International Journal of Marine Engineering Innovation and Research, Vol. 10(3), Sept. 2025. 891-901
(pISSN: 2541-5972, eISSN: 2548-1479)

Bibliometric Analysis: Collaboration to Optimize Service Capacity to Inland Areas and Logistics Cost Efficiency Through Bundling Strategies and Inter-Port Cooperation

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(Received: 29 July 2025 / Revised: 25 August 2025 /Accepted: 26 August 2025 / Available Online: 22 September 2025)

***Abstract*— Optimizing logistics costs and service capacity is a critical focus in modern supply chain management, particularly for connecting ports to inland "hinterland" areas. This paper investigates how inter-port cooperation, strategic service bundling, and enhanced connectivity can improve logistics cost efficiency in these regions. The methodology combines an in-depth literature review with a bibliometric analysis using VOSviewer and Publish or Perish software. The literature review focuses on five key dimensions: hinterland connectivity, inter-port cooperation, cost efficiency, bundling strategies, and service improvement. The findings indicate that a strategic combination of inter-port collaboration and logistics service bundling significantly enhances logistics cost efficiency in the hinterland region. The bibliometric analysis also identifies key research clusters and highlights opportunities for future studies, particularly in under-researched regions like Indonesia, where green port implementation is underway. These findings have important implications for managers and policymakers in developing collaborative strategies to improve supply chain performance. The study concludes by proposing several hypotheses for future research concerning transportation costs, user priorities, and the performance of collaboration models.**

Keywords—bundling, cost efficiency, hinterland, inter-port cooperation, service capacity

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I. INTRODUCTION

Landlocked countries that rely on land transportation routes both use highways and railways. This is different from maritime countries or archipelagic countries that rely on sea transportation routes in carrying out economic activities, but in the reality of maritime countries also need land transportation routes so that goods or commodities can be delivered to consumers. The challenge of optimizing transportation networks connecting ports to inland areas is seldom discussed, in essence is to reduce transportation costs so as to create efficiency and increase competitiveness for producers. In addition to the cost factor, the speed of delivery is also a competitive factor. Thus, port connectivity, with inland areas and transportation facilities are the m[1]ain keys [1]. Failure to anticipate this has an impact on the welfare of the industrial world and affects the market structure, because this directly has implications for transportation costs [2]. Various scenarios in cost reduction have been implemented, the right scenario gives the lowest shipping cost especially looking at the total shipping cost first before combining it with the cost of land transportation [3] and this is a consideration for port authorities to reconfigure port infrastructure. After the problem from the port is resolved, then a new problem arises, namely congestion caused by port activities. Government intervention is required for more careful planning regarding the impact of port activities, because congestion has an impact on higher costs in transportation and port infrastructure investment in inland areas needs to be implemented [4]. Every country has the same problems regarding transportation at ports, the increasing volume of trade will cause various social problems such as traffic accidents, congestion, fuel consumption, and pollution emissions. Consequently, the establishment of an efficient, safe and environmentally friendly intermodal freight transportation system [5]. One form of efficient and safe transportation system is the use of containers and allows sea and land transportation modes to connect with each other more effectively [6]. Product standardization makes it easier to be accepted by consumers around the world, ship containers make ocean shipping easier, faster, and cheaper [7].

The improvement of port facilities and the development of transportation infrastructure have entered a new chapter, namely competition between ports that is increasingly real. The high level of competition among ports in the industrial area, causes each port to strive to retain its current customers and also attract new customers and investors, as well as maintain its position thus it is important to facilitate port accessibility to its interior. The country must also contribute greatly to improving inland port connectivity by building new roads and railways, as well as inter-port

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cooperation to improve port-to-inland connectivity [8]. With high spread and connectivity can contribute to the most cost-effective, environmentally friendly, and safe mode of transportation, the country's increasing demand for transportation by diverting more and more of its commodity movements to inland waters, the best way is the development of corridors to connect major sea ports to the main inland [9]. Port competitiveness lies in achieving regional accessibility in the distribution of goods and improving inland accessibility and intermodal efficiency. Containers are transported through a variety of transport nodes, with the infrastructure and large-capacity transport services required to help ports meet trade demand using containers. The connectivity of container ports with their inland areas including their concept and measurement has an impact on trade performance [10].

II. RESEARCH METHOD

This research employs a literature review approach to investigate strategic collaboration for optimizing service capacity to the hinterland and improving logistics cost efficiency through bundling strategies and inter-port cooperation. The methodology consists of three main stages: problem identification, data collection (literature review), and data processing (synthesis and analysis).

At the problem identification stage, the focus is on understanding the current challenges in optimizing logistics costs and increasing service capacity at ports and in the hinterland. This involves identifying existing conditions in the delivery of goods across various routes and with different modes of transport, aiming to pinpoint obstacles that hinder efficiency. The study specifically addresses the efficiency levels of different types of intermodal transportation in goods movement.

Data collection is primarily conducted through an in-depth literature review. This involves exploring related academic works, including economic analyses, public policy studies, case studies, and transportation theories. The literature review focuses on five key dimensions:
Hinterland: Reviewing concepts related to transportation and logistics connectivity, and their influence on goods distribution, regional economic growth, and infrastructure development.

Inter-port cooperation: Examining various forms of collaboration between ports, such as partnership agreements, strategic alliances, and cross-border initiatives involving logistics services and relevant stakeholders.

Cost efficiency: Studying factors that impact cost efficiency in transportation and logistics.

Bundling: Analyzing bundling practices within the transportation and logistics industry.

Service improvement: Exploring innovations in transportation and logistics services, including the application of information technology, speed, and timeliness in goods delivery.

The data processing stage involves synthesizing and analyzing the findings from the literature. This includes identifying existing conditions, analyzing those conditions in the context of the five dimensions, analyzing alternative strategies for goods delivery with new modes (such as inter-port collaboration and bundling), and ultimately aiming to minimize unit costs. The goal is to develop a collaborative model between adjacent ports that leads to efficient costs by combining hinterland-port connectivity with transport bundling. This is expected to optimize transportation routes from inter-port cooperation, and reduce the cost of goods flow from the port to the hinterland. This is expected to lower goods prices, which in turn would increase consumer demand and expand the port's market share.

This study employed bibliometric analysis. Bibliometric analysis is a research method used to analyze a collection of literature or references related to a specific topic[11]. In this study, data collection was conducted using the search term "strategic port collaboration" in the Harzing's Publish or Perish application, using a database consisting of international journals indexed by Google Scholar.

Data collection was conducted on July 17, 2025, obtaining 200 publications for analysis covering the last 10 years, from 2015 to 2025. The data was then analyzed using VOS Viewer to create a visual data mapping of research related to strategic port collaboration.

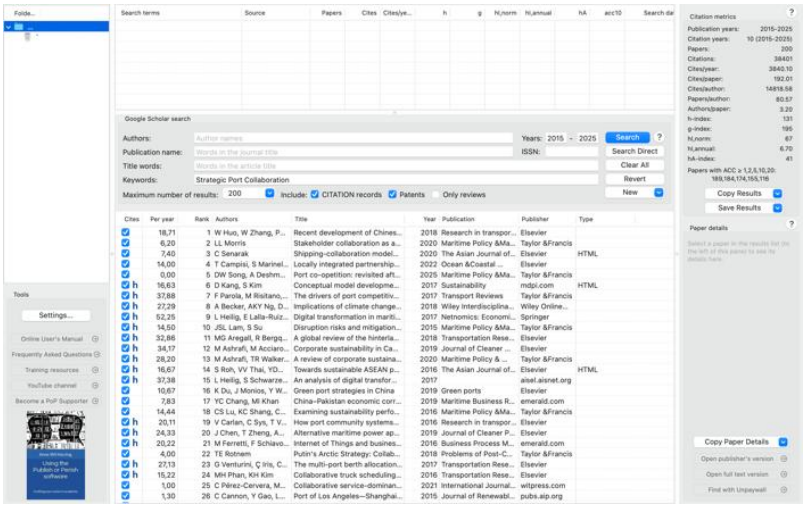

Figure. 1. Data Collection VOS Viewer

This research commenced with the data acquisition phase, wherein the Google Scholar database was queried using Publish or Perish (PoP) software with the search term "strategic port collaboration". This process retrieved a population of 200 articles. The resulting dataset was exported in two formats: Microsoft Excel for subsequent data processing and the RIS format for analysis in VOSviewer. VOSviewer, a tool for constructing and visualizing bibliometric networks, will be utilized to map international scientific publication trends related to the core keyword.

III. ANALYSIS AND DISCUSSION

The central finding of this study is that the integration of inter-port cooperation with a bundling strategy presents a powerful model for enhancing logistics cost efficiency and improving service to hinterland regions. This conclusion is supported by both established economic theory and the novel bibliometric analysis conducted.

A. Port

A port is a geographical location where cargo undergoes a change in mode of transportation, one of which is a ship as a resource that provides access to the world market [12]. Ports are characterized as a gathering place for the activities of port authorities, customs, depot operators, warehouses and transportation services as a third party including railway companies, shipping companies, truck companies, freight forwarding companies and freight forwarding agents [13]. Ports were originally just destinations starting to develop into nodes in the global supply chain Thus, sea ports have become an important link in the global supply network, and their success is inseparable from the success of the supply chain in which they are located [14]. The introduction of containers has resulted in the growth of hinterland areas that were initially closed to flourishing, in the continuation of which hinterland areas become competitive with other regions, thus expanding the influence of ports [15].

B. Collaboration Between Ports

Collaboration between ports can be interpreted as an effort to cooperate between ports to achieve common goals so that it can increase the efficiency and operational effectiveness of each port. In this collaboration, the ports will work together in various aspects, including information exchange, shared resource use, joint infrastructure development, and improved logistics services. Collaboration between ports can optimize routes and fleet placement for all networks used. Determining the shipping route from one point to another is the most economical and efficient mode for the flow of goods between ports as well as on port routes to the area farthest from the port [16].

Collaboration between ports is a relationship between two or more ports with compatible interests or objectives and is expected to provide mutual benefits. This collaboration is not only for the benefit of the two ports that work together, but also provides prosperity for the community. This means that collaboration between ports has an impact on economic development, as well as business sustainability. Cooperation between ports is not an end in itself, but a means to achieve certain goals, namely in the form of increasing profits from a business perspective and regional economic development [17]. There are many benefits of collaboration between ports when starting to work together, namely optimizing the global supply chain, increasing port capacity, reducing operational costs, and increasing port competitiveness in international trade. In the context of a growing global economy, collaboration between ports is important to improve connectivity and efficiency in managing the flow of goods [18].

The hinterland area is one of the main aspects to analyze the market area. The main key is the most efficient cost of shipping goods, so it must be thought about how to integrate well between container ports and existing transportation chains in the inland area (hinterland), this has an impact on increasing the competitiveness of the port [19].

Transportation connectivity in the hinterland region is the second most important factor driving the competitiveness of the port after the port fee. The concept of a port-hinterland has evolved over time, as a result of changes in trade and transportation. This is a challenge for regions to design more informative and effective regional development. The development of containerization of cargo significantly changed the network of ports-hinterland, and continues to the present day by examining the contemporary relationship between ports-hinterland. The latter has prompted a transition from a distance approach to a more functional approach to port-hinterland analysis, where the role of distance remains valid but is assessed differently and in a broader context, where a number of additional parameters are also considered. This parameter is related to the dynamics of the hinterland network which now plays an important role along with the collaboration of each port. This approach leverages expanded and regional network upgrades, in order to evaluate the on-time delivery that is the impact of new trends and trading models. Market development and adoption of innovative technologies, which are now happening much faster than ever [20].

The increase in port competitiveness also depends on the type of commodity that is often produced in the hinterland area and the consumption needs in the hinterland area. So that the type of cargo handled by the port and the readiness of the port in carrying out the loading and unloading of these commodities will attract port service users. Bulk commodities and containers have different types of loading and unloading treatments, the technology used in the port and the available transportation structure as well as the transportation policy have an impact on the activities carried out at the port, the business cycle that depends on the season determines the loading and unloading behavior at the port [21]. Thus, port collaboration to increase competitiveness and expand services in the hinterland area needs to consider the above factors, including the type of commodity, business cycle, technology used, transportation structure and policies enacted in the port.

C. Port-Hinterland Connectivity

Hinterland connectivity refers to the level of connectivity and accessibility between a port or trade center and the associated hinterland area. It includes transportation infrastructure, road networks, rails, waterways, and logistics services that connect ports with hinterland regions. Port hinterland refers to the region or area that depends on the port as the main gateway to send or receive goods from foreign ports. It involves export and import activities as well as the distribution of goods to and from the region [22].

Hinterland accessibility describes the level of ease and speed of access to and from ports to the hinterland region. It involves efficient transportation connectivity, including a network of roads, rails, waterways, and logistics facilities that allow for a smooth flow of goods between ports and hinterland regions. Hinterland transportation infrastructure includes a network of roads, rail systems, waterways, and transport terminals that support connectivity between ports and hinterland areas. It includes the construction, maintenance, and development of physical infrastructure that enables the efficient movement of goods and people between ports and hinterlands. Multimodal connectivity refers to the integration of various modes of transportation such as roads, rails, and waterways in an interconnected transportation system. It aims to improve the efficiency and performance of connectivity between the port and the hinterland region by optimizing the utilization of different modes of transportation.

Connectivity theory provides a framework for understanding the relationship between location, transportation networks, and accessibility. This theory involves understanding how transportation infrastructure and networks affect connectivity between economic centers and hinterland regions. In some cases related to hinterland connectivity, the significant growth in transhipment at ports results from infrastructure development, especially from improved hinterland connectivity. Hinterland connectivity is very minimal, causing many companies to use alternative port services that are more intertwined with hinterland connectivity. However, with road investments, the travel time between the port and the hinterland is shorter. In addition, the development of railway lines and the increase in the number of intermodal container terminals in hinterland also increase accessibility to the port. Rail transportation is essential to maintain the competitiveness of ports in times of cutting-edge industrial change, increasing the role of economies of scale in shipping[23].

The importance of hinterland connections for competitiveness and port development, this requires coordination between stakeholders who were previously less productive in developing hinterland connections with ports. Therefore, it is necessary to make a strategy to obtain a connection from the port of hinterland in a way that facilitates the flow of containers or the flow of goods directly. The success of a collaborative governance system between stakeholders, public investment, and the ability to meet the expectations of hinterland connection users will reduce technical bottlenecks[24].

D. Pricing and Bundling Strategy

Pricing in the transportation chain shows the extent of the competitive conditions that exist in the region's market. Thus, the cost of each supply chain will have an impact on the price of products offered to consumers. Transportation costs to trade barriers include the distance traveled from the port to the inland area, containers, export volume, and the level of port efficiency are determining factors in transportation costs. Port efficiency is not only on infrastructure, but also affected by applicable regulations [25]. However, points as transportation costs sometimes do not apply in general and become non-transparent depending on the determination of costs that are set by competitors, this means that shipping companies do not always provide clear information, only price is linked to competitors. This competition leads to price wars, which is a phenomenon of market competition and has a bad impact on companies [26].

The pricing of shipping companies is influenced by 2 (two) things, namely port of call pricing and handling pricing. Port of call pricing costs include tonnage dues, mooring dues, sea pilotage, river pilotage, dock pilotage, river tugboat, port tugboat, berthing/unberthing, ship reporting, waste reception facilities, bunkering, supplies. Meanwhile, handling pricing costs include cargo handling on quay, transport to/from storage, handling of empty boxes [27]. Additional costs, beyond the two categories mentioned above, include shipping costs both using railways and highways, warehousing fees, container rental costs.

The large number of costs that must be borne by the shipping company is a burden on the price of products that utilize the services of the shipping company as well as land transportation and warehousing companies. Therefore, a bundling strategy can be used to reduce these costs and achieve efficiency. The bundling strategy is a strategy that utilizes the sale of 2 (two) or more product services so that it is made into 1 (one) package at one cheaper price when compared to purchasing one product service at a time [28]. The bundling strategy directly implies higher profits for consumers, because in bundling the price is lower in one package compared to sales and this creates a positive dependence of consumers on the products offered [29].

The Bundling strategy, which aims to optimize service capacity to hinterland so that logistics cost efficiency is achieved through cooperation between ports, can start from grouping transportation costs ranging from ports to inland areas. Then it was continued by recording the collectivity of services between ports so that they could be combined through inter-port cooperation. The mode of bundling transport or combined transportation is a mode of combining or combining several modes of transportation for several ports so that more efficient costs are obtained. When port A and port B, each manage their own modes of transportation, it will be different if the two work together in transportation management and generate lower costs. This can be seen in the following illustration [30].

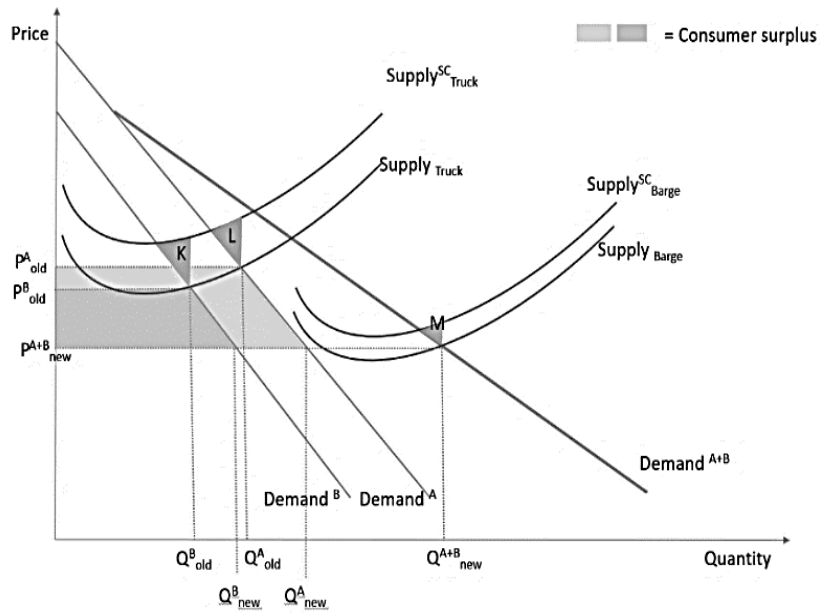

Figure. 2. Increase in the number of consumers in transport bundling

Theoretically, the model's strength lies in its ability to achieve economies of scale. As shown in the economic illustration (Figure 2), collaboration allows ports to consolidate cargo volumes, achieving the necessary scale to utilize more cost-effective transport modes like barges or rail instead of individual trucks. This consolidation, framed as a service "bundle," effectively lowers the overall supply curve, resulting in reduced prices and increased demand for transport services. This confirms that cooperation is not merely an operational tactic but a strategic tool for reshaping market dynamics.

The demand line A and the demand line B are lines that show the demand for transportation services at each port A and port B. The number or quantity of the demand increases when bundling is carried out as the Demand line A + B shifts to the right (x-axis) so that the quantity or number of requests increases and the cost (price) of the Y-axis decreases. This can be achieved if the two ports serving the same hinterland reach a sufficient volume of goods to carry out deliveries. The ultimate goal of this transportation consolidation is to lower the general cost represented on the supply curve for freight forwarders. The use of this combined mode of transportation requires a minimum volume that must be achieved in order for the cost (price) to be lowered. The use of the type of mode of transportation has an effect on the costs incurred. The cost of a truck will be higher than the cost of a barge/train. In the K and L shades, higher costs are obtained if the two port authorities only focus on their respective ports. But it will be cheaper if the two port authorities work together to create the right scenario in the cost of transporting goods on the M shade.

Calculation of the increase in the number of consumers who use the cooperation services of 2 ports in each port based on the following equation.

Increase in the number of consumers at port A

$$\left[(P^{A}_{old} + P^{A+B}_{New}) \times Q^{A}_{old}\right] + \left[(Q^{A}_{New} - Q^{A}_{old}) \times \frac{(P^{A}_{old} - P^{A}_{New})}{2}\right]$$

Increase in the number of consumers at port B

$$\left[(P^{B}_{old} + P^{A+B}_{New}) \times Q^{A}_{old}\right] + \left[(Q^{B}_{New} - Q^{B}_{old}) \times \frac{(P^{B}_{old} - P^{B}_{New})}{2}\right]$$

External costs are represented on the SC Supply curve, where these costs are added to the combined transportation costs, but the total value is still low when compared to the cost of land freight (trucks) at each port. Thus lower costs result in high demand. The next impact on hinterland is an increase in market share due to the ease of obtaining goods and cheaper prices. As a result, the value of cargo volume will increase at the two ports and increase the market share of the two ports because they have succeeded in reducing prices and accelerating the flow of goods.

E. Literature Review

This study follows the Systematic Literature Review (SLR) methodology which helps in reviewing the journals that will be used in this study. In the early stages of SLR, keyword identification was carried out in each study related to hinterland, ports, transportation costs, and connectivity [31]. The source of literature used is journals indexed by Scopus, and collected into 40 journals that have keywords related to this research that have a big impact and are printed in English. The application used to search for the 40 journals uses the Publish or Perish application, with a special filtering setting for the sources of journals indexed by Scopus. In the next stage, the convidence application was used to filter the literature starting from checking duplicates in the database and declaring that there were no duplicates in the 40 journals entered in the application. The next stage is filtering based on title and abstract. After screening titles and abstracts, 40 journals were obtained that passed as a whole [32].

In the next stage, a full text review or review of the entire content of the 40 journals reviewed. This stage is time-consuming, as it requires reading each journal individually and is assisted by include and exclude filtering. With this help, it can make it easier for researchers to quickly read what content is in each

journal and which parts can later be used as a reference for this research. The results of this full text review were obtained 31 journals related to the research to be conducted, and 9 journals did not meet the requirements, the cause was that 3 journals had different topics, 2 journals had inappropriate setting, 2 journals had results that were not related to the research to be conducted, and 2 journals used different study designs. The literature review process is shown in the following figure.

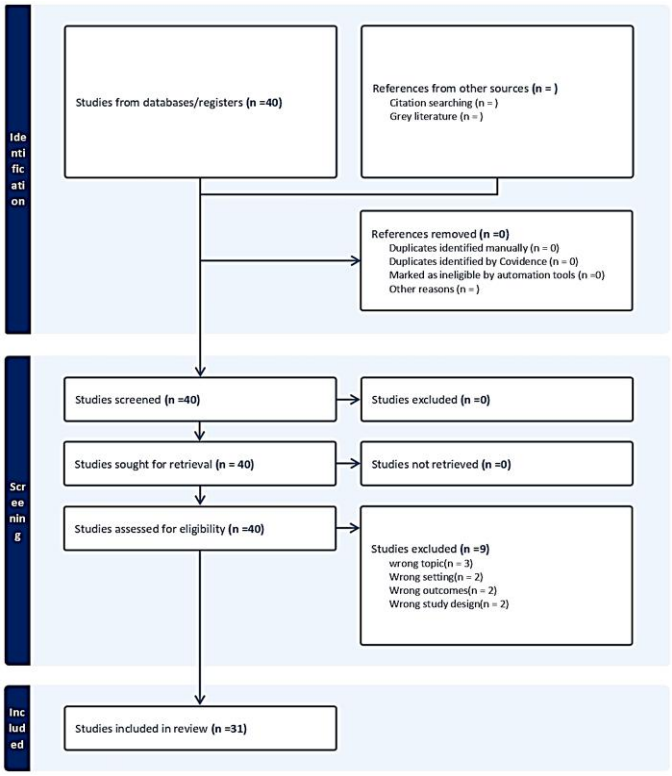

Figure. 3. Literature Review Flow

In the next stage, keyword analysis and ongoing research trends are carried out from year to year. The keywords obtained from each journal are the basis for the selection of the journals used. This analysis uses VOS viewer to spatially find out which research has keyword relationships and what clusters are formed in the keyword pool in the meta data. The following is the view of VOSviewer in this study [33].

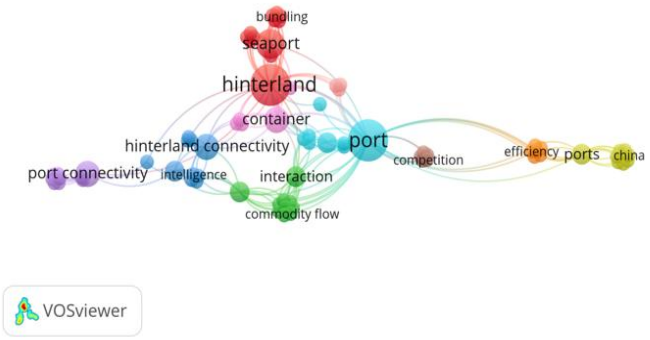

Figure. 4. Keyword Display in VOSviewer

Based on figure 3, keywords that are closely related to hinterland are obtained, namely seaport or port, bundling or joining and closely adjacent to the cargo. If the research trend is tracked from year to year, the following image is obtained (figure 4).

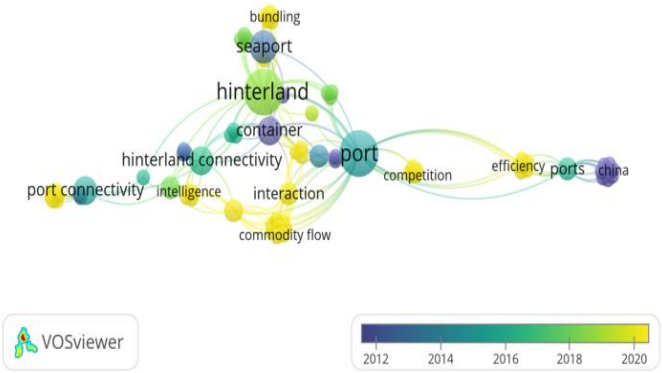

Figure. 5. Keyword Trends From 2012-2020

The most research conducted in recent years is related to the keywords bundling, competition, efficiency, commodity flow, port. Thus, the research that will be carried out related to hinterland – port, budling, efficiency, port collaboration and hinterland collaboration can still be said to be the latest research and follows the development of the times at this time.

The findings of this literature review research are in the form of a merger of 2 adjacent ports so that a collaboration model between ports is obtained to produce efficient costs. By combining hinterland port connectivity with transport bundling that facilitates port service providers (port authorities), it is expected to be able to determine the transportation route scenario from cooperation between ports, the flow of goods from the port to the hinterland area has a low cost. With low transportation costs, it will reduce the price of goods so that consumer demand will increase. With the increase in consumer demand, it will be able to increase the volume of goods passing through the port and increase the market share of the port itself.

F. Global Publication Trends

The data for this research was sourced from Google Scholar, an extensive database that provides unrestricted access to scientific publications from numerous national and international journals, thereby promoting swift knowledge dissemination. A systematic search was implemented based on the established research methodology, employing the keyword "green port" to identify a maximum of 200 relevant documents. This process yielded a final selection of 200 articles aligned with the study's thematic focus. The following section presents a detailed analysis of these articles published between 2015 and 2025.

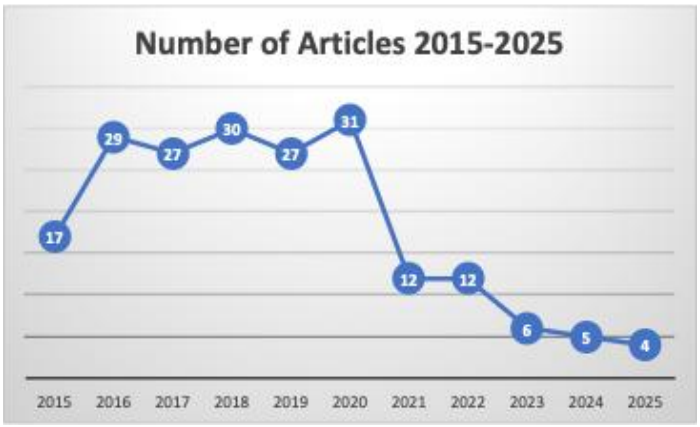

Figure. 6. Growth in the number of scientific publications per year

According to the figure, the number of article publications from 2015 to 2025 shows significant fluctuation. The publication count increased and remained high between 2016 and 2020, reaching its peak in 2020 with 31 articles. However, a very drastic decline occurred after 2020. The number of articles dropped sharply to 12 in 2021 and held steady at that number in 2022. This downward trend continued in subsequent years, with 6 articles in 2023, 5 in 2024, and 4 in 2025. Observing this annual trend leads to the conclusion that research interest in "green port" has declined drastically after reaching its 2020 peak.

G. Most Citations

Citation frequency is a widely accepted indicator of a scholarly article's impact and utility as a reference. Since publications indexed in Google Scholar are extensively referenced in academic literature, a high citation count signifies significant influence. Utilizing the Publish or Perish (PoP) software, our data query for the years 2015-2023 yielded a corpus of 131 articles, which have accumulated a total of 1,864 citations. A summary of the articles with the highest citation counts from this collection is presented in Table 1.

TABLE 1.
ARTICLE WITH THE MOST CITATIONS

No	Author Name	Article Title	Year	Publication	Number of Citations
1	Y Kang, J Hauswald, C Gao, A Rovinski...	Neurosurgeon: Collaborative intelligence between the cloud and mobile edge	2017	dl.acm.org	1678
2	K Emerson, T Nabatchi	Collaborative governance regimes	2015	books.google.com	1380
3	A Ajoudani, AM Zanchettin, S Ivaldi, A Albu-Schäffer...	Progress and prospects of the human–robot collaboration	2018	Springer	910
4	HO Al-Shamsi, W Alhazzani, A Alhuraiji...	A practical approach to the management of cancer patients during the novel coronavirus disease 2019 (COVID-19) pandemic: an international collaborative group	2020	academic.oup.com	840
5	RJ Garmston, BM Wellman	The adaptive school: A sourcebook for developing collaborative groups	2016	books.google.com	772

H. Mapping Using VOS Viewer

The database, stored in RIS format, was processed using VOSviewer software to conduct a bibliometric analysis. From the initial dataset, the software identified key terms based on their co-occurrence. By setting a minimum number of occurrences for the terms, a network visualization was generated, as shown in the figure below. The visualization maps the prominent keywords and their relationships within the research area of port management and sustainability.

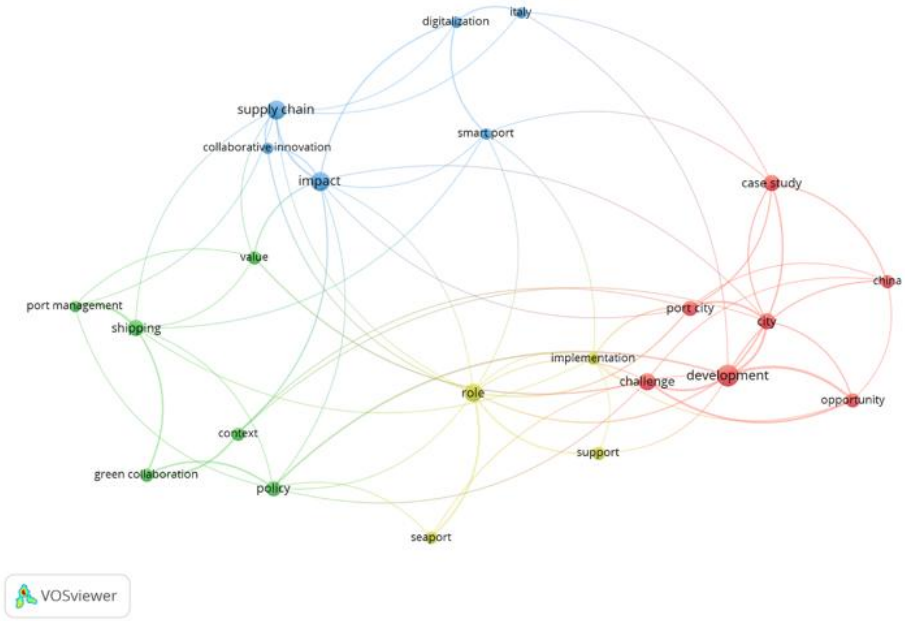

Figure. 7. Circles Network Visualization

The analysis of the network visualization from VOSviewer reveals 4 main clusters, each representing a distinct thematic area within the research:

1. Cluster 1 (Red): This cluster focuses on themes of regional development and strategic analysis. It consists of 6 terms: case study, area, risk, port city, development, and opportunity.
2. Cluster 2 (Green): This cluster relates to port governance and environmental strategy. It includes 5 terms: port management, shipping, context, green collaboration, and policy.
3. Cluster 3 (Blue): This cluster centers on digital transformation and supply chain innovation. It consists of 5 terms: digitalization, smart port, supply chain, collaborative innovation, and impact.
4. Cluster 4 (Yellow): This cluster deals with the practical aspects of implementation. It is composed of 4 main terms: role, implementation, challenge, and support.

The VOSviewer overlay visualization in the figure illustrates the evolution of research themes over time within the topic of Green Ports. According to the color bar at the bottom right, the analysis covers the period from 2018 to 2020. The colors indicate the average publication year for each keyword, with blue and purple representing older terms and bright yellow representing the most recent ones.

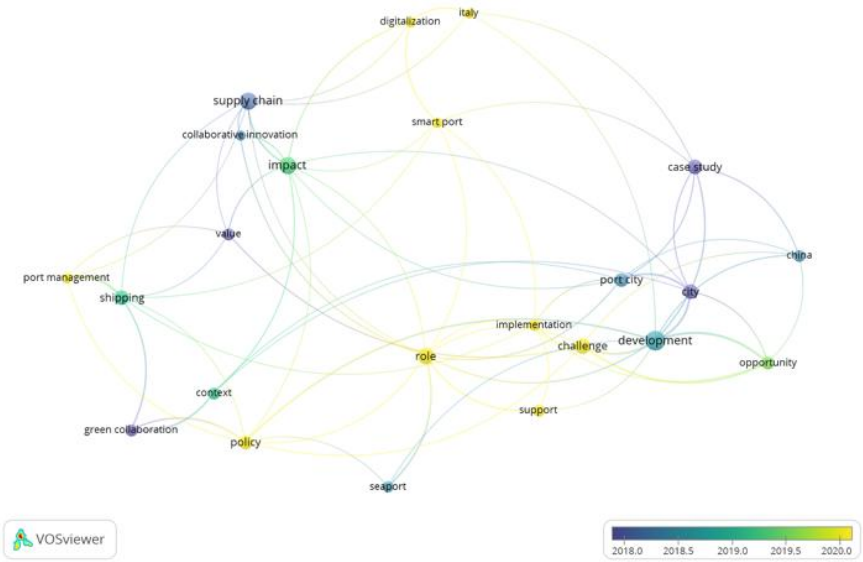

Figure. 8. Frames Overlay Visualization

In summary, the trend shows an evolution from foundational, regional studies toward a more modern focus on technology-driven solutions and collaborative implementation in the context of green ports.

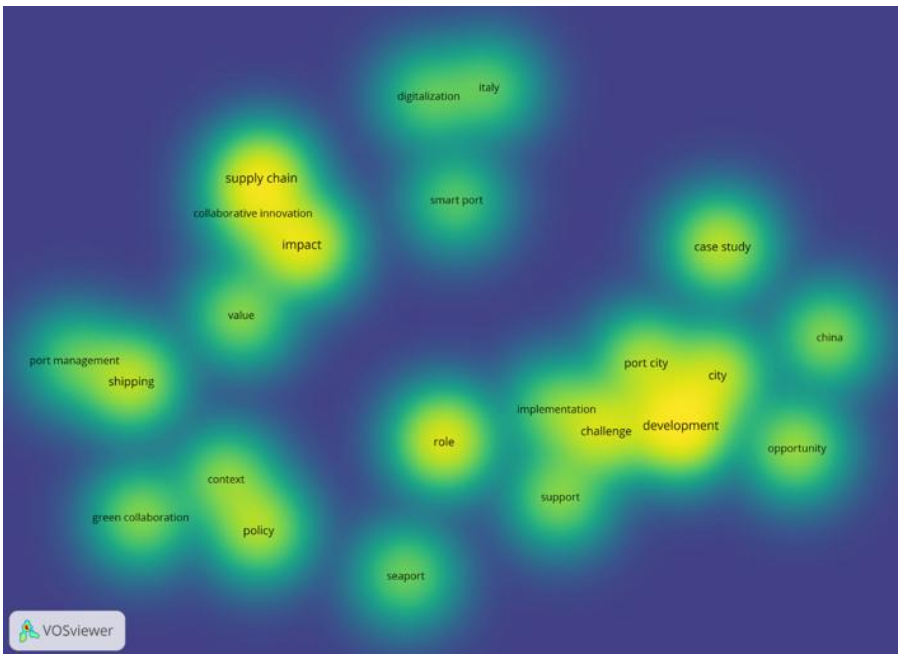

Figure. 9. Density Visualization

The Density Visualization from VOSviewer, shown in the figure, illustrates the concentration of research themes. The bright yellow areas, or 'hotspots,' indicate themes with a high density of related research, while the darker blue areas represent topics that are less frequently studied.

The analysis of the map reveals two main research hotspots. The first major concentration is around terms like development, port city, and challenge. The second prominent hotspot is centered on supply chain, collaborative innovation, and impact. This indicates that a significant amount of existing research has focused on these areas.

Conversely, themes with lower density, such as italy, china, and seaport, appear on the periphery of the map. These dimly colored areas represent less-explored niches within the literature and can be considered opportunities for future research.

Based on this analysis, while the field has heavily investigated port city development and supply chain innovation, there are still research gaps. For a country like Indonesia, which has begun implementing green ports but does not appear as a prominent research area in this map, this presents a significant opportunity. Conducting research on the specific implementation of green ports in Indonesia would address a key gap in the literature and evaluate the suitability of current practices. Beyond confirming this model, the novelty of this research lies in using bibliometric analysis to map the intellectual structure of this domain. The VOSviewer analysis (Figures 7-9) reveals that while research hotspots exist around "port city development" and

"supply chain innovation" , the direct linkage between bundling, inter-port cooperation, and hinterland is a more recent and less densely populated research theme. This highlights a significant gap between theoretical models of port collaboration and empirical research on their real-world implementation.

This gap is further underscored by the density visualization (Figure 9), which shows no major research hotspots for terms like "green collaboration" in specific geographical contexts. The absence of a country like Indonesia—a major maritime nation actively implementing green port policies—represents a critical opportunity. Future research focusing on the Indonesian case could provide essential empirical validation for the collaborative models discussed, evaluating their suitability and addressing a clear deficiency in the global academic literature. Therefore, this study's contribution is twofold: it reinforces the theoretical benefits of bundling and inter-port cooperation, and it uses bibliometric evidence to pinpoint specific, high-impact areas for future empirical investigation.

CONCLUSIONS

Cooperation between ports, logistics service bundling strategies, and improved infrastructure connectivity can significantly improve logistics cost efficiency in hinterland areas. So that policymakers are developing collaborative strategies to improve supply chain performance in hinterland areas. This study confirms that cooperation between ports, the implementation of bundling strategies, and improving infrastructure connectivity are key steps to improve logistics cost efficiency in the hinterland area.

In response to the research objective, this study concludes that inter-port cooperation, combined with strategic service bundling, is a highly effective approach to improving logistics cost efficiency for hinterland areas. By collaborating, ports can aggregate cargo, enabling the use of more economical and sustainable transport modes, which in turn lowers costs and stimulates demand.

The primary implication for policymakers and logistics managers is that strategic alliances between ports should be prioritized as a tool for enhancing regional competitiveness and supply chain performance. Furthermore, the bibliometric analysis identified several promising avenues for future research. This has led to the formulation of five key hypotheses centered on user perceptions, cost structures, and the development of effective collaboration models that can guide subsequent empirical studies.

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