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# Mapping the Intellectual Structure of Seaport Competitiveness Research: A Bibliographic Coupling Analysis

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**Abstract.** Seaport competitiveness is a central theme in maritime and supply chain research, yet systematic knowledge of its thematic evolution remains limited. This study examines the intellectual structure of seaport competitiveness research using a bibliographic coupling analysis of 574 peer-reviewed articles published between 1995 and 2025 from Scopus. Bibliographic coupling and VOSviewer are applied to identify thematic clusters and their intellectual linkages. The results reveal eight major research streams: port policy and strategy, logistics network optimization, inter-port competition and cooperation, port authority roles, efficiency, maritime connectivity, hinterland connectivity, and multi-criteria evaluation. While earlier studies emphasized infrastructure, governance, and operational efficiency, recent research identifies maritime and hinterland connectivity as the emerging cornerstone of seaport competitiveness, indicating a shift from viewing ports as isolated facilities toward integrated components of global transport and logistics networks. The study consolidates fragmented knowledge into a coherent research agenda and provides analytical foundations for future research on port competitiveness.

**Keywords:** Seaport competitiveness, Bibliometric Analysis, Bibliographic coupling.

# 1. Introduction

Over 80% of global trade by volume is carried by sea, making seaports indispensable nodes of the global economy (UNCTAD, 2023). In addition to serving as gateways for cargo flows, ports increasingly shape national competitiveness by influencing logistics efficiency, trade facilitation, and regional connectivity. Amid globalization, supply chain reconfigurations, sustainability imperatives, and digital transformation, the competitive landscape among seaports has become increasingly complex and multidimensional.

Against this backdrop, seaport competitiveness has emerged as one of the most prominent and enduring topics in maritime and logistics research. While the earliest academic work can be traced back to Britton (1963), systematic investigations gained momentum in the late 1980s with contributions from Williams (1988), Murphy et al. (1989), and Warf and Kleyn (1989). Since then, scholars have conceptualized port competitiveness as a composite function of resources, capabilities, and the collective strength of the port community (van der Lugt et al., 2007), emphasizing not only rivalry but also cooperative dynamics, consistent with the co-opetition perspective (Brandenburger and Nalebuff, 1996).

Current scholarship on seaport competitiveness has often been summarized into two broad streams. The first seeks to identify the drivers of port competitiveness by examining operational, organizational, and strategic dimensions. The second develops quantitative models to measure and validate the relative impact of these drivers, thereby providing empirical support for strategic decision-making (Parola et al., 2017). While this dichotomy has shaped the theoretical underpinnings of port competitiveness, it may also oversimplify the field. In reality, the research landscape has become more fragmented and diversified, suggesting the need for a more fine-grained mapping of its contemporary thematic structure.

Despite the extensive body of research on port competitiveness, several limitations persist. Existing reviews are scarce and have primarily relied on co-citation analysis or qualitative synthesis. While these methods are valuable for tracing the historical intellectual roots of a field, they are less effective in capturing emerging thematic linkages in rapidly evolving domains. This limitation is particularly critical for seaport competitiveness, where recent disruptions, such as digitalization, decarbonization, supply chain resilience, and geopolitical shifts, have reshaped research priorities. Without systematically addressing these contemporary dynamics, the literature risks providing a fragmented and retrospective view. The absence of systematic mapping not only constrains academic knowledge development but also restricts the ability of policymakers and port authorities to anticipate and respond to emerging challenges in maritime competition.

To date, the intellectual structure of seaport competitiveness research has not been systematically examined using bibliographic coupling. Unlike co-citation analysis, which reflects established schools of thought, bibliographic coupling is uniquely suited to uncover the current thematic landscape by linking documents through shared references. This methodological shift is not merely technical but has important analytical implications. By identifying research clusters that represent contemporary debates and directions, bibliographic coupling enables scholars to understand how the field is evolving in its current stage of development. In the context of seaport competitiveness, such capability is particularly important for understanding the growing prominence of topics such as maritime connectivity, hinterland integration, digital transformation, and sustainability. For practitioners and policymakers, such insights are vital: they highlight where academic attention is converging, which themes are emerging, and where future evidence may inform strategic port development and policy formulation.

Bibliometrics provides statistical techniques for analyzing authorship, keywords, and references, thereby revealing the developmental patterns of a research field (Nicolaisen, 2010; van Raan, 2005). Among its approaches, bibliographic coupling is particularly effective for mapping the contemporary thematic structure, as it identifies relationships between documents through shared references (Leung et al., 2017). This technique enables the identification of research clusters and facilitates the mapping of the intellectual structure of the field. Applying this approach makes it possible to visualize the

thematic landscape of seaport competitiveness studies and to derive meaningful insights into its evolution, current focal areas, and emerging directions.

Accordingly, this study applies bibliographic coupling to systematically map the intellectual structure and thematic evolution of seaport competitiveness research, thereby strengthening the theoretical and practical foundations of the field. In doing so, the study makes three primary contributions to the literature on seaport competitiveness.

First, it provides a methodological contribution by applying bibliographic coupling to map the contemporary intellectual structure of seaport competitiveness research. Compared with traditional co-citation approaches, bibliographic coupling enables the identification of current research frontiers and emerging thematic developments within the field.

Second, the study offers a thematic and intellectual-structure contribution by identifying eight major research clusters that characterize the evolution of seaport competitiveness scholarship. These clusters reveal the multidimensional nature of the field, covering operational efficiency, governance and institutional roles, network connectivity, sustainability, and methodological evaluation approaches.

Third, the study contributes policy-relevant insights by highlighting the growing importance of seaport connectivity within the competitiveness discourse. The findings suggest that improving maritime, hinterland, and digital connectivity has become a central strategic pathway through which ports enhance their competitive performance in global logistics networks.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature and defines key concepts. Section 3 outlines the research methodology. Section 4 presents the results. Section 5 discusses the findings and their implications for both scholarship and practice. Section 6 concludes the study by summarizing contributions, acknowledging limitations, and suggesting directions for future research.

# 2. Literature Review

## 2.1. The conceptualization of seaport competitiveness

Seaport competitiveness is a complex issue that cannot always be fully explained through easily identifiable and quantifiable factors (Notteboom, 2009). From a macroeconomic perspective, seaport competitiveness is often defined in terms of a port's relative position compared to other ports and its contribution to the socioeconomic development of the surrounding region (Huybrechts, 2002; Meersman et al., 2009). This approach emphasizes the port's role as a catalyst for regional value creation and serves as a foundation for policy-making in port system development.

However, from a micro-level perspective, particularly from the viewpoint of customers and supply chain stakeholders, seaport competitiveness is closely associated with the ability of a port to optimize total logistics costs (de Martino and Morvillo, 2008). Ports that can minimize transportation costs, time, and risks throughout the logistics chain tend to be favored as port-of-call choices. Accordingly, seaport competitiveness is also defined as a port's ability to provide efficient and reliable services that meet domestic and international market expectations at a reasonable cost (da Cruz et al., 2013; Kaliszewski et al., 2020; Yeo and Song, 2006).

Beyond definitional debates, the literature on seaport competitiveness has evolved through several complementary analytical perspectives. One major stream emphasizes strategic and institutional dimensions of port competitiveness, examining how governance structures, port authority models, regulatory frameworks, and public–private partnerships shape competitive performance (de Langen, 2002; Van de Voorde and Verhoeven, 2014).

A second stream focuses on operational and logistical performance, highlighting the role of resource utilization, terminal productivity, service quality, and logistics coordination in improving port efficiency and competitiveness (Sánchez et al., 2003; Tongzon and Heng, 2005). Within this perspective, ports are increasingly viewed as integral nodes within global supply chains, where intermodal integration and logistics collaboration play a critical role in shaping competitive advantage (Carlan et

al., 2016; De Martino and Morvillo, 2008).

More recently, growing attention has been directed toward the role of connectivity within global maritime and inland transport networks. Studies adopting this perspective emphasize the importance of maritime connectivity and hinterland integration in determining a port's strategic position within international logistics systems (Deshmukh and Song, 2023; Martinez-Moya et al., 2023; Tovar et al., 2015). The increasing prominence of connectivity reflects the transformation of ports from isolated infrastructure facilities into interconnected logistics hubs embedded within global supply networks.

Together, these perspectives highlight the multidimensional nature of seaport competitiveness and provide a conceptual foundation for interpreting the thematic clusters identified in the subsequent bibliometric analysis.

## 2.2. Existing review studies

Over the past few decades, seaport competitiveness has emerged as a key research domain within the fields of logistics and supply chain management, as reflected in the increasing number of academic publications and the broadening scope of inquiry. Several review studies have been conducted to consolidate knowledge in this area. For example, Parola et al. (2017) reviewed 170 articles published between 1983 and 2014 to identify the main drivers and evolving trends related to seaport competitiveness. Following this, Munim and Saeed (2019) used citation and co-citation analysis on 267 articles to identify the most influential authors, institutions, and countries. However, their work primarily focused on measuring academic influence and citation relationships, rather than examining the contemporary thematic structure of the field.

More recent reviews by Chang and Talley (2019), Luo et al. (2022), and Yu et al. (2023) extended the research scope to include port performance, industry collaboration, and development strategies. In particular, Yu et al. (2023) applied a systematic literature review approach to 81 high-quality articles to identify key influencing factors and strategic initiatives for enhancing seaport competitiveness. They also proposed a classification framework consisting of four major factor groups. While insightful and valuable in synthesizing key concepts and strategic perspectives, these reviews remain largely qualitative and descriptive in nature. As a result, they did not apply quantitative scientific mapping techniques, such as bibliographic coupling, that can systematically visualize the structural relationships within the literature.

In addition, co-citation analysis, as used in studies like Munim and Saeed (2019), tends to reveal the historical intellectual structure of a field by identifying documents that are frequently cited together. This approach is useful for uncovering foundational schools of thought, but it is limited in its ability to capture current or emerging research themes. In contrast, bibliographic coupling, which identifies links between publications based on shared references, provides a more timely reflection of the current research landscape and active thematic clusters. However, this technique has not yet been systematically applied to the seaport competitiveness literature. To address this gap, the present study employs bibliographic coupling to identify and analyze the thematic clusters that characterize the current state of research in this field. This approach provides a robust academic foundation for shaping future research directions and informing port policy development in the context of increasing global competition and accelerated digital transformation.

## 2.3. Bibliometric analysis

Bibliometrics applies mathematical and statistical methods to scientific communication and outputs (Luc, 2022). At its core, bibliometric analysis employs metrics such as publication volume, citation counts, interdisciplinarity, and network ties to gauge scholarly influence and map field dynamics.

Furthermore, bibliometric analysis serves as a valuable tool for mapping the intellectual landscape of a research area. It can highlight interdisciplinary connections, track the evolution of ideas over time, and identify key contributors and institutions driving progress in a field. This bird's-eye view of the

research ecosystem is particularly valuable for scholars seeking to understand the state of the art in their discipline or identify promising areas for future investigation.

In essence, bibliometric analysis offers a rigorous, transparent, and reproducible method for evaluating scientific literature. Its ability to process large volumes of data and uncover hidden patterns makes it an indispensable tool for conducting comprehensive literature reviews and guiding strategic research decisions (Jugović et al., 2022).

## 3. Method

This study employs a bibliometric research design to analyze the intellectual structure of seaport competitiveness research. Bibliometric techniques enable the systematic examination of large volumes of scientific publications through citation relationships and bibliographic metadata.

The bibliometric literature review was conducted in three stages: document retrieval, preliminary screening, and bibliometric analysis. Bibliometric methods are widely used to quantitatively assess published research outputs and to reveal the developmental patterns of a research field (Ellegaard and Wallin, 2015). The bibliometric analysis stage examines institutional and geographical perspectives, the temporal evolution of the field, research areas, document types, and contributing authors. This approach therefore serves as a powerful quantitative tool for mapping academic knowledge in this domain.

Specifically, the study applies bibliographic coupling to identify relationships among publications based on shared references. This method enables the identification of research clusters that represent the contemporary thematic structure of the field. Documents that share a larger number of references are considered to have stronger intellectual connections and are therefore more likely to belong to the same research specialty (Peters et al., 1995).

Figure 1 illustrates the three-step bibliometric workflow applied in this study.

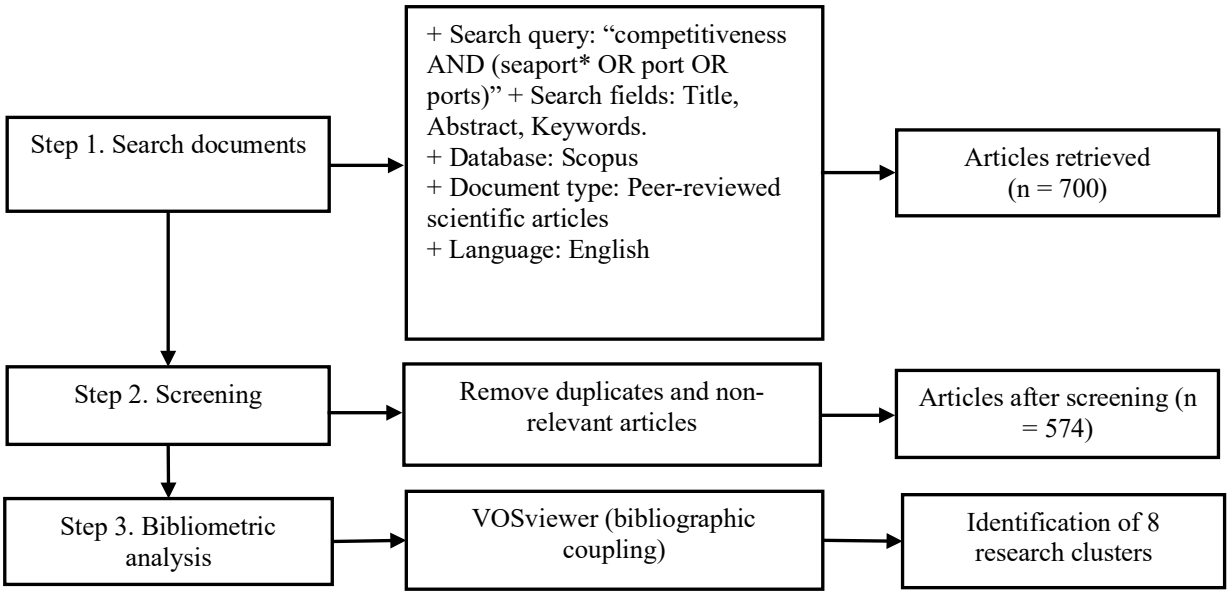


Fig. 1. Three-step bibliometric research workflow

Step 1: Search documents

A systematic search was conducted using the Scopus database. The search query included the terms "competitiveness AND (seaport* OR port OR ports)" applied to the title, abstract, and keywords of peer-reviewed articles. The search was restricted to English-language documents to ensure consistency and broad accessibility of the research findings. The search was performed on 30 Dec 2025 and returned 700 records matching the specified criteria.

Step 2: Screening

The 700 retrieved records were screened to remove duplicate entries and studies not directly related to seaport competitiveness in cargo transportation. A manual content check was conducted to ensure that only studies focusing on freight-handling seaport competitiveness were retained. Manual screening is considered an important step in bibliometric studies to improve the relevance and accuracy of the dataset (Jugović et al., 2022).

During the screening process, 126 records were excluded based on several criteria. These included studies focusing on passenger ports and cruise tourism, inland transport systems, generic transport or logistics competitiveness, non-freight maritime operations, port-related studies without an explicit competitiveness focus, and other topics not directly related to seaport competitiveness in cargo transportation. In addition, several port-related studies were excluded because they did not address competitiveness issues. The detailed exclusion categories and the number of records removed under each criterion is presented in Table 1. After the screening process, a total of 574 articles remained as the final dataset. All records were exported with full records and cited references in CSV format for subsequent analysis.

Step 3: Bibliometric analysis

The final dataset of 574 articles was analyzed using bibliographic coupling in VOSviewer (van Eck and Waltman, 2010) to identify relationships among publications based on shared references. This technique enables the identification of research clusters representing the contemporary thematic structure of the field.

In the analysis, bibliographic coupling was selected as the type of analysis, with documents used as the unit of analysis. The full counting method was applied to calculate link strengths between publications. No minimum citation threshold was applied, allowing all 574 documents in the dataset to be included in the network construction.

The clustering of publications was performed using the default VOSviewer clustering algorithm, which groups documents according to the strength of shared references, thereby revealing the main thematic structures within the literature.

Table 1. Exclusion categories during screening

| Exclusion category | Number of records |
|---|---|
| Passenger ports and cruise tourism studies | 16 |
| Inland transport / non-seaport transport studies | 22 |
| Generic transport or logistics competitiveness studies | 27 |
| Non-freight maritime operations (shipping, vessels, fuel, safety, AIS, etc.) | 21 |
| Irrelevant economic, regional, or sectoral studies | 30 |
| Port studies without competitiveness focus | 10 |
| **Total excluded** | **126** |

# 4. Research Findings

## 4.1. Descriptive statistics

### 4.1.1. Growth of research over time

The initial descriptive statistics of the dataset provide an overview of the current knowledge base in the field of seaport competitiveness. The data collection period spans from 1995 to 2025. The number of published articles during this period, along with their citation frequency in the Scopus database, is illustrated in Figure 2.

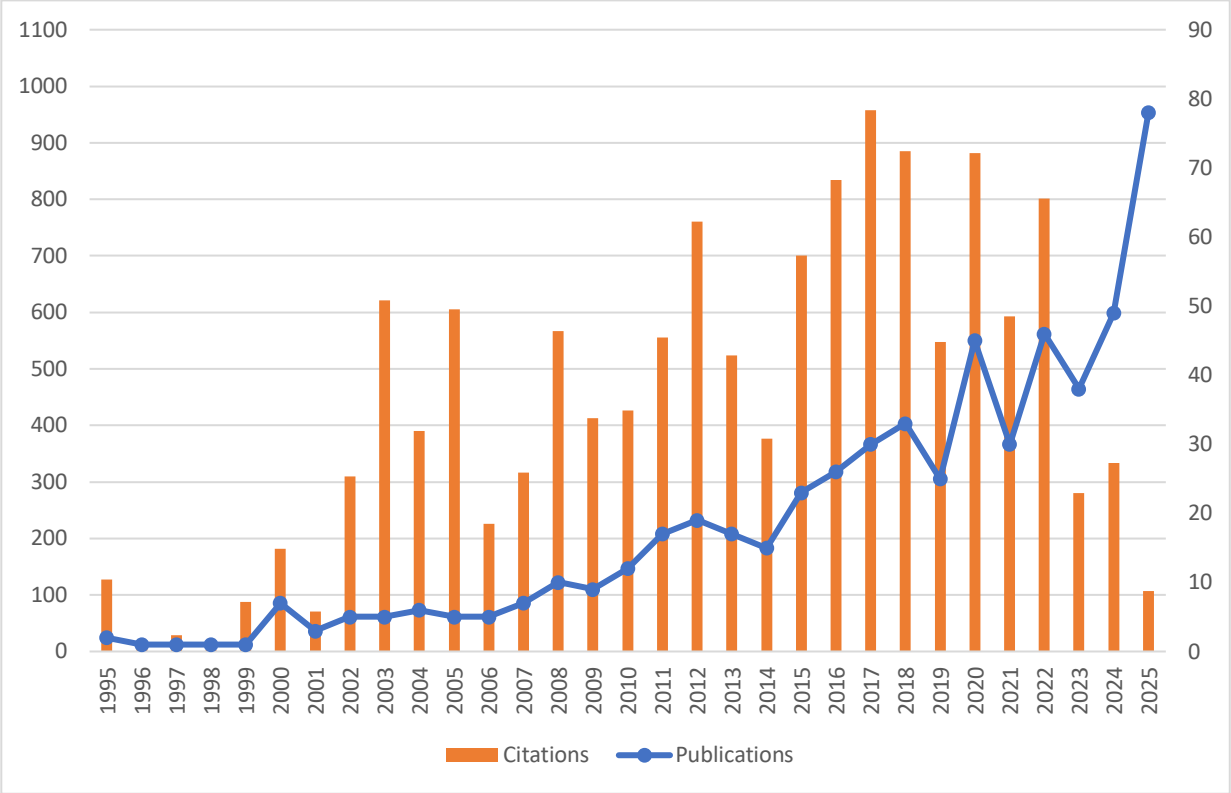


Fig. 2. Annual scientific output on seaport competitiveness (1995–2025)

Figure 2 shows that the average number of publications per year is approximately 18.42 articles over the 31-year period from 1995 to 2025. Academic interest in this topic has grown significantly over time. Notably, there has been a substantial surge in publications since 2017, with the average annual output increasing to 41.56 articles between 2017 and 2025. This trend reflects the growing scholarly recognition of seaports as strategic assets in global trade, logistics, and economic development. This pattern is also associated with several structural transformations in the maritime and logistics sectors. In particular, increasing academic attention has been directed toward digital transformation in port operations, the need for greater supply chain resilience following global disruptions, and the decarbonization agenda in maritime transport. At the same time, the strategic importance of port connectivity within global logistics networks has become a major focus in both academic research and industry practice. These developments have stimulated a growing body of research examining how ports respond to technological change, environmental pressures, and evolving supply chain configurations.

However, it should be noted that publication counts for the most recent years, particularly for 2024 and 2025, may be affected by indexing delays in the Scopus database. Publication counts for these years should therefore be interpreted with caution.

Table 2 presents the leading journals in terms of publication volume on the topic of seaport competitiveness. The journal Maritime Policy and Management ranks first, with 62 articles, accounting for nearly 11 percent of the total sample. It is followed by Maritime Economics and Logistics, Transport Policy, Journal of Transport Geography, and Asian Journal of Shipping and Logistics, each of which has published more than 20 relevant articles during the examined period.

Table 2. Top 15 journals publishing on seaport competitiveness

| Ordinal Number | Scientific Journal | Articles | Percentage | Citations |
|---|---|---|---|---|
| 1 | Maritime Policy and Management | 62 | 10.80% | 1992 |
| 2 | Maritime Economics and Logistics | 28 | 4.88% | 1005 |
| 3 | Transport Policy | 25 | 4.36% | 774 |
| 4 | Journal of Transport Geography | 24 | 4.18% | 873 |
| 5 | Asian Journal of Shipping and Logistics | 20 | 3.48% | 485 |
| 6 | Pomorstvo | 18 | 3.14% | 39 |
| 7 | Sustainability (Switzerland) | 17 | 2.96% | 430 |
| 8 | Research in Transportation Business and Management | 13 | 2.26% | 292 |
| 9 | Transportation Research Part A: Policy and Practice | 12 | 2.09% | 1203 |
| 10 | International Journal of Transport Economics | 11 | 1.91% | 193 |
| 11 | Journal of Maritime Research | 10 | 1.74% | 15 |
| 12 | Transportation Research Part E: Logistics and Transportation Review | 10 | 1.74% | 476 |
| 13 | Marine Policy | 8 | 1.39% | 182 |
| 14 | International Journal of Shipping and Transport Logistics | 8 | 1.39% | 141 |
| 15 | Australian Journal of Maritime and Ocean Affairs | 7 | 1.05% | 63 |

### 4.1.2. Most cited studies

The top 10 most cited articles in the field of seaport competitiveness are listed in Table 3. These publications have had a significant influence on the development of the literature and continue to serve as key references for contemporary research. The most highly cited works address various themes such as port efficiency, privatization, competition, and hub network design.

Notable among these is the article titled "Port privatization, efficiency and competitiveness: some empirical evidence from container ports", which has received substantial academic attention. Other prominent studies include "A competitive analysis of Chinese container ports using the analytic hierarchy process", "Port efficiency and international trade: port efficiency as a determinant of maritime transport costs", and "Liner shipping hub network design in a competitive environment". Additionally, the article "Regional container port competition and co-operation: the case of Hong Kong and South China" explores port dynamics in a regional context, while "Clustering and performance: the case of maritime clustering in the Netherlands" provides insights into the spatial and strategic aspects of port competitiveness.

Together, the ten leading articles account for 1,933 citations, reflecting their central role in shaping the theoretical and empirical foundations of the seaport competitiveness literature.

Table 3. Top 10 most-cited articles on seaport competitiveness

| Ordinal Number | Title | Scholar | Citations | Average citations per year |
|---|---|---|---|---|
| 1 | Port privatization, efficiency and competitiveness: some empirical evidence from container ports | Tongzon and Heng (2005) | 450 | 21.43 |
| 2 | Port efficiency and international trade: port efficiency as a determinant of maritime transport costs | Sánchez et al. (2003) | 211 | 9.17 |
| 3 | A competitive analysis of Chinese container ports using the analytic hierarchy process | Song and Yeo (2004) | 189 | 8.59 |
| 4 | Liner shipping hub network design in a competitive environment | Gelareh et al. (2010) | 183 | 11.44 |
| 5 | The drivers of port competitiveness: a critical review | Parola et al. (2017) | 174 | 19.33 |
| 6 | Regional container port competition and co-operation: the case of Hong Kong and South China | Song (2002) | 163 | 6.79 |
| 7 | Post-entry container port capacity expansion | Luo et al. (2012) | 148 | 10.57 |
| 8 | Clustering and performance: the case of maritime clustering in the Netherlands | de Langen (2002) | 147 | 6.13 |
| 9 | Port competitiveness from the users' perspective: an analysis of major container ports in China and its neighboring countries | Yuen et al. (2012) | 142 | 10.14 |
| 10 | The implications of increased competition among ports for port policy and management | Heaver (1995) | 126 | 4.06 |
| | **Total** | | **1933** | |

Table 4 indicates that the top 12 most influential scholars collectively contribute nearly one quarter of the total academic output on seaport competitiveness, accounting for 16.90 percent of all publications included in the dataset. Among them, several authors have demonstrated consistently high research productivity in this domain.

Specifically, Jeevan, J., Lam, J. S. L., Salleh, N. H. M., Yeo, G. T., Van de Voorde, E., Song, D. W., and Pallis, A. A. are listed as the most prolific authors, each contributing more than seven publications to the field. Notably, Jeevan, J. stands out as the most productive scholar, with 16 published articles on seaport competitiveness. These researchers have made substantial contributions to shaping the discourse, offering insights into various aspects such as port strategy, efficiency, connectivity, and governance.

Table 4. Top 12 contributing authors in the dataset

| Ordinal Number | Scholar | Articles | Percentage |
|---|---|---|---|
| 1 | Jeevan, J. | 16 | 2.79% |
| 2 | Lam, J.S.L. | 13 | 2.26% |
| 3 | Salleh, N.H.M. | 9 | 1.57% |
| 4 | Yeo, G.T. | 8 | 1.39% |
| 5 | Van de Voorde, E. | 7 | 1.22% |

| Ordinal Number | Scholar | Articles | Percentage |
|---|---|---|---|
| 6 | Song, D.W. | 7 | 1.22% |
| 7 | Pallis, A. A. | 7 | 1.22% |
| 8 | Kawasaki, T. | 6 | 1.05% |
| 9 | Mohamad, R. | 6 | 1.05% |
| 10 | Martínez-Moya, J. | 6 | 1.05% |
| 11 | Notteboom, T. | 6 | 1.05% |
| 12 | Parola, F. | 6 | 1.05% |

## 4.2. Bibliographic coupling

Bibliographic coupling is defined as the frequency with which two later publications cite the same earlier work (Kessler, 1962). It has been shown that documents sharing common references with a highly cited publication tend to exhibit greater similarity in vocabulary structure than those without such connections, suggesting that bibliographically coupled publications are likely to belong to the same research specialty (Peters, 1995).

Applying this principle to the current dataset, bibliographic coupling enables the identification of major thematic clusters that reflect the key areas of scholarly focus within the field of seaport competitiveness. Figure 3 provides a visual representation of the bibliographic coupling network. The analysis reveals the presence of eight clearly defined clusters, suggesting that studies grouped within the same cluster address related topics and frequently rely on similar references.

Table 5 summarizes the eight thematic clusters identified through bibliographic coupling, including the number of documents associated with each cluster and representative studies. It should be noted that these eight clusters comprise 451 documents in the visualized bibliographic coupling network, whereas the remaining documents in the dataset were not assigned to the major clusters because of weaker linkage patterns or more peripheral positions in the network.

The analysis also highlights that a limited number of recent studies are dispersed across different clusters, indicating emerging subfields or interdisciplinary connections. The following section presents a detailed interpretation of these clusters, focusing on recent developments in seaport competitiveness research. This examination provides deeper insight into emerging trends, prevailing methodologies, and key findings that are shaping the current landscape of this research domain.

Table 5. Thematic clusters identified through bibliographic coupling

| Themes | Number of documents | Representative citations |
|---|---|---|
| Theme 1. Seaport competitiveness related to Policy and strategy in sustainable development of seaports | 81 | Hollen et al. (2015), Woo et al. (2018), Hossain et al. (2019), Salleh et al. (2020), Ma et al. (2021), Jeevan et al. (2023), Guo and Zeng (2024). |
| Theme 2. Seaport competitiveness related to Optimizing transportation networks and seaport logistics activities | 73 | De Martino and Morvillo (2008), Gelareh et al. (2010), Carlan et al. (2016), Wang et al. (2016), Heilig and Voß (2017), Xu et al. (2018), Martínez-López and Chica González (2023). |
| Theme 3. Seaport competitiveness related to competition and strategic cooperation between seaports in the regional context. | 66 | Fleming and Baird (1999), Fung (2001), Song (2002), Cullinane et al. (2004), Luo et al. (2012), Zhang et al. (2016), Song et al. (2016). |

| Themes | Number of documents | Representative citations |
|---|---|---|
| Theme 4. Seaport competitiveness related to the roles and actions of port authorities | 58 | Heaver (1995), de Langen (2002), de Langen and Visser (2005), Pallis and Vaggelas (2005), Ng and Gujar (2009), Kaselimi et al. (2011), Lai et al. (2014), Van de Voorde and Verhoeven (2014), Ferrari et al. (2015), Panayides et al. (2015). |
| Theme 5. Seaport competitiveness related to seaport efficiency | 49 | Sánchez et al. (2003), Tongzon and Heng (2005), Lin and Tseng (2007), Dias et al. (2012), Daofang et al. (2015), Lagoudis et al. (2017), Kammoun and Abdennadher (2022). |
| Theme 6. Seaport competitiveness related to maritime connectivity | 45 | Song and Yeo (2004), Yeo et al. (2011), Yuen et al. (2012), da Cruz et al. (2013), Yeo et al. (2014), Parola et al. (2017), Kaliszewski et al. (2020, 2021), Munim et al. (2022). |
| Theme 7. Seaport competitiveness related to hinterland connectivity | 42 | Tovar et al. (2015), Sdoukopoulos and Boile (2020), Caballé Valls et al. (2020), Guo et al. (2022), Deshmukh and Song (2023), Saha (2023), Martinez-Moya et al. (2023). |
| Theme 8. Seaport competitiveness involves multi-criteria evaluation methods | 37 | Lirn et al. (2003), Lee et al. (2013), Rezaei et al. (2019), Bartosiewicz (2020), Pham (2021), Panaro et al. (2023). |

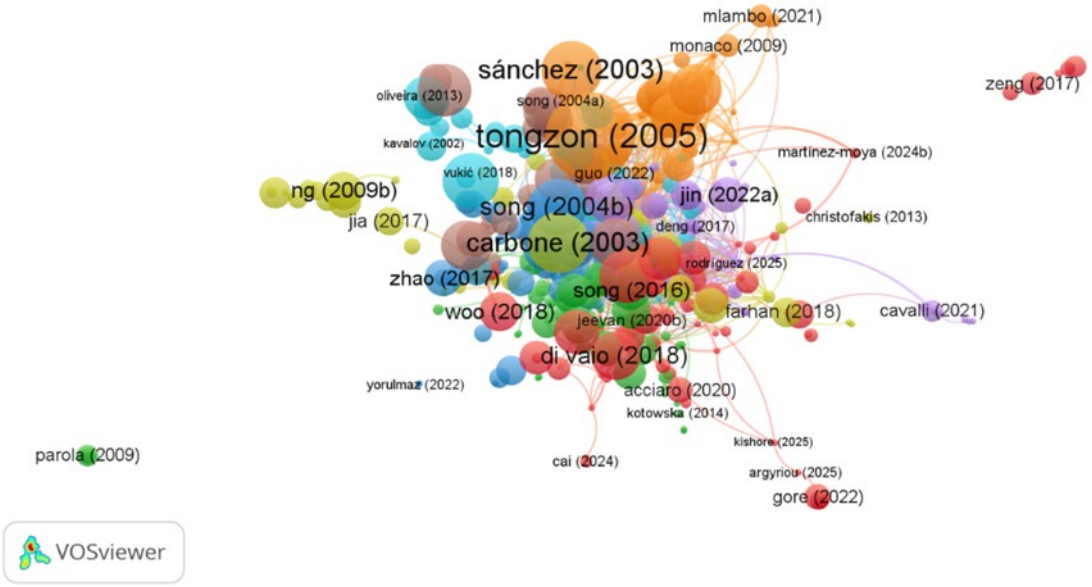


Fig. 3. Bibliographic coupling network

To clarify the conceptual structure of the identified clusters, it should be noted that the eight clusters do not belong to a single conceptual category but instead encompass both substantive research topics and methodological approaches within the broader field of seaport competitiveness. The clusters can

therefore be conceptually organized into three higher-order research streams. The first stream concerns strategic and institutional dimensions of port competitiveness, including studies addressing governance structures, port authority roles, and policy frameworks. The second stream focuses on operational and network-related aspects, such as port efficiency, maritime connectivity, hinterland connectivity, and logistics optimization. The third stream consists of evaluative and methodological approaches, particularly studies employing multi-criteria decision-making methods to assess port competitiveness and performance.

This classification clarifies the intellectual structure of the field by distinguishing between substantive research domains and the analytical tools used to examine them.

The first cluster explores port competitiveness from the perspective of policy and strategic development, with particular emphasis on environmental sustainability, industrial integration, and governmental support mechanisms. Scholars in this group analyze institutional frameworks to identify areas where effective government intervention can enhance port performance.

The second cluster centers on the optimization of transport and logistics networks, highlighting the role of information and communication technologies (ICT) in improving operational efficiency, reducing logistics costs, and fostering stakeholder collaboration within port ecosystems.

The third cluster investigates the competitive positioning of ports in both regional and global contexts. This body of research explores models of inter-port competition and cooperation, as well as methods for forecasting container demand and evaluating port service strategies.

The fourth cluster emphasizes the role of port authorities in managing operations and navigating the trade-off between cost efficiency and interoperability. Studies in this group focus on institutional governance and the strategic coordination of port activities.

The fifth cluster addresses the relationship between resource utilization and port efficiency. These studies investigate how optimal use of physical and human capital contributes to enhanced performance and, ultimately, to greater competitiveness.

The sixth cluster focuses on the importance of maritime connectivity in shaping port competitiveness. These studies underscore the need for robust integration with global shipping lines and international port networks to strengthen a port's position in global trade.

The seventh cluster shifts attention to hinterland connectivity, analyzing its role in expanding a port's hinterland reach. Topics include multimodal transport development, dry port integration, and logistics hub optimization, which are seen as essential for improving inland accessibility and extending port influence.

Finally, the eighth cluster concentrates on the application of multi-criteria decision-making (MCDM) methods in evaluating port competitiveness. Techniques such as the Analytic Hierarchy Process (AHP) and Multi-Criteria Decision Analysis (MCDA) are employed to provide comprehensive, systematic assessments of port performance across multiple dimensions.

Beyond the individual cluster descriptions, the bibliographic coupling analysis also reveals important interconnections among the identified research themes. In particular, the connectivity cluster is closely linked with studies on operational efficiency and port performance, as improved maritime and hinterland connectivity often serves as a key mechanism through which ports enhance their competitiveness. Similarly, research on governance and institutional frameworks frequently interacts with sustainability-oriented studies, as regulatory policies and port authority strategies increasingly shape environmental performance and sustainable port development.

In addition, the cluster focusing on multi-criteria evaluation methods plays a methodological role that extends across several substantive research themes. These analytical approaches are widely used to assess port performance, competitiveness, sustainability, and strategic decision-making, thereby functioning as methodological tools rather than representing a completely independent thematic domain.

Taken together, the eight clusters reveal that seaport competitiveness research is structured around three broader dimensions: operational performance and network connectivity, institutional and

governance frameworks, and methodological approaches for evaluating port competitiveness. This interconnected structure highlights the multidimensional nature of seaport competitiveness and reflects the increasing integration of operational, institutional, and analytical perspectives within the field.

# 5. Discussion and Avenues for Future Research

## 5.1. The conceptualization of seaport competitiveness

Seaport competitiveness is a complex issue that cannot always be fully explained through easily identifiable and quantifiable factors (Notteboom, 2009). From a macroeconomic perspective, seaport competitiveness is often defined in terms of a port's relative position compared to other ports and its contribution to the socioeconomic development of the surrounding region (Huybrechts, 2002; Meersman et al., 2009). This approach emphasizes the port's role as a catalyst for regional value creation and serves as a foundation for policy-making in port system development.

For example, Munim and Saeed (2019) conducted a co-citation analysis of 267 academic papers and identified seven key research streams: port competition, efficiency, institutional change, pricing, embeddedness, choice, and cooperation. Their study was instrumental in highlighting the foundational themes that have shaped the field and provided valuable insights into its intellectual development. Because co-citation analysis focuses on highly cited works, it tends to emphasize the historical intellectual foundations of the field. By contrast, the present study reveals more recent developments, particularly the increasing academic attention to cross-cutting trends such as digitalization and sustainability, which appear across multiple research themes rather than forming independent clusters. These emerging themes reflect a shift in research focus and provide a more thorough and forward-looking theoretical framework for understanding port competitiveness.

This study offers a more refined understanding of the evolving direction of port competitiveness research by analyzing how contemporary topics such as methods based on multiple criteria for evaluating competitiveness and the application of logistics information technology are organized within the literature. These insights complement previous reviews by providing an additional perspective on the contemporary thematic structure of seaport competitiveness research.

One significant contribution of this study is its identification of seaport connectivity as an emerging and distinct research theme. Through bibliographic coupling analysis, the study identified two separate thematic clusters: maritime connectivity, which refers to integration within ocean shipping networks, and hinterland connectivity, which focuses on inland logistics linkages.

This distinction is particularly important because earlier literature reviews did not consider connectivity as an independent theme, despite its increasing theoretical relevance. For example, Chang and Talley (2019) highlighted the limited number of studies examining port competitiveness from a supply chain perspective, noting that most research before 2019 treated ports in isolation. The recognition of connectivity as a distinct theme in this study indicates a shift in academic discourse, as scholars increasingly recognize the essential role of ports within global supply chains and logistics networks in shaping port competitiveness.

This aligns with broader industry trends of ports transforming into logistics hubs, where digital integration and intermodal linkages become key competitive advantages. By documenting this trend, this study adds theoretical insight into how port competitiveness is no longer solely defined by internal efficiency or infrastructure, but also by external network position and integration. This new perspective encourages theorists to incorporate network connectivity (both seaward and landward) into models of port competitiveness, reflecting the reality of an interconnected global trade system.

## 5.2. Policy and Managerial Implications

In addition to making academic contributions, the findings of this study also have practical implications for policymakers and industry practitioners in the maritime and logistics sectors. The diverse clusters

identified suggest that enhancing port competitiveness requires a multifaceted strategy, and different stakeholder actions correspond to different thematic areas.

The policy and managerial implications of this study can be better understood when interpreted in relation to the thematic clusters identified through bibliographic coupling. In particular, research on maritime and hinterland connectivity highlights the importance of strengthening both seaward and inland transport networks through integrated transport infrastructure and logistics corridors. Studies focusing on port governance emphasize the critical role of port authorities and institutional frameworks in shaping competitiveness, suggesting the need for effective governance structures and stakeholder coordination. In addition, research on logistics optimization and digital technologies underlines the growing importance of information systems and smart port solutions in improving operational transparency and efficiency. Finally, studies employing multi-criteria evaluation methods provide analytical tools that can support evidence-based policy formulation and strategic decision-making in complex port environments.

First, the cluster focused on policies and strategies for competitiveness highlights the importance of government support and sustainable development policies. It is crucial for port authorities and policymakers to recognize that regulations and initiatives promoting environmental sustainability and community engagement can strengthen port competitiveness in the long run. This means that ports should not only prioritize throughput and profit, but also balance economic goals with environmental and social responsibilities. For example, investing in green port infrastructure and ensuring compliance with international environmental standards can be a competitive strategy.

Second, the literature on logistics network optimization and global port positioning underscores the need to enhance operational efficiency and supply chain integration. Experts in port management recommend that port authorities adopt advanced technologies such as terminal automation, blockchain applications, and artificial intelligence to streamline logistics processes and improve efficiency, reliability, and connectivity. For example, implementing real-time data exchange platforms with shippers and integrating inland transport services has been shown to enhance a port's attractiveness as a strategic node within the global supply chain.

The identification of separate thematic clusters on maritime and hinterland connectivity highlights the necessity of making balanced investments in both dimensions. Strengthening connectivity at both ends of the logistics chain helps ensure seamless cargo flow, improves service quality, and reduces transit times. Enhancing seaport connectivity also has direct policy implications. Governments can support this goal by investing in port–hinterland transport projects, simplifying trade facilitation procedures, and promoting regional cooperation to improve market accessibility. These policy initiatives not only expand the port’s service area and cargo base but also improve overall competitiveness by increasing network integration, reducing logistical bottlenecks, and aligning with global supply chain expectations.

One key insight from the cluster on port governance and resource utilization is the significant influence of management models and governance structures on port performance. Whether a port is managed publicly or privately, or follows a landlord or operating port authority model, these choices directly affect operational efficiency. Therefore, it is essential for port regulators and operators to adopt effective governance frameworks and maintain transparency in decision-making. Best practices such as engaging stakeholders, investing in human capital, and using performance benchmarking can enhance port agility and competitiveness.

The cluster on multi-criteria evaluation methods also underscores the importance of using comprehensive assessment tools for strategic planning. Tools like balanced scorecards and composite competitiveness indices, incorporating dimensions such as digital readiness and resilience, help port authorities identify strengths and address weaknesses.

Overall, the findings provide practical guidance for both policymakers and port managers. Key priorities include promoting sustainability-oriented policies, adopting advanced technologies,

enhancing seaport connectivity, and reforming governance models. Prioritizing these areas is essential to strengthening seaport competitiveness.

### 5.3. Emerging Cluster: Seaport Connectivity and its Growing Relevance

One significant finding from the analysis is the emergence of seaport connectivity as a distinct thematic cluster, reflecting its increasing relevance in the study of port competitiveness. Although connectivity is only one of the eight identified clusters, its appearance is both novel and significant.

Seaport connectivity encompasses both maritime connections, such as integration into global shipping networks and hub-port systems, and inland connections, including intermodal transport routes, dry ports, and hinterland logistics networks. The rising importance of this theme suggests that researchers are increasingly evaluating a port's competitive advantage in terms of how effectively it connects and integrates with other nodes in the supply chain.

To further explore emerging research themes, a keyword overlay visualization was conducted using VOSviewer (Figure 4). The overlay map illustrates the temporal distribution of keywords within the literature and highlights the evolution of research topics over time. Several recent keywords are associated with network integration and logistics connectivity within the port system. In particular, terms related to port connectivity, dry ports, and intermodal transport appear more frequently in recent publications, suggesting an increasing research focus on the role of ports within global logistics networks. This observation provides additional support for the identification of seaport connectivity as an emerging theme in the literature.

This shift aligns with current developments in the maritime industry, where supply chains are becoming more integrated and time-sensitive. As a result, shippers and carriers assess ports not only based on internal efficiency and cost structures but also on their network position within global logistics systems. Key considerations include the frequency of shipping services, the breadth of destination coverage, the availability of inland transport modes, and the port’s role as a strategic logistics hub.

Our findings reinforce the growing emphasis on seaport connectivity in studies on port selection and strategy. Recent analyses have shown that both shipping lines and cargo owners consider a port's multimodal connectivity a critical factor in decision-making. A well-connected port attracts greater cargo throughput and gains strategic relevance, creating a self-reinforcing cycle of competitiveness.

It is important to note that digitalization does not appear as a standalone thematic cluster in the bibliographic coupling results. Instead, digital technologies emerge as cross-cutting elements embedded within several clusters, particularly those related to logistics optimization, port governance, and connectivity. With the implementation of digital technologies such as port community systems, blockchain-based documentation, and real-time tracking, the traditional boundaries between ports, carriers, and inland logistics are becoming increasingly blurred. Ports are transforming into smart, interconnected platforms rather than simply functioning as physical transit points.

In this context, the academic focus on connectivity reflects an effort to conceptualize and theorize these structural transformations. This theme is expected to continue expanding and intersect with other strategic areas such as sustainability (e.g., optimizing routes to reduce emissions) and resilience (e.g. ensuring alternative transport routes and multimodal options during disruptions).

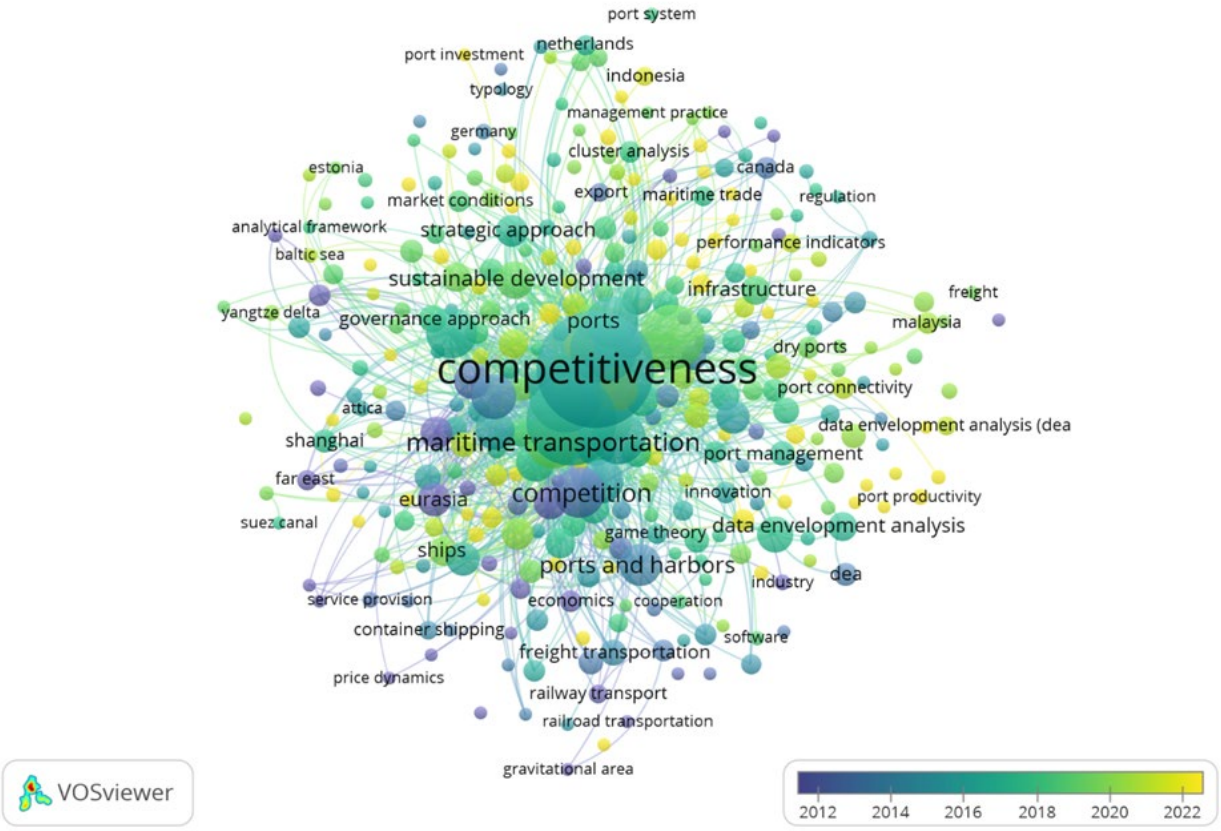


Fig. 4. Keyword overlay visualization of seaport competitiveness research

It is important to note that previous literature reviews did not consider connectivity as a distinct theme, but rather as a secondary issue within broader topics such as competition or cooperation. However, recent bibliometric findings have highlighted seaport connectivity as a standalone cluster, indicating its increasing significance in academic discussions. Although it is one of several thematic areas, seaport connectivity serves as a crucial nexus linking operational efficiency, supply chain collaboration, and strategic positioning.

Future research could investigate key questions such as: How does improved maritime and hinterland connectivity affect port market share and customer satisfaction? Which governance or policy frameworks are most effective in promoting connectivity? In what ways can digital platforms and data sharing among ports, shippers, and inland carriers enhance overall network integration?

These questions, if addressed, could provide valuable guidance for researchers and practitioners aiming to leverage connectivity as a strategic lever of port competitiveness in the context of an increasingly integrated global supply chain.

## 5.4. Applications to Other Port Domains

Bibliographic coupling analysis can also be applied to other emerging domains of port research. For example, the same workflow used in this study could be employed to map the intellectual structure of smart port research by identifying clusters related to automation technologies, Internet of Things (IoT) applications, and digital platform integration. Similarly, in the context of green ports, bibliographic coupling could reveal thematic clusters associated with emission reduction strategies, renewable energy adoption, and sustainable logistics practices.

Another potential application concerns port-city integration research. By applying the same bibliometric workflow, researchers could identify how themes such as waterfront redevelopment, port governance, and urban sustainability interact within the evolving port–city interface literature.

Recent bibliometric studies on port digitalization and sustainability further demonstrate the adaptability of this approach. When applied to domains such as port governance or port-city integration, bibliographic coupling can provide strategic insights by revealing research gaps, emerging themes, and key contributors. These applications support both academic development and policy formulation by enhancing understanding of intellectual progress and research maturity across disciplines related to ports.

# 6. Conclusion and Research Limitations

## 6.1. Conclusion

This study provides a comprehensive bibliometric analysis of seaport competitiveness research, revealing eight thematic clusters and identifying seaport connectivity as a rising focus. By adopting a bibliographic coupling approach, the research advances the theoretical foundation of port competitiveness and highlights the transition from infrastructure-based views to integrated supply chain perspectives. The findings contribute to maritime business and logistics by demonstrating how seaport connectivity influences network performance, service reliability, and value creation in global supply chains. In addition to these academic contributions, the study offers practical insights for port managers and policymakers by identifying strategic priorities such as connectivity enhancement, digitalization, and sustainability-oriented governance. Finally, the approach provides a roadmap for future research on maritime operations and port management, supporting data-driven strategies and system optimization.

## 6.2. Research Limitations

Although this study provides a systematic overview of seaport competitiveness research, several limitations should be acknowledged. First, the dataset was derived exclusively from the Scopus database. While Scopus offers extensive coverage of peer-reviewed journals, relying on a single database may exclude relevant studies indexed in other sources, such as Web of Science or regional databases. This may influence the relative representation of research themes within the bibliographic coupling network and potentially affect the composition and size of the identified clusters. Nevertheless, most core journals in maritime transport, port management, and logistics studies are indexed in both Scopus and Web of Science. Therefore, while database selection may introduce minor variations in dataset composition, it is unlikely to alter the overall intellectual structure and the main thematic clusters identified in this study.

Second, the analysis was limited to English-language publications. As maritime and port-related research is also published in other languages, particularly in regions with strong port industries, this restriction may underrepresent certain regional research perspectives. Consequently, some thematic areas related to local port governance or regional logistics systems may be less visible in the identified cluster structure.

Third, the findings are influenced by the keyword-based search strategy used to construct the dataset. Although the search query was carefully designed to capture studies on seaport competitiveness, relevant publications employing alternative terminology may not have been included. Such variations could potentially affect the thematic distribution of the literature and the relative prominence of specific clusters.

Fourth, bibliometric techniques, including bibliographic coupling, primarily capture structural relationships among publications through citation patterns. While this approach is effective for identifying thematic clusters and mapping the intellectual structure of a research field, it may not fully capture the deeper conceptual nuances of individual studies. As a result, the interpretation of clusters,

including the identification of emerging themes such as seaport connectivity, should be understood as reflecting broader citation patterns rather than definitive conceptual boundaries.

Future research could address these limitations by incorporating multiple bibliographic databases, expanding the language scope of the dataset, and combining bibliometric analysis with qualitative review approaches to provide a more comprehensive understanding of the evolving research landscape of seaport competitiveness.

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