

The Role of Maritime Transportation in Improving Logistics Efficiency and Regional Economic Competitiveness in Indonesia: A Literature Review

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ABSTRACT

Maritime transportation plays a strategic role in supporting trade, goods distribution, and economic connectivity in Indonesia as an archipelagic country. However, its economic effectiveness faces challenges related to port efficiency, transportation costs, interregional connectivity, infrastructure, technology, and human resource quality. This study analyzes the role of maritime transportation in supporting economic activities and identifies factors influencing the efficiency and competitiveness of Indonesian trade. Using a qualitative literature review, it examines academic articles, government publications, and reports from UNCTAD, the World Bank, OECD, and BPS. The findings indicate that port efficiency reduces logistics costs and improves distribution reliability, while effective maritime connectivity expands market access and promotes balanced regional economic development. Conversely, high transportation costs, infrastructure disparities, limited hinterland connectivity, and disruptions to global shipping networks undermine trade competitiveness. Digitalization and improved human resource quality support productivity and system resilience. The study concludes that strengthening maritime transportation economics requires an integrated approach involving improved port productivity, expanded connectivity, logistics cost control, digitalization, and enhanced human resource capacity.

Keywords: *Logistics Costs, Maritime Connectivity, Maritime Transportation Economics, Port Efficiency, Trade Competitiveness.*

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1. | INTRODUCTION

Maritime transportation is a strategic component of Indonesia's economic system because it connects production centers, industrial areas, ports, and markets distributed across numerous islands. As an archipelagic country, Indonesia relies heavily on maritime transportation to facilitate the movement of goods between regions and to support both domestic and international trade. Sea transportation is particularly important for inter-island distribution because it can move large volumes of goods at relatively reasonable costs, although achieving similar logistics performance across geographically distant regions remains challenging (Sunitiyoso et al., 2022). The availability of reliable maritime services therefore contributes to the continuity of economic activities and strengthens connections between production and consumption areas. In this context, maritime connectivity is increasingly recognized as an important determinant of economic development because stronger connections between ports and regional economies can improve access to wider markets (Li et al., 2023).

From the perspective of transport economics, however, the availability of infrastructure does not automatically generate optimal economic benefits. The effectiveness of a transportation system is also determined by operational and economic factors, including transportation costs, cargo handling processes, vessel service time, port productivity, and connections with inland transportation networks. Sunitiyoso et al. (2022) demonstrate that port performance in Indonesia is shaped by interactions among infrastructure, information and communication technology, service procedures, and human capital. These components influence the overall efficiency of the logistics system because maritime transportation involves not only the movement of goods by sea but also cargo handling and connections with inland destinations. When transportation operations are inefficient, additional logistics costs may emerge and reduce the competitiveness of businesses. Recent evidence also shows that increasing maritime transportation costs can affect international trade, import prices, and broader economic activity, particularly when economies have limited alternatives for transportation (Ferrari et al., 2023).

These issues are particularly important because the benefits generated by maritime transportation are not necessarily distributed evenly across regions. Differences in access to major ports, infrastructure capacity, shipping frequency, and the quality of distribution networks can create disparities in economic opportunities between regions. Maritime connectivity has been shown to have an important relationship with regional economic growth because stronger connections between ports, local economies, and global logistics networks can expand economic access (Li et al., 2023). At the port level, connectivity is also associated with operational efficiency. Tovar and Wall (2022) found a positive relationship between maritime connectivity and port efficiency, indicating that improvements in connectivity can contribute to better port performance. In the Indonesian context, this issue is particularly relevant because maritime logistics must serve geographically dispersed regions with different levels of infrastructure and

economic activity. Recent research on eastern Indonesia further indicates that increasing local economic activity can raise cargo throughput and contribute to reductions in sea transportation and maritime logistics costs (Amin et al., 2024).

In addition to transportation costs and connectivity, port efficiency needs to be understood from the perspectives of various stakeholders. Port performance that is considered efficient by operators does not necessarily generate the same benefits for service users and communities if service costs remain high or accessibility remains limited. Zhang et al. (2024), based on a review of 301 studies, emphasize that port efficiency encompasses technical, allocative, and economic dimensions and that efficiency may be interpreted differently by port authorities, operators, users, and the public. This suggests that port performance should not be evaluated solely through operational indicators but should also consider the broader economic implications of port services. Similarly, research on market access and seaport efficiency highlights the importance of considering the relationship between port performance and the connectivity of foreland and hinterland networks (Rødseth et al., 2023).

Based on these issues, this study aims to analyze the role of maritime transportation in improving logistics efficiency and regional economic competitiveness in Indonesia. The study specifically examines the relationship between port performance, distribution costs, maritime connectivity, and regional economic development. It also identifies structural barriers in the provision of maritime transportation and formulates policy implications for improving the efficiency of the maritime logistics system. This focus is supported by recent literature showing that maritime transportation performance is influenced by the interaction between infrastructure, port efficiency, connectivity, transportation costs, and institutional factors (Sunitiyoso et al., 2022; Zhang et al., 2024). Moreover, evidence from Indonesia indicates that maritime logistics costs and regional economic capacity are interconnected, particularly in geographically dispersed island regions (Amin et al., 2024). By examining these interconnected dimensions, the study seeks to provide a broader understanding of how improvements in maritime transportation can support more efficient logistics systems and strengthen regional economic competitiveness in Indonesia.

2. | LITERATURE REVIEW

Maritime transportation plays a strategic role in supporting regional economic development, particularly in archipelagic countries where economic activities are geographically dispersed. The connection between ports, local economies, and global logistics networks makes maritime transportation an important component of regional economic integration. Improvements in maritime connectivity can generate positive effects on regional economic growth, particularly when supported by adequate transport infrastructure and accessibility to markets (Li et al., 2023). This suggests that the economic role of maritime transportation extends beyond the physical movement of goods, as stronger shipping networks can improve the integration between regional production systems and wider markets.

Port performance is closely associated with logistics efficiency because the effectiveness of terminal operations influences cargo handling, vessel processing, service time, and transportation costs. Improvements in port infrastructure and operational capacity can contribute to greater efficiency, particularly when ports are able to utilize their physical resources effectively. Evidence from major Latin American ports shows that infrastructure and operational characteristics are important determinants of port efficiency (Miller & Hyodo, 2022; Shi et al., 2022). Port efficiency should therefore be understood not only in terms of infrastructure availability but also in terms of how effectively existing resources are utilized to support maritime services.

The assessment of port performance has also expanded beyond conventional operational indicators. Changes in shipping markets, vessel characteristics, carrier structures, and terminal operations can influence the efficiency of port and terminal activities. A study of global terminal operators demonstrates that differences in operational characteristics can produce variations in efficiency across terminal operators (Jeh et al., 2022; Wang et al., 2021). Therefore, evaluating port performance requires consideration of multiple operational dimensions rather than relying solely on cargo throughput or physical infrastructure. This broader perspective is important because efficient port operations can contribute to more reliable cargo movement and reduce inefficiencies throughout the maritime logistics chain.

Maritime connectivity also influences the ability of regional economies to access markets and participate in broader trade networks. Connectivity determines how effectively ports are linked with shipping routes and other transportation networks, thereby affecting the accessibility of goods and services across regions. Research on maritime connectivity indicates that improvements in shipping connections and transport infrastructure can support economic growth by facilitating greater access to markets and economic activities (Li et al., 2023). In addition, stronger maritime connections can contribute to more efficient port operations because connectivity and port performance are mutually related dimensions of maritime transportation.

Logistics costs represent another important dimension of regional economic competitiveness. The costs associated with maritime transportation extend beyond freight charges and may include vessel operations, port services, cargo handling, and other logistics-related activities. From a broader shipping perspective, the total cost structure is influenced by the interaction between vessels, ports, cargo operations, and supporting logistics services (Stavroulakis & Papadimitriou, 2022; Xiao et al., 2024). Consequently, improvements in one component of the maritime transportation system may not necessarily reduce total logistics costs if inefficiencies remain in other parts of the distribution chain.

Higher maritime transportation costs can also influence trade competitiveness by increasing the overall cost of moving goods between markets. Rising maritime transport costs may be transmitted through international trade networks and affect the prices and volume of traded goods. Empirical evidence from a multi-region general

equilibrium model indicates that increases in maritime transport costs can have significant implications for international trade, demonstrating the broader economic consequences of changes in shipping costs (Ferrari et al., 2023). This finding reinforces the importance of cost efficiency in maritime transportation, particularly for economies that depend heavily on sea-based trade.

Logistics efficiency also depends on coordination between maritime transportation, port operations, inland transportation, and information systems. Digitalization has increasingly become an important mechanism for improving coordination and information exchange among actors within maritime logistics networks. Digital technologies can support more efficient operational processes, improve information visibility, and facilitate coordination among port stakeholders, thereby contributing to the transformation of maritime port operations (Heilig et al., 2017). However, technological adoption needs to be accompanied by appropriate organizational capabilities and human resources so that digital systems can generate meaningful improvements in logistics performance.

Although previous studies have examined port efficiency, maritime connectivity, transportation costs, and digitalization, these dimensions are often analyzed separately. Studies focusing on port efficiency primarily emphasize infrastructure and operational performance, while research on maritime transportation costs concentrates on the economic consequences of shipping expenses. Meanwhile, connectivity studies emphasize the relationship between shipping networks, transport infrastructure, and regional economic development. These different perspectives indicate that maritime transportation economics should be examined through an integrated framework that considers the interaction between port performance, logistics costs, maritime connectivity, and regional economic competitiveness. Based on this literature, the present study positions these dimensions within a broader analysis of how maritime transportation can support logistics efficiency and regional economic competitiveness in Indonesia.

3. | RESULTS

The literature review indicates that maritime transportation holds a strategic position in supporting Indonesia's economic activities. As an archipelagic country, Indonesia requires an extensive maritime transportation network to connect production centers, industrial areas, ports, and consumption centers located across different islands. Maritime transportation therefore serves not only as a means of moving goods from one location to another but also as an integral part of the broader chain of economic activities that supports trade, distribution, and interregional mobility. The scale of domestic maritime transportation activities demonstrates the important contribution of this sector to the smooth distribution of goods and the continuity of national economic activities. The availability of reliable maritime transportation enables goods to move between regions and supports interactions between production and consumption areas. Consequently, changes in the capacity, costs, and efficiency of maritime transportation

have the potential to influence economic activities more broadly, particularly through their effects on distribution processes and market accessibility (Sunitiyoso et al., 2022; Delfin-Ortega, 2025).

The synthesis of the literature further indicates that port efficiency is one of the key components determining the economic performance of maritime transportation. Ports with efficient cargo handling, vessel services, and administrative processes can reduce the time vessels spend in port and consequently lower operational costs. Efficient port operations also contribute to more predictable and reliable distribution processes because delays in cargo handling and vessel services can be minimized. Conversely, long waiting times, inefficient procedures, and poorly integrated services can generate additional costs and reduce the reliability of goods distribution. Port efficiency, therefore, is not solely determined by physical infrastructure or handling capacity. It is also influenced by the quality of governance, the application of technology, the effectiveness of service procedures, and the level of connectivity between ports and their hinterland areas. These elements are interconnected because improvements in physical capacity may not produce optimal results when administrative processes, technological systems, and inland connectivity remain inefficient (Sunitiyoso et al., 2022; Danladi et al., 2024).

The review also demonstrates a close relationship between maritime connectivity and economic access across regions. Regions with better shipping networks and greater access to ports tend to have broader opportunities to obtain production inputs and reach wider markets. Improved maritime connectivity can facilitate the movement of goods between production areas and consumption centers while reducing the geographical barriers associated with Indonesia's archipelagic characteristics. In contrast, limited connectivity can increase distribution costs and restrict the ability of businesses to access broader markets. These conditions may particularly affect regions that are geographically distant from major economic centers or have limited access to regular shipping services. In the Indonesian context, the geographical characteristics of an archipelagic country make the equal distribution of maritime connectivity an important aspect of transportation development. Consequently, improving connectivity between regions is closely related to efforts to support more balanced economic opportunities and facilitate the movement of goods throughout the national economy (Delfin-Ortega, 2025; Verschuur et al., 2022). Evidence from port-level analysis also indicates that stronger maritime connectivity is positively associated with port efficiency, reinforcing the importance of connectivity in improving maritime transportation performance (Tovar & Wall, 2022; Xiao et al., 2024).

In addition, maritime transportation costs represent an important factor influencing trade competitiveness. Changes in fuel prices, disruptions to shipping routes, imbalances in cargo flows, and geopolitical conditions can contribute to fluctuations in freight rates. Increases in shipping costs may subsequently raise overall trade costs and potentially be transferred to the prices of goods received by consumers or businesses.

Higher transportation costs can therefore reduce the competitiveness of products, particularly when businesses depend heavily on maritime distribution. The literature also indicates that disruptions to global shipping networks may extend delivery times and increase fuel requirements. Such disruptions can affect the reliability of supply chains and create additional costs for businesses involved in domestic and international trade. The stability and efficiency of maritime transportation are consequently important not only for the movement of goods but also for maintaining the competitiveness and reliability of broader economic activities (Ferrari et al., 2023; Yue & Mangan, 2023). In addition, research on maritime supply-chain resilience shows that disruptions such as port congestion, labor shortages, and abnormal freight-rate fluctuations can affect the continuity and performance of maritime logistics systems (Gu et al., 2023).

Another finding indicates that technology and human resource quality are important supporting factors for improving transportation efficiency. The digitalization of documents, cargo tracking systems, automation, and data integration have the potential to reduce service times, improve transparency, and support more efficient coordination among actors within the maritime transportation system. However, the implementation of technology requires human resources with competencies that correspond to the development of modern transportation systems. Technological improvements may not generate optimal benefits if personnel lack the skills required to operate, maintain, and integrate new systems effectively. Therefore, the overall findings indicate that the economic performance of maritime transportation is determined by the interrelationship among port efficiency, maritime connectivity, transportation costs, infrastructure, technology, and human resource capacity. These factors should be considered as interconnected components of the maritime transportation system because improvements in one component may depend on the effectiveness of the others (Theotokas et al., 2024; Autsadee et al., 2023). Digital transformation research further indicates that technologies such as artificial intelligence, blockchain, the Internet of Things, and big data require appropriate organizational and technological conditions to improve port operations effectively.

4. | DISCUSSION

The findings of the literature review indicate that the development of maritime transportation economics needs to be viewed as an interconnected system. Transportation efficiency is not determined solely by the availability of vessels or port capacity, but also by how the entire distribution chain operates in an integrated manner. Ports with large physical facilities may still experience distribution constraints when they are not supported by adequate hinterland connectivity. Therefore, increasing infrastructure capacity needs to be accompanied by improvements in governance, service quality, and intermodal integration so that the economic benefits of transportation infrastructure can be distributed more broadly. An integrated transportation system allows the movement of goods to be managed more efficiently

from production areas to ports and ultimately to destination markets (Zhang et al., 2022; Wang et al., 2021).

From a cost perspective, port efficiency and connectivity have important implications for trade competitiveness. Vessel waiting times, lengthy cargo handling processes, and repetitive administrative procedures can increase operational costs. These costs subsequently become part of the logistics costs borne by businesses. This condition becomes increasingly important as companies face more open and competitive markets. Products with high distribution costs are likely to experience greater competitive pressure than products originating from regions with more efficient transportation systems. High logistics costs can reduce the ability of businesses to compete in wider markets and may limit the economic benefits generated by improved maritime connectivity. Therefore, increasing port productivity can serve as an important instrument for strengthening economic competitiveness by reducing inefficiencies throughout the distribution process (Mthembu & Chasomeris, 2023; Danladi et al., 2024).

Maritime connectivity also has an important dimension related to economic equity. The development of shipping networks that focuses primarily on major commercial centers may potentially widen disparities between regions with relatively good transportation access and those with limited access. In contrast, more evenly distributed inter-island connectivity can provide greater market access for production areas, facilitate the supply of goods, and support the development of local economic activities. From a regional development perspective, the presence of ports and transportation networks can generate multiplier effects through the growth of trade, warehousing, industry, services, and other supporting economic activities. Improved connectivity can therefore contribute not only to the movement of goods but also to the expansion of economic opportunities across different regions (Wang et al., 2021; Notteboom et al., 2021).

Technology has become increasingly important because maritime transportation requires rapid coordination among various actors. Digitalization can reduce uncertainty by providing information regarding vessel schedules, cargo locations, port services, and administrative processes. Access to more timely and integrated information can support better coordination and improve the efficiency of transportation operations. However, digitalization cannot be regarded as a single solution to all transportation challenges. Differences in digital infrastructure, limitations in human resource capabilities, and variations in capacity among ports may constrain the benefits generated by technological adoption. Therefore, modernization policies need to combine technological investment with workforce competency development and the standardization of information systems. Such an approach is necessary to ensure that technological improvements can be implemented effectively across different parts of the maritime transportation system (Mthembu & Chasomeris, 2023; Heilig et al., 2017).

From the perspective of economic resilience, Indonesia's maritime transportation system also faces external risks, including changes in energy prices, disruptions to shipping routes, geopolitical conflicts, climate change, and instability in global trade. These conditions demonstrate that efficiency alone is insufficient; the transportation system must also have the capacity to maintain the continuity of distribution when disruptions occur. External shocks can affect transportation costs, delivery times, and the reliability of supply chains, thereby influencing the broader economic activities that depend on maritime transportation. Diversification of shipping networks, increased port capacity, and stronger regional connectivity can therefore form part of a broader strategy to strengthen the resilience of the maritime transportation system. These measures can help reduce dependence on particular routes or facilities and provide greater flexibility when disruptions occur (Lau et al., 2024; Xiao et al., 2024). Research on climate-related port disruptions similarly shows that diversification of trade and transport routes and additional port capacity can be important resilience strategies for reducing systemic risks.

The development of Indonesia's maritime transportation economics requires an integrated approach. Infrastructure development needs to be implemented alongside improvements in port productivity, logistics cost control, more equitable connectivity, digitalization, human resource development, and stronger governance. These components are interconnected and should be developed simultaneously because weaknesses in one component may limit the effectiveness of improvements in others. Through such an integrated approach, maritime transportation can function not only as a means of distributing goods but also as an instrument for strengthening trade, investment, productivity, and national economic competitiveness. This perspective emphasizes that improving maritime transportation efficiency is closely connected to broader efforts to support sustainable and balanced economic development across Indonesia (Lau et al., 2024; Mthembu & Chasomeris, 2023).

5. | CONCLUSION

Maritime transportation plays a strategic role in Indonesia's economy by supporting goods distribution, interregional connectivity, trade, and connections with international markets. The findings of the literature review indicate that the economic benefits of maritime transportation are strongly influenced by port efficiency, transportation costs, connectivity, infrastructure quality, technology, and human resources. Port efficiency is one of the important factors because shorter service times can reduce transportation costs and improve supply chain reliability. Meanwhile, effective maritime connectivity can expand access to markets and help reduce economic disparities between regions. Conversely, high transportation costs and limited connectivity can constrain trade competitiveness and contribute to higher prices of goods.

The development of Indonesia's maritime transportation economy also faces challenges, including infrastructure disparities, limited hinterland connectivity, uneven technology adoption, human resource quality, and various external disruptions

affecting global shipping networks. Therefore, maritime transportation policies need to adopt a more integrated approach by combining infrastructure development, improvements in port productivity, digitalization, human resource development, and enhanced supply chain resilience. Ultimately, maritime transportation should be positioned not merely as a transportation sector but as an integral part of the national economic development strategy. Improvements in maritime efficiency and connectivity have the potential to reduce trade costs, strengthen competitiveness, expand economic opportunities, and support more inclusive and sustainable economic growth.

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Data Disclosure Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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