IMPLEMENTATION OF MULTIMODAL TRANSPORTATION IN LOGISTICS ON JAVA ISLAND

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ABSTRACT
This study discusses the implementation of multimodal transportation in Java, Indonesia, with a focus on economic and logistical aspects. Key infrastructure for economic growth is lagging, particularly in the eastern regions, impacting investments. The literature review strengthens its potential benefits. A multimodal system is necessary to enhance logistics and reduce costs, especially in archipelagic nations. Implementation has the potential for cost savings in shipments. Close coordination of key stakeholders is essential. Infrastructure investment is crucial. Periodic evaluations are needed to ensure objectives are met. Implementation in the Pantura Corridor improves efficiency and sustainability in cargo transportation on Java, with positive local and global impacts, contingent on collective commitment.

Keywords: java; multimodal transportation; logistics infrastructure

INTRODUCTION
Java is crucial to Indonesia's economy, requiring efficient logistical transportation. This is key for timely distribution of goods, low logistics costs, and product competitiveness. Challenges include limited infrastructure, heavy traffic, difficult connectivity, high costs, and insufficient coordination. Multimodal transportation presents an intriguing alternative that warrants further research. It leverages various modes (road, rail, river, port) to optimize the flow of goods and services, providing benefits in efficiency, flexibility, and connectivity. It reduces dependency on a single mode and optimizes infrastructure, crucial in addressing logistics issues in Java. Evaluating its potential benefits and implementation challenges is crucia

Potential analysis involves evaluating infrastructure (roads, railways, ports, airports) on Java, identifying strengths and weaknesses. Consideration is given to connectivity between modes and potential integration. Supporting facilities (storage, intermodal terminals) are also noted for smooth operation of multimodal transportation. Regulations and policies are evaluated to identify constraints in implementing multimodal transportation. Government efforts in promoting its use, including incentives, are explored. Benefitanalysis encompasses cost reduction, increased speed and reliability of deliveries, operational efficiency, and positive environmental impact. Understanding these benefits is crucial in driving the adoption of multimodal transportation in Java.

METHOD
This research employs a qualitative literature review method to analyze the potential of multimodal transportation on Java. The researchers will evaluate and synthesize previous studies related to this topic, selecting relevant and high-quality literature sources. Data analysis will involve reading, comprehending, and evaluating information from the literature. Key findings will be documented, including aspects of infrastructure, connectivity, facilities, regulations, and the benefits obtained. The outcomes will aid in the development of logistics transportation on Java.

RESULT AND DISCUSSIONS

Multimodal Transport

Multimodal transportation integrates different modes of transport into one system, recognizing the need for varied modes for efficient travel. It focuses on the interaction and complementation of transportation modes within urban systems. Understanding demand, capacity, and accessibility is crucial. It enables adaptation to disruptions and demand fluctuations, promoting seamless connections between transportation modes for efficient travel. By considering unique needs, decision-makers can enhance the resilience and sustainability of urban transportation systems. Multimodal transportation optimizes the strengths of different transportation modes for overall system efficiency (Wang et al., 2023).

Eydi & Shirinbayan (2023) explain the concept of multimodal transportation, leveraging the strengths of different transportation modes to enhance network efficiency. Placing gates near strategic transportation hubs maximizes the efficiency of each mode. For example, gates at train stations utilize cost-effective long-distance transportation, while gates at ports capitalize on international shipping via waterways. This approach allows for the selection of the most suitable mode for each stage of travel, enhancing supply chain responsiveness and resilience. Overall, multimodal transportation offers an efficient and robust solution to the demands of goods movement in an interconnected world.Furthermore, Bergantino et al., (2023) elaborate on the concept of regional multimodality, which integrates various modes of transport to improve accessibility and travel efficiency within a region. The goal is to create a connected system for an optimal travel experience. This approach provides options tailored to individual needs, improving access to services and destinations, and reducing reliance on private vehicles. It supports sustainable economic development and enhances quality of life. Multimodal transportation provides benefits such as cost reduction, efficiency, greenhouse gas emission reduction, and delivery reliability. It encourages collaboration between transportation modes for a more integrated and effective system.

Logistics Transport in Java

Cargo transport involves the movement of goods via vehicles on roads. There are two types: general transport (for regular goods) and specialized transport (for hazardous goods). Monitoring the cargo involves inspections of loading procedures, dimension measurements, pressure weighing, and document checks. The type of goods influences the choice of transportation mode. Cargo transport is crucial in the production process and the economy. Overloaded cargo can damage roads, and weighbridges help address this issue. With proper oversight, cargo transport can run efficiently and safely, supportings economic activities as a whole (Minister of Transportation Regulation No.60/2019).Java serves as the industrial base and a densely populated center, making logistics pivotal for Indonesia's economy. The logistics concept here is crucial for trade, production, and distribution. Various modes of transportation (roads, railways, ports, airports) are vital for efficient goods movement. Inventory management encompasses control, planning, procurement, and stock monitoring. With effective management, logistics in Java can ensure adequate availability of goods and avoid the risk of excess stock.

Dhista Ayunia et al., (2020) emphasize that investments and improvements in infrastructure for cargo transport via railways and airways in Java have the potential to accelerate movement and positively impact the Gross Domestic Product (GDP). While maritime transport has a more limited impact on the GDP, revitalizing ports and implementing sea toll programs can enhance its contribution to regional economic growth. Therefore, the government needs to consider strategies and policies that support all modes of transportation, especially maritime transport,

in logistics management in Java. On the other hand, Rifni et al., (2013) highlight the limitations of logistics infrastructure in Java, which directly affects the operational aspect of cargo transport. The lack of logistics facilities such as warehouses, forklifts, and hand lifts is a source of traffic problems, road damage, as well as economic and environmental impacts. One potential solution is optimizing the use of railways through the development of adequate terminals. In this regard, the government should strengthen investments, update regulations, and provide incentives. Public-private partnerships can also enhance efficiency and safety in the logistics chain in Java, which in turn will support economic growth and sustainable development.

Furthermore, the logistics concept in Java also encompasses warehousing and storage aspects. Adequate warehousing facilities, such as central warehouses, transit warehouses, and distribution centers, are crucial for temporarily storing goods or facilitating distribution activities. With proper warehousing infrastructure, logistics in Java can optimize the goods storage process, minimize the risk of damage or loss, and enable smooth distribution operations overall. By implementing this logistics concept, Java has significant potential to become a strategic logistics hub and support sustainable economic growth. By ensuring the efficiency, reliability, and speed of goods delivery, as well as optimizing resource and cost management, the logistics concept in Java serves as a crucial foundation for the success of logistics activities in this region.

Implementing the Multimodal Transportation in Java

Wirabrata et al. (2012) stated that the economic crisis of 1997/1998 shifted the government's focus away from infrastructure, resulting in a deficiency of infrastructure across the country. Its impact was felt on economic growth, foreign investment, poverty reduction, and environmental quality. Infrastructure serves not only as an economic growth enabler but also as an integral provider of services. To drive the economy, the government must encourage infrastructure growth. Reform in transportation infrastructure is needed to overcome barriers to economic growth and enhance national competitiveness. The current state of infrastructure in Indonesia, especially in the eastern regions, is far from satisfactory. This gap significantly affects potential investors and requires substantial maintenance investments.Despite growing confidence in investments in Indonesia, infrastructure remains a primary concern for businesses. Reports indicate that the quality of infrastructure in Indonesia requires significant improvement. The government has made efforts, as seen in the National Development Plan 2010-2014, which shows progress in roads and bridges. However, the archipelagic nature necessitates a greater focus on infrastructure to ensure even benefits. Efficient transportation infrastructure is crucial in connecting and supporting economic activities Wirabrata et al. (2012).

A multimodal transportation system is crucial for improving logistics efficiency and reducing transportation costs, especially in archipelagic countries like Indonesia. Adequate loading and unloading facilities are necessary, but inadequate infrastructure conditions in Indonesia impact logistics costs and economic competitiveness. Efforts to improve transportation management face challenges such as a shortage of skilled labor and limited funds. Government support and strategic planning are key in accelerating infrastructure development, with priorities based on regional potential. The implementation of multimodal transportation in the Pantura Corridor, especially in the Surabaya-Jakarta corridor, has significant potential to alleviate road congestion on Java. Four main transportation modes were evaluated: general cargo trucks, container trucks, container trains, and container ships. The research results indicate that with multimodal transportation, approximately 47.97% of the total cargo can be shifted from the Pantura

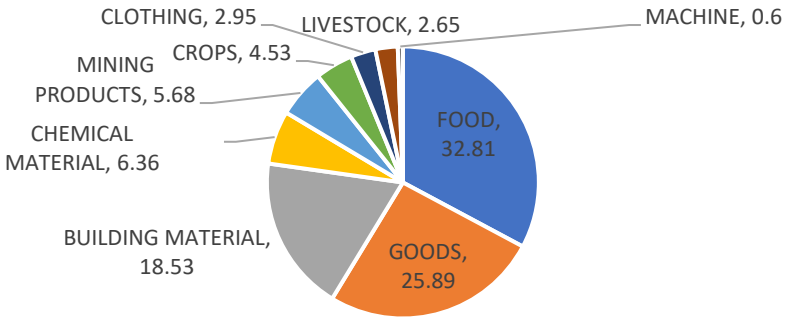

Figure 1. Commodity Composition towards the West
Source: Prasetyo et. al. (2013)

Corridor in the first year. The fleet plays a key role in the success of this implementation, with container ships becoming a more dominant mode of transportation in the future (Prasetyo et. al. (2013).

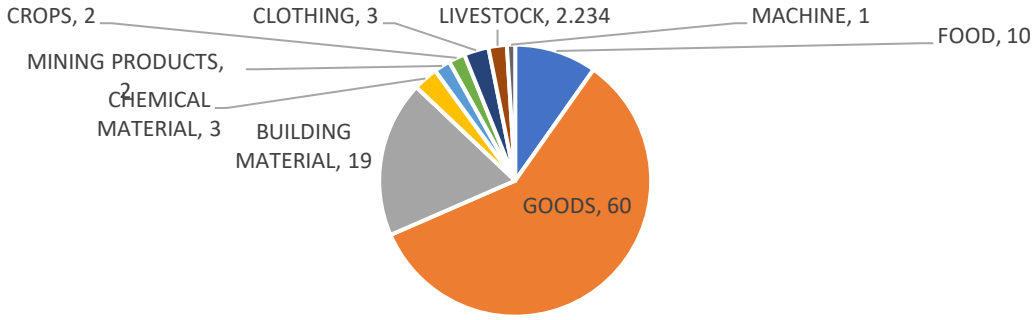

Figure 2. Commodity Composition towards the East
Source: Prasetyo et. al. (2013)

The implementation of multimodal transportation in the Pantura Corridor, especially in the Surabaya-Jakarta corridor, has a significant impact on the efficiency and sustainability of logistics in Java. Taking into account the characteristics of commodities, transportation strategies can be tailored to maximize the efficiency of transportation modes. This reduces the logistics costs of shipping goods, providing substantial potential savings for manufacturers and distributors, as well as reducing the risk of accidents. Good coordination between the government, transportation operators, and other stakeholders is necessary. Investment in infrastructure, especially ports and rail networks, is also crucial. Periodic evaluations are needed to ensure that the goals of reducing road congestion and increasing efficiency are achieved. Globally, the implementation of multimodal transportation can help mitigate climate change by using more environmentally-friendly transportation modes. With the right commitment and cooperation, the potential of this implementation can be fully realized, bringing significant benefits to society, the environment, and the economy.

Benefits and Potential of Multimodal Transportation as a Logistics Solution

Multimodal transportation is a freight delivery system that utilizes more than one mode of transportation to optimize efficiency and speed of delivery. This concept offers several significant benefits in the context of modern logistics.The primary advantage of multimodal transportation lies in leveraging the strengths of each mode of transport. Using railways for long-distance shipments reduces time and costs, while road transport is suitable for short distances or direct deliveries. By choosing the right mode, multimodal transportation maximizes route efficiency and avoids hindrances. This results in a significant reduction in both

time and cost of delivery. By judiciously combining modes of transportation, companies can minimize operational costs and shorten delivery times. In addition to efficiency gains, multimodal transportation also enhances capacity and scalability in cargo delivery. By harnessing various modes of transportation, this system can overcome capacity limitations of any single mode, enabling an increase in delivery volume and adaptability to market demand fluctuations.Overall, multimodal transportation holds significant potential in shaping modern logistics. By capitalizing on the strengths of each mode of transportation, optimizing routes, and enhancing scalability, this system brings substantial benefits in terms of delivery efficiency and speed. With effective management and seamless integration between transportation modes, multimodal transportation can play a pivotal role in enhancing logistics performance and supporting sustainable economic growth.

Advancing Logistics Efficiency and Sustainability

Multimodal transportation in Java enhances the efficiency and speed of deliveries by optimizing routes and modes of transport. Intermodal facilities and supporting infrastructure facilitate swift handling of goods at transfer points. Optimal selection of transportation modes based on the characteristics of the goods and delivery destinations further enhances efficiency. Synchronization of schedules and intermodal coordination are crucial to avoid delays. Inspection facilities and intermodal terminals play a significant role in ensuring the smoothness of the delivery process. Additionally, multimodal transportation improves connectivity and accessibility to remote areas in Java through the integration of transportation modes, supporting infrastructure, and integrated services.

In terms of reducing logistics costs and environmental impact, multimodal transportation offers a significant solution. The use of an optimal and efficient combination of transportation modes, along with the selection of the best routes, can reduce overall logistics costs. Furthermore, the use of environmentally-friendly transportation modes and more efficient resource management can reduce emissions and negative environmental impacts. By optimizing the use of transportation modes, minimizing emissions, and implementing efficient waste management practices, multimodal transportation is capable of providing a sustainable and efficient logistics solution in Java.The implementation of multimodal transportation in Java has the potential to enhance the efficiency and speed of goods distribution through the integration of different transportation modes. This includes the use of trucks, trains, shipping, or even air transport to optimize the movement of goods. With proper coordination and adequate infrastructure, such as port services and road and railway networks, goods distribution can be carried out more swiftly and efficiently. In major cities like Jabodetabek, multimodal transportation helps alleviate traffic congestion and accelerates goods distribution. For instance, by combining trucks and trains, travel time can be minimized (Wibowo et al., 2017).

Supporting Multimodal Facilities

Pertiwi (2017) reveals the significant potential of utilizing railway wagons for transporting heavy goods, emphasizing the pivotal role it can play in fortifying the logistics infrastructure in Java. The island is currently equipped with a diverse range of multimodal facilities, including seaports, container terminals, railway stations, and international airports. By capitalizing on the proposed multimodal transportation model in her thesis, Pertiwi advises stakeholders and relevant authorities in Java to further optimize the utilization of existing multimodal facilities. This endeavor is expected to enhance the efficiency and effectiveness of goods transportation, subsequently driving economic growth and solidifying Java's position as a key logistics hub in Indonesia. Key transportation hubs such as Soekarno-Hatta International Airport (CGK), Tanjung Priok Port, Surabaya Port (Tanjung Perak), Semarang Container Terminal (TPKS),

Cilacap Container Terminal, and Jakarta Kota Railway Station play a vital role in streamlining goods distribution through various modes of transportation.

Rifni et al. (2015) reported that in 2010, the market share of railway transportation in cargo transport on Java was only 0.6%, with a total transport volume of 19,149,000 tons. However, projections for 2030 show impressive growth, estimated to reach around 534 million tons per year in Java and about 403 million tons in Sumatra. To support this growth, the government has set a program to increase the minimum share of railway freight to 5%. Tanjung Perak Port, as the second busiest port in Indonesia, recorded more than 3.1 million international container visits, with 1.2 million TEUs from international containers. Economically, using the railway from Jakarta to Surabaya offers a more efficient alternative with a cost of around IDR 2.5 million and a travel time of only one day, compared to truck costs of IDR 4 million to IDR 5 million with a travel time of three days. Lagoa and Kalimas terminals have large capacities to accommodate a considerable number of TEUs per day, facilitating the loading and unloading process. The railway accident rate is considered low, at around 0.025 incidents per 1 million km of railway travel, indicating a high level of safety in goods transportation using this mode.

With integrated multimodal infrastructure in Java, including seaports, container terminals, railway stations, and airports, there is significant potential to advance the logistics sector. The analysis emphasizes the strategic role of railway wagons in goods distribution, with high growth projections up to 2030. The government is committed to increasing the use of railway transportation. The number of international container visits at major ports and the cost efficiency of using the railway are compelling reasons to choose this mode. Safety in goods transportation via railway is also a positive factor. With strategic planning and optimization of existing multimodal facilities, Java can strengthen its role as a primary logistics hub in Indonesia, driving economic growth in the region.

Regulatory Review for Multimodal Transport

Java serves as the primary hub for the implementation of the National Logistics System (SISLOGNAS) in Indonesia, boasting an integrated multimodal infrastructure. However, transportation costs, infrastructure, and administrative processes remain significant challenges. Government support, including financial incentives, is needed to optimize the logistics sector in Java. Harmonizing regulations and coordinating project management approaches are key to enhancing the efficiency of the logistics system. The evaluation of SISLOGNAS progress in Java must consider the unique characteristics of this island as a vital logistics hub in Indonesia. Strong institutions are also crucial to coordinate functions, policy setting, and monitoring of SISLOGNAS in Java, which stands as a highly vital logistics activity center in Indonesia.

Figure 3. Logistics Supply Chain

Regulations related to multimodal transportation in Indonesia play a crucial role in governing various aspects of a transportation system involving more than one mode. These laws and regulations cover a range of aspects, from operational permits to stringent safety standards. One of the key laws governing transportation in Indonesia is Undang-Undang No. 22 Tahun 2009 concerning Traffic and Road Transportation. This law provides the legal framework for land transportation modes, encompassing motor vehicles and roadways. It includes requirements for operational permits, safety standards, and other obligations for all stakeholders in the land transportation industry.

Meanwhile, railway transportation is regulated by Law No. 23/2007 concerning Railways. This law covers various aspects related to railway operations, including operational permits for railway companies, railway infrastructure, and railway services. In addition to laws specifically regulating modes of transportation, there are also more specialized regulations pertaining to multimodal facilities. For instance, Minister of Transportation Regulation No. 26/2015 regarding Terminals governs the licensing and management of terminals. This encompasses various aspects, such as technical and security requirements, procedures for licensing, and the rights and obligations of terminal operators. Customs regulations also play a crucial role in multimodal transportation. Every import and export activity must adhere to strict customs provisions. This includes the payment of customs duties and related taxes, as well as security inspections of goods. The aim of these customs regulations is to ensure that goods entering and exiting Indonesia comply with established standards, without compromising national security and public health.

The legal framework for maritime transport in Indonesia, based on Law No. 17/2008 concerning Shipping, covers aspects of maritime, river, and lake transport, as well as ferries. While it has provided comprehensive regulation, specific revisions are needed for alignment with the Omnibus Law and clearer guidelines at the regional level. Restrictions on foreign investors in buying or leasing ships need to be evaluated to facilitate partnerships and the growth of the domestic shipping industry. Government Regulation No. 31/ 2021 provides clear guidelines, including arrangements, control, and supervision of maritime transportation. With well-defined tariff structures, including criteria for determining freight rates, this regulation provides a strong framework for the shipping industry. Collaboration between foreign investors and local companies can drive industry growth, but it must ensure balanced benefits for all parties. Overall, the current legal framework provides a solid foundation for the maritime transport industry in Indonesia, but it must be continually monitored and updated in line with recent developments.

Regulation of air transportation in Indonesia encompasses Law No. 1/2009 concerning Aviation, Government Regulation No. 32/2021, Minister of Transportation Regulation No. 35/2021, and Minister of Transportation Regulation No. 90/2018. While Law No. 1 of 2009 provides a comprehensive legal framework, there is potential for streamlining permit requirements related to domicile letters. Government Regulation No. 32 of 2021 is a follow-up to the Job Creation Law, focusing on business permits. Minister of Transportation Regulation No. 35 of 2021 aligns with Government Regulation No. 32/2021, particularly regarding business permits. However, compensation for scheduled commercial air transport to remote areas can be a barrier. Incentives such as tax breaks or training subsidies are needed to promote commercial transport growth to remote areas. Minister of Transportation Regulation No. 90 of 2018 covers OSS-based licensing without significant barriers. Overall, these regulations form an adequate legal framework, but some adjustments are needed for effective and efficient implementation.

In addition to regulations, the government also provides various incentives to support the development of multimodal transportation. These incentives may include tax exemptions or reductions, easy access to logistics infrastructure, or other forms of financial support. These measures aim to encourage investment and growth in the multimodal transportation sector, as well as improve efficiency in the national logistics system.

Challenges in Implementing Multimodal Transportation

The implementation of multimodal transportation in coastal areas, particularly in Java, presents challenges that need to be addressed. Buses tend to be more efficient, with over two-thirds of coastal destinations reachable in less than 2 hours, while trains have good accessibility, reaching 46% of destinations in less than 1 hour. However, over 50% of destinations face accessibility constraints from airports and ports. Therefore, investment in transportation infrastructure and intermodal planning is needed to consider the implications of new investments. Improving public transportation services and modernizing vehicle fleets are also crucial for reducing carbon emissions and promoting sustainable mobility (Bergantino et al., 2023).

The main challenge in implementing multimodal transportation in Java is to build adequate and high-quality infrastructure. This includes intermodal terminals, warehouses, ports, airports, and road networks capable of handling the volume and variety of goods. However, land availability can be a constraint, especially in densely populated areas like urban areas. Coordination and integration of infrastructure are key to the success of multimodal transportation. Collaboration between the government, transportation operators, and infrastructure managers is essential to ensure that infrastructure components function synergistically. Without effective coordination, multimodal transportation operations may face hindrances.

Additionally, (Wibowo et al., 2017) point out that challenges in implementing multimodal transportation in Java involve fragmented responsibilities and unintegrated documents. Responsibilities are still dispersed, and transportation documents are not coordinated, resulting in ambiguity. The document resolution process is still manual, impeding the smooth flow of goods. Port capacity constraints also need to be addressed. Improvement of human resources and infrastructure in distribution areas is required. Incentives for railways and ships are also needed to make logistics costs more efficient. Maintenance and development of infrastructure are also crucial for optimal performance. These challenges can be overcome with careful planning, effective coordination, and adequate allocation of financial resources.

CONCLUSIONS

The implementation of multimodal transportation in Java enhances the efficiency and sustainability of goods distribution through a combination of transportation modes.The main challenges include the need for adequate infrastructure, requiring investment and coordination among the government, transportation operators, and infrastructure managers.Integrated regulations and coordinated project management are necessary to streamline and enhance the efficiency of the logistics system.Regulations also govern operational permits, security standards, and customs aspects, with government incentives to support the development of multimodal transportation.This implementation has positive local and global impacts, with full potential that can be realized through appropriate commitment and cooperation.

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