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Maritime ports and operational barriers: tracing research trajectories through bibliometric mapping

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ABSTRACT

Maritime ports are critical nodes in facilitating global trade, yet they encounter persistent challenges that sizably affect their operational performance and efficiency. This study is identified as a systematic review using bibliometric analysis to provide an overview of research developments and trends in operational challenges within maritime ports from 2010 to early 2025. This study utilises the PRISMA framework, obtaining 96 peer-reviewed journal articles from 60 sources obtained from the Scopus database. Data analysis was conducted using tools such as R-studio, Bibliometrix, VOSviewer and NVivo. Our analysis identified the most productive and influential journals, institutions, and regions, highlighting the key contributions to the field. This study emphasised articles with the highest citation count, which can serve as reference points based on current trends. We also employed co-occurrence techniques and thematic maps to identify trending topics and concepts within the domain. Thematic coding of the literature was conducted to identify the major challenges affecting ports. This analysis provides a noteworthy trajectory of the growth in literature concerning Asian nations, most prominently China, India and Singapore, which emerged as leaders within this domain. It further shows that previous studies have emphasised emerging themes like digitalisation, congestion, berth allocation, and port risks, which reinforce the major operational barriers faced by ports globally.

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SUBJECTS
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1. Introduction

Maritime ports continue to be the main gateway to the global marketplace, where the former have emerged as pivotal for global economic development. Trade via sea accounts for more than 80% of worldwide merchandise trade and connects countries across borders and various transportation modes, with an anticipated year on year (YOY) increase of 3% from 2024 to 2028 (Kishore et al., 2024). Additionally, ports are one of the primary components of the general transportation sector and are pivotal in the ever-expanding world economy. The performance of ports directly influences national economic growth, trade efficiency, and supply chain resilience. As the principal conduits for global trade, handling a substantial portion of cargo, the performance of ports remains critical in a country's economic development (Gayathri et al., 2022). Efficient port operations facilitate international trade, fostering economic growth and global ties of countries and regions.

Operational performance in a general context has no commonly accepted definition, as it is perceived in various ways. (Tan et al., 2007) provide a definition that is regularly cited. It describes operational performance as 'the output or result achieved due to unique operational capabilities'. Operational performance is typically measured with indicators representing an organisation's internal operations in terms of efficiency, productivity, while many studies also focus on output quality, customer satisfaction and delivery performance (Dow et al., 1999; Yu et al., 2014). In maritime ports, the

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operational performance relies on several factors. One main determinant of measuring operational performance is the number of containers moved through a port (throughput) (Tongzon, 1995). Other factors include ship turnaround time, which is the total time a ship takes to arrive and prepare for its departure from the port. Berth occupancy is the proportion of the total time the berth is occupied by a vessel to the entire amount of time available during that period. Moreover, factors such as pre-detention time and output per ship-berth day determine the operational performance of ports.

Efficient and well-performing ports bring growth prospects to the country. Consequently, port performance can be a potential factor that impacts a country's trade competitiveness (Mlambo, 2021). Well-equipped and connected container ports are key to reducing trade costs, linking supply chains, and facilitating international trade. Additionally, maritime ports in strategic locations create opportunities to promote global trade and improve its performance and efficiency. For instance, the Colombo Port of Sri Lanka, positioned at the centre of the main sea routes connecting Europe and Asia, is one of the top-performing and key ports in South Asia (Kavirathna et al., 2021). Despite the critical function played by maritime ports as facilitators of logistics and global trade, maritime ports operate in an ever-changing and challenging environment, as various events and causes severely impact container ports worldwide (Yap & Ho, 2023).

Container ports and terminals face huge challenges in managing expected growth by sustaining their performance and remaining competitive. Existing research has identified various and isolated categories of challenges and barriers that affect performance in maritime ports. Infrastructure and capacity constraints fuelled by a lack of berths, navigation tools, and cranes and draft which are required to handle larger vessels (Nanyam & Kumar Jha, 2023; Sahoo et al., 2025). In the era of Industry 4.0, ports have undergone significant adaptation to digitalisation. Yet, to a large extent, ports worldwide have still failed to optimise digitalising operations due to high investment costs, implementation complexities, and resistance to change among port authorities and employees (Brunila et al., 2021; Inkinen et al., 2019). Additionally, barriers including congestion and hinterland connectivity (Bai et al., 2024), impacts of disruptions (Notteboom et al., 2021), and planning inefficiencies such as berth planning (Zhen et al., 2019), have been widely discussed. However, these studies provide an isolated view of the operational issue, highlighting the need for a comprehensive understanding of the challenges and barriers that influence operational performance in ports globally. During the recent past years, many bibliometric analyses spotlighting themes including 'port digitalisation', 'smart ports', 'green ports', 'port sustainability' and 'port competitiveness' have been published by several scholars (Davarzani et al., 2016; Munim & Saeed, 2019; Pham, 2023). A more recent study conducted by Boadu et al. (2025) provides a decade-long review of the evolution of smart ports, outlining the benefits of seamless digital operations, emerging future trends including smart city integration, green infrastructure and seamless digital ecosystems and challenges such as high capital investment, skill gaps and integration issues. In addition to that, recent research on green ports sheds light on energy efficiency, electric supply infrastructure development, and renewable energy promotion as green strategies that will not only increase operational efficiency but also enhance corporate social responsibility initiatives and ensure environmental concerns are addressed while meeting the expectations of the stakeholders (Satta et al., 2025). Furthermore, with the growing importance of sustainable innovations within the maritime sector, recent literature provides a state-of-the-art review of sustainable strategies, revealing emerging solutions such as alternative energy sources and smart port technologies that yield positive results in practice, improving sustainability performance (Shabib et al., 2025).

In contrast, a bibliometric analysis focusing on port operational performance cannot be discovered in the current consensus of the literature. This also indicates a research gap in the given context. The operational performance of ports acts as the backbone of a country's economic development (Munim & Schramm, 2018). Several studies have discovered how the operational performance of maritime ports positively influences economic development (Clark et al., 2004; OConnor et al., 2019). Given the strategic importance of operational performance in influencing global trade and boosting economic development, a growing trend is visible in exploring ports' operational performance. In light of the above, the present study aims to bridge the above-explained lacuna. A bibliometric analysis can be vital in synthesising the existing studies, providing a comprehensive overview of the challenges hindering port operational performance.

Therefore, building on these insights, this study aims to explore bibliographic data from research articles published after 2010 to provide a novel and comprehensive overview of the current research on persisting challenges in maritime ports that hinder operational performance. The base year was set as 2010 to trace the most recent literature that directly focuses on operational performance and port management. This will allow explorational into the current challenges limiting ports' operational performance. Moreover, the said era further marks the beginning of the Fourth Industrial Revolution (Industry 4.0), where ports are influenced by cutting-edge technology that reshapes port operations. Yet, even with the availability of modern technologies, ports continue to confront issues that directly harm its operational performance. Additionally, by employing bibliometric techniques, this study aims to derive findings at the broader level, to identify trends and gaps regarding the challenges and barriers associated with maritime ports' operational performance. The research objectives aim to:

Perform a descriptive analysis of research trends and publication metrics, thereby, to:

I. Assess the most cited and influential documents and sources
II. Investigate and analyse keywords and themes via keyword co-occurrence analysis and thematic evaluation.

The structure of the paper is designed to facilitate a thorough understanding of the subject matter. It begins with the methodology that gives an overview of the research strategies employed, the screening of the articles and the analytical tools used. Subsequent sections employ multiple analytical techniques to examine the selected articles, including descriptive, bibliometric and thematic analysis.

2. Methodology

The study employed a systematic literature review (SLR) methodology to identify major challenges affecting the operational performance of maritime ports. This work also combines bibliometric analysis to reveal the interconnected themes and growing research trends. A systematic literature review aims to provide group insights by synthesising many topics (Tranfield et al., 2003). The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework was followed to guide the selection of suitable publications and for the reporting of findings. This is because this framework is recommended for conducting SLRs (Dogra & Priyashantha, 2023; Moher et al., 2010; Tranfield et al., 2003).

As shown in the PRISMA article selection flow diagram in Figure 1, PRISMA consists of three stages: identification, screening, and inclusion (Dogra & Priyashantha, 2023). These steps are mandatory to shortlist pertinent articles that set the ground for this bibliometric analysis. The identification stage involves determining the databases to be referred, search strings, inclusion criteria, and data extraction. The PRISMA framework states that a predefined inclusion criterion must be followed to filter the identified documents. The article selection process entailed manual evaluation of publications by the authors in the screening phase. Full-text documents of all screened articles were retrieved, bibliometric data were extracted, and the eligibility of each publication was carefully assessed.

2.1. Selection process and search strategy

Selecting the appropriate databases is crucial for conducting a comprehensive literature review (Pranckutė, 2021). This study identified relevant articles from Scopus, from which bibliographic data were also extracted due to being a robust and user-friendly database for analysing and visualising research trends and patterns. The next step involved defining the resources by searching within these databases. Creating specific keywords is essential to narrow down the scope of the literature search and thus maintain focus on research objectives. Keywords useful in retrieving pertinent publications are 'operational performance,' 'efficiency,' 'productivity,' 'container ports,' 'cargo terminals,' 'maritime ports,' 'shipping ports,' 'challenges,' 'issues,' 'problems,' and 'barriers.' Word combinations are ('operational performance' OR 'efficiency' OR 'productivity') AND ('container ports' OR 'cargo terminals' OR 'maritime ports' OR 'shipping ports') AND ('challenges' OR 'issues' OR 'problems' OR 'barriers'). These keyword combinations aimed to ensure the retrieval of pertinent documents to operational limitations, inefficiencies, and performance-related challenges

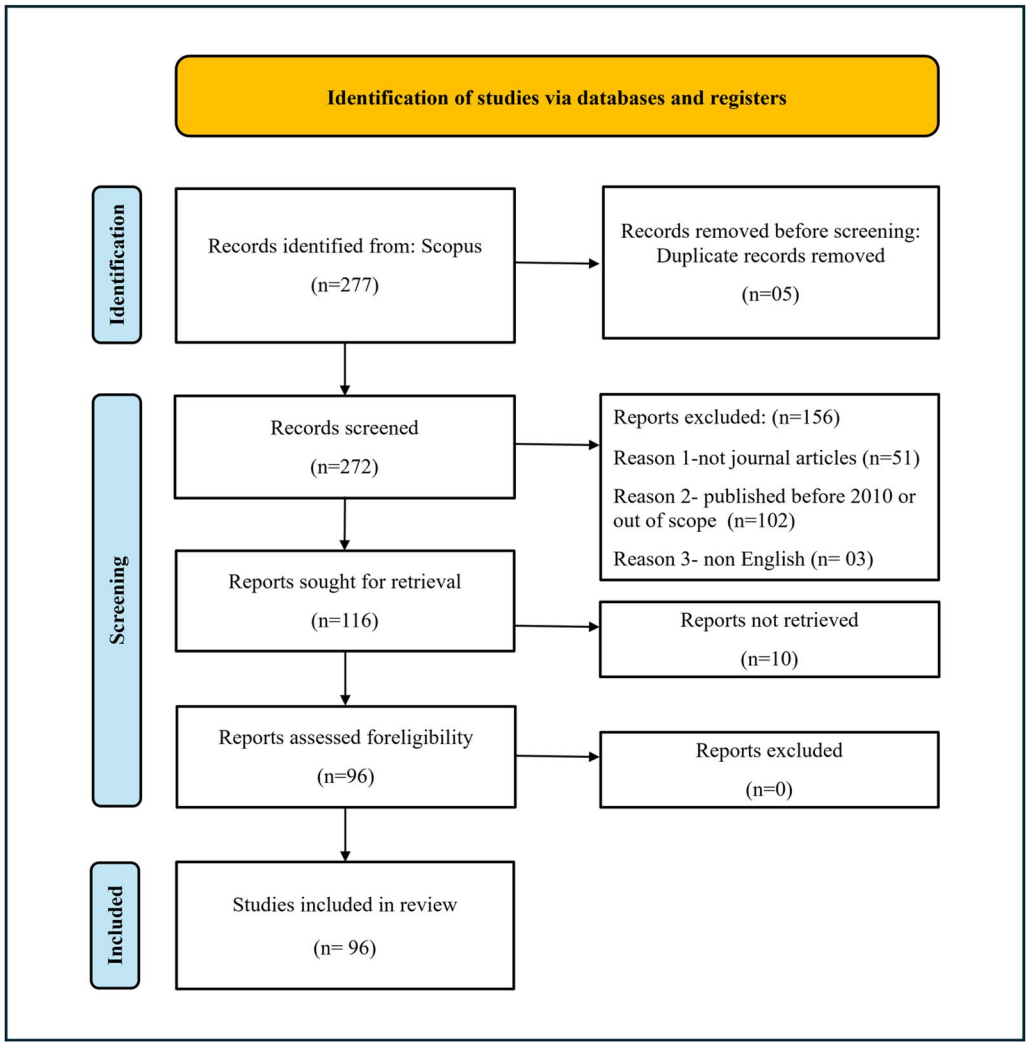


Figure 1. PRISMA flowchart. PRISMA checklist: https://bit.ly/3X6eotv.

Table 1. Inclusion criteria.

Aspect	Description
Article search strategy	PRISMA guidelines
Search string	'Operational performance' OR 'Efficiency' OR 'Productivity' AND 'Container ports' OR 'Cargo terminals' OR 'Maritime ports' OR 'Shipping ports' AND 'Challenges' OR 'Issues' OR 'Problems' OR 'Barriers'
Inclusion criteria	Journal Articles and Reviews Publication year: 2010 to 2025 February, which discusses challenges and barriers affecting port operational performance. Articles in English

Source: Authors' compilation.

maritime ports and terminals encounter. The created search strings were developed to capture publications addressing the major problems that affect port operations. Additionally, filters were used to maintain focus of the search to peer-reviewed journal articles published in English, excluding all other document types.

During the search, predefined inclusion criteria such as document type, language, scope and publication years were carefully taken into consideration, as depicted in Table 1. The time frame was defined as those published from 2010 to early 2025. The scope of this study was limited to publications in English, and the type of documents considered was confined to articles and reviews, while the source type was restricted to journals. Missing data were addressed by consulting the original publications where necessary.

2.2. Data extraction process

As previously mentioned, the data extraction process followed the PRISMA methodology (Figure 1; Page et al., 2021), which is a frequently employed and widely recognised framework that ensures rigour in the selection and evaluation of studies (Shamseer et al., 2015). In addition, this method allows a thorough and methodical search for relevant academic publications, reducing bias and improving replicability (Pilelienė et al., 2022). The review upholds high standards of quality, integrity, and consistency by following this methodology.

Two individual authors manually extracted the data and carefully evaluated the information to ensure the accuracy and reliability of the applicable information.

An advanced search for articles was conducted using Scopus, utilising the search terms presented in Table 1. The relevance of the studies identified was ensured through narrowing down the search to only peer-reviewed articles and reviews, excluding other documents, including book chapters and conference proceedings. The initial search yielded a total of 277 documents. After eliminating the duplicates, the number of records decreased to 272. Followed by a screening-based approach on the inclusion criteria resulted in excluding another 156 articles, with 10 articles that could not be retrieved. The final dataset, thus, comprised 96 articles eligible for the final analysis.

2.3. Analysis techniques

Bibliographic and descriptive data for the publications included in the study were downloaded from Scopus. Thus, we used a combination of analytical tools to assess the data retrieved from journals, including Microsoft Excel, NVivo (Allsop et al., 2022), VOSviewer (Van Eck & Waltman, 2010) and R-studio Bibliometrix (Aria & Cuccurullo, 2017). These analytical techniques were then employed for this study based on their relevance in visualising data and their specific features. These assist to conduct the present study, which gives the authors key insights into publications in this field.

This study focuses on performance analysis and science mapping techniques to analyse bibliographic data. Performance analysis was conducted to identify the total number of publications and to identify the citation score (i.e. total number of citations) per publication. Similarly, science mapping was used as keyword co-occurrence analysis to determine the main themes, trending topics and intellectual structure of a research field by analysing how frequently keywords appear together in academic publications.

3. Results

This section describes a comprehensive analysis of bibliometric data and discusses descriptive characteristics, publication trends, source productivity, the most globally cited documents, and thematic evaluation, stressing trending topics.

3.1. Descriptive characteristics of data

The literature analysed in this study covers a time span from 2010 to 2025, drawing from 60 sources. As shown in Figure 2, 4,979 cited references supported the foundation of the analysis, showing broad engagement. The literature articles analysed are relatively new, and these show an average document age of 4.96. The high scholarly level of literature articles is proven by an average of 49.7 citations per document, carrying much weight in the study. Keyword analysis represents a large variety, with 375 author's keywords and 412 keywords discovered, which span a wide scope.

3.2. Publication trends

In 2010, a strong initial output is markedly evident. During the period 2012–2014, although with a decline, it potentially indicates a consolidation phase. During the 2016 to 2018 period, output remained relatively low but stable. In 2020, it emerged clearly as a peak year, with a high growth rate. Movements in the year 2020 suggest a response to emerging thematic importance, technological advancements, or critical events driving research activity within the field. According to the publication trends analysed in Figure 3, a dynamic growth



Figure 2. Descriptive characteristics of a dataset.

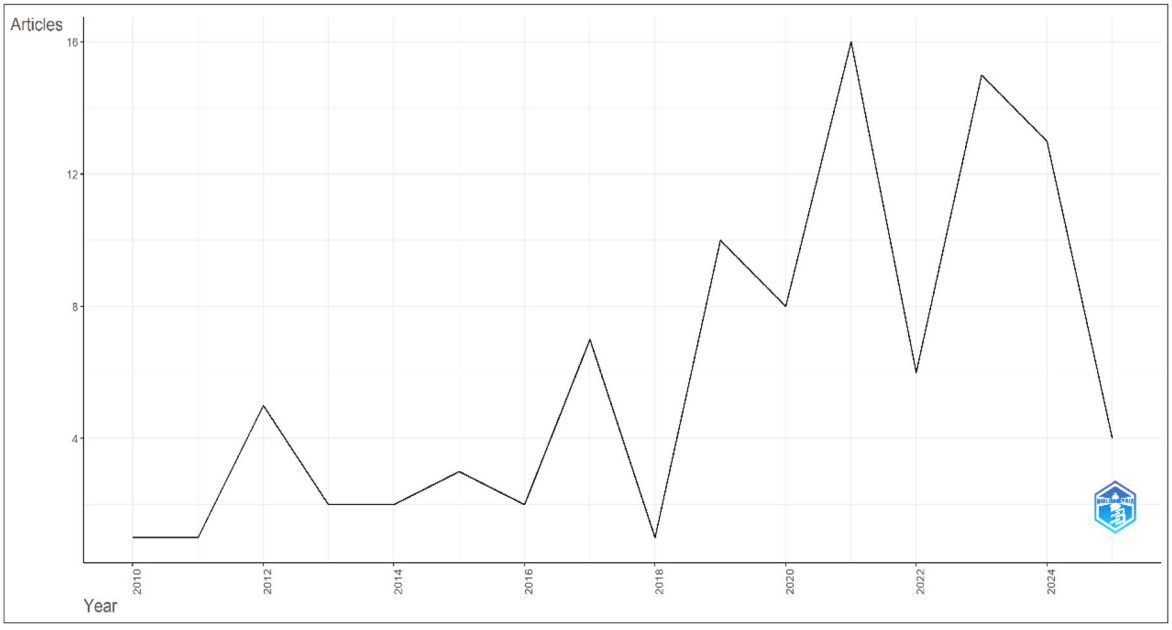


Figure 3. Annual scientific publication.

is evident from 2010 to 2024. Post-2018, publication trend shows much progress than in the past years, representing a 9.68% annual growth rate. This value is substantially higher than the average growth rate observed in many scientific disciplines, depicting a higher interest in the field of study. As per the average scientific production, the number of articles published during the 2020 and 2022 periods peaked, mainly due to the global pandemic of COVID-19. Likewise, the year 2021 recorded the highest number of publications, with 16 articles published during the year, with 15 in 2023. Existing studies have focused on developing countries in Africa, as ports in these nations confront major challenges such as infrastructural barriers, congestion and customs-related issues. A remarkable growth is seen in studies focusing on ports in emerging countries such as India, China and Singapore, showing that ports in these fast-growing economies still face bottlenecks.

3.3. Influential journal analysis

Figure 4 below shows the top 10 journals in the field of study. The statistics of 60 sources, which published 96 papers, provide valuable insights into the field of study. However, the given data does not allow for extracting those publications from the top journals' unique identities. It shows an average of 1.6 documents per source, indicating that information transmission is distributed fairly among a range of sources.

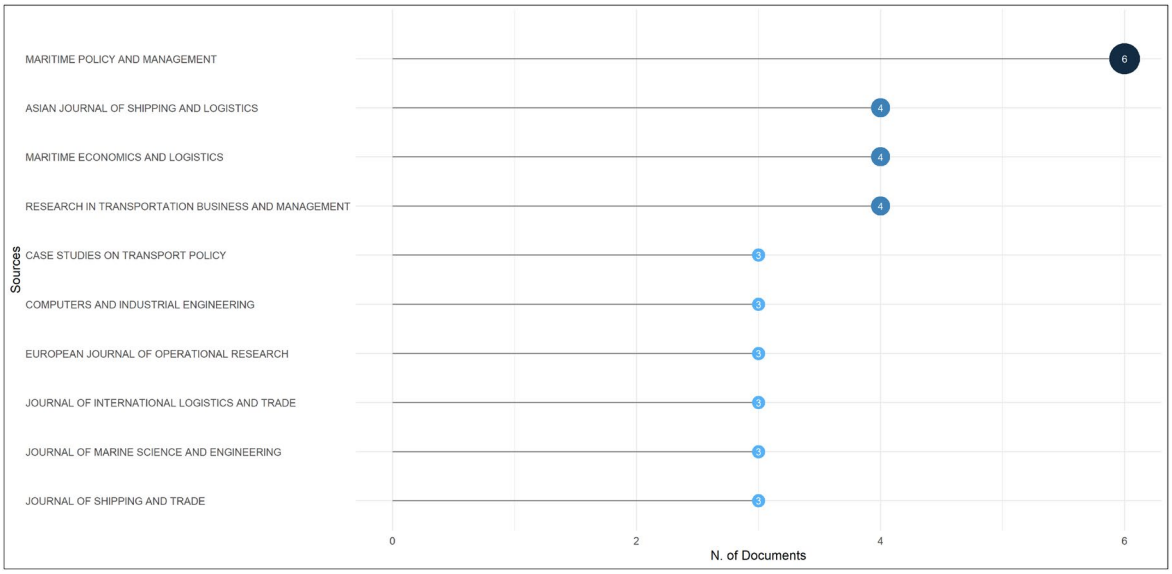


Figure 4. Most relevant sources.

Table 2. Top 10 most cited articles.

Authors	Title	Total citations	Citation rate per year
(Bierwirth & Meisel, 2010)	A survey of berth allocation and quay crane scheduling problems in container terminals	726	48.40
(Notteboom et al., 2021)	Disruptions and resilience in global container shipping and ports: the COVID-19 pandemic versus the 2008–2009 financial crisis	310	77.50
(Munim et al., 2020)	Big data and artificial intelligence in the maritime industry: a bibliometric review and future research directions	263	52.60
(Heilig et al., 2017)	Digital transformation in maritime ports: analysis and a game theoretic framework	189	23.63
(De La Peña Zarzuelo et al., 2020)	Industry 4.0 in the port and maritime industry: A literature review	183	36.60
(Chen et al., 2013)	Managing truck arrivals with time windows to alleviate gate congestion at container terminals	171	14.25
(Tijan et al., 2021)	Digital transformation in the maritime transport sector	158	39.50
(Verschuur et al., 2020)	Port disruptions due to natural disasters: Insights into port and logistics resilience	155	31.00
(Fruth & Teuteberg, 2017)	Digitisation in maritime logistics—What is there and what is missing?	136	17.00
(Zhen et al., 2017)	Daily berth planning in a tidal port with channel flow control	130	16.25

Source: Authors' compilation.

Among the top 10 journals, the Maritime Policy and Management journal is the most prominent journal with 6 articles published during the period, while the Asian Journal of Shipping and Logistics and Research in Transportation Business & Management are journals that published 4 articles each.

3.4. Most cited article analysis

According to the articles analysed, Table 2 shows the total number of citations and the average number of citations in all databases, respectively. The period between 2010 and 2021 was when the most cited articles were published. The most cited publications were conducted by Bierwirth and Meisel (2010), with 726 citations and 48.4 citations per year, published in the *European Journal of Operational Research*. The second most cited study was conducted by Munim Z.H. in (2020). This article has a citation score of 263, with an annual citation of 52.6, and has been published in the *Journal of Maritime Economics and Logistics*. Details about the other most-cited articles are presented in Table 2.

3.5. The most productive author affiliations

Figure 5 analyses the top 10 most productive author affiliations within the domain. This analysis can assist researchers who seek collaboration in the domain of Maritime port challenges to determine the

most productive author affiliations. Figure 5 depicts that, Nanyang Technological University of Singapore is the most productive institution, with nine publications, followed by the National University of Singapore, RMIT University, University of Malaysia Terengganu, University of Antwerp, University of Petroleum and Energy Studies, and University of Tasmania with seven publications each. Dalian Maritime University, Shanghai Maritime University, and Shanghai University represent 18 articles, with six articles from each university. These three universities represent China.

3.6. Research region analysis

This subject has attracted the interest of scholars from 28 countries and regions. As shown in Figure 6, scholars from China, India, Singapore and Germany are dominant, with 45.15%, 26.9%, 21.7% and 18.6% publication frequency, respectively. The pie chart displays the highest percentages of scholarly contributions by other countries in the regional analysis.

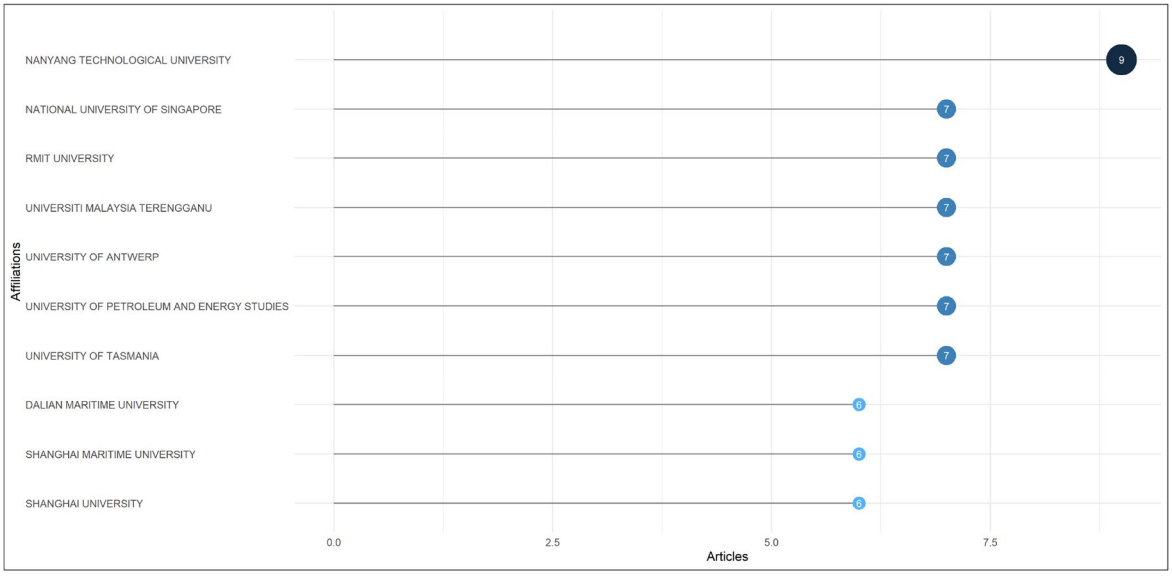


Figure 5. Most relevant affiliations.

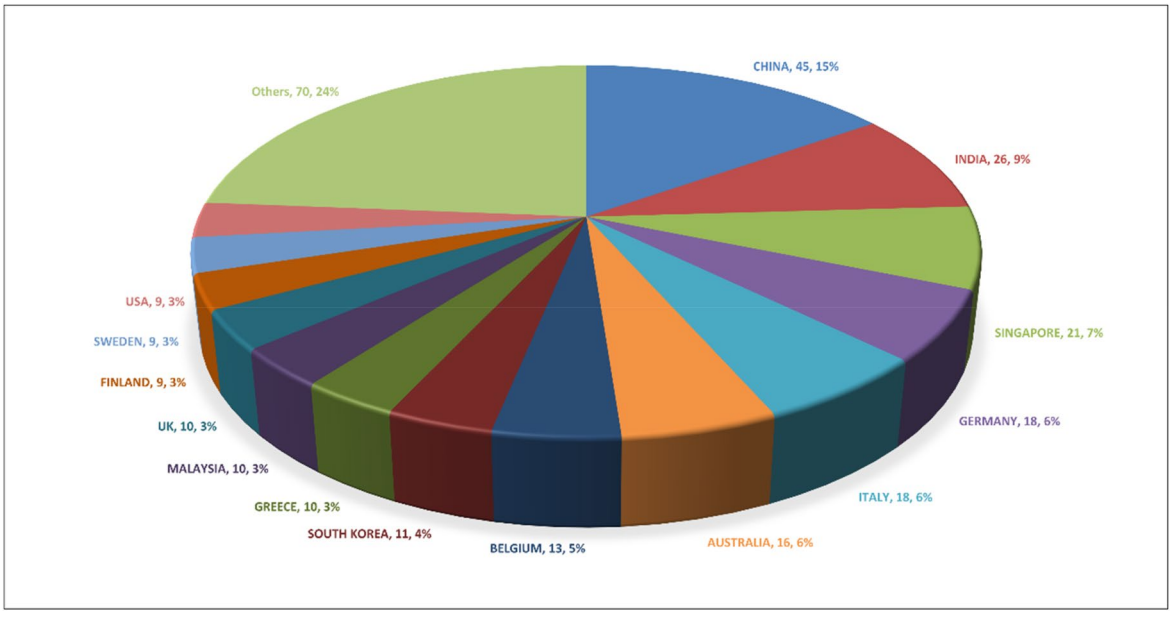


Figure 6. Distribution of research regions.

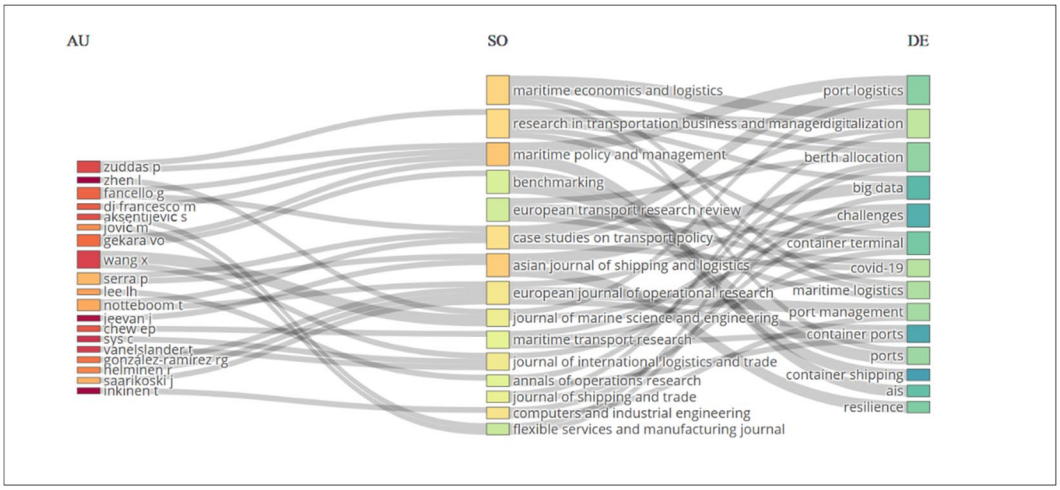


Figure 7. Sankey diagram.

3.7. Three-field plot

The three-field plot is presented as a Sankey diagram. Figure 7 provides a comprehensive view of the interconnection between productive authors (AU), the most relevant sources (SO), and frequent author keywords (DE). This plot is helpful in visually depicting the distribution of publication output, research contributions and publication impact within a specific field of study. The top 25 researchers in the field are shown, together with their most prominent keywords and the top 15 journals in which they publish their work. The three-field plot illustrates that the leading authors have made a substantial input to the field, regularly publishing in prominent journals such as Maritime Economics and Logistics, Research in Transportation Business and Management, and Maritime Policy and Management. These authors commonly explore topics such as port logistics, digitalisation, berth allocation and challenges. This visualisation spotlights the dominant trends and emerging issues within maritime and port-related studies, unveiling some insights about the dynamics of the selected sphere of research. Additionally, it is noteworthy that while the studies discussing challenges were embedded in the study, the author keywords in most articles included general keywords such as 'port logistics', 'container terminal', 'maritime logistics' and 'port management'.

3.8. Keyword co-occurrence network analysis

Tetteh et al. (2024) argued that the keyword co-occurrence map can identify the key terms and trends in literature. The keyword co-occurrence network visualisation, depicted in Figure 8, was developed using VOSviewer to highlight author keywords with a minimum of two occurrences across the dataset. The size of the nodes shown in the network is proportional to the frequency of the keyword occurrences. Larger nodes are denoted by the keywords that have the highest frequency. The line thickness connecting the nodes denotes the strength of the relationship between keywords. The map shows six clusters of keywords, where each colour represents a different cluster. The map reveals prominent keywords, such as 'port operation', 'containers', 'maritime transportation', and 'port terminals', that have the highest frequency. These central keywords serve as foundational elements for more specific and in-depth research topics, such as 'operational performance', 'port efficiency', 'port management', and 'challenges' that branch out from these. These terms reveal deeper research concepts and trends within this domain. Moreover, keywords such as 'port congestion, 'natural disasters', digitalisation', and 'berth allocation' highlight frequent author keywords. This illustration visualises the current trends in research, emphasising issues related to congestion, digitalisation, the pandemic, and scheduling constraints.

3.9. Thematic evaluation

The application of thematic mapping provides a means of understanding how different themes spread within a designated area of research. Figure 9 depicts the thematic mapping of literature related to operational challenges in maritime ports.

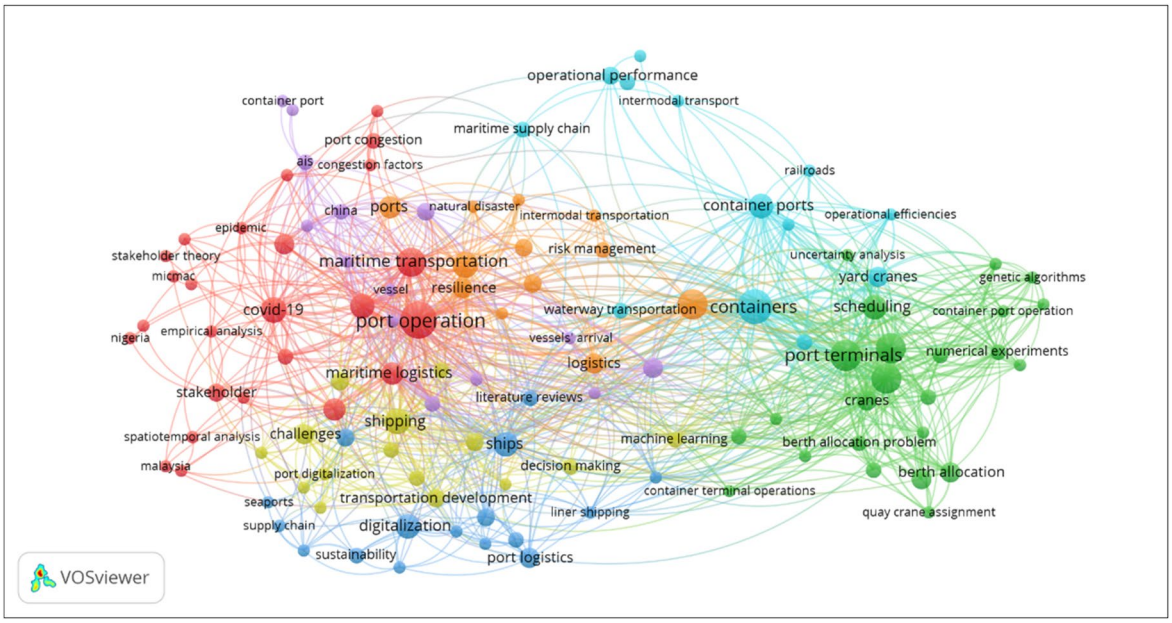


Figure 8. Keyword co-occurrence network analysis.

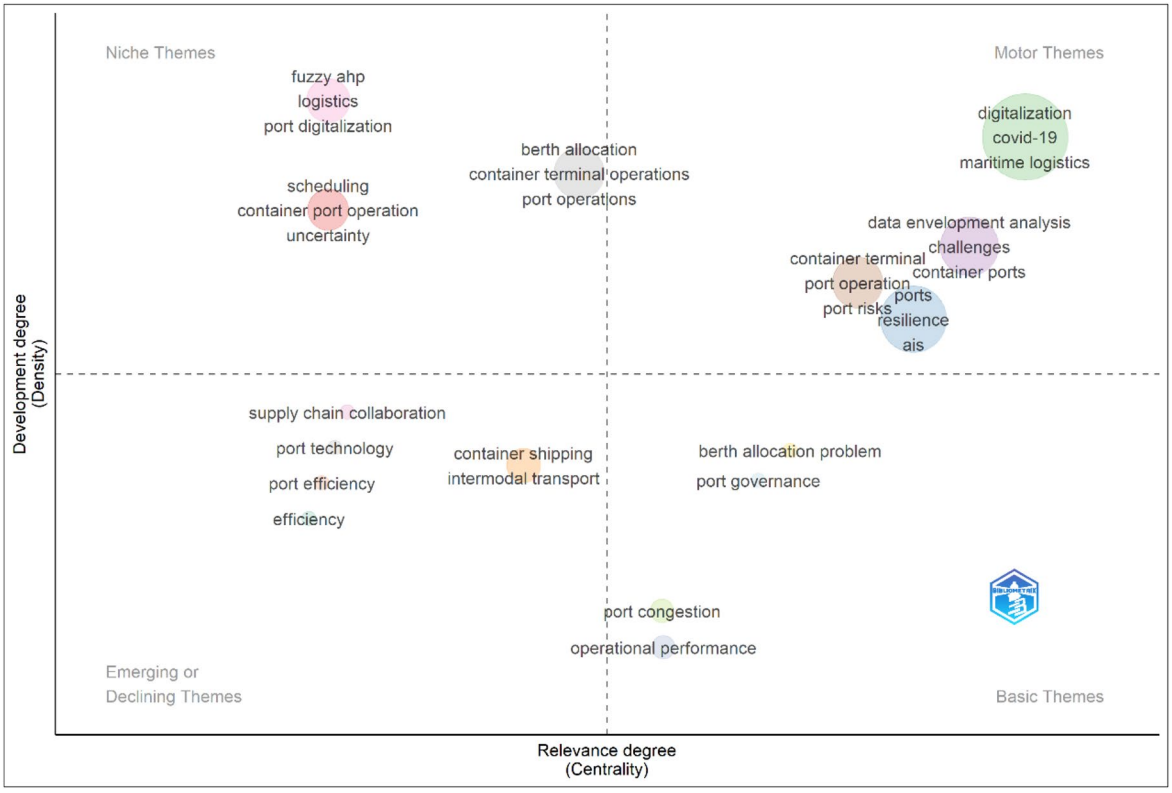


Figure 9. Thematic map of operational port challenges.

The thematic evaluation of research relating to challenges in maritime ports, as analysed through the Scopus database using Biblioshiny, reveals key trends over time. We used a thematic map to identify the trends in the publishing activities, where the thematic map visually organises the themes in four quadrants based on centrality (which measures the level of importance) and density (which measures the level of progress).

The first quadrant encompasses what is referred to as 'motor themes'. Themes in this quadrant are more central and highly developed within the domain of maritime port challenges. Themes, such as

digitalisation, COVID-19 maritime logistics, challenges, port risks, port operations and data envelopment analysis emerged as the most relevant themes in contemporary port studies.

The second quadrant represents the themes that are of high centrality and low density, which are referred to as 'basic themes'. Basic themes include operational performance, port congestion, Berth allocation problems, and port governance, which are central, yet underdeveloped. This emphasises the fundamental and emerging concepts that require further empirical and theoretical research. Additionally, these themes reflect both operational and institutional challenges that directly impact port performance.

The third quadrant is highly known as the 'niche themes'. Themes recorded here are considered to have a high density but a low relevance. These are the themes that have been widely explored but have a widespread centrality in the field. Themes such as Fuzzy AHP and port digitalisation, scheduling and uncertainty are more developed themes that are specialised topics.

The emerging or declining themes encompass topics such as supply chain collaboration, port technology, and intermodal transport. These represent the fastest-growing topics or once prominent topics now declining in growth. Overall, a rise is evident in the use of a few analytical tools, such as data envelopment analysis and fuzzy AHP.

It is essential to recognise the emergence of themes representing analytical methodologies such as data envelopment analysis and fuzzy AHP, while these keywords are not directly related to challenges contributing to operational performance. The keywords used in the inclusion criteria were strictly adhered to in selecting the documents for the analysis. However, the thematic maps were developed based on the author keywords, where the above-mentioned themes reflecting the analytical techniques were often used as keywords by authors. Hence, these were not deliberately included as answers for the study's research questions. Finally, the tree map presented reflects the evolving landscape of maritime research, which helps to position the current and future themes in this domain.

3.10. Tree map analysis

A tree map shown in Figure 10 was generated using NVivo version 15 to represent the distribution and relative weights of the major challenges derived from coding 96 full-text articles on maritime port challenges. Each rectangle on the tree map represents a thematic code, and the size of the rectangle indicates the number of coding preferences in terms of respective themes.

The larger blocks represent the themes that were frequently discussed in existing literature. The most prominent themes identified were planning & scheduling, labour issues, inadequate infrastructure, digital transformation and congestion & evacuation issues. Among these challenges, planning & scheduling emerged as the most dominant theme, reflecting a strong emphasis on critical issues like berth

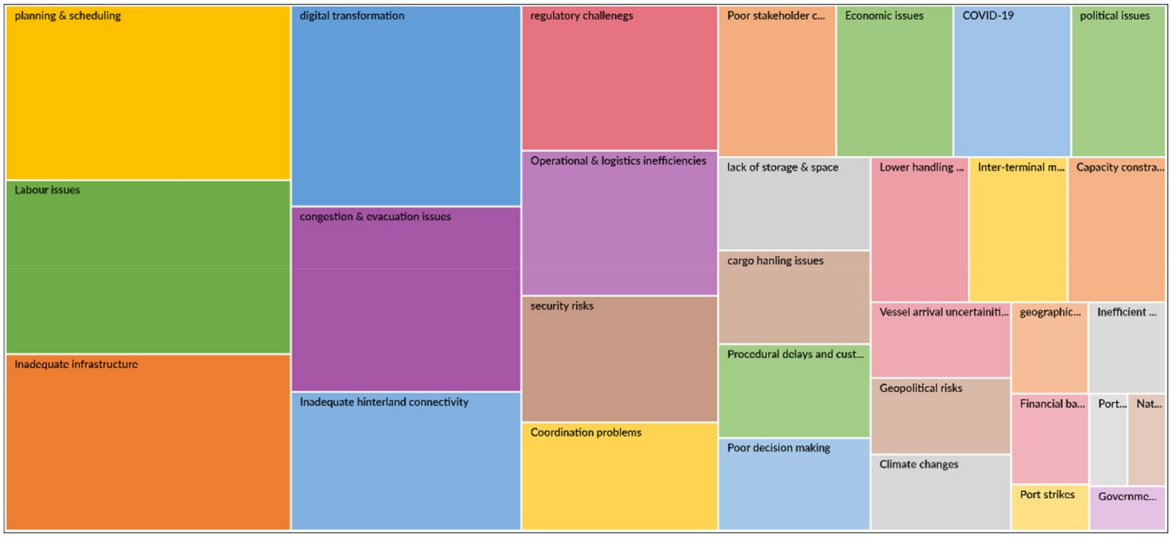


Figure 10. Tree map comparing the items coded.

allocation, quay crane scheduling, and yard operations management. Congestion & evacuation challenges also emerged as a prominent theme, emphasising continuous setbacks in managing high container volumes and coordinating hinterland transport flows.

Infrastructure limitations appeared as another critical theme discussed in many studies, especially relating to developing nations, where capacity constraints and outdated equipment lead to operational inefficiencies. Digital transformation was another substantial theme, demonstrating the field's growth of adapting technologies such as port community systems, automation and analytics. Labour-related issues, including workforce shortages, labour strikes and disputes, resistance to change, and skill gaps, emerged as another frequently coded challenge.

All things considered, this visualisation offers a hierarchical perspective of the most discussed operational constraints. These findings align with the patterns observed in the keyword co-occurrence analysis (Figure 8) and the thematic map (Figure 9) generating similar trends and themes.

4. Conclusion and implications

As mentioned at the onset, maritime ports are crucial in facilitating global trade; however, many ports worldwide grapple with challenges and barriers that impact their operations. This bibliometric and systematic exploration of this subject offers a comprehensive perspective and reveals shifts in trajectories.

This review paper examines 96 publications on maritime port challenges published between 2010 and early 2025. This review spotlighted the major challenges affecting container port operations, with one of the most notable findings being that while ports in developing countries face major issues, ports in developed countries also encounter several factors that impede their operations. However, it is reasonable to assume that the intensity of the issues encountered by developing nations can be far more complex than those faced by developed nations. On top of this, Sri Lanka, being a developing nation, some findings can be largely relevant in this given context, which again confirms the validity of this bibliometric review. The study of challenges in maritime ports has seen a marked growth, particularly in the post-pandemic era, as researchers understand the evolving dynamics of digitalisation, the pandemic, congestion and berth allocation challenges. The thematic evolution of this research discipline shows a clear transition to topics such as COVID-19, digital transformation, berth allocation problem and congestion. Furthermore, the growing dominance of research in Asian and African countries such as India, Singapore, Malaysia and Nigeria reinforces the growing importance of ports in these regions in facilitating global trade. Challenges identified in economies like India and ports in Africa can be eye-openers in global port research, as insights from these emerging economies can direct policymakers in similar regions to devise strategic measures to overcome similar issues and improve resilience. Further, the present research, specifically centred among Asia, highlights a research lacuna in terms of ports in regions like Latin America and those in small island countries, where challenges in these regions are underrepresented.

Notably, few studies (Svanberg et al., 2021; Verschuur et al., 2020) have focused on port disruptions and their cascading snowball effect on port performance, underscoring shifts in key trends in this domain in contemporary maritime research. This shift reflects the growing trend in research aligning with the complex demands of modern maritime logistics. Further studies have employed various analytical methodologies, such as data envelopment analysis, machine learning models, big data and other advanced methods to measure operational performance and identify various challenges and provide solutions. For example, (Nanyam & Kumar Jha, 2023) employed the interpretive structural modelling (ISM) technique as well as the cross-impact matrix multiplication (MICMAC) to identify the critical challenges affecting major ports in India. Consequently, (Figueiredo De Oliveira & Cariou, 2015) use data envelopment analysis (DEA) to identify the impact of competition on container inefficiency, and (Hu et al., 2024) identify berth allocation problems and propose a mixed-integer linear programming model for the problem.

Overall, the current study contributes fresh perspectives, new and authentic insights into the field of maritime and port management by identifying challenges to operational performance, mapping its growth and highlighting key players driving research. However, this study also underscores the need for

future research to explore how emerging challenges impact the operational performance of maritime ports and develop frameworks to minimise the negative impact on performance.

As maritime ports can be the lifeblood of a country's overall economic development, the findings of this study can be thought-provoking for policymakers, port authorities, and practitioners in navigating the complexities through action-based decision making. Recent studies spotlighting developing regions like Asia and Africa imply that ports in such regions are highly vulnerable to these challenges. Emerging themes reflecting barriers such as infrastructure, congestion, digitalisation planning issues and governance, can guide port authorities and stakeholders in the maritime sector in implementing strategic measures and investments in digital tools; it also offers insights about a multitude of frameworks to improve congestion, connectivity and reforms for governance and handle other institutional issues. By acting as a guideline to address prevalent constraints, the study can enhance the overall competitiveness of ports, which in turn can also enhance seaborne trade in these regions.

4.1. Limitations and future research

While this study provides a comprehensive analysis of research on maritime port challenges, it is not without its limitations. The reliance on Scopus as the only data source may include publication bias, as this database indexes high-impact journals, possibly excluding non-indexed journals, regional databases or maritime specialised journals. Additionally, this study only considers peer-reviewed journal articles, and this may overlook valuable insights from conference proceedings, industry reports and book chapters, which could provide valuable contributions to this study. This study is limited to articles published between 2010 and early 2025. While this time frame captures recent developments in research, particularly relating to scheduling, digitalisation and disruption, it may exclude the foundational studies that have shaped the long-term discussion into maritime port challenges. Another limitation is the heterogeneity of bibliometric methods. A multitude of studies included in the dataset may employ distinct frameworks and analytical approaches to identify challenges. Further, the selection of various keywords and classification criteria could affect the consistency in interpreting research themes, trends and significant contributions.

These limitations can be addressed in future research by expanding the range of databases to include a wide range of articles from regional and maritime-specific sources, providing a comprehensive overview. Additionally, expanding the range of document types other than Scopus journals (such as industry reports, blogs from maritime specialised sources) could provide a more diverse perspective of the challenges faced by maritime ports. To enrich findings, future research can redefine bibliometric analysis by employing multiple clustering techniques and sensitivity analysis that can mitigate methodology bias.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author, Herath H.M.R.P.

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