

Jiddah, Salihu Adam; Hanan, Suhaila Abdul; Nur Khairiel Anuar

## Article

# A bibliometric examination of global port facility research propagation (1975 - 2023)

Asian Journal of Shipping and Logistics (AJSL)

## Provided in Cooperation with:

Korean Association of Shipping and Logistics, Seoul

*Suggested Citation:* Jiddah, Salihu Adam; Hanan, Suhaila Abdul; Nur Khairiel Anuar (2024) : A bibliometric examination of global port facility research propagation (1975 - 2023), Asian Journal of Shipping and Logistics (AJSL), ISSN 2352-4871, Elsevier, Amsterdam, Vol. 40, Iss. 4, pp. 167-179, <https://doi.org/10.1016/j.ajsl.2024.08.002>

This Version is available at:

<https://hdl.handle.net/10419/329746>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>

Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

# The Asian Journal of Shipping and Logistics

journal homepage: [www.elsevier.com/locate/ajsl](http://www.elsevier.com/locate/ajsl)

## A bibliometric examination of global port facility research propagation (1975 - 2023)

Salihu Adam Jiddah <sup>a,b,\*</sup>, Suhaila Abdul Hanan <sup>a,2</sup>, Nur Khairiel Anuar <sup>a,3</sup>

<sup>a</sup> School of Technology, Management and Logistics (STML), College of Business, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia

<sup>b</sup> Department of Business Administration, Federal University of Kashere, Gombe State, Nigeria

### ARTICLE INFO

#### Keywords:

Port facilities  
Bibliometric  
Scopus database  
Research focal points  
Journal metrics

### ABSTRACT

Seaports play a crucial role in international trade and economic development. This study aims to analyze the existing literature on port facilities to identify research patterns and emerging areas of interest. Using the Scopus database, the researchers searched for publications related to port facilities and found a total of 178 scholarly articles. The data was analyzed using Microsoft Excel, Publish or Perish and VOS viewer. The study examined subject areas, keywords, citations, and Journal/publishers metrics, to understand the key contributors and collaborative efforts in this field. The findings revealed a lack of scholarly evaluation of port facilities literature until 1975. From 1975 to 2003, there were 57 publications with very few citations. However, interest in this field grew significantly between 2004 and 2023, with 114 publications and 496 citations. Most of the documents were written in English, and there was concentration of research efforts in specific areas. International collaboration was observed among 12 countries. The study suggests the need for more research, collaborations, and citations in the field of port facilities, particularly in areas beyond engineering and earth and planetary sciences. Logistics management, computing, and maritime should be further explored to address gaps in the current literature.

### Introduction

Port facility is an essential element of the maritime transport sector (Song & Panayides, 2012). It includes all physical resources such as berths, quays, cranes, storage facilities, and transportation networks needed for the efficient functioning of ports (Munim & Schramm, 2018). The concept of seaport encompasses economic, geographical, and trade functions on many levels (Jović et al., 2022). Ibrahim (2017) opined that seaports have a significant impact on facilitating international trade and fostering broader economic development. Since the 1990s, the competition between seaports has grown significantly, with an increasing number of seaports servicing a single region and the aspiration to attract shipping lines (Miraj, Berawi, Zagloel, Sari & Saroji, 2021). According to Brooks (2019), seaports are crucial gateways that connect nations, and its facilities accelerate the efficient transit of goods, and serve as hubs for global trade. The importance of Port facility in

promoting economic growth has increased with the growth of global trade in goods (Elentably, 2013). A multi-criteria decision-making model for selecting the location of an intermodal terminal that will increase competitiveness and promote regional integration has been proposed (Wang, Wang & Ji, 2018; Notteboom & Rodrigue, 2009; Cullinane, Wang & Cullinane, 2002; Brooks, 2015; Kim & Talley, 2002). Policymakers, port authorities, researchers, and stakeholders now prioritize understanding and upgrading Port facility (Wan, Zhang & Chang, 2019; Talley & Ng, 1996).

Seaport research has grown significantly in recent decades (Pallis, & De Langen, 2004), resulting in a substantial body of knowledge. Researchers from various disciplines, including management, transportation, engineering, logistics, and economics, have produced academic works in this area. However, Port design, construction, operations, ecological responsibility, regulation, and policy analysis are some of the themes covered in most seaport research (Talley & Ng,

\* Corresponding author at: School of Technology, Management and Logistics (STML), College of Business, Universiti Utara Malaysia, 06010 Sintok, Kedah, Malaysia.

E-mail addresses: [mailjiddah@gmail.com](mailto:mailjiddah@gmail.com), [salihu\\_adam\\_j@cob.uum.edu.my](mailto:salihu_adam_j@cob.uum.edu.my) (S.A. Jiddah), [suhai@uum.edu.my](mailto:suhai@uum.edu.my) (S. Abdul Hanan), [nurkhairiel@uum.edu.my](mailto:nurkhairiel@uum.edu.my) (N.K. Anuar).

<sup>1</sup> <https://orcid.org/0009-0007-2516-3606>

<sup>2</sup> <https://orcid.org/0000-0002-2002-4064>

<sup>3</sup> <https://orcid.org/0000-0002-1936-1127>

<https://doi.org/10.1016/j.ajsl.2024.08.002>

Received 24 September 2023; Received in revised form 10 May 2024; Accepted 14 August 2024

Available online 10 September 2024

2092-5212/Production and hosting by Elsevier B.V. on behalf of The Korean Association of Shipping and Logistics, Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>). This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

1996). Port facility literature is yet to be efficiently utilized (Djabier, Setiawan, Syamsiah & Senda, 2023). This gap in the literature, motivates the current study.

The purpose of this paper is to know the debt of knowledge covered on port facility research and possible areas to be exploited by future researchers. To this end, the study aims to enhance the comprehension of the key contributors in this particular field of inquiry and their collaborative endeavours. To achieve this, the researchers conducted an analysis encompassing three main aspects: (a) identifying the nations that made the most significant contributions to research on Port facilities, (b) examining the primary institutions or affiliations involved in this research, and (c) investigating authorship and citation patterns, among other relevant factors.

The digitalization of seaports, which entails the use of cutting-edge technologies to improve port operations and services, has attracted increasing attention (Jović et al., 2022; Sun, 2021). A seaport can be considered a location where two domains, land traffic, and maritime traffic intersect and merge. Berths, quays, cranes, warehouses, and transportation networks are just a few examples of the physical infrastructure required for seaports to operate efficiently (Bernacki & Lis, 2021). The main challenge for seaports, which can be thought of as administrative and operational clusters (Ibrahimi, 2017), is to build an acceptable infrastructure system (Voogt, 2022). According to Miraj et al. (2021), seaport equipment is a multifaceted system that combines economic purpose, infrastructure framework, geographical space, and trade. To achieve this, smart port development integrates cutting-edge technologies to improve port services and activities (Pham, 2023). These clarifications provide an in-depth understanding of seaport structure and highlight its importance to the maritime transport sector.

To gather knowledge about the definitions and evaluations of Port facility, a bibliometric paper is required. Bibliometric analysis is a quantitative method used to examine the body of literature on a given topic, including the number of publications, authors, and citations (Pham, Miraj et al., & Wagner, 2019).

The existing body of research pertaining to seaports or port facility has predominantly concentrated on port optimization and modelling (Alim, Bekar, Ivanov, Unlu, Brenizer & Azmy, 2006), port facilities security (Anyanova, 2007; Gunawan, Zauhar, Sarwono & Bambang, & Djabier et al., 2019, 2023) intensity and trade costs of Port facilities and services (Rettab & Azzam, 2008), risk management in seaports (Nagi et al., 2017), port construction (Lu & Fan, & Wernli et al., 2015, 2022) port integration, (Kolioussis, 2020), digitalization in the port industry (Sun 2021), design and displacement, (Koh, Kaimok, Tan & Chen, 2021; Chadwick, Baktash, Yee & Andrew, 2022), maintenance and data protection, (Shin et al., 2022), port structure and rehabilitation, (Rojas, Miranda, Barros, Rosero, Márquez & García, 2022), disaster and coastal defense, (Kawai, 2022) smart port development (Pham, 2023) digitalization in maritime transport and seaports (Jović et al., 2022) circular economy and sustainability (Razmjooei, 2023) data measurement (Matsunaga, Kyouda, Itakura, Yamamoto, Sone & Kadono, 2023) amongst others.

Despite several bibliometric studies pertaining to research on seaports that have been previously done, this study is the near first attempt to conduct a bibliometric analysis of research pertaining to Port facility. Hence, Scopus database was used for conducting a bibliometric analysis and mapping exercise with the objective of enhancing comprehension of worldwide patterns in research pertaining to the study area. The study conducted an investigation of several aspects of the area of Port facility, including the growth of publications, patterns of cooperation and authorship, the most active institutions, favorite journals, prolific writers, countries contributions, and the identification of top-cited works among others. This analysis spanned the time period from 1975 through 2023. However, using only Scopus data base is considered as a limitation to this study. To this end, further researchers should consider using both Scopus and Web of Science data base to provide a nuance understanding of studies of this nature.

In conclusion, this bibliometric analysis seeks to provide a holistic overview of the research landscape in Port facility by examining a substantial number of journal articles in the field. The findings of this study is not only beneficial to scholars and practitioners but also contributes to the overall advancement of seaport research. By understanding the key areas of focus and emerging trends, stakeholders can propel the expansion of seaport facilities to meet the growing demands of international trade.

### Objective of the study

In this paper, the researchers intend to map the conceptual structure of the field of Port facility. However, the specific objectives are:

RO1: To examine the progression of published articles pertaining to Port facility.

RO2: To conduct an analysis of co-authorship networks, collaboration networks between nations, co-citations, and co-words in the context of Port facility.

RO3: To ascertain the lead writers who have produced the greatest quantity of scholarly works pertaining to Port facility.

RO4: To determine who among these authors has garnered the biggest number of citations, indicating their influence and impact within the field.

RO5: To analyze the various forms of scholarly publications, such as journal articles, books, chapters, conference papers and observe their contributions to the knowledge in this area.

RO6: To ascertain the countries, academic journals, and institutions that have produced a substantial body of literature on the subject of Port facility. Additionally, this research seeks to determine the impact factor associated with these publications.

RO7: Finally, to ascertain the primary sponsors of research papers pertaining to Port facility. The objective is to furnish prospective researchers in the field of Port facility with comprehensive information on the sources of financing that are available and accessible.

The present article is organized in the following manner. Section 1 is dedicated to providing an introduction. Section 2 provides a comprehensive account of the methodology implemented in this research, encompassing a thorough examination of the bibliometric tools and software utilized. Section 3 of this research paper offers the findings derived from the investigation, which are effectively communicated via the utilization of tables and bibliometric maps. Section 4 provides a comprehensive analysis and examination of the findings. Section 5 thereafter presents the results derived from the study, the implications for future research, and the limits of the current analysis.

### Methodology

To gain a deeper insight into this field, this study proposed conducting a bibliometric analysis of journal articles, books, chapters etc., published in the area of Port facility. Bibliometric analysis is a quantitative approach that explores patterns, trends, and structures within a body of literature. By applying bibliometric techniques, which includes but not limited to citation analysis, bibliometric coupling, co-citation analysis and keyword analysis, the researchers aim to identify influential authors, leading journals, impactful theories, and emerging research areas within the field of Port facility. To conduct this study, comprehensive collection of Scopus publications spanning 1975–2023 was assembled. The articles cover all topics in Port facility that have been published up to August 2023. By analyzing this corpus of articles, the study derived meaningful insights that can inform future research directions, identify research gaps, and support evidence-based decision-making in the domain of Port facility.

The data was refined using Microsoft Excel, employing appropriate percentages and charts. Herzling's Publish or Perish was employed to assess publishing metrics, while VOS viewer was applied to visually represent the results of several indicators. The scope of our inquiry

encompassed an examination of the existing scholarly literature, the identification of the primary sources, an assessment of the materials and documents employed, and an analysis of the prevailing languages employed within this domain. The investigators analyzed many variables, including primary subject areas, used keywords, number of citations, and supplementary metrics such as cite scores, SJR ranking, NIPS ranking, author count, and title analysis, among other things.

**Information extraction**

The approach employed in this study is depicted in Fig. 1. This was possible through the Scopus robust interface that provides opportunity for proper screening and filtering. Using the article title, it was easier to consider all articles that had the topic (Port Facility) in its titles. Looking at the numbers which was very minimal, filtering became unnecessary. The researchers considered conducting the bibliometric analysis on all documents to ascertain appropriate details needed for this study. Universiti Utara Malaysia (UUM) Scopus access was used to extract the needed data on the date and time as indicated in Fig. 1. Citation metrics were obtained with the aid of Herzing’s publish or perish software version 7.33.3388.7819. The researchers relied on Microsoft Excel 365 of University Utara Malaysia to compute the frequencies and percentages of the published materials, and additionally to generate the corresponding charts and graphs where necessary. In addition, VOSviewer (version 1.6.19.0) was adopted to construct and visualize the bibliometric networks. **Description of Retrieved Literature:**

**Document type**

Table 1 shows the types of publications that were included in the study. The majority of the publications were conference papers (49.44%) and articles (44.94%). Book chapters, notes, reviews, editorials, and books made up a smaller percentage of the publications. The results suggest that conference papers and articles are the most common types of publications in the field of seaport facilities showing the types of publications that researchers in this field are producing.

**Source type**

The results in Table 2 shows that research output derived from journals and conference proceedings collectively make up 91.58% of the

**Table 1**  
Retrieved documents (1975–2023).

| Document Type    | TP  | Percentage % |
|------------------|-----|--------------|
| Conference Paper | 88  | 49.44        |
| Article          | 80  | 44.94        |
| Book Chapter     | 4   | 2.25         |
| Note             | 2   | 1.12         |
| Review           | 2   | 1.12         |
| Book             | 1   | 0.56         |
| Editorial        | 1   | 0.56         |
| Total            | 178 | 100          |

TP=Total Publication

Source: Authors Computation 2023

| Source type      | TP  | %     |
|------------------|-----|-------|
| Journal          | 82  | 46.07 |
| Conf. Proceeding | 81  | 45.51 |
| Book             | 7   | 3.93  |
| Book Series      | 7   | 3.93  |
| Trade Journal    | 1   | 0.56  |
| Total            | 178 | 100   |

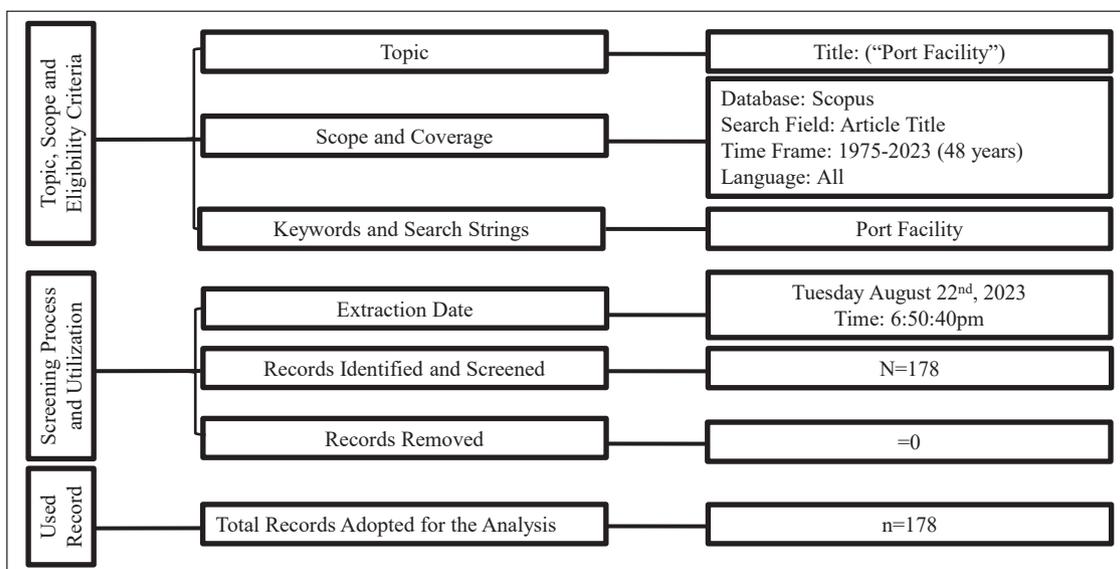
Source: Authors computation 2023.

total papers. This underscores the significance of these two sorts of sources within the domain of academic inquiry. Books and book series provide very little contribution to the overall research output, suggesting that they are not as frequently utilized to disseminate research findings in this particular subject. The contribution of trade journals is relatively minimal, accounting for a mere 0.56% of the whole corpus. This implies that their contribution to research productivity in the field is not substantial. The dataset contains 178 documents, which may be utilized as a benchmark for subsequent studies and comparisons.

Growth of publications by year:

**Subject area**

Table 3 shows topic categories, paper counts, and percentages. Engineering dominates the collection with 128 items (71.91%). The second most frequent topic is Earth and Planetary Sciences, with 30 publications (16.85%). Environmental Science is important, as 27 documents



**Fig. 1.** Prisma Flow diagram of the search strategy (Page et al., 2021). N= total number of paper retrieved. n= Total records adopted for the analysis. Source: Authors 2023.

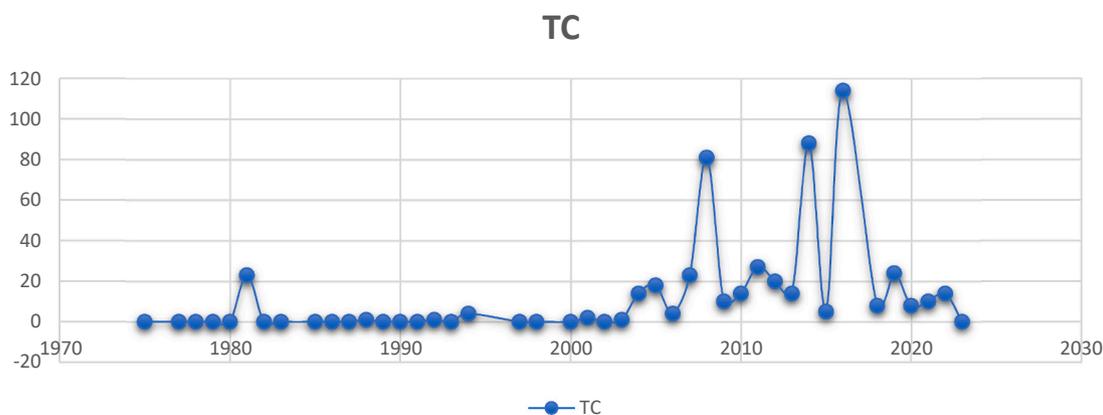


Fig. 2. Growth of publications by year. TC= (Total Citations). Authors computation 2023.

Table 3 Subject Area.

| Subject Area                                 | TP  | %     |
|--|-----|-------|
| Engineering                                  | 128 | 71.91 |
| Earth and Planetary Sciences                 | 30  | 16.85 |
| Environmental Science                        | 27  | 15.17 |
| Social Sciences                              | 26  | 14.61 |
| Energy                                       | 15  | 8.43  |
| Computer Science                             | 11  | 6.18  |
| Materials Science                            | 10  | 5.62  |
| Physics and Astronomy                        | 9   | 5.06  |
| Business, Mgt & Accounting                   | 7   | 3.93  |
| Mathematics                                  | 6   | 3.37  |
| Agricultural and Biological Sciences         | 5   | 2.81  |
| Arts and Humanities                          | 5   | 2.81  |
| Decision Sciences                            | 5   | 2.81  |
| Chemical Engineering                         | 4   | 2.25  |
| Chemistry                                    | 2   | 1.12  |
| Biochemistry, Genetics and Molecular Biology | 1   | 0.56  |
| Economics, Econometrics and Finance          | 1   | 0.56  |
| Medicine                                     | 1   | 0.56  |
| Total  | 178 | 100   |

TP= Total Papers

Source: Authors Computation 2023

(15.17%) demonstrate. Social Sciences comprises 26 documents, (14.61%). Energy is represented by 15 papers, (8.43%). Computer Science contains 11 documents (6.18%). Materials Science comprises 10 documents (5.62%). Physics and Astronomy has 9 documents, (5.06%). Business Management, and Accounting 7 (3.93%), Mathematics 6 (3.37%). Agriculture, Biological sciences and Arts and Humanities, and Decision Sciences 5 (2.81%) Chemical Engineering, 4 Chemistry 2, Biochemistry, Genetics and Molecular Biology 1, Economics, Econometrics and Finance 1, and Medicine, 1 (2.25), (1.12) (0.56 each) respectively. This suggests a limited scope focused on a specific discipline. However, multi-discipline participation indicates a positive outlook for collaborations across different areas in future research in this area. This shows that the field is a multi-discipline one even down they exist lopsidedness in few areas as shown in the table.

Source title

Table 4 shows fifteen most active sources in port facility research. From the results, it could be seen that most of the sources are active and up to date on the Scopus database with their three major ranking scores. From the table and indications, Maritime Policy and administration is the most outstanding source with a cite score of 6.5 (2022) SJR 0.8 (2022), and SNIP score of 1.4 (2022). In that order. This is a pathfinder for researchers who wish to publish in this area. Consistency of sources

are rated based on cite score and coverage of journals on Scopus. The presents of these journals up to 2022 represents that claim.

Active tongues/languages used

Table 5 provided in the question shows the breakdown of languages used in academic research, the number of documents, and their percentages. English is the dominant language used in the dataset, with 167 documents, accounting for 92.27% of the total. French, German, Japanese, and Russian are each represented by two documents, each making up 1.10% of the total. Croatian and Italian are both represented by one document, each accounting for 0.55% of the total. Four documents are classified as undefined, making up 2.21% of the total. The findings provide various perspectives on the impact of language on academic research, including the importance of language precision in disseminating research findings especially in this area, the influence of language diversity on knowledge sharing in international contexts, and the potential barriers and cross-cultural collaboration in this area.

Authors co-occurrence keywords

Table 6 give proper perspective to this figure, with number of documents that a key word appeared in and the percentages. Fig. 3 Revealed the keywords that appeared most in port facility research. As seen in the visualization, Port facility/facilities appeared 11 times with a link strength of 52 making it the target keyword for authors in this area. It is connected all other key wards like ports, ships, port terminal etc. The strength of the keywords is determined by the side of the circle while the link strength is determined by the thickness of the connecting lines. Visualization was based on fractional counting for keywords that have appeared a minimum of five times. Based on this, 21 keys met this requirement in 5 clusters as shown in the figure (Green, Maroon, Light blue, Orange and Pink). Total link of the keywords was 80 with total link strength of 77.00. out of this, Port facility/facilities as keywords received the link strength of 52, leaving 25 points for the remaining keys. Fig. 4 also visualized the co-occurrence network based on title field.

Influential Countries in Port Facility Research

Table 7 indicated a variety of information related to academic research from various countries on this topic, their publication output and research productivity by country. The sources offer insights into the importance of data analysis and interpretation in academic research, as well as the significance of international collaboration and cross-disciplinary research. The table shows 33 countries with total contribution of 133 papers to port facility research out of 178 documents

| Source Title  | TP | %    | Publisher                             | Cite Score    | SJR             | SNIP            | NCP | TC | C/P  | C/CP  | h | G |
|---|----|------|---------------------------------------|---------------|-----------------|-----------------|-----|----|------|-------|---|---|
| Bulk Solids Handling  | 4  | 2.25 | Vogel Verlag                          | 0.3<br>(2018) | 0.102<br>(2020) | 0.00<br>(2022)  | 1   | 2  | 0.50 | 2.00  | 1 | 1 |
| Geotechnical Special Publication  | 4  | 2.25 | Ame. Soc. of Civil Engineering        | 0.8<br>(2022) | 0.244<br>(2022) | 0.296<br>(2022) | 2   | 4  | 1.00 | 2.00  | 1 | 2 |
| Ports 2022 Engineering papers from sessions of the 16th Triennial International Conference              | 4  | 2.25 | Ame. Soc. of Civil Engineering        | Nil           | Nil             | Nil             | 0   | 0  | 0.00 | 0     | 0 | 0 |
| Proceedings of the International Offshore and Polar Engineering Conference                              | 4  | 2.25 | Intl Soc. Of Offshore Polar Engineers | 0.5<br>(2022) | 0.17<br>(2022)  | 0.208<br>(2022) | 1   | 1  | 0.25 | 1.00  | 1 | 1 |
| IoP Conference Series on Earth and Environmental Sciences   | 3  | 1.69 | IOP Pub. Ltd                          | 0.8<br>(2022) | 0.20<br>(2022)  | 0.205<br>(2022) | 0   | 0  | 0.00 | 0     | 0 | 0 |
| Port Development in the Changing World. Ports 2004 Proceedings of the Conference                        | 3  | 1.69 | Ame. Soc. of Civil Engineering        | Nil           | Nil             | Nil             | 1   | 11 | 3.67 | 11.00 | 1 | 1 |
| AIP Conference Proceedings  | 2  | 1.12 | America Institute of Physics Inc.     | Nil           | 0.16<br>(2022)  | Nil             | 0   | 0  | 0.00 | 0     | 0 | 0 |
| Applied Sciences Switzerland  | 2  | 1.12 | AIP Conference Proceedings            | 4.5<br>(2022) | 0.49<br>(2022)  | 0.97<br>(2022)  | 2   | 7  | 3.50 | 3.50  | 2 | 2 |
| Beton Und Stahlbetonbua   | 2  | 1.12 | USA, Willey-Blackswell                | 2.2<br>(2022) | 0.45<br>(2022)  | 1.044<br>(2022) | 0   | 0  | 0.00 | 0     | 0 | 0 |
| Iop Conference Series, Material Science and Engineering   | 2  | 1.12 | IOP Pub. Ltd                          | 1.1<br>(2021) | 0.25<br>(2022)  | 0.517<br>(2022) | 1   | 1  | 0.50 | 1.00  | 1 | 1 |
| Journal of Marine Science and Engineering   | 2  | 1.12 | MDPI AG                               | 3.7<br>(2022) | 0.54<br>(2022)  | 1.119<br>(2022) | 0   | 0  | 0.00 | 0     | 0 | 0 |
| Maritime Policy and Management  | 2  | 1.12 | Taylor and Francis                    | 6.5<br>(2022) | 0.80<br>(2022)  | 1.35<br>(2022)  | 1   | 14 | 7.00 | 14.00 | 1 | 2 |
| Ports 2013, Success Through Diversification. Proceedings of the 13th Triennial International Conference | 2  | 1.12 | Ports 2013 SD                         | Nil           | Nil             | Nil             | 0   | 0  | 0.00 | 0     | 0 | 0 |
| Proceedings of the International Conference on Offshore Mechanic and Arctic Engineering (OMAE)          | 2  | 1.12 | Ame. Soc. Of Mech. Engineers          | 1.0<br>(2022) | 0.23<br>(2022)  | 0.365<br>(2022) | 2   | 8  | 4.00 | 4.00  | 1 | 2 |
| Transactions of the American Nuclear Society  | 2  | 1.12 | American Nuclear Society              | Nil           | Nil             | Nil             | 1   | 2  | 1.00 | 2.00  | 1 | 1 |

TP = total number of publications; NCP = number of cited publications; TC = total citations; C/P = average citations per publication; C/CP = average citations per cited publication; h = h-index; and g = g-index.

Source: Authors Computation 2023.

**Table 5**  
Language Used.

| Language  | TP  | %     |
|-----------|-----|-------|
| English   | 167 | 92.27 |
| French    | 2   | 1.10  |
| German    | 2   | 1.10  |
| Japanese  | 2   | 1.10  |
| Russian   | 2   | 1.10  |
| Croatian  | 1   | 0.55  |
| Italian   | 1   | 0.55  |
| Undefined | 4   | 2.21  |
| Total     | 178 | 100   |

TP= Total Publication

Source: Authors computation 2023

retrieved while 45 documents are unidentified. U.S.A has 36 documents, Japan, 16; and Russia 13; as top contributors, Germany, United Kingdom, and Indonesia lead the middle class with 8,7 and 6 publications respectively, while Saudi, 2; and Malaysia, 1; are in the group of lowest contributors.

**Main institutions**

Table 8 shows the institutions from which most of the publications on port facility originated. Universities and Colleges emerged as the major contributors to this research field (most of the researchers are Academics) with 15 (83.3%) out of the 18 institutions with at least two contributing documents coming from the Universities, leaving only 16.7% to other research institutions. This therefore very encouraging. Out of these Universities, U.S.A has 4, Italy 2, Colombia, Russia, Japan, Brazil, Germany, Greece, and U.K, having 1 each. The table also shows that there are 49 publications contributions of these 18 institutions out

**Table 6**  
Keywords Analysis.

| Keywords            | Total Documents | Percentages |
|---------------------|-----------------|-------------|
| Port Facilities     | 44              | 24.72       |
| Ports and Harbors   | 24              | 13.48       |
| Earthquakes         | 11              | 6.18        |
| Mathematical Models | 9               | 5.06        |
| Piles               | 9               | 5.06        |
| Port                | 9               | 5.06        |
| Port Terminals      | 9               | 5.06        |
| Risk Assessment     | 9               | 5.06        |
| Facilities          | 7               | 3.39        |
| Port Facility       | 7               | 3.39        |
| Ports               | 7               | 3.39        |
| Ships               | 7               | 3.39        |
| Design              | 6               | 3.37        |
| Seismic Design      | 6               | 3.37        |
| Construction        | 5               | 2.81        |
| Disasters           | 5               | 2.81        |
| Port Development    | 5               | 2.81        |
| Security System     | 5               | 2.81        |
| Soil Liquefaction   | 5               | 2.81        |

Source: Authors computation 2023

of which 24 (49%) documents have received 91 citations. Surprisingly, the most efficient authors are in Colombia with only 3 documents all received citations with a total of 34, ahead of Italy and U.S.A with 27 and 25 respectively.

**Authorship analysis/count: Authorship analysis**

The number of authors per document is shown in Table 9. 53 (29.8%) of the 178 publications considered in this study were single authored, while the remaining publications had multiple authors. The majority of

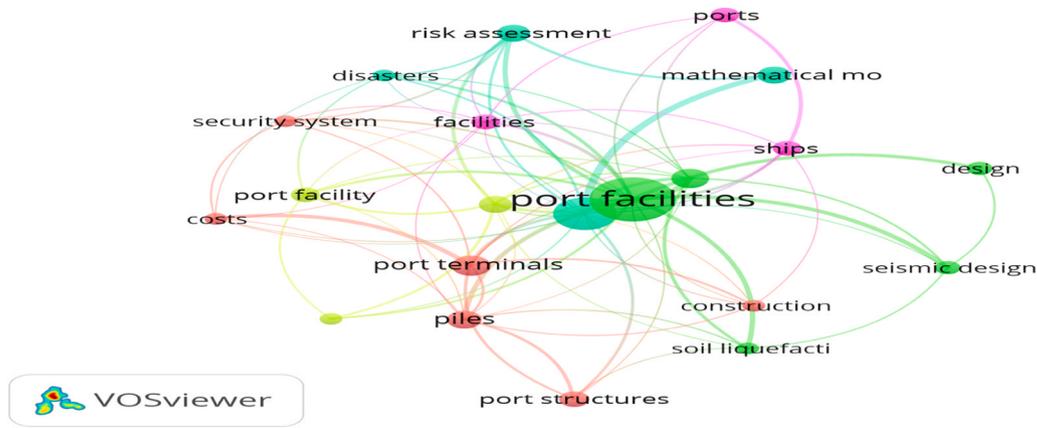


Fig. 3. Keyword Analysis: Vos viewer Network Visualizations of authors keys with at-least 3 occurrences. Source: Authors visualization 2023.



Fig. 4. Visualization of co-occurrence network based on title fields using binary counting. Source: Authors visualization 2023.

Table 7  
Countries contribution to Port facility research.

| Country        | TP | %     | h <sub>i</sub> | g <sub>i</sub> | Country      | TP | %    | h <sub>i</sub> | g <sub>i</sub> |
|----------------|----|-------|----------------|----------------|--------------|----|------|----------------|----------------|
| United States  | 36 | 20.22 | 6              | 14             | Saudi Arabia | 2  | 1.12 | 1              | 1              |
| Japan          | 16 | 8.99  | 2              | 4              | South Korea  | 2  | 1.12 | 1              | 1              |
| Russian Fed.   | 13 | 7.30  | 3              | 4              | Taiwan       | 2  | 1.12 | 1              | 2              |
| Germany        | 8  | 4.49  | 2              | 2              | Chile        | 1  | 0.56 | 1              | 1              |
| United Kingdom | 7  | 3.93  | 2              | 7              | Croatia      | 1  | 0.56 | 1              | 1              |
| Indonesia      | 6  | 3.37  | 1              | 1              | Ecuador      | 1  | 0.56 | 0              | 0              |
| Italy          | 6  | 3.37  | 3              | 6              | Honduras     | 1  | 0.56 | 0              | 0              |
| Australia      | 5  | 2.81  | 0              | 0              | Malaysia     | 1  | 0.56 | 1              | 1              |
| Canada         | 5  | 2.81  | 1              | 5              | Mexico       | 1  | 0.56 | 1              | 1              |
| China          | 5  | 2.81  | 2              | 2              | Norway       | 1  | 0.56 | 0              | 0              |
| Greece         | 4  | 2.25  | 1              | 1              | Poland       | 1  | 0.56 | 1              | 1              |
| Spain          | 4  | 2.25  | 3              | 4              | Romania      | 1  | 0.56 | 1              | 1              |
| Brazil         | 3  | 1.69  | 1              | 1              | Sweden       | 1  | 0.56 | 1              | 1              |
| Colombia       | 3  | 1.69  | 3              | 3              | Thailand     | 1  | 0.56 | 1              | 1              |
| India          | 3  | 1.69  | 1              | 1              | Turkey       | 1  | 0.56 | 1              | 1              |
| Hong Kong      | 2  | 1.12  | 0              | 0              | UAE          | 1  | 0.56 | 1              | 1              |
| Netherlands    | 2  | 1.12  | 1              | 1              | Undefined    | 45 | ?    | ?              | ?              |

TP = total number of publications; h = h-index; and g = g-index.

Source: Authors computation 2023

articles on port facility were co-authored by two (42/23.6%), three (27/15.2%), four (24/13.5%), five (8/4.5%), six (11/6.2%), and seven (5/2.8%) authors, while a single document was written by ten authors, representing 0.6%. This result indicates a high degree of collaboration in this field.

**Most productive authors**

Table 10 presents a comprehensive overview of the writers who have

made significant contributions to the field of port facility research, highlighting their productivity and affiliations with various universities across different nations. A group of four individuals affiliated with the Pennsylvania State University in the United States collectively produced a total of twelve publications, with each member contributing four publications. Alim, F.; Azmy, Y.; Brenizer, J.; and Ivanok, K. This observation demonstrates the United States’ prominent position in this particular domain. Interestingly, the United States of America (USA) and Japan also exhibited a commonality in terms of the subsequent four

**Table 8**  
Major institutions with at least 2 documents on port facility research.

| Institution  | TP | %     | Country     | NCP | TC |
|--|----|-------|-------------|-----|----|
| Port and Airport Research Institute                              | 8  | 4.49% | Japan       | 4   | 12 |
| Pennsylvania State University                                    | 5  | 2.81% | USA         | 3   | 7  |
| Università degli Studi di Genova                                 | 3  | 1.69% | Italy       | 1   | 11 |
| University of Nebraska–Lincoln                                   | 3  | 1.69% | USA         | 1   | 2  |
| Universidad Pontificia Bolivariana                               | 3  | 1.69% | Colombia    | 3   | 34 |
| Branch FGBU “TSNIIP Russian MoC” DalNIS                          | 2  | 1.12% | Russia      | 0   | 0  |
| King Abdulaziz University  | 2  | 1.12% | Saudi A.    | 1   | 1  |
| Universidade de São Paulo  | 2  | 1.12% | Brazil      | 0   | 0  |
| Tokai University   | 2  | 1.12% | Japan       | 0   | 0  |
| Stanford University  | 2  | 1.12% | USA         | 1   | 15 |
| University of Florida  | 2  | 1.12% | USA         | 1   | 1  |
| Aristotle University of Thessaloniki                             | 2  | 1.12% | Greece      | 2   | 2  |
| Università della Calabria  | 2  | 1.12% | Italy       | 2   | 16 |
| University of Plymouth   | 2  | 1.12% | UK          | 1   | 1  |
| Universität Hamburg  | 2  | 1.12% | Germany     | 2   | 5  |
| College of Engineering   | 2  | 1.12% | Unspecified | 0   | 0  |
| Zoological Inst. of the Russian Academy of Sc                    | 2  | 1.12% | Russia      | 1   | 3  |
| Admiral Makarov State University of Maritime and Inland Shipping | 2  | 1.12% | Russia      | 1   | 6  |

Note: TP=Total Publications, NCP= Number of cited papers, TC=Total Citations  
Source: Authors computation 2023

**Table 9**  
Authors Count.

| S/N | Author count | N0. Of Documents | Percentage | Cumulative % |
|-----|--------------|------------------|------------|--------------|
| 1   | 0            | 7                | 3.9        |              |
| 2   | 1            | 53               | 29.8       | 33.7         |
| 3   | 2            | 42               | 23.6       | 57.3         |
| 4   | 3            | 27               | 15.2       | 72.5         |
| 5   | 4            | 24               | 13.5       | 86.0         |
| 6   | 5            | 8                | 4.5        | 90.4         |
| 7   | 6            | 11               | 6.2        | 96.6         |
| 8   | 7            | 5                | 2.8        | 99.4         |
| 9   | 10           | 1                | 0.6        | 100.0        |
|     | N = 9        | 178              | 100        |              |

Note: N = Total cluster number  
Source: Authors Computation 2023

writers, each of whom had three (3) publications. The authors of this study are Kasugai, Y. and Takahashi, K from Nihon University in Japan, as well as Sarikaya, B and Ünlü, K from the University of Pennsylvania in the United States. All other writers exhibited a total of two (2) publications, as indicated in the table.

**Table 10**  
Most Productive authors with at least 2 publications.

| Author Name   | Affiliation/country                             | TP | %     | Author Name      | Affiliation/Country                                       | TP | %     |
|---------------|---|----|-------|------------------|---|----|-------|
| Alim, F.      | Pennsylvania State University/USA               | 4  | 2.25% | Elentably, A.    | Ministry of Construction/Russia                           | 2  | 1.12% |
| Azmy, Y.      | Pennsylvania State University/USA               | 4  | 2.25% | Fukuda, I.       | Port and Airport Research Institute/Japan                 | 2  | 1.12% |
| Brenizer, J.  | Pennsylvania State University/USA               | 4  | 2.25% | Gutiérrez, L. B. | Universidad Pontifica/Colombia                            | 2  | 1.12% |
| Ivanov, K.    | Pennsylvania State University/USA               | 4  | 2.25% | Hauser, I.       | University of Oslo/Norway                                 | 2  | 1.12% |
| Kasugai, Y.   | Nihon University (1)/Japan                      | 3  | 1.00% | Kasai, T.        | Aristotle University/Greece                               | 2  | 1.12% |
| Sarikaya, B.  | Pennsylvania State University/USA               | 3  | 1.69% | Kindahl, J.K.    | Zoology Institute_Academy Sc/Russia                       | 2  | 1.12% |
| Takahashi, K. | Nihon University/Japan                          | 3  | 1.69% | Malyuk, V.D.     | Branch FGBU, Min. of Constrction/ Russia                  | 2  | 1.12% |
| Ünlü, K.      | Pennsylvania State University/USA               | 3  | 1.69% | Malyuk, V.V.     | Branch FGBU, Min. of Constrction/ Russia                  | 2  | 1.12% |
| Birkeland, O. | Norwegian University of Scince and Tech./Norway | 2  | 1.12% | Mathai, T.       | Geological Survey of Kolkata/India                        | 2  | 1.12% |
| Boorstein, L. | Stanford University/USA                         | 2  | 1.12% | Watabe, Y        | Port and Airport Res. Institute/Japan                     | 2  | 1.12% |
| Cooper, J.S.  | Port of Brisbane Authority/Australia            | 2  | 1.12% | Valencia, R.A    | Universidad Pontifica (2) Universidad EAFIT (1) /Colombia | 2  | 1.12% |
| Date, S.      | University of Tokai/Japan                       | 2  | 1.12% | -                | -   | -  | -     |

Note: TP= Total Publication  
Source: Authors 2023

**Co-authorship fractional mapping**

Co-authorship refers to the practice of multiple individuals collaborating on a scholarly work. While fractional mapping refers to the process of transforming a given region or domain onto another region or domain using fractional linear transformations. In this study, the VOS viewer was utilized to provide a network visualization (see Fig. 5) depicting the co-authorship relationships among various writers. The mapping procedure employed the fractional counting approach, utilizing comprehensive data encompassing all authors involved in research pertaining to port facilities. The color, size of the circles, and font size are used as visual indicators to represent the intensity of the link between the writers. .

**Co-authorship of countries**

Fig. 5 presents a network visualization map that depicts the authors’ affiliations with different nations. This investigation encompassed all nations that possessed a minimum of one document. Initially, this criteria yielded a total of 43 nations, of which just 12 countries exhibited a substantial level of interconnectedness, forming two distinct clusters. The use of the fractional counting approach revealed a notable involvement of writers affiliated with the United States in partnership endeavours with authors from other nations in the field of port facility research. The results indicate that the focal point lies inside the first and primary cluster, where tight collaborations have been established with writers from several countries, including Canada, Ecuador, Australia, Chile, the United Arab Emirates, Italy, and Taiwan. Furthermore, writers hailing from Greece, India, the United Kingdom, and Canada have also developed several joint endeavours with colleagues in different nations. Canada serves as a pivotal connection between the two clusters, directly linking the United States and the United Kingdom along a distinct axis.

**Countries co-authorship link strength**

Table 11 explains the Fig. 5 above. It reveals the connections between the countries, 12 countries as visualized above had the highest numbers of citations and link strength as shown with the United State as the leader of the network. In the 178 papers, the USA has 36 documents, 210 citations and total link strength of 9, followed by Italy with 6 documents, 107 citations a link strength of 3. And all other countries as shown in the table. Link strength is determined by the thickness of the link line.

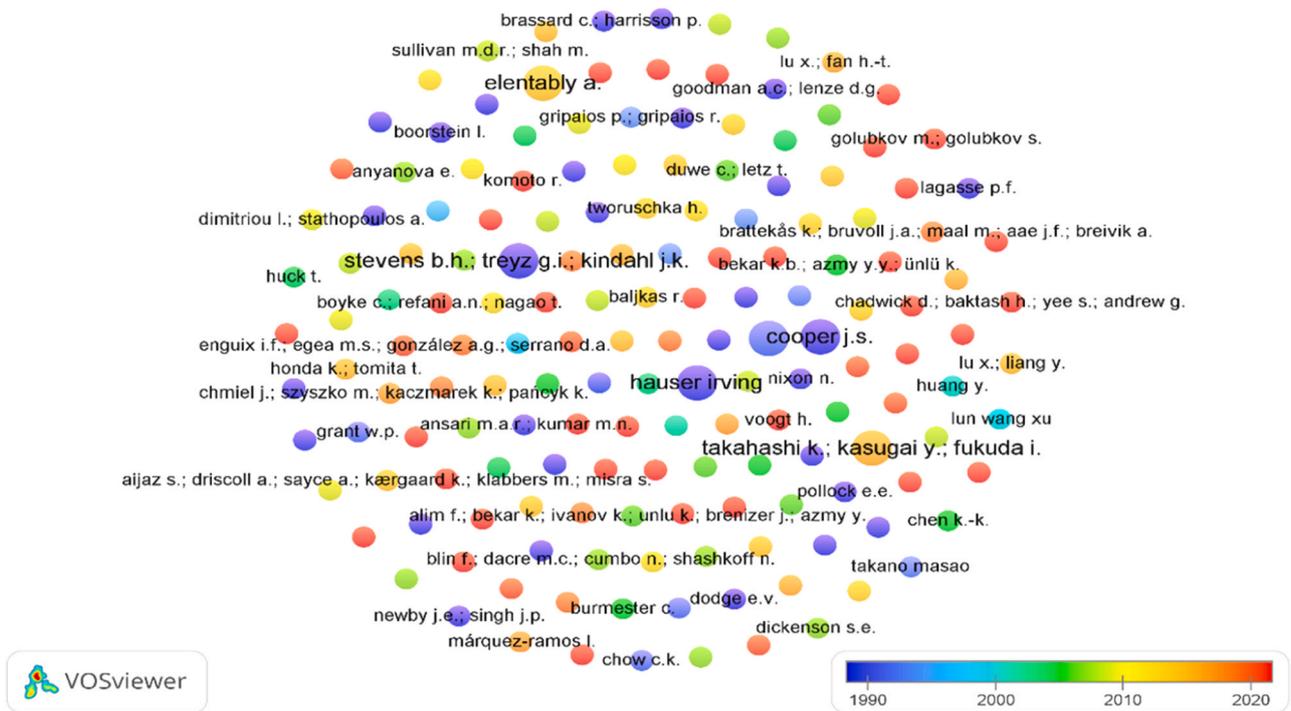


Fig. 5. Visualize the co-authorship mapping. Source: Authors visualization 2023.

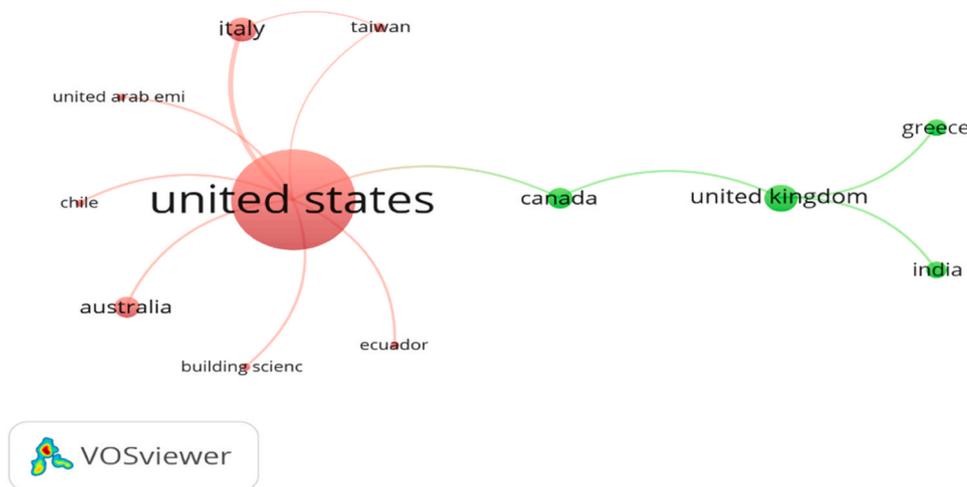


Fig. 6. Visualization of Countries Co-authorship. Source: Authors visualization 2023.

**Citation analysis**

Table 12 reports the citation metric of the papers obtained from the Scopus database. These metrics were obtained from Herzing’s Publish or Perish software. Accordingly, there were 528 citations reported in 48 years (1975–2023) for the 178 documents authored by 68 writers. This shows an average citation count of 11.00 citations per year. Citation per paper stood at 2.97, authors per paper at 2.61, citation per authors was 4.78, paper per author at 2.52 with h-index and g-index of 12 and 20 respectively.

**Most influential documents**

Table 13 summarizes the 9 documents on Port facility most often cited, based on the number of times each was cited. The two documents most often cited were “A new risk quantification approach in port

facility security assessment” by Yang, Z., et. al, (2014), as well as ‘Wise port and business energy management: Port facilities, electrical power distribution’ Praise, G., et. al, (2016). These literatures have received an average citation per author of 27 and 13 respectively and they are both article papers. Other materials with significant attention are also reported as seen in the table.

**Citations of documents**

Fig. 7 presents the mapping of citations for documents with a minimum of 1 citations. It illustrates the key authors in the field as shown in Table 13 above as reflected in the size of the circle in relation to Yang, et al. (2014) and Praise et al. (2016). Fig. 8 further shows the citation coverage by country with United States of America and Japan topping the chart as reported in Table 10 (Most Productive Authors).

Citation by Countries.

**Table 11**  
Country Co-authorship Network Analysis Based on link strength.

| S/N | Country                  | Documents | Citations | Total Link Strength |
|-----|--------------------------|-----------|-----------|---------------------|
| 1   | United States            | 36        | 210       | 9                   |
| 2   | Italy                    | 6         | 107       | 3                   |
| 3   | United Kingdom           | 7         | 89        | 3                   |
| 4   | Canada                   | 5         | 80        | 2                   |
| 5   | Taiwan                   | 2         | 80        | 1                   |
| 6   | Chile                    | 1         | 15        | 1                   |
| 7   | Building Science Section | 1         | 6         | 1                   |
| 8   | Greece                   | 4         | 4         | 1                   |
| 9   | India                    | 4         | 3         | 1                   |
| 10  | United Arab Emirates     | 1         | 2         | 1                   |
| 11  | Australia                | 5         | 0         | 1                   |
| 12  | Ecuador                  | 1         | 0         | 1                   |

Source: Authors computation 2023

**Table 12**  
Citation Analysis.

| Metric              | Data  |
|---------------------|-------|
| Total papers        | 178   |
| Total citations     | 528   |
| Number of years     | 48    |
| Citations per year  | 11.00 |
| Citations per paper | 2.97  |
| Authors per paper   | 2.61  |
| Citation per Author | 4.78  |
| Paper per Author    | 2.52  |
| h-index             | 12    |
| g-index             | 20    |

Source: Authors computation 2023 using (HPoP)

**Co-citation references**

The co-citation reference diagram generated by VOS Viewer is a graphical depiction of the interconnections of various scholarly papers, as determined by the frequency with which they have been jointly cited in other scholarly works. The diagram is comprised of nodes, which serve as representations of individual articles, and edges, which symbolize the co-citation connections that exist between them. The magnitude of the node corresponds to the frequency of citations received by an

**Table 13**  
Most Influential Documents: Those with a Minimum of 5 Citations per Document.

| Authors   | Title  | Year | Source  | TC | CPY  | CPA | Type |
|---|--|------|---|----|------|-----|------|
| Yang, Ng & Wang                                       | A new risk quantification approach in port facility security assessment  | 2014 | Transportation Research Part A: Policy and Practice                               | 80 | 8.89 | 27  | A    |
| Parise, Parise, Martirano, Chavdarian, Su, & Ferrante | Wise port and business energy management: Port facilities, electrical power distribution   | 2016 | IEEE Transactions on Industry Applications  | 80 | 11.4 | 13  | A    |
| Sullivan & Shah                                       | Visual surveillance in maritime port facilities  | 2008 | Proceedings of SPIE - The International Society for Optical Engineering           | 34 | 2.27 | 17  | C    |
| Márquez-Ramos   | Port facilities, regional spillovers and exports: Empirical evidence from Spain  | 2016 | Papers in Regional Science  | 32 | 4.57 | 32  | A    |
| Stevens, Treyz & Kindahl                              | Conjoining an input-output model and a policy analysis model: a case study of the regional economic effects of expanding a port facility ( Boston. USA). | 1981 | Environment and Planning A  | 23 | 0.55 | 8   | A    |
| Parihar, Vergara & Clutter                            | Methodology for consequence analysis of LNG releases at deep-water port facilities   | 2011 | Safety Science  | 23 | 1.92 | 8   | A    |
| Dekker & Stevens                                      | Maritime security in the European Union - Empirical findings on financial implications for port facilities   | 2007 | Maritime Policy and Management  | 14 | 0.88 | 7   | A    |
| Valadez-Rocha & Ortiz-Lozano                          | Spatial and temporal effects of port facilities expansion on the surface area of shallow coral reefs   | 2013 | Environmental Management  | 13 | 1.30 | 7   | A    |
| Wilk  | Solidification/stabilization treatment and examples of use at port facilities  | 2004 | Port Development in the Changing World, PORTS 2004, Proceedings of the Conference | 11 | 0.58 | 11  | C    |

Note: Total Citation (TC), Citation Per Year (CPY), Citation Per Author (CPA), Type (A), Article, Type (C), Conference

Source: Authors computation 2023

article, whilst the width of the edge signifies the intensity of the co-citation association between two articles. Through the examination of the diagram, scholars can discern groupings of interconnected articles and acquire a deeper understanding of the principal topics and patterns within a certain academic discipline.

In the present visualizations, the researchers employed a criterion wherein visualizations were limited to writers who had received a minimum of 1 citation. The findings indicate that of the total of 1893 items, (indicating that some papers have multiple authors) 103 items satisfied the specified criterion and were subsequently chosen and visually represented. The research outreach of the authors materials is categorized into two primary groupings, namely the red cluster and the green cluster. The comprehensive network consists of a total of 103 objects, including 3108 linkages and exhibited a cumulative link strength of 3144. The majority of writers belonging to cluster 1 (red) examples, such as Cao J. et al., Ding Y. et al., Chase M. et al., and Berman T.S et al., have cited sources inside their respective clusters, in contrast to the green cluster. Cluster 1 is associated with a total of 63 connections, exhibiting a strength of 63 links and a single reference from various authors.

On the contrary, Cluster 2 (green) contains writers such as Kumar P.S et al., De Mangalhaes I. et al., as well as Cao S. et al. and Bianchi T.S et al., who are also present in Cluster 1. The majority of the writers within this cluster exhibit a consistent pattern of having 47 links, 47 links strengths, and 1 citation apiece. However, the primary authors linking both clusters are Golubkov M. et al., Martyanov S. et al., Kottek M. et al., Remy M. et al., and De Jorge V.N, among others as shown in the Map. They all belong to the green cluster. This implies that the authors in question possess a greater extent of reference coverage compared to other authors. The aforementioned writers own a total of 102 references, with a cumulative link strength of 110. Additionally, their work is supported by 2–3 citations. They are visualized at the center of the clusters though in green showing that they belong to cluster 2, they are considered as the major authors in this area in terms of reference coverage..

**Discussion**

The study conducted a bibliometric analysis of research output in the field of Port facility. The results showed that research output derived from journals and conference proceedings collectively make up 91.58%



Fig. 7. Citation per document. Authors Visualization 2023.

### Citation by Countries

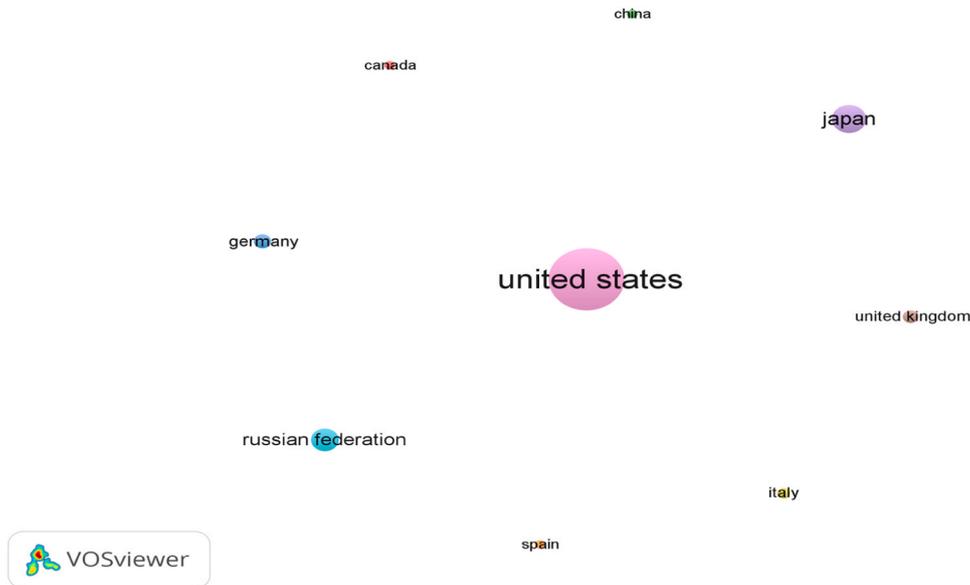


Fig. 8. Visualization of Citation by Countries with minimum of 5 documents and citations. Authors Visualization 2023

of the total papers, while books and book series provide very little contribution to the overall research output. The dataset contains 178 documents, which may be utilized as a benchmark for subsequent studies and comparisons. Engineering dominates the collection with 128 items (71.91%), followed by Earth and Planetary Sciences with 30 publications (16.85%). Environmental Science is important, as 27 documents (15.17%) demonstrate. Social Sciences comprises 26 documents, (14.61%). The study also identified the most active sources in port facility research, with Maritime Policy and administration being the most outstanding source. The implication of the above distribution is that port facility research is yet to be looked into majorly by management and social sciences as a means of comparative advantage, performance evaluation of ports and economic contributions to maritime sector and

the economy. This is however a very distinctive aspect. Port facility should not be looked at as the machines, their availability, usage and needs alone as Engineering field focuses but as a means of performance evaluation.

The study provides a holistic overview of the research landscape in Port facility by examining a substantial number of journal articles in the field. The findings of the study emphasize the importance of expanding research efforts, collaborations, and citations in the field of port facilities. This findings will not only be beneficial to scholars and practitioners but contribute to the overall advancement of seaport research. By understanding the key areas of focus and emerging trends, stakeholders can propel the expansion of seaport facilities to meet the growing demands of international trade. The study shows that port

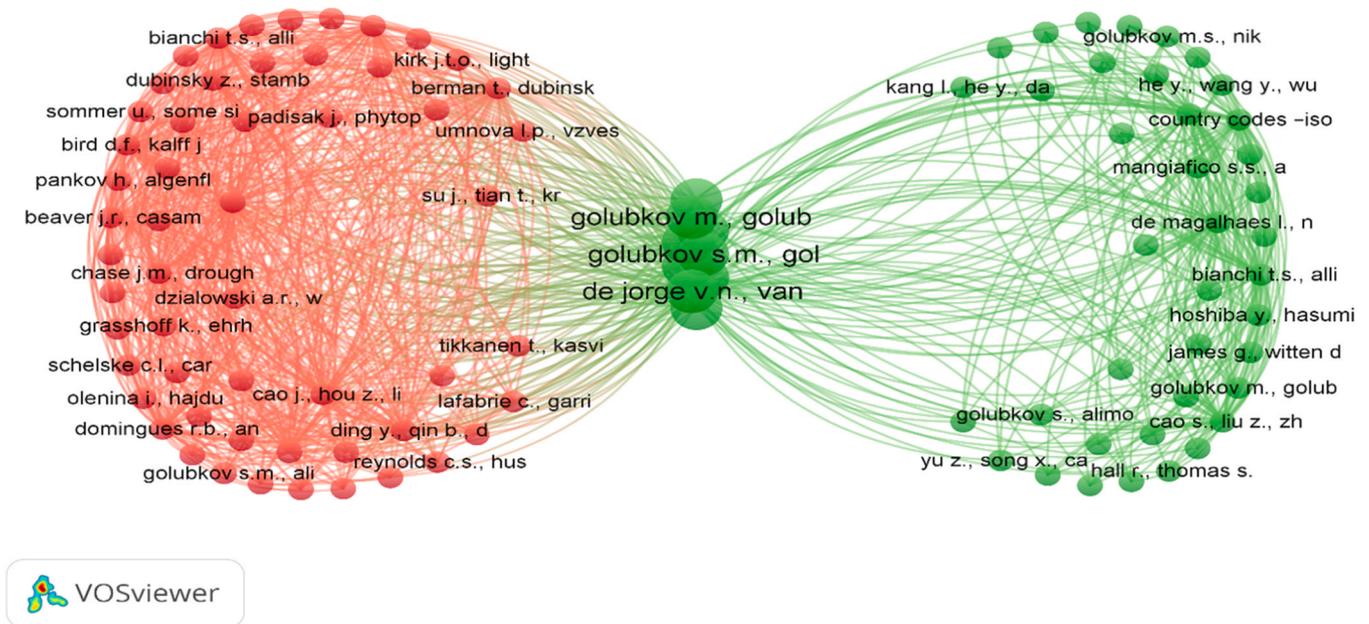


Fig. 9. Visualization of citation coverage by Authors. Authors Visualization 2023.

facility research is a multi-discipline one, including areas such as engineering, earth and planetary sciences, social sciences, and computer science, among others.

The article provides insights into the most productive institutions, research areas, and the most impactful theories in port facilities studies. Further, the study highlights the importance of data analysis and interpretation in academic research, as well as the significance of international collaboration and cross-disciplinary research. The findings of this study are expected to benefit scholars, practitioners, and policymakers alike in the seaport industry, providing a holistic overview of the research landscape in port facilities.

### Summary of findings

Retrieved documents (1975–2023) shows that conference papers and journal articles represent the majority of publications about port facilities - These two types of publications account for > 94% of the total publications in the field. In terms of source type, journal articles and conference proceedings are the most common sources of literature in the port facility field - Books provide only a fraction of the overall research output in port facilities. It also revealed that Engineering is the primary subject of research in the port facility field, with more than half of the total papers falling under this category - Other subject areas with significant contributions include earth and planetary sciences, environmental science, and management and social sciences. Similarly, Maritime transport, performance, and efficiency are the most commonly used words in the titles of publications about port facilities. On countries contribution and research Productivities, the study analyzed research productivity by country in the port facility field and placed the United States of America as the highest research productive country in this area, followed by Japan, Russia, and Germany. There is also a substantial collaboration and connection between different nations in the field of port facility research. Citation Analysis shows that papers on port facilities receive an average of 2.97 citations per paper and the average citation count was 11.00 citations per year. These documents have h-index and g-index of 12 and 20, respectively.

Overall, this study provides valuable insights into the existing body of literature on port facilities, identifying primary sources, research focal points, and emerging areas of interest within this particular field. The

findings show that port facility research is a multi-discipline one, emphasizing the contributions of different subject areas such as engineering, earth and planetary sciences, and social sciences. This article's implications can be beneficial for various stakeholders, including scholars, policymakers, and practitioners, who can use this information to facilitate the development of the port facility. But there is a need to increase attention to this field of studies in terms of research efforts, collaborations, and citations.

### Recommendation

Based on the findings of the study, it is recommended that future research in the field of Port facility should not focus on the areas dominated by Engineering and Earth and Planetary Sciences, other fields like Logistics Management, Computing, Maritime etc should be widely researched to cover the ideas that may be lacking in the present literatures. Researchers should also consider publishing their work in high-ranking sources such as Maritime Policy and administration but also other notable Logistics and related journals to achieve spread and cross fertilization of ideas.

### Contributions to knowledge

The research novelty is that it provides a comprehensive bibliometric analysis of the existing body of literature on port facility. This study is the near first attempt to conduct a bibliometric examination of research pertaining to port facility. The study analyzed a corpus of 178 journal publications, including conference papers, journal articles, book chapters and books, to identify the primary sources, research focal points, and emerging areas of interest within this particular field. The study provides valuable insights for scholars and practitioners and contributes to the overall advancement of seaport research.

### Suggestions for further studies

The article suggests several directions for further research in the field of port facilities. Some of them are:

1. Examination of the scope and impact of research contributions of specific countries, institutions, and authors in the field of port facility.
2. Investigation of the factors influencing international collaboration in port facility research.
3. Analysis of the factors affecting the utilization of port facility literature.
4. Studying the impact of digitalization and innovation in seaports on port facility literature.
5. Analyzing the impact of regulations, policies, and laws related to port facilities on international trade and seaport operations.
6. Investigation of the role of environmental concerns and sustainability in port facility research and operations.
7. Assessment of the role of private and public financing in port facility research and development.
8. Examination of Global Port Facility Research Propagation using data from both Scopus and Web of Science

These and other potential research areas could shed further light on the current state of port facility research and provide valuable insights into the challenges and opportunities in this field.

**Dedication**

To the blessed memories of my late parents Alh Salihu Zakari and

**Appendix**

*VOS viewer Data visualization Table*

The table presents an innovative contribution to the field of bibliometrics research through the utilization of the Vos viewer. Its primary significance lies in providing a direct means of verifying authors’ claims to both readers and editors. By downloading the identical dataset from the Scopus database using Figure1 and visualizing it within the Vos viewer through this table, it becomes possible to confirm the results of the analysis, holding all relevant factors constant. This unique integration of the Vos viewer and the novel application of the Scopus database through Figure1 underline the originality and importance of this table within the academic domain of bibliometrics research.

| Visualization Steps and Criteria          |      |                      |               |                                       |            |          |       |       |
|---|------|----------------------|---------------|---------------------------------------|------------|----------|-------|-------|
| Visualization Process and Characteristics |      |                      |               | Visualization Information and metrics |            |          |       |       |
|   | Mode | Min. No. of Document | Min. Citation | Selected                              | Visualized | Clusters | Links | TLS   |
| <b>Co-authorship</b>                      |      |                      |               |                                       |            |          |       |       |
| Authors Mapping                           | FRC  | 1                    | -             | 165                                   | 165        | -        | -     | -     |
| By Country                                | FRC  | 1                    | -             | 43                                    | 12         | 2        | 12    | 12.50 |
| <b>Co-occurrence</b>                      |      |                      |               |                                       |            |          |       |       |
| Authors keywords                          | FLC  | 1                    | -             | 283                                   | 55         | 9        | 159   | 33.00 |
| Index keywords                            | -    | 4                    | -             | 28                                    | 28         | 6        | 121   | 88.00 |
| <b>Citations</b>                          |      |                      |               |                                       |            |          |       |       |
| By Documents                              | -    | 1                    | 1             | 69                                    | -          | -        | -     | -     |
| By Countries                              | -    | 5                    | 5             | 9                                     | 9          | -        | -     | -     |
| <b>Co-citation</b>                        |      |                      |               |                                       |            |          |       |       |
| Cited Reference                           | -    | -                    | 1             | 1893                                  | 103        | 2        | 3108  | 3144  |

Note: Min.= Minimum; FRC= Fractional Counting; FLC= Full Counting; TLS= Total Link Strength.

Source: Authors Computation 2023

**Appendix A. Supporting information**

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ajsl.2024.08.002](https://doi.org/10.1016/j.ajsl.2024.08.002).

**References**

Alim, F., Bekar, K., Ivanov, K., Unlu, K., Brenizer, J., & Azmy, Y. (2006). Modeling and optimization of existing beam port facility of PSBR (Scopus) *Annals of Nuclear Energy*, 33(17–18), 1391–1395. <https://doi.org/10.1016/j.anucene.2006.10.007>.  
 Anyanova, E. (2007). The EC and enhancing ship and port facility security. In *Journal of International Commercial Law and Technology*, 2 pp. 25–31). Scopus.

Hajja Rukayyah Uwodi of Okabo, Ofu LGA of Kogi State-Nigeria, my wife, Aisha and my kids, Afnaan, Zayyan, Zakiyyah, Salih-Ashfaq, and Ruqayyah.

**Funding**

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**CRedit authorship contribution statement**

**Adam Jiddah Salihu:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing, Investigation, Project administration, Software, Supervision, Validation. **Nur Khairiel Anuar:** Conceptualization, Investigation, Project administration, Supervision, Validation, Writing – review & editing. **Suhaila Abdul Hanan:** Conceptualization, Investigation, Supervision, Validation, Writing – review & editing, Project administration.

**Conflict of interest**

All authors declared that they have no conflict of interest.

- Chadwick, D., Baktash, H., Yee, S., & Andrew, G. (2022). Designing Conveyors for Large Seismic Induced Displacements at a Port Facility. In P. J. Erbland, & B. N. Jones (Eds.), *Ports: Port Eng. - Pap. Sess. Trienn. Int. Conf.* (Vol. 1, pp. 145–155). American Society of Civil Engineers (ASCE); Scopus. <https://doi.org/10.1061/9787804484395.015>.
- Djabier, A., Setiawan, H., Syamsiah, S., & Senda, P. J. (2023). Port facility security assessment in Indonesian port. In H. Setiawan, null Rukmini, & null Nurwahidah (Eds.), *AIP Conf. Proc.* (Vol. 2675). American Institute of Physics Inc.; Scopus. <https://doi.org/10.1063/5.0117740>.
- Elentably, A. (2013). The positive implications for the application of the international ship & port facility security and its reflects on Saudi's ports. In *Journal of Maritime Research*, 10 pp. 3–12. Scopus.
- Gunawan, E., Zauhar, S., Sarwono, S., & Bambang, S. (2019). The implementation of ship and port facility security policy based on ISPS code at PT Pelindo II (Cirebon branch) (Scopus) *Journal of Management History*, 25(1), 67–96. <https://doi.org/10.1108/JMH-07-2018-0037>.
- Ibrahimi, K. (2017). A theoretical framework for conceptualizing seaports as institutional and operational clusters. *Transportation Research Procedia*, 25, 261–278. <https://doi.org/10.1016/j.trpro.2017.05.393>
- Ibrahimi, K. (2017). A theoretical framework for conceptualizing seaports as institutional and operational clusters. *Transportation Research Procedia*, 25, 261–278. <https://doi.org/10.1016/j.trpro.2017.05.393>
- Jović, M., Tijan, E., Bričić, D., & Pucihar, A. (2022). Digitalization in Maritime Transport and Seaports: Bibliometric, Content and Thematic Analysis. *Journal of Marine Science and Engineering*, 10(4), 486. <https://doi.org/10.3390/jmse10040486>
- Kawai, H. (2022). Recent Storm Surge and Wave Disasters and Actions on Coastal Defense and Port Facility Design in Japan. *Proc Int Offshore Polar Eng Conf*, 2601–2608 (Scopus) (<https://www.scopus.com/inward/record.uri?eid=2-s2.0-85142186553&partnerID=40&md5=1407f8ff0eca7b8556f775632d354210>).
- Kim, N., & Talley, W. K. (2002). The globalization of the ocean cruising industry: A bibliographic essay. *Cruise Ship Tourism* (pp. 383–393). CABI Publishing.
- Koh, S. J., Kaimok, C., Tan, R., & Chen, E. (2021). In A. Globa, J. van Ameijde, A. Fingrut, N. Kim, & T. T. S. Lo (Eds.), *Proj. - Proc. Int. Conf. Assoc. Comput.-Aided Archit. Des. Res. Asia: Vol. 2. Optimising harbour typology in the form finding process using computational design: A case study of a greenfield port facility* (pp. 619–628). CAADRIA (The Association for Computer-Aided Architectural Design Research in Asia (CAADRIA); Scopus) (<https://www.scopus.com/inward/record.uri?eid=2-s2.0-85104829592&partnerID=40&md5=1c8e5cdd0bd5889074d988698c7ea277>).
- Koliouis, I. (2020). A conceptual framework that monitors port facility access through integrated Port Community Systems and improves port and terminal security performance (Scopus) *International Journal of Shipping and Transport Logistics*, 12(4), 251–283. <https://doi.org/10.1504/IJSTL.2020.108400>.
- Lu, X., & Fan, H.-T. (2015). Study on the risk assessment approach of port facility security based on a comprehensive model of Delphi method, analytic hierarchy process, grey theory and fuzzy evaluation method (Scopus) *ICTIS - Int Conf Transp Inf Saf, Proc*, 628–632. <https://doi.org/10.1109/ICTIS.2015.7232095>.
- Matsunaga, H., Kyouda, J., Itakura, S., Yamamoto, T., Sone, A., & Kadono, T. (2023). Development of a Port Facility Diagnostic System that Utilizes Data Measured by Strong Motion Seismographs (LNCE). In Y. Li, Y. Hu, P. Rigo, F. E. Lefler, & G. Zhao (Eds.), *Lect. Notes Civ. Eng.* (Vol. 264, pp. 363–371). Springer Science and Business Media Deutschland GmbH; Scopus. [https://doi.org/10.1007/978-981-19-6138-0\\_32](https://doi.org/10.1007/978-981-19-6138-0_32) (LNCE).
- Miraj, P., Berawi, M. A., Zagloel, T. Y., Sari, M., & Saroji, G. (2021). Research trend of dry port studies: A two-decade systematic review. *Maritime Policy & Management*, 48(4), 563–582. <https://doi.org/10.1080/03088839.2020.1798031>
- Munim, Z. H., & Schramm, H.-J. (2018). The impacts of port infrastructure and logistics performance on economic growth: The mediating role of seaborne trade. *Journal of Shipping and Trade*, 3(1), 1. <https://doi.org/10.1186/s41072-018-0027-0>
- Notteboom, T., & Rodrigue, J. P. (2009). The future of containerization: Perspectives from maritime and inland freight distribution. *Geoforum*, 40(1), 95–102.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamsler, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., ... Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *PLoS Medicine*, 18(3), Article e1003583. <https://doi.org/10.1371/journal.pmed.1003583>
- Pallis, A. A., & De Langen, P. W. (2004). Port investment: An analysis of the investment policies and strategies of seaports. *Maritime Policy & Management*, 31(4), 305–320.
- Pham, T. Y. (2023). A smart port development: Systematic literature and bibliometric analysis. *The Asian Journal of Shipping and Logistics*, Article S2092521223000354. <https://doi.org/10.1016/j.ajsl.2023.06.005>
- Rettab, B., & Azzam, A. (2008). Re-export intensity and trade costs: Port facilities and services (Scopus) *Maritime Economics and Logistics*, 10(3), 229–242. <https://doi.org/10.1057/mel.2008.2>
- Rojas, P., Miranda, E., Barros, J., Rosero, D., Márquez, W., & García, L. (2022). Case History of a Rehabilitated Port Facility after the 2016 Ecuador Earthquake. In P. J. Erbland, & B. N. Jones (Eds.), *Ports: Port Eng. - Pap. Sess. Trienn. Int. Conf.* (Vol. 1, pp. 93–103). American Society of Civil Engineers (ASCE); Scopus. <https://doi.org/10.1061/9780784484395.010>.
- Cullinane, K., Wang, T. F., & Cullinane, S. (2002). The relationship between the volume of imports and exports with seaports: The case of Hong Kong. *Maritime Policy & Management*, 29(1), 65–76.
- Shin, S., Moon, H., & Shin, J. (2022). BIM-Based Maintenance Data Processing Mechanism through COBie Standard Development for Port Facility (Scopus) *Applied Sciences (Switzerland)*, 12(3). <https://doi.org/10.3390/app12031304>.
- Song, D. W., & Panayides, P. M. (2012). *Maritime logistics in the global economy: Current trends and issues*. Edward Elgar Publishing.
- Talley, W. K., & Ng, A. K. (1996). Ports as elements in value-driven chain systems: The new paradigm. *Maritime Policy and Management*, 23(4), 339–350.
- Voogt, H. (2022). Port Facilities' Asset Management: Coping with Aging Infrastructure and Constrained Budgets in the Long Term. In P. J. Erbland, & B. N. Jones (Eds.), *Ports: Port Eng. - Pap. Sess. Trienn. Int. Conf.* (Vol. 2, pp. 656–663). American Society of Civil Engineers (ASCE); Scopus. <https://doi.org/10.1061/9780784484401.065>.
- Wagner, N. (2019). Sustainability in Port Cities – a Bibliometric Approach. *Transportation Research Procedia*, 39, 587–596. <https://doi.org/10.1016/j.trpro.2019.06.060>
- Wan, Y. K., Zhang, A., & Chang, Y. T. (2019). Trans-pacific maritime gateway region: A comparative study between North America and Asia. *Transport Policy*, 72, 180–191.
- Wang, Z., Wang, J. J., & Ji, X. (2018). A multi-criteria decision-making model for selecting intermodal terminal location in seaport hinterland. *Journal of Cleaner Production*, 202, 198–215.
- Wernli, M., Cotrell, J., & Barutha, P. (2022). Port Facility Requirements for Construction of Modular Concrete Substructures for Offshore Wind. In P. J. Erbland, & B. N. Jones (Eds.), *Ports: Port Eng. - Pap. Sess. Trienn. Int. Conf.* (Vol. 1, pp. 456–467). American Society of Civil Engineers (ASCE); Scopus. <https://doi.org/10.1061/9780784484395.046>.