supojavnosti

Source: Author's elaboration based on [27]

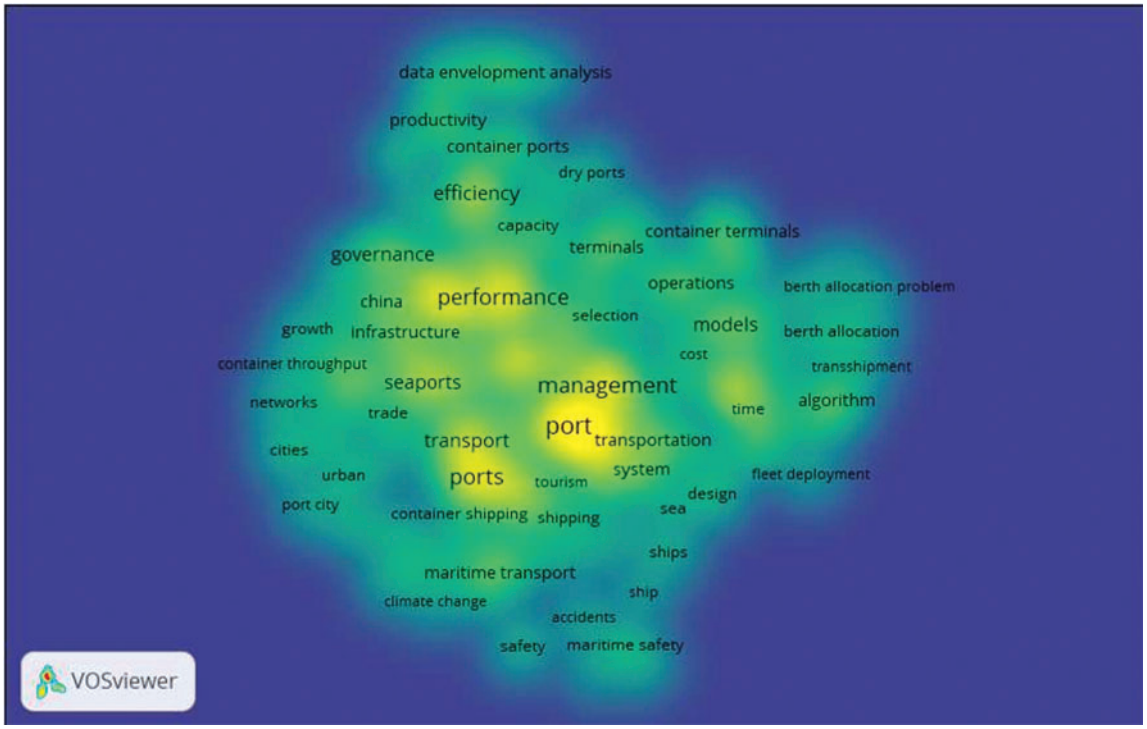

Figure 5 Density visualization of keywords based on the co-occurence analysis
Slika 5. Vizualizacija gustoće ključnih riječi na temelju analize supojavnosti
Source: Author's elaboration based on [27]

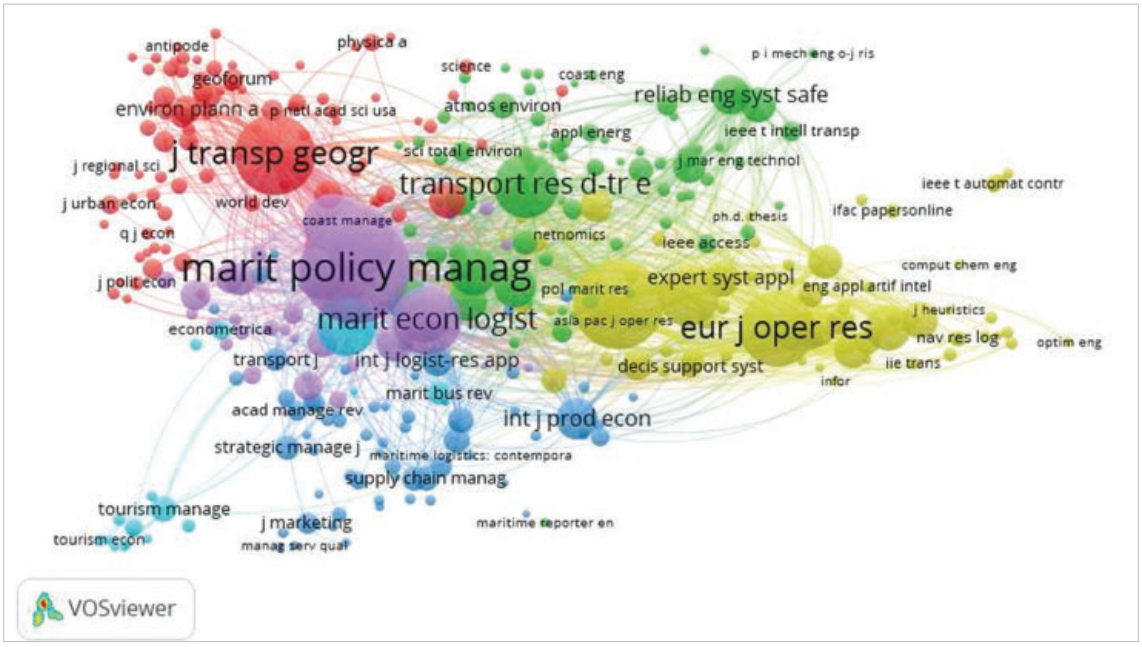

Figure 6 Clustered network of cited sources based on the co-citation analysis
Slika 6. Klasterirana mreža citiranih izvora na temelju analize kocitiranosti

Source: Author's elaboration based on [27]

Figure 7 shows clustered network of journals based on the bibliographic coupling. Bibliographic coupling is a bibliometric method that uses the number of references (i.e. cited publications) that two publications (i.e. the citing publications) have in common as a measure of the similarity between them [32]. It is assumed that the more references two publications have in common, the more related they are. It is recommended to apply bibliographic coupling to publications from the same time period or within a certain time frame. Bibliographic coupling focuses on the references cited by the publications rather than the citations they receive (as is the case with co-citation analysis). This means that even the most recent publications, which have not been cited much, gain concrete visibility when this method is applied [24]. This means that bibliographic coupling is particularly valuable as it enables the identification of emerging research trends and helps to map the development of new research areas, even if the more recent publications have not yet had time to accumulate citations.The

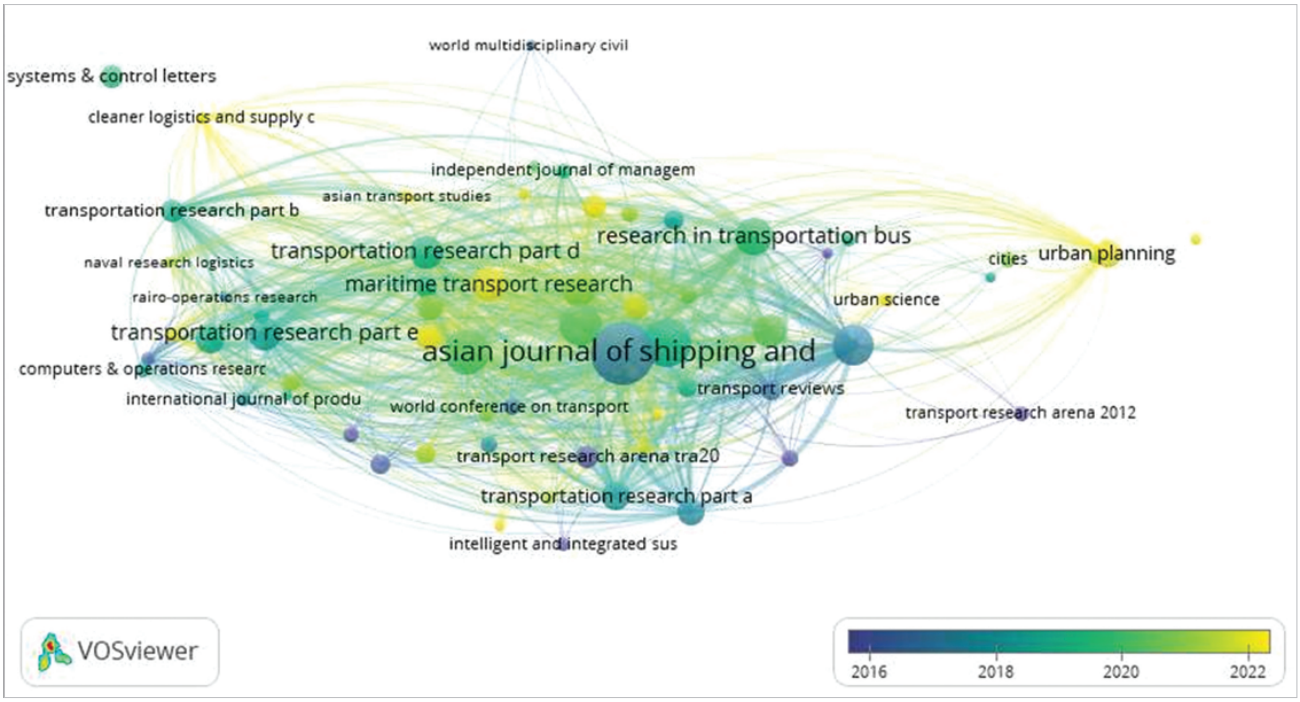

Figure 7 Clustered network of journals based on the bibliographic coupling
Slika 7. Klasterirana mreža časopisa na temelju bibliografskog spajanja

Source: Author's elaboration based on [27]

minimum number of documents in a source was set at five. 63 sources were identified, grouped into five clusters with 1462 links. The total number of links is 96634.

5. DISCUSSION / *Rasprava*

The results of this study show that the role of ports in regional development is very popular in academic circles and the number of publications on the topic of the role of ports in regional development is increasing significantly. Journals with a high impact factor and renowned publishers recognize this topic as topical and relevant, as the results of the bibliometric analysis show. Most publications on ports and their relation to regional development are published in SSCI-indexed journals published by Taylor and Francis and Elsevier, one of the best publishers of scientific journals. It is also interesting to note that the articles analysed were mainly written by researchers from countries with major world ports. This also shows the link between academic research and practice. The analysis of co-authorship shows the strong links between authors and indicates that the research community in this field is strongly engaged in collaborative knowledge production. This networking is also crucial for the development of innovative solutions and policy recommendations for regional development. The co-cccurrence network shows the keywords that occupy central positions in the network. These leading keywords provide valuable insights into current research priorities and the conceptual focus of the literature on port and regional development. Co-citation analysis, which highlights publications that are frequently cited together, helps to identify the most influential works in the field. The results of the analysis indicate that the publications within this co-citation network are strongly interconnected. This underscores the notion that the field of port and regional development is not fragmented, but rather a coherent field of research in which scholars often build on each other's work. These frequently cited publications are considered seminal texts that have shaped the theoretical framework, methodology and practical approaches to the study of ports and regional development. The fact that these works are often cited together suggests that they are fundamental to several areas of research. This suggests that they have provided crucial insights or established key concepts that continue to influence contemporary studies. Bibliographic coupling with a total of 1,462 links and a total link strength of 96,634, indicates a strong connection between these sources, suggesting that the publications within these clusters are closely related in terms of their theoretical foundations, research methods and topics of investigation.

6. CONCLUSIONS / *Zaključak*

The aim of this research was to map the evolution of scientific work on the relationship between ports and regional development. To this end, we conducted a bibliometric analysis, i.e. co-authorship analysis, co-occurrence analysis, co-citation analysis and bibliographic coupling. The results of the search revealed the most important research papers, journals and publishers on the topic mentioned. The results also show the strong presence of this topic in the academic literature as well as the growing trend of published works on this topic in the last five years.

To take this research further, additional notions of co-occurrence analysis and even other types of bibliometric analysis could be included. This work shows the current state of academic literature on ports and their relationship with regional development. However, the bibliometric study cannot make predictions about future development, which is also the limitation of this study. Indeed, the results of bibliometric studies tend to change over time as the number of publications, citations and citation trends change. Therefore, any predictions based on this type of literature review are volatile and require

the whole process to be repeated in the future. Our analysis was based on the Web of Science Core Collection, but future research could also include publications from other databases such as Scopus or use other filters. We limited our investigation to the time period, language and open source publication. Therefore, other research could come to different conclusions based on other filters.

This research provides a mapping of the of port and regional development filed by identifying

The bibliometric network reveals the interdisciplinary nature of port and regional development and suggests that research on port development should not be limited to one academic discipline, but should incorporate findings from different fields.

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