SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 2.1, (2026), pp. 5624-5639
Open Access. Online & Print

DOI: 10.5281/zenodo.19264587

PERSPECTIVES INSIGHTS AND CHALLENGES IN SHORT SEA SHIPPING: SYSTEMATIC LITERATURE REVIEW OF FREIGHT MODE CHOICE

Aditya Mutiara Dewi[*1,2], Miming Miharja[1], Puspita Dirgahayani[1], M. Aji Luhur P[2*]

1Doctoral Program in Department of Transportation, School of Architecture, Planning and Policy Development, Bandung Institute of Technology, Ganesa Street No. 10, Bandung 40132, Indonesia
2Department of Marine Transportation, Polytechnic Bumi Akpelni, Semarang, Indonesia.
email : tiara@akpelni.ac.id, mimingm@itb.ac.id, pdirgahayani@itb.ac.id, aji.luhur@akpelni.ac.id

Received: 05/02/2026
Accepted: 07/03/2026

Corresponding Author: Aditya Mutiara Dewi (tiara@akpelni.ac.id)

ABSTRACT

The growth of logistics activities increases the use of different modes of transport, potentially creating various levels of externalities in the transport system. Therefore, freight transport is a significant concern in many countries, including the European Union, New Zealand, South Africa, and Indonesia. This paper presents a systematic literature review of modal shift in Short-Sea Shipping (SSS), focusing on mode-choice methodologies and descriptive analyses relevant to Indonesia. It identifies key attributes influencing transport mode selection from the perspectives of shipping companies, shippers, and authorities. These attributes fall into observable and unobservable categories, with shippers playing the most influential role due to their high interest, power, and the number of relevant factors. The findings provide a foundation for further research on freight transport mode selection.

KEYWORDS: Freight Transport, Mode Choice, Short Sea Shipping.

1. INTRODUCTION

For a long time, one aspect of logistics carried out by shipping companies has been the movement of commodities. However, physical distribution has been recognised as essential to the economies of nations and companies (Singh et al., 2018) and as a crucial component of supply chain competitiveness (Lagoudis et al., 2006). A nation's economic development is highly dependent on its ability to move products, which directly affects the availability of goods and their market prices (Arencibia et al., 2015). A practical and reliable system for transporting goods has a significant impact on a nation's economic expansion and development. (Samimi et al., 2011). Global freight logistics require numerous logistics hubs and collaborative planning among various stakeholders (Carlan et al., 2016). On the other hand, a significant increase in freight transport has a negative environmental impact.

The transport industry is expanding the fastest. Encouragement to shift to short-sea shipping (SSS), a more carbon-efficient mode of transportation, could help meet this goal. By adopting SSS, it is anticipated that the carbon emissions of the rapidly expanding transport industry and road accidents can be reduced. This aligns with efforts to achieve environmental sustainability and mitigate the negative impacts of climate change. (Santos & Soares, 2016). Compared to traditional coastal shipping, SSS is a concept that closely connects land, sea, and air transport. It first appeared in Europe in the 1900s. SSS entails a sophisticated shipping-focused transport network that boosts the logistics sector's added value. It refers to an eco-friendly and effective integrated transportation system or logistics (Seo et al., 2012).

SSS encompasses both domestic and international maritime transport, including feeder services along the coasts, to and from islands, rivers, and lakes (Russo et al., 2016). When analysing SSS as a substitute for motorways, it is essential to consider that it can operate in three distinct contexts: interurban, regional, and international (Paixão Casaca & Marlow, 2005). 80% of global trade volume is transported by sea (Development, 2015), with dry and liquid bulk accounting for the majority of cargo (60.3% in 2014) (Paixão Casaca & Marlow, 2005). The role of maritime transport in domestic freight logistics remains unclear, as door-to-door water transport is rarely feasible without support from rail or road modes (Casaca et al., 2017).

Compared to other modes of transportation (such as trucks, trains, and planes), shipping is the preferred mode for North Korea because it reduces private-level contact between citizens of the two Koreas. (Kim Y. , 1998). Since 2005, the volume of shipping trade and the number of ships operating between the two Koreas have increased significantly. The "North-South Shipping Agreement," based on active exchanges between the two Koreas, is driving this growth in trade volume. (Lee et al., 2020). Due to extended periods spent at the port and unjustifiable delays, it was observed that the SSS moved more slowly than the road. (Paixão Casaca & Marlow, 2005); (Papadimitriou, 2001); (Strandenes & Marlow, 2000).

In 2007, road freight comprised 45.6% of all European cargo (measured in tonne-kilometers). 2.9 percentage points more than in 1998. In the meantime, the sea's share decreased by 0.3 percentage points (Feo et al., 2011).

In the US, trucks are the most productive mode of freight transportation, accounting for 69% of total national tonnage in 2007 (Transportation, 2010). Based on estimates, the Southern Africa Development Community (SADC) region's regional ports would handle 500 million tonnes of cargo by 2027, up from 92 million tonnes in 2009 (SADC, n.d.). Considering the preferences and demands of the customers it serves is crucial to the success of a transport service, especially if those needs vary and evolve. (Khakdaman et al., 2020).

Choosing a mode of transportation to provide unimodal or multimodal/intermodal services involves a complex decision-making process, as well as qualitative and quantitative service attributes. (Paixão Casaca & Marlow, 2005). The most crucial aspect of decision-making is selecting the appropriate mode of transportation. Therefore, an in-depth understanding of the variables that control these decisions is essential for assessing goods transport policy. (Arencibia et al., 2015). Some agents participating in the logistics chain typically make decisions about goods travel, including the shipper/recipient, the expedition business, and the transportation provider. In the context of goods transportation, multiple agents typically make decisions. All parties involved in the transportation chain are generally involved, including shippers, recipients, shipping companies, and logistics and transportation providers. Decision-makers are people or organisations that weigh the trade-offs among characteristics when determining the value of a given choice (Román et al., 2016).

It found that, while the expedition firm often plays a consultative role and the cargo owner makes most of the mode choice decisions in SADC, the expedition company still makes about 20% of the

decisions (Konstantinus & Zuidgeest, 2019). The intermodal transportation network serves as the basis for route selection for intermodal operators, such as shippers, carriers, and terminal operators, who often construct their service offerings in accordance with dynamic resource allocation laws (such as those governing air and sea resources) (Wang & Meng, 2017); (Wang et al., 2017). When making modal decisions, shippers will take into account modal attributes, shipping characteristics, and their decision-making characteristics when presented with highways and hypothetical SSS alternatives. (Konstantinus et al., 2020). (Brooks & Trifts, 2008) Canadian shippers were prepared to explore maritime options due to their frustration with land-based traffic. Short sea shipping (SSS), either in addition to or instead of roadways, might address current transportation issues and meet development requirements. (Konstantinus, A., 2019). Further socioeconomic benefits from developing SSS in SADC could include reduced traffic accidents, increased energy efficiency, and the connection of isolated and peripheral communities without significant infrastructure investment. (Rennie, 2002); (NDoT, 2011); (Ombo, 2012); (Konstantinus et al., 2019).

Since the intended mode shift has yet to take place, it is evident that the SSS cannot supply the demand for goods transportation. To develop this new type of intermodal service, a comprehensive understanding of the variables influencing modal choice, the demand for freight transport, and the barriers hindering conventional short-haul ocean shipping services from realizing their full potential is necessary. (Feo et al., 2011). Most SADC ports need greater efficiency, which is the main obstacle to SSS development. This indicates that, for long-distance road transit across SADC routes, the quality of accessibility via SSS remains worse. (Konstantinus et al., 2020). However, a key competitive advantage of SSS is its ability to offer freight rates that are highly competitive with road and rail, thanks to scale and density savings. (Konstantinus et al., 2019).

Cargo interests have reviewed their mode choices in response to US highway congestion. (Bendall & Brooks, 2011). Due to the need for further study in the freight transport sector, most studies focus on actual demand rather than the variables that influence it. This is because freight transport is much more complex and heterogeneous than passenger transport, and there are also negative externalities associated with goods transportation, especially road transport, as well as limited availability of appropriate data. (Arencibia et al., 2015). The modal shift has piqued the attention of many researchers, with most of them focusing on shifting away from road transport, as indicated by (Raza et al., 2020). Research has been conducted on the modal shift from land to short-sea shipping (SSS). In contrast to earlier studies, this study adds value and provides opportunities for future research on decision-makers' perspectives when choosing between road and SSS transit for freight transportation.

This study aims to understand previous research findings on the influencing factors of observable and unobservable variables in SSS mode choice, examining different multi-agent perspectives (shipper, operator/shipping company, and authorities) using Systematic Literature Review (SLR) techniques. The term "multi-agent" refers to the various stakeholders involved in the decision-making process regarding the choice of short-sea shipping (SSS) as a mode of transportation. The scope of "multi-agent" in this study includes:

1. Shippers: Individuals or companies that require the transportation of goods. Their perspective is crucial as they are the primary clients of shipping services, and their preferences and requirements significantly influence the choice of transportation mode. (Konstantinus, 2021)
2. Operators/Shipping Companies: These entities are responsible for providing the shipping services. Their operational capabilities, cost structures, and service offerings play a vital role in determining the attractiveness and feasibility of SSS as a transportation option (Paixão Casaca & Marlow, 2005).
3. Authorities: This includes governmental and regulatory bodies that establish the legal and regulatory framework within which shipping operations occur. Their policies and regulations can significantly impact the viability and attractiveness of SSS, through measures such as subsidies, environmental regulations, and infrastructure development (Perakis & Denisis, 2008).

The inclusion of these multi-agent perspectives is essential because each group has distinct interests, priorities, and influences on the decision-making process. By examining the interplay between these perspectives, the study aims to provide a comprehensive understanding of the factors influencing SSS choice, thereby facilitating more informed and adequate decision-making in the transport industry.

In this study, the results are viewed from several

perspectives, and they also reveal that factors can be distinguished based on both observable and unobservable variables. Observable variables are those that can be measured or observed directly through instruments or data-collection methods, such as surveys, interviews, or experiments (Wooldridge, 2016). At the same time, unobservable variables are those that cannot be measured directly but can be estimated or inferred from observed indicators (Hair et al., 2010).

The SLR technique is a method to find, select, analyse, and compile relevant articles on a given subject, using the (SLR) technique (Pace et al., 2011). The methods used to identify the literature for our evaluation are outlined in Section 2, with descriptions based on the research categories outlined in Section 3. In Section 4, the study's conclusion provides an overview of the results and offers recommendations for further research.

2. METHOD

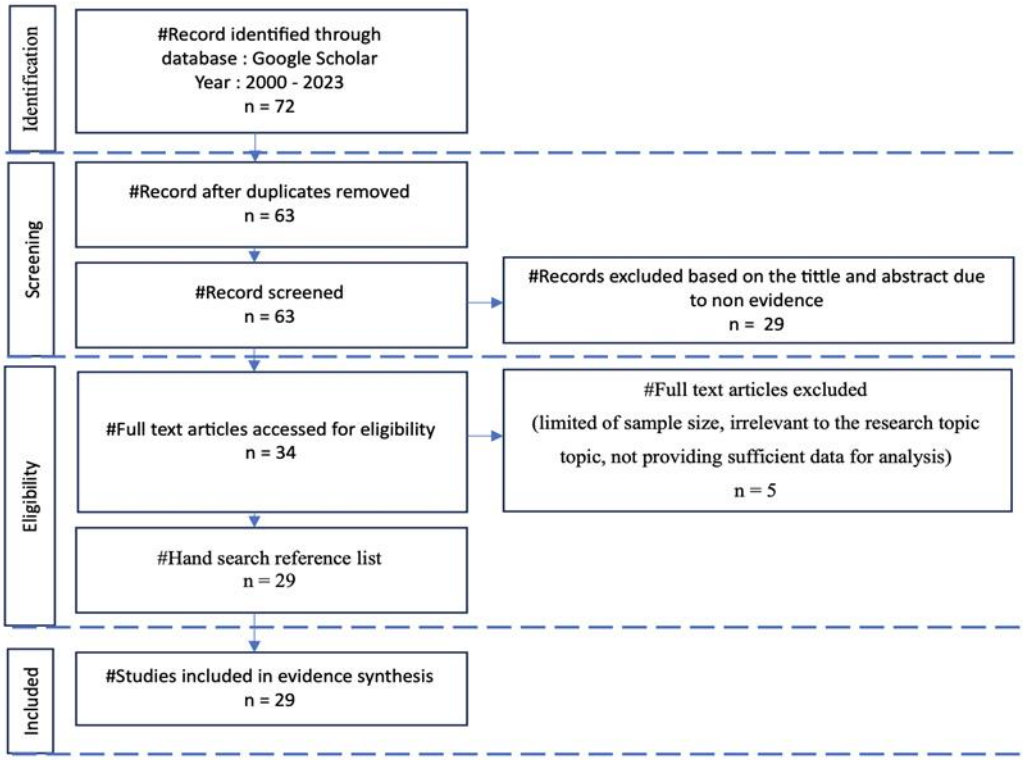
One of the most essential steps in the planning stage of our research is finding suitable keywords for a literature search. A literature review provides a comprehensive compilation and assessment of the literature on a particular subject. (Davarzani et al., 2016) It is followed by providing an appropriate framework for using keywords in a literature search. In this study, the author recognizes the importance of selecting relevant keywords for conducting a literature search. As mentioned, the author has identified a set of keywords to search for related articles over the past 20 years. These keywords have been carefully chosen for their relevance to the research topic and their potential to yield comprehensive results in the literature review. The specific keywords the author intends to use include (Short Sea Shipping, Freight Transport, Mode Choice).

In our context, the term "non-evidence" refers to information or claims that lack empirical support or verifiable data. This distinction is crucial to ensure that our literature review is based on reliable sources. We will ensure our review focuses on studies that meet the eligibility criteria outlined in our methodology, including relevance, quality, and recency. The eligibility criteria for selecting articles in our literature review will include Relevance: Articles must be directly related to the research question or topic of interest. Quality: Only studies published in reputable journals and employing sound methodology will be considered. Recency: Prioritizing newer studies to reflect the current state of knowledge in the field. The author acknowledges that certain information may be classified as non-evidence for various reasons, such as the lack of empirical data supporting claims, reliance on anecdotal evidence or personal accounts, theoretical statements not yet supported by clear research with authentic evidence, and outdated information that does not reflect contemporary practices or knowledge.

3. DATA SOURCE

This systematic literature analysis aims to use the PRISMA protocol (Moher et al., 2009). This study aims to understand the findings of previous research by examining the interplay of several elements that influence the decision on the mode of freight transport, and to highlight significant aspects that must be considered in transforming the global freight transportation system through various modes as shown figure 1. system through various modes, as shown in

Figure 1. PRISMA 4 phase protocol flow diagram



Source: Author.

As shown in Figure 1, a total of 29 articles that met all eligibility criteria were included in the evidence synthesis across all processes. The discussion of Short Sea Shipping (SSS) falls within a multidisciplinary area, categorized by fields of study, namely transportation journals (International Journal of Shipping and Transport Logistics, Journal of International Logistics and Trade, Journal of Transport Economics and Policy, Journal of Transport Geography, Maritime Transport Research, Transport), business journals (Maritime Business Review, Maritime Policy and Management, Research in Transportation Business & Management Sustainability), environmental journals (Coastal Management, Transport and Sustainability, Sustainability), logistics journals (Maritime Economics & Logistics, Expert Systems with Applications, The Asian Journal of Shipping and Logistics), and policy journals (Case Studies on Transport Policy, Transport Policy). This emphasizes that SSS is a multidisciplinary topic that requires approaches from various perspectives to fully understand its implications and benefits in the context of modern transportation. This screening process aims to ensure that only relevant and high-quality articles are included in the literature review. By excluding articles that do not meet the criteria, authors can ensure that the resulting evidence synthesis is valid and reliable.

4. RESULT AND DISCUSSION

The data gathered from SLR analysis is reviewed to map the chosen literature in descriptive analysis and gain insight into the ideas the articles focus on.

Content Analysis

Based on the subjects and issues covered in the literature study, research categories have been developed, primarily focusing on the factors influencing mode choice from three perspectives. In contrast to the research conducted by (Raza et al., 2020), although they also conducted SLR on SSS with the problem categories discussed from a multi-agent perspective, they did not explicitly discuss the factors that influence each of them. Three perspectives are used to identify and categorise factors that affect SSS's competitiveness and selection over alternative modes, namely:

a. Attributes Influencing the Preference on Short Sea Shipping based on shippers' perspective

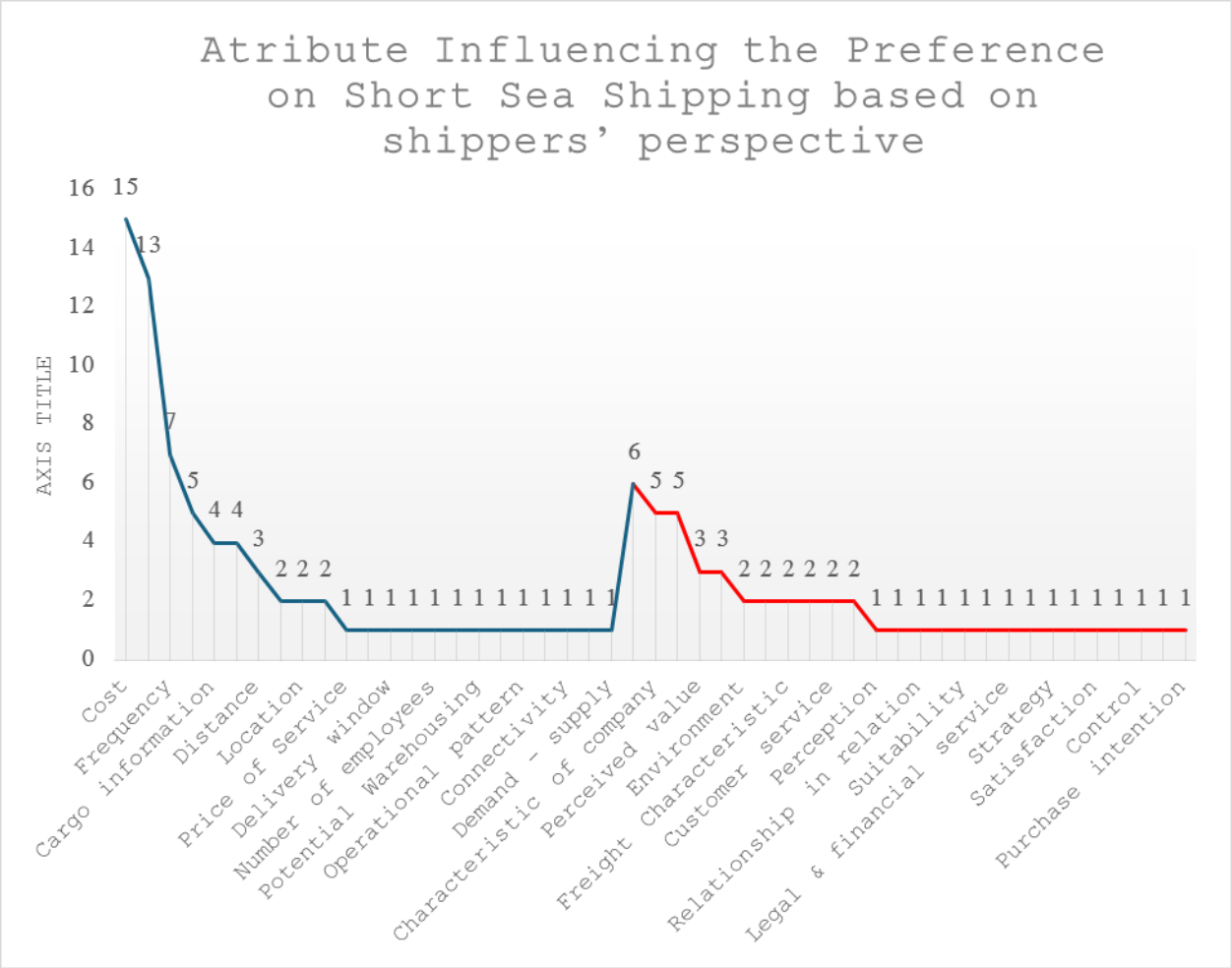


Figure 2. Observable and unobservable variable on shippers perspective

Legend :

Observable Attribute

Unobservable Attribute.

Based on Figure 2, the attributes are divided into two types: observable and unobservable ones. The most common observable attributes are cost and time, which are adopted by 15 and 13 studies, respectively, demonstrating that shipping costs and delivery time are critical considerations for companies. Cost refers to the total expenditures required to transport goods, including shipping fees, insurance, and other additional costs. Due to the comparatively high cost of transporting goods, a 10% reduction in both the cost and transit time of commodities is required when moving from land to sea (Balau, 2009). Transportation rates, customs and licence fees, port and dock fees, cargo handling, and other expenses associated with moving products from point of origin to destination are all considered part of the costs associated with obtaining transportation services dock fees, cargo handling, and other costs related to transporting goods from one place to another (Rodrigue, 2017). High costs can be a barrier to companies when selecting specific shipping methods, thereby affecting pricing strategies and market competitiveness. An increase in transportation costs of 1% can reduce the possibility of choosing between modes by up to 6.27% (Román et al., 2016).

On the other hand, time refers to the duration required to complete the shipping process, which is often a primary consideration for customers. In an increasingly fast-paced business world, short delivery times can provide a significant competitive advantage. Customers tend to prefer service

providers that can guarantee timely delivery, especially for time-sensitive goods. Therefore, companies must find a balance between cost and time to meet customer expectations while maintaining operational efficiency and profitability. The two factors are interconnected: reducing delivery time often incurs additional costs, and decisions made in one aspect can affect the other. "Transport time" in a door-to-door transportation system is the time required to deliver a shipment from the origin to the destination. Since transit time and distance are correlated, time tends to shorten as distance increases, and vice versa.

Additionally, the attributes of frequency, delay, and cargo information also receive significant attention, emphasizing the importance of damage, loss and distance in goods delivery. Frequency indicates how often a service is available, and delay measures the additional time needed to complete the service. When the number of weekly departures for sea transport modes increases, the probability of selecting this alternative among other modes changes to 2.515% (Feo et al., 2011). Service frequency can be increased by encouraging SSS to carry larger freight volumes, thereby making vessels more profitable and enabling more regular services (Konstantinus et al., 2020). (Puckett et al., 2011); (Brooks & Trifts, 2008) shows that frequency is a crucial service characteristic in studies on mode transport preference and, additionally, in studies involving SSS.

In the context of research, unforeseen delays in modes of transport at border crossings and cargo transhipment locations are referred to as delays or extended delays (Konstantinus et al., 2020). In terms of freight distance, (Brooks & Trifts, 2008) discovered that, in certain situations, trucking and shipping may compete in corridors of fewer than 1,000 nautical miles; land transit times are longer due to the physical network structure and congestion being a problem. On shorter routes (less than 750 km of road), trucks are preferred for carrying cargo. In comparison, the sea receives a substantial amount of business on longer routes (more than 1,000 nautical miles), particularly during periods of low traffic, such as train competition (Bendall & Brooks, 2011). Moreover, the majority of shippers prefer using SSS for longer routes, enabling the utilisation of the fundamental benefits of shipping to realise economic scale and distance (Konstantinus et al., 2020).

Different from observable variables in mode selection, reliability, characteristic of company, perceived quality are included in unobservable variables, they also related to service performance but differ in focus: reliability emphasizes consistency, while the characteristic of company encompasses the attributes and reputation of the shipping company, which significantly influences customer trust in the services provided. In marketing, perceived quality and perceived value are crucial concepts. Perceived quality refers to the assessment of a product's quality based on measurable attributes, such as durability. Perceived value, on the other hand, reflects the benefits consumers associate with a product relative to its costs, including emotional and social factors. Understanding these differences enables companies to create effective marketing strategies, enhance customer satisfaction, and foster brand loyalty, making it essential for businesses to focus on both perceived value and quality to meet consumer expectations. Perceived value is a key strategic determinant of business success (Park et al., 2004) (Gil-Saura et al., 2010), and is an essential factor for industrial and individual customer purchase decisions.

Due to their flexibility, LSP (Logistic Service Provider) can respond to changes in demand and resource/network availability by deciding in real time to switch between different transportation modes and routes (Khakdaman et al., 2020). Flexibility is defined as a logistics system's capacity to adjust service elements at any time, both before and after freight or commodities arrive at their destination, in response to the receiver's company requirements. This can involve altering the destinations, extending or shortening the transit duration, combining or dividing the delivery quantities, and furthermore (Khakdaman et al., 2020).

To ensure total control over the goods' delivery, the shipper decides on each aspect of their transportation, Shippers refer to individuals or entities responsible for transporting goods from one location to another. In the context of logistics and transportation, shippers can include manufacturers, distributors, or retailers who have goods to deliver to customers or business partners. They play a crucial role in the supply chain, as the decisions made by shippers regarding shipping methods, transportation selection, and logistical arrangements can significantly impact efficiency. Shippers must also consider various factors, such as the type of goods being shipped, applicable regulations, and customer requirements, to ensure that shipments are carried out safely and on time. Thus, shippers play a key role in ensuring the smooth flow of goods within the global trade system.

Shippers and freight forwarders are examples of logistics stakeholders who may consider a variety of criteria (factors) simultaneously. Many characteristics, or subfactors, make up a criterion (Chen et al., 2017). One of the significant factors in influencing how a mode choice decision turns out is perception (Bendall & Brooks, 2011). Alternative variables yield different assessments depending on the alternatives considered, also referred to as perceptions (Birke et al., 2015), or, in this case, as unobservable variables, requiring specific alternative estimators for measurement.

b. Attributes Influencing the Preference on Short Sea Shipping based on Operators/shipping company's perspectives.

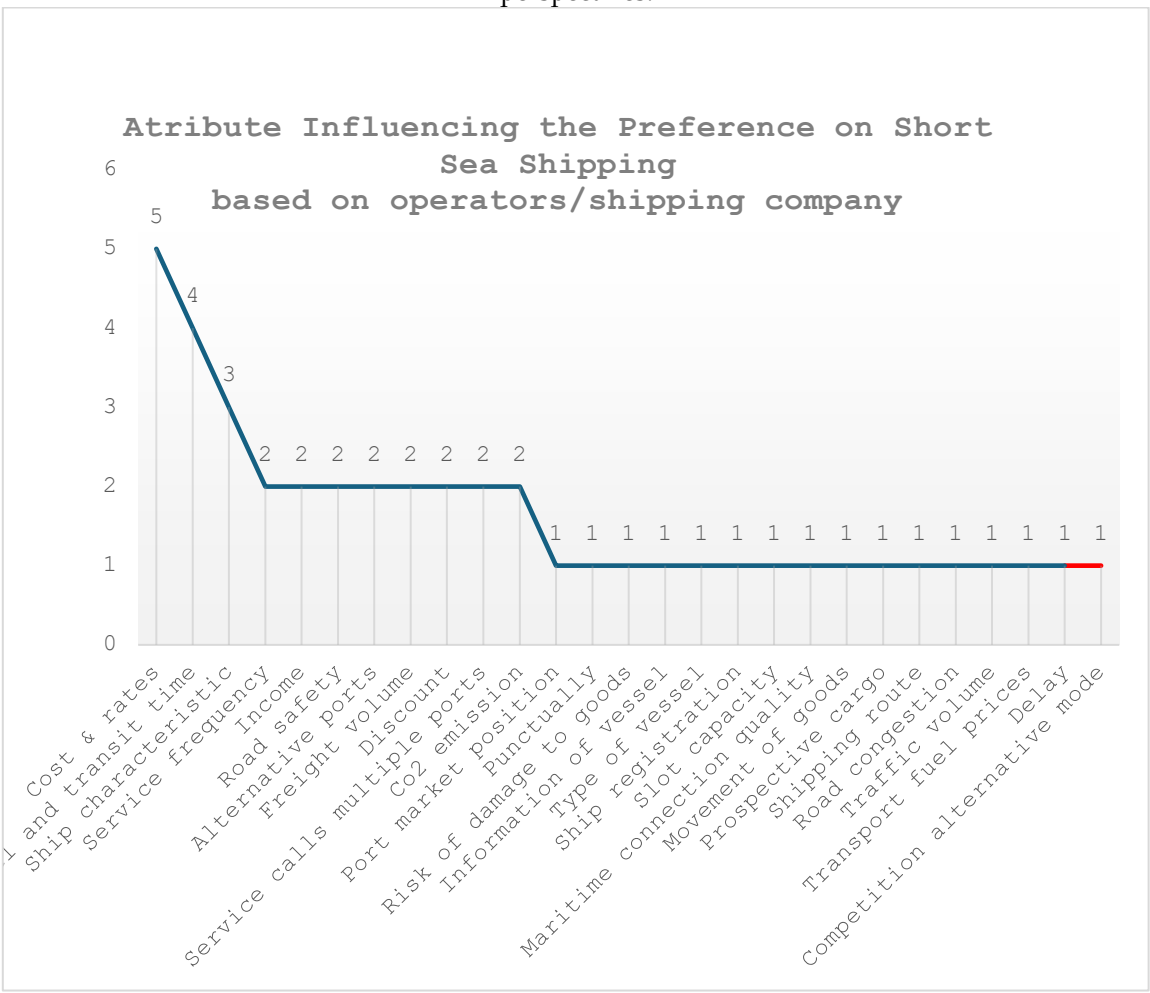


Figure 3. Observable and unobservable variable on operator perspective

Legend :

Observable Attribute

Unobservable Attribute

Based on Figure 3, the primary factors are cost & rates in 5 articles, travel & transit time in 4 articles, and also ship characteristics in 3 articles. From the perspective of operators or shipping companies, several important factors influence their decisions and operational strategies. First, cost efficiency is a primary concern, as companies must balance shipping costs with prices acceptable to customers. (Brooks & Trifts, 2008) explore the benefits needed to encourage modal shift to SSS; they identified that price was more important than transit time required to switch from trucking to SSS. Companies may prioritize modes of transport that offer cost efficiency while meeting the demands of their customer base. Transport mode selection is the result of a series of interactions including transportation characteristics, logistics characteristics, and product characteristics (Kim et al., 2014). Furthermore, shipping companies

must consider risk management, including the potential for damage or loss of goods, which can impact their reputation and profitability. Therefore, shipping operators must integrate these various factors into their strategies to achieve competitive advantage and ensure customer satisfaction in an increasingly complex business environment. Rather than focusing solely on the operational efficiency of a single port, greater emphasis should be placed on connectivity between multiple ports. It may also be essential to consider related cross-border issues.

More in-depth data is provided by (Ramanathan, 2013)'s research to assist port managers and policymakers in their decision-making. The variety of these connections is indicated by the capacity and frequency of ship slots (Martinez-Moya & Feo-Valero, 2020). By making it easier for exporting businesses to reach foreign markets, the employment of larger vessels on some routes at the same frequency levels will increase connectivity (Zhang et al.). Research conducted by (Martinez-Moya & Feo-Valero, 2020) gives legislators and port managers more precise information to assist in their decision-making. When deciding whether to use a port for export operations, corporations often consider the availability of shipping services. The exporter is likely to make higher profits the more shipping providers they connect with a specific market. By providing companies involved in import and export greater freedom to organize and handle their shipments, increased frequency directly enhances connectivity (Martinez-Moya & Feo-Valero, 2020). Like in Hong Kong, Stakeholders are satisfied with infrastructure and connectivity, as well as well-developed custom laws and government policies (Chen et al., 2017).

Income is a critical factor in the company's selection of transport mode. Higher income levels often correlate with increased demand for goods and services, which can drive higher shipping volumes. For instance, businesses operating in higher-income regions might opt for faster shipping methods to ensure timely delivery, thereby enhancing customer satisfaction and loyalty. Shipping companies must assess how income levels affect consumer behavior and adjust their operational strategies accordingly. This could involve selecting routes or modes that align with the purchasing power of target markets.

Road safety is another significant consideration for operators when choosing transportation modes. The risk of accidents or delays due to unsafe road conditions can impact not only the reliability of service but also the overall cost associated with transporting goods. Companies need to evaluate road safety data when planning logistics operations. A safer route may be prioritized even if it incurs slightly higher costs, as it reduces potential liabilities arising from accidents or cargo damage.

The availability of alternative ports plays a vital role in enhancing supply chain connectivity and flexibility. When primary ports face congestion or operational challenges, access to alternative ports enables shipping companies to maintain service continuity. When deciding where to ship goods, operators should consider factors such as port capacity, infrastructure quality, and customs efficiency at alternative ports. This strategic approach helps mitigate the risks of relying solely on a single port. In this discussion, it is evident that observable factors have a greater impact on decision-making from the operators' perspective.

In contrast to the other two perspectives, from an authority perspective it is constrained regarding unobservable factors. In the SLR results, only one attribute was identified as related to the authority perspective. Competition in alternative modes refers to competition between different types or modes of transportation (e.g., land vs. sea, land vs. air) that provide alternative ways to meet the same travel demand. This concept is crucial in transportation planning, economics, and policy because it helps decision-makers understand decision maker perception and plan infrastructure accordingly.

c. Attributes Influencing the Preference on Short Sea Shipping based on Authorities' Perspectives.

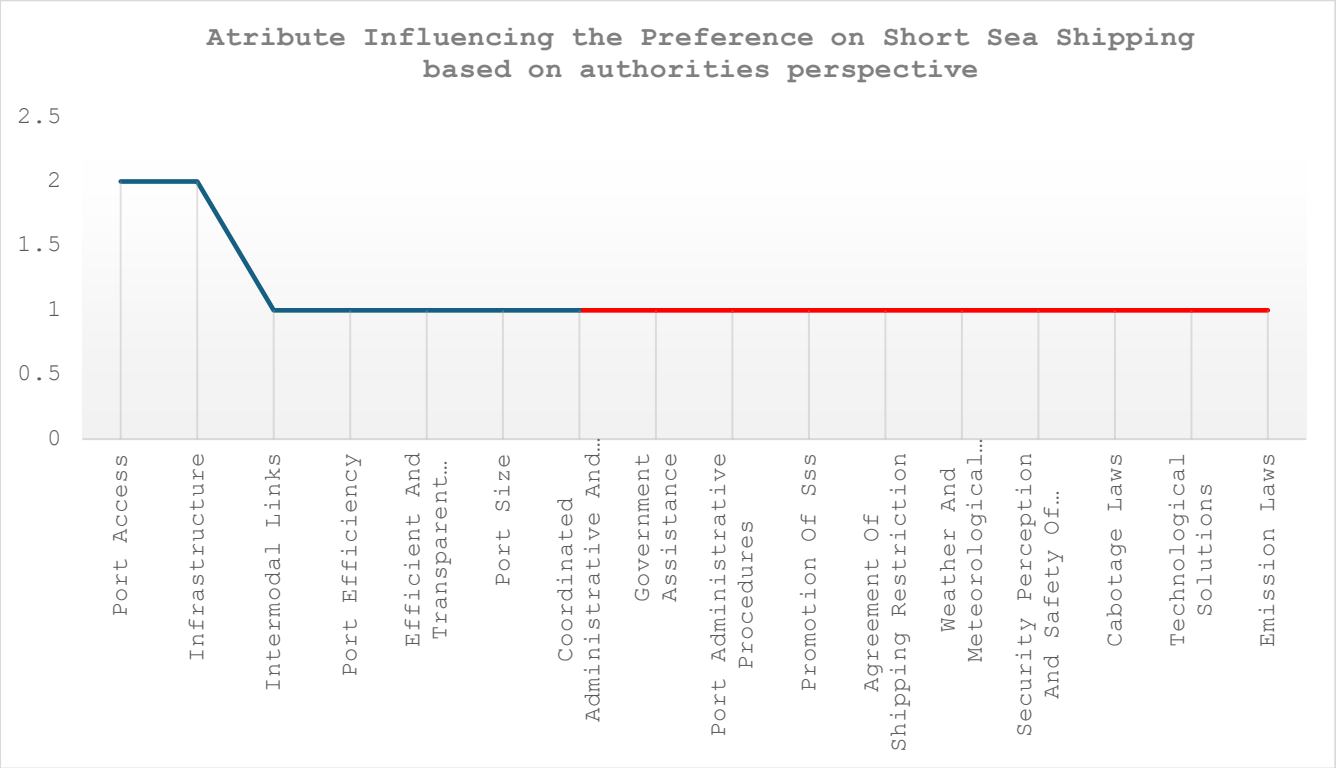


Figure 4. Observable and unobservable variable on authorities perspective

Legend :

Observable Attribute

Unobservable Attribute

Based on Figure 4, the primary factors in observable variables are port access and infrastructure. The authority's perspective is taken into consideration in research by (Bendall & Brooks, 2011) if they decide to support the shift from land to coastal shipping as a way to promote domestic industry, improve the transportation sector's greenhouse gas efficiency, or both. To determine the essential elements required to promote the shift to short-haul maritime operations, a modal-choice analysis of cargo importance is needed.

The availability of ports to support short-distance marine activities is essential to the success of coastal shipping operations. Regulation is the primary barrier to the growth of the American Maritime Highway, according to studies of the short-sea market in the United States (Brooks & Frost, 2009). Europe, for instance, benefits from a short and active maritime industry due to its strictly open cabotage system. Short-sea market in Europe indicated that the conditions of the cabotage regime significantly influenced the development of short-sea services.

In addition to observable factors, unobservable factors were found to have a greater influence on freight transport mode choice from the authorities' perspective. In addition to enabling ship operators to access longer routes, the EU's liberalisation of the cabotage market has also expanded the areas where short-haul marine services can operate. An exploratory analysis of the business players who have started research, provided incentives, and taken other steps to promote the preservation of this capital is presented in (Gonzalez-Aregall et al., 2021). This study also describes how various port management systems in Europe affect the implementation of port-related environmental programme decisions to optimise land traffic distribution through modal shifts. Since there are now no European port laws governing market regulation, the involvement of port authorities is crucial to maintaining regional cohesion. Short programme (modelled after Europe's Marco Polo programme to support new businesses or promote capital flow). The five Marco Polo programmes focused on promoting the development of new short-haul maritime services and on relocating freight transport from the road network. The European Commission has also acknowledged that a modal shift will only occur with promotional

programmes to encourage the change (Brooks & Frost, 2009). As a result, there are now corridors long enough for SSS to compete with land-based options. To manage environmental challenges associated with transporting commodities to and from ports, each port authority has its own governance structure and programmes (typically going beyond basic standards) (Gonzalez-Aregall et al., 2021).

Many countries protect their shipping industries through cabotage laws because they consider the marine sector crucial to their economies and, in some cases, their national security (Lewarn & Francis, 2009). The lack of long-term maritime promotion, taxation (unequal treatment between time charters and bareboat or demise charters, the latter of which are subject to royalties that undercut tax), and employment rules appear to be the current obstacles to the development of SSS in Australia. In many nations, policymakers not only take Short Sea Shipping (SSS) for granted (Rowlinsom & Wixey, 2002), but the shipping industry also pays little attention to it. (Everard and Boyle, 1995) Claimed that the industry's lack of visibility derived from coastal shipping operators' incapacity to market their services fifteen years ago efficiently.

While Macintosh (2007) shows that coastal shipping is more energy-efficient than other options for transporting one tonne of cargo over a kilometre, short-haul shipping alternatives seem to receive less attention, except for small-scale shipping. Several barriers and challenges, including operational rules and regulations, government planning, customs concerns, and stakeholder execution of policies. Still, influences the choice of air or sea transportation. (Chen et al., 2017). The Hong Kong government has prioritised airport expansion while providing ports, such as implementing the DTL policy, with less attention.

Seaports in Hong Kong have demonstrated a different determination to preserve their position and competitiveness than seaports in Mainland China, which are progressively developing with modern facilities and technology. Such a development deficiency will create problems and obstacles for shippers and 3PLs in fully utilising the regulations. Operators and third-party logistics providers require assistance in managing freight due to inadequate infrastructure and unclear cargo information. Taiwanese ports are viewed with concern by carriers and 3PLs due to their frequent insensitivity to handling and operational modifications.

To improve the competitiveness of logistics ports, the government must provide an open legal and financial system, a fair and transparent market, and greater business opportunities. Governments should be aware that modernising current infrastructure and streamlining relevant rules are crucial to enabling one-stop hub services. (Chen et al., 2017). To create efficient, competitive port systems and enhance land connections, port managers and policymakers worldwide are investing in port infrastructure. (Wang et al., 2016); (Mohamed-Chérif & Ducruet, 2016); (Calatayud et al., 2017). To increase land connectivity and expand their connections to destination markets, port authorities strive to maintain their attractiveness to shipping businesses.

Analysing the negative impacts of ship pollution, creating a sustainable maritime transportation system through relevant shipping policy laws, and reducing ship sulphur emissions are all essential steps in developing SSS. The three primary technical methods for reducing sulphur emissions from ships are using low-sulfur gasoline, installing scrubbers aboard boats, and using LNG as ship fuel. (Chen , et al., 2018)

5. CONCLUSION

SSS has benefits in several countries, including reducing congestion in China, where air pollution poses a significant threat to public health. It reduces traffic accidents, increases energy efficiency, and represents a sustainable transportation mode that can facilitate inter-regional connectivity without requiring high infrastructure investments. Additionally, SSS can offer very competitive transport rates compared to road and rail transport. Frooman (1999) found that stakeholders can influence decision-makers both directly and indirectly. Although many stakeholders may claim involvement in the decision-making process, only those with the capacity to influence decision-makers' objectives should be prioritized for involvement.

This study aims to understand previous research findings on the influencing factors of observable and unobservable variables in SSS mode choice, examining different multi-agent perspectives (shipper, operator/shipping company, and authorities) using Systematic Literature Review (SLR) techniques. The research findings indicate that the factors determining mode choice include both observable and unobservable characteristics. Observable variables are those that can be measured or observed directly through instruments or data-collection methods, such as surveys, interviews, or experiments (Wooldridge, 2016). While unobservable variables are those that cannot be measured directly but can be estimated or inferred

from observed indicators (Hair et al., 2010).

The findings of this study indicate that freight mode choice decisions are influenced not only by observable variables such as cost, time and service frequency but also by unobservable factors that capture user's perception transport services. From the shippers perspective, observable variables such as cost efficiency, time and frequency remain critical determinants. However unobservable factors such as reliability and characteristic of company show a significant influence. The perspective of shippers has been characterized by high interest and high power, thus having the most significant influence in decision-making. This is supported by numerous attributes that can affect the selection of freight transport modes; the greater the number of attributes, the more significant the stakeholder becomes. Therefore, it is essential to delve deeper into the contributions and influences of each stakeholder in future research.

For operators, the analysis shows that observable variables have a stronger impact on decision-making, especially factors related to cost & freight rates, travel & transit time, and ship characteristics, Meanwhile, only two unobservable variables were found to have a measurable but relatively limited influence. This indicates that operators tend to prioritize tangible, performance-based attributes in evaluating service competitiveness. From the authoritys perspective, observable factors, including port access, infrastructure quality and intermodal connectivity play a crucial role in shaping policy direction. Unobservable factors such as government assistance, port administrative procedures, and promotion of Short Sea Shipping (SSS), demonstrate an even stronger perception and strategic influence. These unobservable factors highlight the importance of institutional support, regulatory efficiency and policy communication in encouraging modal shift. Overall, integrating both observable and unobservable variables provides a more comprehensive understanding of freight mode choice perceptions. This approach offers valuable insight for developing a more efficient, reliable, and user oriented maritime transport system.

The integration of observable and unobservable factors allows decision-making models to move beyond traditional cost-time trade-offs, incorporating perceptual dimentions. This approach not only improves quantitative accuracy but also provides qualitative insight for designing more user-centered, reliable and sustainable transport systems.. Therefore, it is essential to delve deeper into the contributions and influences of each stakeholder in future research.

Author Contributions: Conflict of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper, and that the contents of this article have not been published previously.

Funding: This work is supported in part by Indonesian Education Sholarship, the Center for Higher Education Funding and Assessment (PPAT) Ministry of Higher Education, Science, and Technology of Republic Indonesia, and the Indonesia Endowment Fund for Education Agency (LPDP) of the Republic of Indonesia.

REFERENCES

1. Arencibia et al. (2015). Modelling mode choice for freight transport using advanced choice experiments. Transportation Research Part A, 252-267.
2. Arianto, D., Marpaung, E., Malisan, J., Humang, W. P., Puriningsih, F. S., Mutharuddin, . . . Kurniawan, A. (2022). Cost Efficiency and CO2 Emission Reduction in Short Sea Shipping: Evidence from Ciwandan Port–Panjang Port Routes, Indonesia. Sustainability, 14.
3. AROF, A. M. (2018). Decision Making Model for Ro-Ro Short Sea Shipping Operations in Archipelagic Southeast Asia. The Asian Journal of Shipping and Logistics, 033-042.
4. Arof, A. M., & Nair, R. (2017). The identification of key success factors for interstate Ro-Ro short sea shipping in Brunei-Indonesia-Malaysia-Philippines: a Delphi approach. International Journal of Shipping and Transport Logistics, 9, 261-279.
5. Balau, J. (2009). A Importância do Porto Brasileiro no Desenvolvimento da Cabotagem. Proceedings of the 1o Seminário Sobre o Desenvolvimento da Cabotagem Brasileira. Brazil.
6. Bardauskaite, I. (2014). Loyalty in the business-to-business service context: a literature review and proposed framework. Journal of Relationship Marketing, 13 (1), 28-69.
7. Bendall, H. B., & Brooks, M. R. (2011). Short sea shipping: lessons for or from Australia. International Journal Shipping and Transport Logistics, 3(4).
8. Bergantino, A. S., Bierlaire, M., Catalano, M., & Migliore, M. (2013). Taste heterogeneity and latent

preferences in the choice behaviour of freight transport operators. Transport Policy, 77-91.
9. Brooks, M. R., & Trifts, V. (2008). Short sea shipping in North America: understanding the requirements of Atlantic Canadian shippers. Maritime Policy & Management, 145-158.
10. Brooks, M., & Frost, J. D. (2009). Short sea developments in Europe: lessons for Canada. Annual Meeting of Canadian Transportation Research Forum,. Victoria.
11. Calatayud et al. (2017). Connectivity to international markets: a multi-layered network approach. Journal Transport Geography, 61, 61-71.
12. Carlan et al. (2016). How port community systems can contribute to port competitiveness: Developing a cost-benefit framework. Research in Transportattion & Management, 19, 51-64.
13. Casaca et al. (2017). Domestic short sea shipping services in Brazil: competition by enhancing logistics integration. Int. J. Shipping and Transport Logistics, 9.
14. Chang, C., & Thai, V. V. (2016). Do port security quality and service quality influence customer satisfaction and loyalty? Maritime Policy & Management: the Flagship Journal of Inter- national Shipping and Port Research, 43 (6), 720-736.
15. Chang, C.-H., & Thai, V. V. (2017). Shippers' Choice Behaviour in Choosing Transport Mode: The Case of South East Asia (SEA) Region. The Asian Journal of Shipping and Logistics, 33 (4), 199-210.
16. Chen , J., Wan, Z., Zhang, H., Liu, X., Zhu, Y., & Zheng, A. (2018). Governance of Shipping Emission of SOx in China's Coastal Waters: The SECA Policy, Challenges, and Directions. Coastal Management, 46, 191-209.
17. Chen et al. (2017). Transshipment hub selection from a shipper's and freight forwarder's perspective. Expert Systems With Applications, 396-404.
18. chen, g., Cheung, W., Chu, S.-C., & Xu, L. (2017). Transshipment hub selection from a shipper's and freight forwarder's perspective. Expert Systems With Applications, 396-404.
19. Christodoulou, A., & Cullinane, K. (2020). Potential for, and drivers of, private voluntary initiatives for the decarbonisation of short sea shipping: evidence from a Swedish ferry line. Maritime Economics & Logistics.
20. Davarzani et al. (2016). Greening ports and maritime logistics: A review. Transportation Research Part D: Transport and Environment, 48, 473-487.
21. Development, U. N. (2015). Review of Maritime Transport 2015. Diambil kembali dari http://unctad.org/en/PublicationsLibrary/rmt2015_en.pdf
22. Di Gravio et al. (2016). Overall safety performance of the air traffic management system: The Italian ANSP's experience on APF. Research in Transportation Business and Management, 20, 3-12.
23. Du et al. (2017). Modeling multimodal freight transportation scenarios in Northern Canada under climate change impacts. Research in Transportation Business & Management.
24. Everard and Boyle, C. (1995). The single market and the removal of obstacles to the greater use of shortsea shipping. The 2nd Round Table Conference on Shortsea Shipping. Delft.
25. Feo et al. (2011). An stated preference analysis of Spanish freight forwarders modal choice on the south-west Europe Motorway of the Sea. Transport Policy, 60-67.
26. Fornell, C., & Larcker, D. (1981). Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research, 18 (1), 39-50.
27. Garcıa-Menendez, L., & Inmaculada, M.-Z. (2004). Determinants of Mode Choice between Road and Shipping for Freight Transport : Evidence for Four Spanish Exporting Sectors. Journal of Transport Economics and Policy, 38, 447-466.
28. Gil-Saura et al. (2010). An- tecedents and consequences of logistics value: and empirical investigation in the Spanish market. Industrial Marketing Management, 39(3), 493-506.
29. Gil-Saura et al. (2018). Satisfaction and Loyalty in B2B Relationships in the Freight Forwarding Industry: Adding Perceived Value and Service Quality Into Equation. Transport, 33, 1184-1195.
30. Gonzalez-Aregall et al. (2021). A Review of Port Initiatives to Promote Freight Modal Shifts in Europe: Evidence from Port Governance Systems. Sustainability, 13, 5907.
31. Hensher, D. R. (2005). Applied choice analysis: a primer. Cambridge University Press.
32. Hong, Q. N., Pluye, P., Bartlett, G., Fabregues, S., Boardman, F., Cargo, M., . . . Vedel, I. (2019). Improving the content validity of the mixed methods appraisal tool: a modified e-Delphi study. Journal of Clinical Epidemiology, 49-59.
33. Hurtubia et al. (2014). Integrating psychometric indicators in latent class choice models. Transp. Res.

Part A Policy Pract, 64, 135-146.
34. Keya, N., Sabreena , A., & Eluru, N. (2019). Joint model of freight mode choice and shipment size: A copula- based random regret minimization framework. Transportation Research Part E, 97-115.
35. Khakdaman et al. (2020). Shippers' willingness to delegate modal control in freight transportation. Transportation Research Part E.
36. Kim, H.-C., Nicholson, A., & Kusumastuti, D. (2014). Freight Transport Mode Choice and Mode Shift in New Zealand: Findings of a Revealed Preference Survey. Sustainable Logistics, 165-192.
37. Kim, Y. (1998). 1998. Current Status of the shipping industry in North Korea and Inter-Korean Cooperation in the Shipping Sector. Korea: Korea Institute for National Unification.
38. Konstantinus & Zuidgeest. (2019). An investigation into the factors influencing inter- urban freight mode choice decisions in the Southern African Development Community region. J. Transp. Supply Chain Manag, 13.
39. Konstantinus et al. (2019). Barriers and enablers for short-sea shipping in the Southern African Development Community, sustainable short sea shipping. Sustainability, 11 (6).
40. Konstantinus et al. (2020). Assessing inter-urban freight mode choice preference for short-sea shipping in the Southern African Development Community region. Journal of Transport Geography.
41. Konstantinus, A. (2019). Opportunities for Short-Sea Shipping in SADC: Evidence Based on Discrete Choice Modeling. Cape Town, South africa: Ph.D. Dissertation. Department of Civil Engineering, University of Cape Town.
42. Konstantinus, A. (2021). Short sea shipping: Stated intentions of shipowners and operators in the Southern Africa Development Community Region. Maritime Transport Research, 2.
43. Konstantinus, A., & Woxenius, J. (2022). Case study: Coastal shipping in sub-Saharan Africa. Case Studies on Transport Policy, 2064–2074.
44. Lagoudis et al. (2006). Ranking of factors contributing to higher performance in the ocean transportation industry: a multi-attribute utility theory approach. Maritime Policy & Management: The Flagship Journal of International Shipping and Port Research, 33 (4), 345-369.
45. Lam, J. (2011). Patterns of maritime supply chains: slot capacity analysis. Journal Transport Geography, 19 (2), 366-374.
46. Lee et al. (2020). Short Sea Shipping on the West Coast of Korea: Keys to Activating the Shipping Industry in Preparation for Korea Unification Era. Journal of International Logistics and Trade, 18(2), 91-105.
47. Lewarn, B., & Francis, J. (2009). Salvaging and Developing a National Fleet. Occasional Paper No. 2, Australian Maritime College, Launceston.
48. Lin, C.-C., Chen, Y. J., & Wang, J.-W. (2021). Double matching service preference for promoting short sea shipping: evidence from Taiwan. Maritime Business Review, 6, 392-413.
49. Lu, C.-S. (2003). The impact of carrier service attributes on shipper–carrier partnering relationships: a shipper's perspective. Transportation Research Part E: Logistics and Transportation Review, 39(5), 399-415.
50. Macintosh, A. (2007). Climate Change and Australian Coastal Shipping.
51. Malisan, J., Marpaung, E., Hutapea, G., & Puriningsih, F. S. (2023). Development of short sea shipping in the north coast of Java Island, Indonesia as a potential market. Transportation Research Interdisciplinary Perspectives.
52. Marcucci, E. (2013). Logistics managers' stated preferences for freight service attributes: a comparative research method analysis. In Freight Transport Modelling. Emerald Group Publishing Limited, 251-280.
53. Martínez-López, A. (2020). A multi-objective mathematical model to select fleets and maritime routes in short sea shipping: a case study in Chile. Journal of Marine Science and Technology.
54. Martinez-Moya, J., & Feo-Valero, M. (2020). Measuring foreland container port connectivity disaggregated by destination markets: An index for Short Sea Shipping services in Spanish ports. Journal of Transport Geography.
55. Mohamed-Chérif, F., & Ducruet, C. (2016). Regional integration and maritime connectivity across the Maghreb seaport system. Journal Transport Geography, 51, 280-293.
56. Moher et al. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. Annals of Internal Medicine.

57. NDoT. (2011). Part 2: Coastal and Short-Sea Shipping. SA Maritime Transport Sector Study.
58. Ombo, G. (2012). Coastal shipping in Africa: prospects and challenges. Marit. Ind. Conf. South Africa.
59. Pace et al. (2011). Testing the reliability and efficiency of the pilot Mixed Methods Appraisal Tool (MMAT) for systematic mixed studies review. International Journal of Nursing Studies, 47-53.
60. Paixão Casaca, A., & Marlow, P. B. (2005). The competitiveness of short sea shipping in multimodal logistics supply chains: service attributes. Marit. Policy Manag, 32, 363-382.
61. Paolo, F., Gianfranco, F., Simona, M., Claudia, P., & Patrizia, S. (2020). Design and optimisation of an innovative two-hub-and-spoke network for the Mediterranean short-sea-shipping market. Computers & Industrial Engineering.
62. Papadimitriou, S. (2001). Short Sea Shipping in Europe: Experience and Prospects. Diambil kembali dari https://www.itf-oecd.org/sites/default/files/docs/01shortsea.pdf
63. Park et al. (2004). The effect of airline service quality on passengers' behavioural intentions: a Korean case study,. Journal of Air Transport Management, 10(6), 435-439.
64. Peters, L. J., Chattopadhyay, G., & Tuck, M. A. (2022). Studies on the impact of road freight transport and alternative modes in Australia: a literature study. International Journal of System Assurance Engineering and Management .
65. Puckett et al. (2011). Preferences for alternative short sea shipping opportunities. Transp. Res. E Logist. Transp, 47, 182-189.
66. Ramanathan, U. (2013). Aligning supply chain collaboration using analytical hierarchy process. Omega, 41, 431-440.
67. Raza et al. (2020). Modal shift from road haulage to short sea shipping:a systematic literature review and research directions. Transport Reviews, 40 , 382-406.
68. Rennie, C. (2002). The role of coastal shipping within Southern Africa'S Transport Infrastructure. In: 21st Annual South African Transport Conference "Towards Building Capacity and Accelerating Delivery". MoT, Pretoria.
69. Rodrigue, J.-P. (2017). The Geography of Transport Systems, 3rd ed. Routledge, New York.
70. Román et al. (2016). A latent class model with attribute cut-offs to analyze modal choice for freight transport. Transportation Research Part A, 212-227.
71. Roso, V. W. (2009). The dry port concept: connecting container seaports with the hinterland. Journal Transport Geography, 17 (5), 338-345.
72. Rowlinsom, M., & Wixey, S. (2002). The politics and economics of developing coastal shipping. Annual Conference of the International Association of Maritime Economists. Panama.
73. Russo et al. (2016). Competition between ro–ro and lo–lo services in short sea shipping market: The case of Mediterranean countries. Research in Transportation Business & Management, 27-33.
74. Russo, F., & Musolini, G. (2013). Geographic factors affecting the presence of transhipment services in regional maritime container markets. Geographical Analysisi, 45, 90-102.
75. Russo, F., Musolino, G., & Assumma , V. (2023). Ro-ro and lo-lo alternatives between Mediterranean countries: Factors affecting the service choice. Case Studies on Transport Policy.
76. Saaty, T. L. (1990). How to make a decision: The analytical hierarchy process. European Journal of operational Research, 48 (1), 9-26.
77. SADC. (t.thn.). SADC Regional Infrastructure Development Master Plan [WWW Document]. (South. African Dev. Community) Diambil kembali dari http://www.sadc.int/files/9313/5293/3536/ RegionalInfrastructureDevelopmentMasterPlanTransportSectorPlan.pdf
78. Saldanha, J., & Gray, R. (2002). The potential for British Coastal shipping in a multimodal chain. Maritime Policy and Management, 29 No.1, 77-92.
79. Samimi et al. (2011). A behavioral analysis of freight mode choice decisions. Transportation Planning and Technology, 857-869.
80. Santos, T. A., & Soares, C. G. (2016). Modeling transportation demand in short sea shipping. Maritime Economics & Logistics.
81. Seo et al. (2012). Recent development in technologies for short sea shipping and its implications. implications. Journal of Navigation and Port Research, 36, 883-888.
82. Seoane, M. J., Laxe, F. G., & Montes, C. P. (2017). Short sea shipping in the Atlantic Arc: a spatial shift-share approach. Int. J. Shipping and Transport Logistics, 9.
83. Singh et al. (2018). Supply chain collaboration: a state-of-the-art literature review,. Uncertain Supply

Chain Management, 6 (2), 149-180.
84. Strandenes, S., & Marlow, P. B. (2000). Port pricing and competitiveness in short sea shipping. Int. J. Transp. Econ, 27, 315-334.
85. Thorhauge et al. (2017). The role of intention as mediator between latent effects and behavior: application of a hybrid choice model to study departure time choices. Transportation.
86. Train, K. (2009). Discrete choice methods with simulation. Cambridge University Press.
87. Transportation, U. D. (2010). DOT releases new freight transportation data. Diambil kembali dari from: http://www.fhwa.dot.gov/pressroom/fhwa1062.htm
88. Wang et al. (2016). Port connectivity in a logistic network: the case of Bohai Bay, China. Trans. Res. E Logistics Transport., Rev. 95, 341–354.
89. Wang et al. (2017). Dynamic resource allocation for intermodal freight transportation with network effects: Approximations and algorithms. Transportation Research Part B: Methodological, 99, 88-112.
90. Wang, Y., & Meng, Q. (2017). Discrete intermodal freight transportation network design with route choice behavior of intermodal operators. Transportation Research Part B: Methodological, 95, 76-104.
91. Yang et al. (2010). An analytic network process approach to the selection of logistics service providers for air cargo. Journal of Operational Research Society, 61 (9), 1365-1376.
92. Yazdanpanah, M., & Hosseinlou, M. H. (2016). The influence of personality traits on airport public transport access mode choice: A hybrid latent class choice modeling approach. Journal of Air Transport Management, 147-163.
93. Zeeshan et al. (2020). Modal shift from road haulage to short sea shipping: a systematic literature review and research directions. Transport Reviews, 40:3, 382-406.
94. Zhang et al. (t.thn.). Connectivity at Chinese airports: the evolution and drivers. Transp. Res. A Policy Pract, 103, 490-508.