Unlocking Efficiency: Seaport Infrastructure, Warehouse Integration, and Commodity Availability

Atong Soekirman[1]

[1] Institut Transportasi dan Logistik Trisakti, Jakarta, Indonesia, a.soekirman@gmail.com

Corresponding Author: a.soekirman@gmail.com

Abstract: This study investigates the interaction and impact of key variables in the supply chain, including commodity availability, shipping information, port infrastructure, warehouse integrators, and fuel prices in reverse logistics. Through a deeper understanding of these variables, this study aims to help companies identify challenges, optimize operational performance, and develop adaptive strategies in the face of market and environmental changes. Conduct a thorough literature review of related research in the areas of port infrastructure, warehouse integration, and commodity availability to gain a deep understanding of current issues and trends. This qualitative research contributes to the results of its research for reference and is used by other researchers. By paying attention to all these factors, companies can improve the efficiency and effectiveness of their reverse logistics operations and reduce their activities' environmental impact. In addition, further research and proper strategy implementation are essential to achieve optimal results in reverse logistics.

Keywords: Seaport Infrastructure, Warehouse Integration, Commodity Availability.

INTRODUCTION

The existence and smooth supply chain is crucial for business success in various industrial sectors. One of the key elements in maintaining a smooth supply chain is observing and managing several important variables such as commodity availability, information on shipping lines, infrastructure, port facilities, availability of warehouse integrators, and fuel prices in reverse logistics. Accurate knowledge of delivery schedules, available routes, and transportation conditions can help companies plan shipments efficiently and avoid unwanted delays (Zhang and Liu, 2021). Interruptions in shipping information, such as weather uncertainty or political unrest in delivery lines, can delay delivery and affect customer satisfaction (Elmi *et al.*, 2022).

The availability of commodities becomes the starting point in the supply chain. Accurate information about the availability of commodities is essential for companies to plan production and procurement appropriately (Paul and Chowdhury, 2021). When commodities are available in sufficient quantities, companies can place orders with the optimal shipping line to get the goods to their location. Fluctuations in commodity availability can disrupt production and distribution flows, which can impact the availability of the final product in the

market (Xiuzhen, Zheng and Umair, 2022). In an era of globalization, where the supply of goods can come from different countries, ensuring stable availability of commodities requires careful monitoring of factors such as seasonal changes, political disruptions, and logistical issues (Tetteh, 2022).

Information about shipping lines and shipping lines is key in maintaining the smooth movement of goods from one point to another (Susanto, Subagio, *et al.*, 2024). With good access to information about delivery schedules, available routes, and transportation conditions, companies can make the right decision to choose the most efficient and economical delivery line (Tseng and Cullinane, 2018). Information about shipping lines has also become very important. Delays or interruptions in delivery can result in production delays, additional costs, and customer disappointment (Costa *et al.*, 2018). Therefore, fast and accurate access to information on delivery schedules, alternative routes, and weather conditions is key in managing risk in the supply chain.

In order to support the above, port infrastructure and facilities play an important role in facilitating the delivery of goods (Susanto, Saribanon, *et al.*, 2024). A good seaport equipped with adequate infrastructure can speed up the loading and unloading process and reduce ship waiting times, thereby optimizing efficiency in the supply chain (Jia, Meng and Kuang, 2021). An efficient and well-integrated seaport can speed up the loading and unloading process and reduce ship waiting times, which in turn can improve the productivity and efficiency of the entire supply chain. However, underinvestment in port infrastructure and lack of facilities can be obstacles in achieving optimal performance levels (Murav'ev *et al.*, 2022). The availability of warehouse integrators is also closely related to the smooth running of the supply chain. An efficient warehouse integrator can provide good inventory storage and management services, enabling companies to manage stock more efficiently and improve responsiveness to market demand (Falkenberg and Spinler, 2022).

Limitations in the number and reach of warehouse integrators can limit a company's ability to leverage their services (Nambiar and Mundra, 2022). Fuel prices affect overall operating costs in the supply chain. Rising fuel prices may encourage companies to seek more efficient logistics solutions, such as shipping consolidation or the use of more fuel-efficient modes of transportation. Fuel prices have a significant impact on reverse logistics, which includes activities such as product returns, goods recovery, and material recycling. Rising fuel prices can increase overall operating costs and reduce a company's profits, thus influencing decisions related to stock management, shipping, and product returns (Liogu and Saerang, 2015). This study aims to investigate the interaction and impact of key variables in the supply chain, including commodity availability, shipping information, port infrastructure, warehouse integrators, and fuel prices in reverse logistics. Through a deeper understanding of these variables, this study aims to help companies identify challenges, optimize operational performance, and develop adaptive strategies in the face of market and environmental changes.

METHOD
Conduct a thorough literature review of related research in the areas of port infrastructure, warehouse integration, and commodity availability to gain a deep understanding of current issues and trends. This qualitative research contributes to the results of its research for reference and is used by other researchers.

RESULTS AND DISCUSSION
Results
Implementation Availability of Commodity on Reverse Logistic
The literature related to this variable already exists and is the result of research that is used as the basis of this literature article where the study from (Fadhel, 2014) states that

developing two models of collection and redistribution systems for the Saudi Food Bank (Eta'am). The first model deals with the collection and redistribution system of excess food and the second model is developed for multi-commodity collection and redistribution systems as an extension of the first. By solving two models for various budget constraints, we identify the point between centralization and decentralization of collection and redistribution centers where system responsiveness increases. The availability of commodities in reverse logistics is very diverse and can include a wide range of products and materials. Effective management of these commodities is essential to reduce waste, conserve resources, and minimize the environmental impact of production and consumption (Ikhlas *et al.*, 2023).

Another study stating findings with regard to this variable states there are obstacles and drivers for the development of reverse logistics in China's e-commerce market. It was revealed that the most significant growth points are technological and political factors contributing to the development of reverse logistics in the e-commerce market, which is effectively organized and managed through the establishment of digital logistics infrastructure (Du, 2024). Other studies state uncertainty in product returns, time dependence of decision variables, capacity limitations, and the possibility to treat several classes of products at once immediately after one product class with consideration of breakdown (Bennekrouf, 2014)

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Implementation Information of Shipping Line, on Reverse Logistic

Studies from (Yang, Xie and Li, 2018) state the proposed method can effectively solve reverse logistics inventory control for electronic commerce shipments. Another study stating the importance of information systems in supporting reverse logistics processes is emphasized, pointing to the need for reverse logistics information systems to improve decision making and value creation in this area (Sharma and Kumar, 2016). Another study states that modelling and simulation of reverse supply chain management systems takes stability into account, with the aim of optimizing reverse product flow and reducing environmental impact, involving transportation and handling of products through shipping channels.

Other studies pertain to many companies have not established what amount of investment should be made in logistics and seek the right balance between responsiveness and efficiency (Kirui, 2017). Other studies state the probability of product fit is moderate, the cost of consumer hassle is low and the retailer's reverse logistics cost is low, the price that drives handling is the optimal strategy for retailers, challenging the conventional wisdom that handling by consumers is always bad for retailers (Balaram, Perdikaki and Galbreth, 2021). Another study states the relationship between information systems and cooperation with senders can be explained as a resource-based view. Secondly, there is an interaction effect between information systems and managers' support of blockchain technology on this cooperation and this can be explained as a resource-based view. Information systems are a resource of shipping and logistics companies, and managers should encourage and incentivize staff to use new technologies such as blockchain, followed by a high degree of cooperation with shippers (Bae, 2021).

Implementation Infrastructure and Facilitation of Seaport on Reverse Logistic

The corresponding results suggest it is better for smaller freight forwarders to collaborate a conclusion that emerges from within the model as a consideration between exploration and exploitation. As a result of these prototype simulations, major freight

forwarding agencies will not always benefit from DSS especially since they are already leveraging economies of scale (Irannezhad, Prato and Hickman, 2020). Another study also stated that the development of inland ports has a positive impact in facilitating bilateral trade between China and South Korea. However, this positive relationship is only seen in areas in China with large trade volumes and close to sea ports. In other regions, the impact of inland ports is not statistically significant (Wang, Chu and Kim, 2020).

Other studies from (Ambekar *et al.*, 2022) The stated identified ten barriers in implementing RL systems in the CRIP sector. The results of the ISM model show that macro level barriers influence each other and encourage other barriers. Organizational barriers at the strategic tactical level, such as rigid corporate mechanisms, lack of awareness of economic benefits, and scarcity of resources, are found at the middle hierarchical level and can be affected by barriers at lower levels and affect barriers at higher levels. Operational bottlenecks such as Inadequate Information Technology systems are at the top of the hierarchy and can be affected by barriers to a lesser extent.

Other studies state it is important to manage this mode of transportation well. Infrastructure planning and management is crucial to ensure a good future for the port sector. However, Indian ports are still far from achieving an adequate level of satisfaction in terms of efficiency and customs inspection processes. The infrastructure of Indian ports is currently in very poor condition (Singh, 2022). Another study states that improving infrastructure and logistics performance can increase the sustainable growth of middle-income countries with increasing international trade volumes (Yeo, Deng and Nadiedjoa, 2020)

Implementation Availability of Warehouse Integrator on Reverse Logistic

The results study states that reverse logistics (RL) is the process of managing returns still one aspect of business that is often overlooked. Warehouse management and third-party logistics (3PL) are key to running RL operations. The warehouse management system (WMS) is the backbone, taking care of incoming goods storage and requires seamless integration and collaboration. However, current return management processes are often poorly integrated with collaborative partners, resulting in delays, high inventory levels, and decreased customer satisfaction (Wanganoo, 2020) Another study stated the fuzzy model was more economically advantageous than the assertive model, finding that the assertive and fuzzy models saw a 0.34% difference in total cost, illustrating this study, and sensitivity analysis was performed using tables and graphs (Kumar, Sarkar and Kumar, 2021).

Another study states Reverse logistics in warehouses has become increasingly important in modern supply chains due to increasingly fierce competition for buyers and the shift from a push sales strategy to a recall strategy (Apostolov, 2021). In the context of reverse logistics, various mathematical models and methods have been developed to analyze and optimize reverse supply chains. These models take into account factors such as revenue from the sale of recovered parts and the use of distribution for vehicle failures (Buyvol *et al.*, 2020). Warehouse management in reverse logistics is critical to the efficiency and cost-effectiveness of the process. The use of mathematical models, AIDC technology, and indoor positioning systems can all contribute to optimizing the process of returning goods in warehouses (Lewczuk and Zaleski, 2018).

Implementation Fuel Price on Reverse Logistic

Reverse logistics, fuel prices can have a direct impact on the cost of transporting returned goods. For example, a study of reverse supply chain optimization found that Weibull's use of distributions for vehicle failures was the most statistically significant for the area of operation under consideration (Buyvol *et al.*, 2020). The use of alternative energy sources, such as biodiesel, can also be a viable option to reduce the impact of fuel prices on reverse logistics. A study on the planning and optimal design of waste-to-energy plants for

aquaculture systems found that the use of biodiesel can reduce electricity costs and costs associated with reverse logistics (Ighravwe *et al.*, 2023).

Another study also states facilitating the transition from oil-dependent transportation to renewable energy transportation by providing solutions for its final products. The output of this article is considered a preparedness plan to help countries seeking a transition from oil-dependent transportation to systems using renewable energy (Alkahtani and Ziout, 2019). The biggest benefits for companies can be obtained through: government financial support for distribution and recycling logistics with the lowest environmental protection tendencies, following the Nash game, reducing greening costs, reducing government investment rejection behavior, and increasing the level of recyclable products (Jolai, Hafezalkotob and Reza-Gharehbagh, 2021).

Discussion

Implementation Availability of Commodity on Reverse Logistic

Effective management of commodity availability in reverse logistics has a significant impact in reducing waste, conserving resources, and minimizing the environmental impact of production and consumption. The importance of a deep understanding of the variables of commodity availability in reverse logistics, both in terms of effective management and in facing challenges that exist in different market and infrastructure contexts. As a researcher, understanding findings from the literature and related research is a crucial first step in crafting relevant and impactful policy arguments and suggestions.

Implementation Information of Shipping Line, on Reverse Logistic

The importance of cooperation and integration between various stakeholders in the supply chain, as well as the role of technology in facilitating this cooperation. Overall, this discussion provides a comprehensive overview of the various aspects of reverse logistics and the importance of understanding the dynamics that occur in this context. As a researcher, understanding the findings of various studies can help in formulating effective strategies and solutions to improve efficiency and responsiveness in reverse logistics processes.

Implementation Infrastructure and Facilitation of Seaport on Reverse Logistic

Provide important insights for researchers in understanding the dynamics and challenges associated with infrastructure implementation and seaport facilitation in the context of reverse logistics. Understanding these findings can help in formulating effective strategies and solutions to improve efficiency and responsiveness in reverse logistics processes across multiple contexts.

Implementation Availability of Warehouse Integrator on Reverse Logistic

This discussion provides important insights for researchers in understanding the complexities and challenges associated with implementing warehouse integrators in the context of reverse logistics. Understanding these findings can help in formulating effective strategies and solutions to improve efficiency and responsiveness in reverse logistics processes across multiple contexts.

Implementation Fuel Price on Reverse Logistic

The discussion on this matter in general perspective presented highlights the complexities and challenges associated with fuel prices in reverse logistics, as well as the importance of sustainable strategies and solutions to deal with fuel price fluctuations in reverse logistics operations.

CONCLUSION

From the various research results that have been described, it can be concluded that the implementation of various factors such as commodity availability, shipping information integration, port infrastructure development, warehouse integration, and fuel price fluctuations are very important in improving the efficiency and effectiveness of reverse logistics operations. First, the availability of commodities in reverse logistics is a key factor in ensuring a smooth process of managing returns. Effective management of these commodities not only helps reduce waste, but also minimizes the environmental impact of production and consumption.

Second, the integration of shipping information is crucial in supporting reverse logistics operations. Good collaboration between information systems and managerial support of blockchain technology can enhance cooperation with shippers, thereby strengthening the overall supply chain. Furthermore, port infrastructure development, especially in the interior, can have a positive impact in facilitating bilateral trade. However, keep in mind that the effect may not be significant in all areas, so careful planning needs to be done.

Then, warehouse integration is also an important factor in running reverse logistics operations. An efficient and well-integrated warehouse management system can help reduce delays and increase customer satisfaction. Finally, fluctuations in fuel prices also need to be considered in reverse logistics planning. The use of alternative energy sources and supportive government policies can help reduce the impact of fuel prices on reverse logistics costs, thus creating a more sustainable operational environment.

By paying attention to all these factors, companies can improve the efficiency and effectiveness of their reverse logistics operations, as well as reduce the environmental impact of their activities. In addition, further research and proper strategy implementation are essential to achieve optimal results in reverse logistics.

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