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Dynamics of Multimodal Transportation and Freight Forwarding in Indonesia: A Comprehensive Analysis of Challenges, Strategic Roles, and Policy Responses

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Abstract: Multimodal transport and freight forwarding play a crucial role in Indonesia's logistics system, especially given its archipelagic geography. This research analyzes the challenges, roles, and government initiatives related to these two sectors. Multimodal transport is defined as the carriage of goods using at least two different modes under a single contract, with the Multimodal Transport Operator (MTO) bearing full responsibility. Meanwhile, freight forwarding involves arranging and coordinating commodity shipments across borders, helping companies simplify processes and enhance efficiency. Notwithstanding their critical importance, Indonesia faces a number of obstacles in implementing multimodal transportation and freight forwarding, such as inadequate infrastructure, intricate regulations, operational problems, and a lack of human resource competency. The government has responded with initiatives such as the National Logistics System Masterplan (Sislognas), National Logistics Ecosystem (NLE) program, digitalization policies (IoT, AI), investment incentives, and human resource development programs. This study employs a comprehensive literature review approach, drawing from recent journals, articles, and books to qualitatively analyze the issues. The analysis reveals that synergy between multimodal transport and freight forwarding, supported by government policies and technology adoption, is essential for enhancing national logistics efficiency and global competitiveness. Recommendations include increased infrastructure investment, regulatory harmonization, accelerated digitalization, and strengthened human resource capacity and public-private partnerships.

Keyword: Multimodal Transportation, Freight Forwarding, Indonesian Logistics, Logistics Infrastructure, Logistics Digitalization.

INTRODUCTION

Background

With more than 17,000 islands, Indonesia is the world's largest archipelagic country and thus faces difficult logistics problems *(Badan Pusat Statistik, 2023).* This unique

geographical condition demands an integrated and efficient transportation system to ensure the smooth distribution of goods between regions and to reduce national logistics costs, which are still relatively high. The high cost of logistics is a significant obstacle to Indonesia's economic competitiveness. According to data, in July 2024, logistics costs in Indonesia reached 14.29% of the GDP *(Badan Pusat Statistik, 2024*). Some sources even mention a higher figure, around 24% of GDP *(Dimerco Indonesia, n.d.).* This figure is much higher compared to neighboring countries in Southeast Asia, such as Singapore, which only has logistics costs of around 8% of GDP *(Word Bank, 2020).* For a more specific example, logistics costs in East Java averaged 24.91% of a company's sales burden in the third quarter of 2023 *(Badan Pusat Statistik, 2023).* This striking difference directly impacts the selling price of products, making Indonesian products less competitive in the global market.

Multimodal transport, defined as the carriage of goods using at least two different modes of transport under a single contract and managed by a single operator (Multimodal Transport Operator/MTO), is recognized as a fundamental solution to improve logistics efficiency and connectivity. This concept allows for faster, safer, and more environmentally friendly delivery of goods, but its implementation in Indonesia still faces many obstacles. In addition to multimodal transport, freight forwarding or transportation management services (JPT) play a vital role as facilitators in the multimodal supply chain. Freight forwarding companies manage the complexity of documents, route optimization, storage, and cargo monitoring *(CKB Logistics, n.d.).* They act as intermediaries who do not always own their own transport vehicles but are fully responsible for the entire shipping process from origin to destination *(Jurnal Sains Teknologi Transportasi Maritim, 2022).*

Through a number of policies and initiatives, the Indonesian government has shown its commitment to improving the country's logistics ecosystem, recognizing the urgency of this issue. These efforts include the preparation of the National Logistics System Masterplan (Sislognas) and the launch of the National Logistics Ecosystem (NLE) program *(ITL Trisakti, n.d.).* In addition, the government also focuses on adopting modern technology such as the Internet of Things (IoT), Artificial Intelligence (AI), and transportation management systems (TMS) to improve efficiency and transparency in the supply chain *(Indotama Partner Logistics, 2024).* Given the complexity of the problems and the importance of the roles of multimodal transport and freight forwarding in overcoming logistics challenges in Indonesia, this research aims to provide a comprehensive analysis of the existing challenges and to evaluate the initiatives that have been and are being carried out by the government and industry players.

Problem Formulation

The problem formulations in this study are as follows, considering the background mentioned above:

- What are the definitions and characteristics of multimodal transport and freight forwarding in the context of logistics in Indonesia?
- What are the main problems faced in the implementation of multimodal transport and freight forwarding in Indonesia, covering geographical, infrastructure, regulatory, operational, human resources, and technology aspects?
- How do freight forwarding and multimodal transport contribute to increasing national logistics efficiency?
- What are the government initiatives and policies that have been implemented to overcome logistics problems in Indonesia, especially related to multimodal transport and freight forwarding?
- How do case studies and empirical data show the success or challenges in the implementation of multimodal transport, freight forwarding, and logistics policies in Indonesia?

Research Objectives

The objectives of this research are to:

- Define and describe the characteristics of multimodal transport and freight forwarding according to academic standards and the Indonesian context.
- Comprehensively identify and analyze the problems that hinder the development of multimodal transport and freight forwarding in Indonesia.
- Analyze the synergistic roles and contributions of multimodal transport and freight forwarding in efforts to improve national logistics efficiency.
- Explore and discuss relevant government initiatives and policies in an effort to improve the logistics system in Indonesia.
- Present case studies and empirical data that support the analysis of problems, implementation, and the successes or challenges of the efforts made.

Research Benefits

The expected benefits of this research are:

For Academics and Students:

- Provides a comprehensive and up-to-date reference on multimodal transport and freight forwarding in Indonesia, which can be used as a basis for further research or as teaching material.
- Helps undergraduate students of Land Transportation Management to understand the complexity of logistics problems in Indonesia and to prepare structured and data-based research journals.

For Government and Policymakers:

- Provides an in-depth analysis of the challenges and opportunities in the transport and logistics sector, which can be input for formulating more effective and integrated policies.
- Provides an overview of the effectiveness of ongoing initiatives and identifies areas that require further attention.

For Industry Players (Logistics Operators, Freight Forwarders, MTOs):

- Offers insights into market conditions, operational problems, and relevant technology trends for the development of business strategies.
- To increase efficiency, encourages cooperation among different supply chain participants.

For the General Public:

- Increases understanding of the importance of an efficient logistics system for the national economy and the availability of goods.

METHOD

Research Approach (Comprehensive Literature Review)

This research will use a comprehensive literature review approach. This approach was chosen to analyze, synthesize, and evaluate existing information from various relevant academic and non-academic sources. This method allows the researcher to gain a deep understanding of the problems of multimodal transport and freight forwarding in Indonesia, identify trends, research gaps, and formulate strong evidence-based recommendations.

A qualitative descriptive method will be used to explain the conditions and views in detail regarding the phenomenon being studied. In addition, public policy analysis will also be applied in order to formulate the role of multimodal transport in realizing the Indonesian logistics vision 2025 *(ITL Trisakti, n.d.).* This approach is relevant for understanding how

existing policies affect practices in the field and identifying areas for future policy improvement.

Data Sources (Journals, Articles, Papers, and Latest Books)

Research data will be collected from credible and up-to-date primary and secondary sources, with a focus on publications within the 2015-2025 time frame to ensure the relevance of the information and reflect current conditions. Data sources include:

- **Scientific Journals:** Indexed journals relevant to the topic of transport, logistics, and freight forwarding in Indonesia, such as:
  - Innovative: Journal of Social Science Research
  - Jurnal Manajemen Bisnis Transportasi dan Logistik
  - Asian Journal of Logistics Management
  - Jurnal Transportasi Multimoda
  - Jurnal Sains Teknologi Transportasi Maritim
  - Jurnal Riset Logistik dan Bisnis, and other journals available through databases such as ResearchGate.
- **Articles and Conference Papers:** Publications from logistics and transport conferences in Indonesia, such as Transport and Logistics Indonesia 2025, as well as articles from research institutions and industry associations that discuss current issues *(Daifuku, 2025).*
- **Books:** The latest books that discuss multimodal transport, freight forwarding, and logistics management in Indonesia, such as "BUKU TRANSPORTASI KOMPREHENSIF DAN MULTI MODA" by Sakti Adji Adisasmita, "Logistik Multimoda", "Buku Intermoda Freight Forwarding" by Meyti Hanna Ester Kalangi and Dr. Gugus Wijonarko, "Logistik Indonesia: Teori, Kebijakan, dan Praktik" by Kuncoro Harto Widodo et al., "Aspek Komersial dan Hukum Transport Multimoda" by the ALFI Team, various books on "Manajemen Rantai Pasokan", "Logistik Maritim" by Dong-Wook Song and Photis M Panayides, and "Sistem Transportasi" by Nur Khaerat Nur et al.
- **Government Policy Documents:** Relevant Government Regulations (PP), Ministerial Regulations (Permen), Presidential Instructions (Inpres), and national logistics system blueprints.
- **Industry Reports and Institutional Publications:** Reports from international organizations such as the World Bank, national institutions such as Supply Chain Indonesia, the Ministry of Transportation, and the like that provide the latest data and analysis on the logistics sector.

Data Analysis Techniques (Qualitative Descriptive Analysis and Literature Synthesis)

The collected data will be analyzed using qualitative descriptive analysis and literature synthesis techniques. The steps include:

- **Data Extraction:** Identifying and extracting key information from each source, including definitions, characteristics, problems, roles, initiatives, policies, and empirical data. The data will be systematically recorded to facilitate the next analysis process.
- **Categorization and Classification:** Grouping the extracted information into categories that have been determined in the report framework (for example, geographical, regulatory, operational, technological problems). This process helps in organizing diverse data into a logical structure.
- **Thematic Content Analysis:** Identifying recurring themes, patterns, trends, as well as cause-and-effect relationships and implications that emerge from the data. This also includes searching for contradictions or gaps in the existing literature. This analysis

will be carried out in-depth to uncover the root of the problems and potential solutions.

- **Synthesis and Interpretation:** Combining findings from various sources to build a coherent and comprehensive narrative. Interpretation will be carried out to explain the meaning of the data in a broader context, identify the relationship between variables, and formulate a deeper understanding of the existing problems.
- **Verification and Validation:** Ensuring the consistency and reliability of the information by comparing data from various sources (data triangulation). If there is repeated information, the most comprehensive and reliable information will be chosen to be included in the report.

RESULTS AND DISCUSSION

Problems with Multimodal Transport and Freight Forwarding in Indonesia

The implementation of multimodal transport and freight forwarding in Indonesia faces various complex challenges, hindering national logistics efficiency and competitiveness in the global market. These problems can be categorized into several main dimensions.

Geographical and Infrastructure Challenges

Indonesia's geographical condition as the world's largest archipelagic country, with more than 17,000 islands, inherently creates high complexity in the distribution of goods, both on land and at sea. Inter-island shipping requires precise coordination and efficient transport solutions but is often hampered by the limitations and unevenness of infrastructure. Many areas, especially outside Java, still have inadequate transportation infrastructure, such as damaged roads, unsafe bridges, and a lack of railway access. This condition directly slows down logistics flow, increases delivery time, and significantly raises transportation costs. In addition, limited port capacity and congestion problems (dwelling time) are still crucial issues. Many ports in Indonesia have inadequate capacity and less sophisticated facilities to handle large volumes of cargo, which often causes congestion and delays in the loading and unloading process *(Dimerco Indonesia, n.d.)*. For example, major ports such as Tanjung Priok and Patimban are still facing density problems that need to be addressed.

Another prominent problem is the lack of interdependence between transport modes. The interdependence between land, sea, and air transport modes is still not optimal. The lack of seamless interconnection between ports, airports, and land transport terminals causes inefficiency in the overall supply chain. This limitation of integrated multimodal infrastructure encourages a high dependence on land transport modes for the distribution of goods in Indonesia. Bad road conditions and frequent traffic congestion in many areas also exacerbate this problem. This dependence on land transport not only impacts the increase in delivery costs and time but also has serious implications for environmental sustainability. Emissions from land transport account for about 89% of the total emissions from the transport sector in Indonesia. This shows that the infrastructure problem is not only about economic efficiency but also about ecological impact. Future infrastructure solutions need to consider sustainability aspects and encourage a shift to more environmentally friendly modes such as rail and sea for long-distance shipping, and ensure better integration between modes.

Regulatory and Policy Challenges

The logistics sector in Indonesia operates in a complex regulatory environment, covering various customs, tax, and export/import rules. Many business actors complain about the length of bureaucracy in managing operational permits and inter-regional shipments, which adds to the administrative burden and delivery time. Existing regulations are still partial and sectoral, with law enforcement tending to be weak, which creates uncertainty and inconsistency in logistics practices. Frequent policy changes can also disrupt the shipping

process, especially for international shipments, as companies have to constantly adapt to new rules. In addition, the absence of an integrated national policy in the logistics sector that covers regulations and policies comprehensively is a major obstacle *(Dinas Perpustakaan dan Arsip Daerah DIY, 2019).*

Although there are Government Regulation Number 8 of 2011 and Minister of Transportation Regulation Number 8 of 2012 that regulate multimodal transport, there is no special arrangement in a higher Law to provide a stronger and more integrated legal basis. The government has a clear logistics vision for 2025, which aims to reduce logistics costs and increase national competitiveness. However, reports consistently show that complex, sectoral, and frequently changing regulations are the main obstacles to achieving this vision. This shows a significant gap between the policy ambitions set and the effectiveness of implementation in the field. Without better regulatory harmonization and comprehensive bureaucratic simplification, government initiatives to improve logistics efficiency will be difficult to reach their full potential. This condition can also create uncertainty for business actors, hinder new investment, and ultimately slow down the growth of the logistics sector as a whole.

Operational and Human Resources Challenges

The management of complex business processes is a significant operational challenge. The increase in demand for goods leads to an increase in the volume of information that must be processed, as well as bloated stock and goods flow management. This complicated business process is not always balanced with organized management, resulting in inefficiency and potential errors. Extreme weather conditions are also an unavoidable operational factor in Indonesia. The tropical climate with long rainy seasons and extreme weather events such as floods or strong winds often disrupt the smooth flow of goods. This leads to delivery delays, potential damage to goods, and unexpected increases in operational costs. In addition, the transfer of goods between transport modes several times in one journey increases the risk of damage due to repeated handling and potential loss of cargo *(ITL Trisakti, 2022).*

The logistics sector in Indonesia still faces a shortage of skilled human resources (HR). There is a lack of workers with expertise in the latest logistics technology or efficient operational procedures. The competence of human resources in the field of multimodal transport still needs to be improved, and adequate professional certification bodies have not been optimally formed. Many operational problems can be overcome with the adoption of technology such as Transportation Management Systems (TMS), Warehouse Management Systems (WMS), Internet of Things (IoT), and Artificial Intelligence (AI). However, there is hesitation among companies to adopt this technology, often because of the stigma of high initial costs. Furthermore, the lack of skilled human resources capable of operating this sophisticated technology is another obstacle. This condition creates a cycle that hinders progress: companies are reluctant to invest in technology because of the absence of competent human resources, while human resources do not develop relevant skills because of the lack of technology adoption in the industry. To break this cycle, aggressive and structured training programs are needed, accompanied by incentives for companies to simultaneously adopt technology and train their employees. The synergy between technology development and human resource capacity building is key to achieving sustainable operational efficiency.

Technology and Information Systems Challenges

Technology adoption in the Indonesian logistics sector is still limited, with many companies still relying on conventional and manual systems. Excessive use of paper for recording and reporting not only takes time and money but also reduces data accuracy and increases the complexity of preparing strategic reports. The lack of standardization of information systems between transport modes is a significant obstacle. This condition hinders

the ability to track and manage shipments efficiently throughout the supply chain. As a result, the lack of integrated information and communication can cause customer dissatisfaction and potentially lower the company's reputation. In addition, there is a gap in the level of technology implementation between ministries/agencies involved in the logistics ecosystem. In the implementation of policies such as the National Logistics Ecosystem (NLE), some processes are still manual, some are semi-automatic, and others are already automatic. This inconsistency hinders the overall efficiency promised by digitalization initiatives.

Various reports explicitly state that technology, including IoT, AI, TMS, and WMS, is a crucial solution for increasing cost efficiency, enabling real-time tracking, and optimizing logistics operations. However, the adoption of this technology in Indonesia is still slow or uneven. This shows that digital transformation is no longer just a choice or a trend but an absolute prerequisite for overcoming fundamental logistics problems in Indonesia. The failure to adopt and integrate technology comprehensively will make Indonesia fall further behind in global logistics competition, maintain high costs, and lower service quality. Therefore, a strong policy push and adequate incentives are needed to accelerate digital transformation throughout the logistics ecosystem, ensuring that different systems can communicate and interact seamlessly (interoperability) to avoid information silos and data duplication. In summary, the main problems faced in multimodal transport and freight forwarding in Indonesia include several categories.

First, geographical and infrastructure challenges, which include the archipelagic condition with more than 17,000 islands, limited and uneven infrastructure of roads, bridges, and railways, limited port capacity and dwelling time issues, and a lack of interdependence between transport modes. The impact of these problems is complex distribution, high costs, long delivery times, hindered logistics flow, inefficient sea shipping, uncertain schedules, and increased risk of damage to goods. Second, regulatory and policy challenges, which are characterized by complex, sectoral regulations and a complicated bureaucracy, frequent policy changes, and a lack of integrated national policy. This leads to slow shipping processes, high compliance costs, uncertainty, disruption of international shipments, fragmentation of improvement efforts, and weak law enforcement. Third, operational and human resources challenges, which include the complex management of business processes and information, the impact of extreme weather and rainy seasons, the risk of damage and loss of goods during transhipment, and the limitation and low competency of human resources. This results in increased errors, inefficiency, difficulty in monitoring, shipping delays, increased operational costs, financial losses, and slow technology adoption. Fourth, technology and information system challenges, which are characterized by limited adoption of technology and conventional systems, a lack of standardization and integration of information systems, minimal digital information and communication, and a gap in technology implementation between institutions. The impacts are operational inefficiency, high costs, low data accuracy, hindered tracking, inefficient shipment management, customer dissatisfaction, a decrease in company reputation, and misaligned business processes in initiatives such as NLE *(Indotama Partner Logistics, 2024).*

Role and Contribution of Multimodal Transport and Freight Forwarding in National Logistics Efficiency

Multimodal transport and freight forwarding synergistically contribute significantly to increasing logistics efficiency in Indonesia. This synergy enables a smoother, faster, and more economical movement of goods throughout the supply chain.

- **Increased Distribution Efficiency:** Multimodal transport, with its ability to integrate land, sea, and air modes, has been shown to increase the efficiency of goods distribution. A study on Java Island shows that the implementation of multimodal

transport can accelerate goods distribution by up to 30-40%. This is achieved by utilizing the advantages of each mode for different journey segments.

- **Reduced Logistics Costs:** By optimizing routes, consolidating cargo by freight forwarders, and selecting the most efficient mode, logistics operational costs can be reduced. Research shows that multimodal systems can significantly affect logistics cost efficiency. Furthermore, the use of digital technology such as IoT and blockchain in multimodal transport has the potential to reduce logistics costs by up to 20%.
- **Increased Connectivity and Accessibility:** Multimodal transport plays a vital role in increasing connectivity between regions, including to remote areas that were previously difficult to reach. This supports the equitable distribution of goods and reduces socio-economic disparities between regions.
- **Supply Chain Optimization:** Freight forwarders play a role in optimizing the supply chain by managing various logistics tasks such as cargo tracking, customs, and inventory management, while ensuring compliance with international trade regulations. They also provide warehouse facilities and proper goods handling, thereby reducing risk and increasing efficiency.
- **Flexibility and Reliability:** Multimodal transport provides flexibility in adjusting to shipping needs and market conditions, and increases the reliability of shipments by diversifying modes. Freight forwarders can offer more efficient, effective, and customer-specific shipping solutions through their networks and expertise.
- **Increased Goods Security:** With centralized management by MTO/freight forwarders and the implementation of enhanced security measures (for example, monitoring systems), the security of high-value goods can be better guaranteed during transit.
- **Support for Economic Growth:** The logistics efficiency achieved through multimodal transport and freight forwarding contributes to inclusive and sustainable economic growth, attracting investment in the manufacturing and logistics sectors.

Although multimodal transport is conceptually very efficient, its implementation in Indonesia still faces challenges such as the lack of a strong national Multimodal Transport Operator (MTO) and fragmentation between modes. In this condition, freight forwarders play a very crucial role. They not only handle documents and choose transport modes but also de facto act as integrators that bridge the operational gaps between various mode providers and logistics facilities. Freight forwarders coordinate fragmented processes, provide end-to-end services, and become a single point of contact for the shipper. This role is very important to ensure the smooth flow of goods amidst the complexity of the Indonesian logistics system. Therefore, strengthening the capacity and capabilities of domestic freight forwarders, including technology adoption and improving the quality of human resources, will directly improve the performance of the overall multimodal system. The ability of freight forwarders to overcome coordination and fragmentation challenges is a key determinant of the effectiveness of multimodal transport in Indonesia today.

The key roles of freight forwarders in the multimodal supply chain in Indonesia include several important aspects. First, they are responsible for document and customs management, including handling the Bill of Lading, export-import documents (PEB, COO), customs permits, and compliance with export-import regulations. This role ensures legal compliance, accelerates the clearance process, and reduces the risk of delays. Second, freight forwarders perform route and transport mode optimization by choosing the most suitable mode (land, sea, air) and the fastest or most efficient route based on the type of cargo and destination. This contributes to a decrease in transport costs, a reduction in delivery time, and an increase in operational efficiency. Third, they act as cargo consolidators, combining small shipments from several shippers into one container or a large shipment. The benefits are a reduction in shipping costs per unit, an increase in mode capacity utilization, and economies of scale.

Fourth, freight forwarders provide goods storage and handling services, including temporary warehouse facilities and secure packaging, which maintain the safety of goods and reduce the risk of damage or loss. Fifth, they perform real-time monitoring and tracking of shipment status using technology such as GPS, thereby increasing transparency and enabling a quick response to problems. Sixth, freight forwarders handle insurance and claims, providing financial protection for the shipper in case of damage or loss. Finally, they function as a liaison and main coordinator, acting as a single point of contact for the shipper and coordinating various parties such as mode operators, terminals, and customs. This role simplifies the process for the shipper, reduces coordination complexity, and ensures the smooth flow of goods.

Government Initiatives and Policies in Overcoming Logistics Problems

The Indonesian government has launched various strategic initiatives and policies to address logistics problems and increase national competitiveness, with a focus on improving infrastructure, digitalization, and increasing human resource capacity.

National Logistics System Masterplan (Sislognas)

The National Logistics System Masterplan (Sislognas) is a comprehensive guide for stakeholders to develop an effective and efficient logistics system, integrated domestically, and connected internationally. The vision of Indonesian Logistics 2025 is to realize a logistics sector that is integrated inter-island and connected with the world's main economies efficiently and effectively, in order to increase national competitiveness in the era of global supply chain competition. The objectives of Sislognas are very broad, including improving the domestic distribution system so that every economic node in all regions can be connected, supporting exports by facilitating the flow of goods from production centers to ports, prioritizing infrastructure development based on transport modes and geography that will have the greatest economic impact, synchronizing policies between departments, and reducing logistics costs and increasing the speed of goods movement. Sislognas refers to the concept of Supply Chain Management (SCM) which is based on the synchronization, integration, and collaboration of various related parties by utilizing the use of information technology.

Although Sislognas has an ambitious vision and goals to integrate national logistics, there are significant institutional problems in its implementation. Reports show low cross-sectoral coordination and the absence of an institution that effectively acts as an integrator of national logistics activities. This is a serious obstacle to achieving the 2025 logistics vision. The success of Sislognas is highly dependent on the government's ability to overcome institutional fragmentation and encourage strong coordination among ministries/agencies. Without an effective institutional structure and clear coordination mechanisms, the implementation of Sislognas is at risk of running partially and not optimally, thereby hindering the achievement of the set goals. Consistent efforts are needed to build synergy among institutions and ensure all stakeholders have the same understanding and commitment to work towards common goals *(Indotama Patner Logistics, 2024).*

Logistics Digitalization Policy (NLE, IoT, AI)

The Indonesian government is actively encouraging digitalization in the logistics sector through various policies and programs:

- **National Logistics Ecosystem (NLE):** NLE is a logistics ecosystem that aligns the flow of international goods and documents, from the arrival of the transport vehicle to the goods arriving at the warehouse. This program aims to simplify the document flow, integrate inter-agency services, and significantly reduce logistics costs. The

implementation of NLE has become a priority, with expansion to other airports and ports after the piloting phase at Djuanda Airport.

- **Utilization of Internet of Things (IoT):** IoT enables real-time shipment tracking, more efficient inventory management, preventive fleet maintenance, route optimization, and prevention of damage or loss of goods. This technology can substantially increase operational efficiency and reduce costs.
- **Utilization of Artificial Intelligence (AI):** AI is used to optimize logistics planning (e.g., route optimization), automate repetitive processes, more accurate demand prediction, dynamic pricing, and predictive fleet maintenance. AI is also applied in ports to increase productivity and operational efficiency, such as accelerating ship docking and reducing goods loading time.
- **Transportation Management System (TMS) and Warehouse Management System (WMS):** This technology helps with the planning, optimization, and execution of transportation operations, reducing errors, improving customer service, and accessing real-time data. WMS also helps optimize warehouse utilization and inventory management.
- **Other Digitalization Policies:** Minister of Communication and Information Regulation (Permen Komdigi) Number 8 of 2025 encourages the consolidation of the national logistics industry and the acceleration of digitalization. The government also encourages the use of technology to accelerate customs processes, such as the Indonesia National Single Window (INSW) system.

Although there is a strong push for digitalization through NLE, IoT, and AI, there is a major challenge related to interoperability in the logistics digital ecosystem. Reports show an uneven level of technology implementation among ministries/agencies; some are still manual, some are semi-automatic, and some are automatic. In addition, the lack of standardization of information systems between modes is also a hindrance. There are also problems with the management of business processes and information that need to be improvised to align with the digital system *(Indotama Patner Logistics, 2024).* This condition creates information silos and data duplication, which ultimately hinders the overall efficiency promised by digitalization. The success of logistics digitalization does not only depend on the adoption of individual technology but on the ability of different systems to communicate and interact seamlessly. A strong framework for data standardization and integration across the entire supply chain is needed so that the full potential of digitalization can be achieved.

Investment Incentives and Public-Private Partnerships

The Indonesian government also provides various incentives to attract investment in the logistics sector and encourage partnerships between the public and private sectors:

- **Bonded Logistics Center (PLB):** The government provides tax incentives, such as the suspension of import duties and the exemption of VAT/import income tax, to companies receiving PLB facilities. PLB aims to encourage investment, create jobs, and increase the efficiency of stock management and the ease of logistics processes. Goods stored in the PLB can be exempted from import duties during the storage period, which significantly reduces import costs.
- **Infrastructure Investment:** The government continues to invest in the construction and improvement of transportation infrastructure, including toll roads, seaports, and airports. Projects such as the Serang-Panimbang Toll Road and the development of Kuala Tanjung and Patimban Ports are expected to reduce vehicle operational costs, reduce travel time, and streamline the distribution of goods.
- **Public-Private Partnership (PPP):** The PPP scheme is a strategic option for financing infrastructure development, given the limited State Budget (APBN). PPP is not only a financing solution but also brings added value in the form of operational

efficiency, technology transfer, and healthier risk management. Presidential Regulation Number 38 of 2015 is the main legal basis for PPP in Indonesia.

The success of PPP in logistics infrastructure is highly dependent on a clear regulatory framework and proper risk allocation. Studies show that the main success factors in PPP road sector projects in Indonesia include a strong commitment from the government, a transparent procurement process, stable political support, and a clear legal framework. However, PPP projects also face challenges such as delays in land acquisition processes and cost increases due to prolonged land acquisition, as well as problems in improper risk allocation. The failure to identify and manage these risks can lead to cost overruns and project delays. Therefore, to attract greater private investment and ensure the success of logistics infrastructure projects through PPP, the government needs to continue to improve the legal framework, increase transparency, and ensure a fair and clear allocation of risk between the public and private sectors *(Indotama Patner Logistics, 2024).*

Case Studies and Empirical Data

Effectiveness of NLE in Reducing Logistics

Costs The National Logistics Ecosystem (NLE) is one of the most significant government initiatives to reduce logistics costs in Indonesia. NLE aims to align the flow of international goods and documents, integrate inter-agency services, and simplify document flow. The expectation is that NLE can reduce the high national logistics costs, which reached 14.29% of GDP in July 2024, and have even reached 24% of GDP *(Indotama Patner Logistics, 2024).*. The implementation of NLE has begun in several major ports such as Tanjung Priok and Tanjung Perak, with plans for expansion to other airports and ports. However, the effectiveness of NLE still faces challenges. One of the main obstacles is the inconsistent level of technology implementation among ministries/agencies; some are still manual, some are semi-automatic, and others are automatic. This inconsistency hinders the overall efficiency promised by NLE. The decline in Indonesia's Logistics Performance Index (LPI) from rank 46 in 2018 to rank 61 in 2023 also indicates that despite efforts, there is still much work to be done to significantly improve national logistics performance.

The Role of Dry Ports in Multimodal Transport

Dry ports or inland terminals play a crucial role in facilitating multimodal transport by acting as an extension of the port on land. One successful example in Indonesia is the Cikarang Dry Port (CDP). Located in Cikarang, West Java, CDP functions as the first inland port in Indonesia that provides rail freight connectivity to major cities along the main line of Java Island. CDP has been designated as an Integrated Customs Service Area (KPPT) and has its own international port code (IDJBK). CDP's role is very important in reducing congestion at Tanjung Priok Port by moving logistics and customs centers inland. CDP is designed to have a faster goods loading and unloading throughput capability and a large capacity, contributing significantly to reducing logistics time and costs. The existence of a dry port like CDP shows how *(Indotama Patner Logistics, 2024).* the integration of land and sea modes can be optimized to increase supply chain efficiency.

The Impact of Technology (IoT, AI, TMS, WMS) on Logistics Efficiency

The use of advanced technology such as the Internet of Things (IoT), Artificial Intelligence (AI), Transportation Management System (TMS), and Warehouse Management System (WMS) has shown a positive impact on increasing logistics efficiency in Indonesia.

- **IoT:** Empirical studies show that IoT plays an important role in increasing supply chain efficiency. IoT enables real-time shipment tracking using GPS and sensors, which increases visibility, allows for a quick response to unexpected situations, and optimizes routes to reduce fuel consumption and travel time. In addition, IoT also

supports more efficient inventory management through RFID technology and smart sensors, as well as preventive maintenance of vehicle fleets.

- **AI:** AI is used to optimize logistics planning, such as route optimization, which can predict shipping delays and the arrival time of ships at ports. AI also helps automate repetitive processes, predict demand, dynamic pricing, and predictive fleet maintenance. In ports, AI can increase productivity by accelerating ship docking and reducing goods loading time.
- **TMS and WMS:** TMS facilitates the planning, optimization, and execution of transportation operations, which can reduce expenses due to errors, improve customer service, and access real-time data. WMS helps optimize warehouse utilization and manage inventory efficiently. The implementation of logistics digitalization, including TMS, in industries such as in East Java, is expected to be able to reduce and curb logistics cost burdens.

Although the potential of this technology is very large, its adoption in Indonesia is still uneven. Many companies are still reluctant to invest due to the stigma of high costs or a lack of understanding. However, companies that have adopted this technology report an increase in operational efficiency and a reduction in costs.

Logistics Human Resources Development Program

The quality of Human Resources (HR) is the main key to the progress of the logistics sector in Indonesia. The development of logistics and supply chain HR in Indonesia is carried out through two main paths:

- **Formal Education:** Through vocational channels (D1 to D4) and scientific channels at the S1 to S3 levels in Higher Education. These programs aim to equip students with relevant knowledge and skills.
- **Professional Path:** Through professional certification programs in the logistics field. For example, there are certification programs that include 20 competency units from 8 occupations, such as Freight Handler, Junior Warehouse Operator, and Logistics Data Entry Officer. Institutions like Supply Chain Indonesia (SCI) also offer certification programs to improve the competence of young talent in the logistics field.

Although there are these efforts, Indonesia still faces challenges in providing experts, specialists, and professionals in the logistics field, both at the managerial and operational levels. There is a wide gap between the existing education and training programs in higher education institutions and the needs of the business world. The most important competencies in the logistics industry, such as foreign language skills and expertise in the planning stage, still need to be improved. To overcome this shortage, there is a need to improve curriculum quality, aggressive and structured training, and closer collaboration between academics, the government, and business actors *(Indotama Patner Logistics, 2024).*

Public-Private Partnership (PPP) in Logistics Infrastructure

Public-Private Partnership (PPP) has become an important infrastructure financing scheme in Indonesia, especially to overcome government budget limitations. PPP not only provides funding but also brings operational efficiency, technology transfer, and healthier risk management. Studies show that the main success factors in the implementation of PPP road sector projects in Indonesia include a strong commitment from the government, a transparent and competitive procurement process, stable political support and environment, and a clear legal framework. However, the implementation of PPP in Indonesia has not been able to run optimally due to several problems. Challenges that often arise include delays in the land acquisition process, which can significantly increase project costs and time. In addition, an unclear or unfair allocation of risk between parties is also a hindrance. Nevertheless, several examples of collaboration between the public and private sectors show

positive potential. PT Pos Logistik Indonesia, for example, has a partnership with the railway to facilitate the delivery of goods between locations. This partnership is seen as a pillar supporting business sustainability and provides broad opportunities for developing a business network. To increase the success of PPP in the future, there is a need to improve the legal framework, a more equitable risk allocation, and a long-term commitment from all parties involved, as well as a simplification of the land acquisition process which is often the main stumbling block (*ITL Trisakti, n.d.)*.

CONCLUSION

Multimodal transport and freight forwarding are two crucial pillars in Indonesia's logistics system, which have a central role in overcoming archipelagic geographical challenges and curbing the still-high national logistics costs. Multimodal transport, with the concept of a single contract and a single operator (MTO), aims to increase distribution efficiency and connectivity. Meanwhile, freight forwarding acts as a key facilitator, managing document complexity, optimizing routes, and providing essential end-to-end services. Although vital, the implementation of these two sectors in Indonesia faces various interconnected problems. Geographical challenges and uneven infrastructure limitations, including limited port capacity and a lack of interconnection between modes, cause inefficiency and dependence on land transport that has a negative impact on the environment. From a regulatory perspective, a complex, sectoral, and frequently changing legal framework creates uncertainty and hinders harmonization, showing a gap between policy vision and implementation effectiveness in the field.

Operationally, the management of complicated business processes, the impact of extreme weather, and the risk of goods damage are still obstacles. The limitation and low competency of Human Resources (HR) in the logistics sector also hinder efficiency and technology adoption. There is a condition where the lack of skilled HR hinders technology investment, and vice versa. In addition, the still-limited adoption of technology and information systems, a lack of standardization, and a gap in implementation between institutions create information silos, showing that digital transformation is an urgent need that has not been fully realized. Nevertheless, multimodal transport and freight forwarding have made a significant contribution to increasing distribution efficiency, lowering costs, and increasing connectivity. Freight forwarders specifically play a crucial integrator role, bridging the operational gaps between various mode providers and logistics facilities amid the not-yet-optimal national MTO. The government has responded with various initiatives, including the National Logistics System Masterplan (Sislognas) for integration, the National Logistics Ecosystem (NLE) program for digitalization, and investment incentives through Bonded Logistics Centers (PLB) and Public-Private Partnership (PPP) schemes. However, the success of these initiatives is still overshadowed by institutional challenges, system interoperability, and implementation in the field. Overall, although there has been progress and government commitment, the logistics problems in Indonesia related to multimodal transport and freight forwarding are still complex and require a more integrated and holistic approach.

Recommendations

Based on a comprehensive analysis of the existing problems and initiatives, here are the recommendations to increase the efficiency of multimodal transport and freight forwarding in Indonesia:

Integrated Infrastructure and Interconnectivity Improvement:

- Continue and accelerate investment in the development and improvement of integrated physical infrastructure, including roads, railways, ports, and dry ports. Prioritize the development of seamless physical connectivity between modes to reduce transhipment time and costs.

- Encourage a modal shift from road transport to more efficient and environmentally friendly modes such as rail and sea for long-distance shipping, with adequate infrastructure support and relevant incentives.

Regulatory Harmonization and Bureaucracy Simplification:

- Formulate a more integrated and comprehensive national logistics policy that addresses the fragmentation of sectoral regulations. Efforts are needed to simplify complex licensing and customs procedures to reduce the administrative burden on business actors.
- Ensure consistency in law enforcement and policy to create a more certain and stable business environment for investors and logistics players.

Acceleration of Digitalization and Improvement of Information System Interoperability:

- Encourage the uniform adoption of digital technology (IoT, AI, TMS, WMS) throughout the logistics supply chain, both by the government and the private sector, through incentive and education programs.
- Develop strong interoperability standards for information systems between transport modes and government agencies. This is crucial to create a truly integrated logistics ecosystem, avoid information silos, and enable seamless data exchange.

Logistics Human Resources (HR) Capacity Development:

- Develop structured and relevant training and certification programs that align with industry needs, with a focus on digital skills, multimodal management, and operational expertise. These programs must involve close collaboration between educational institutions, the government, and industry players.
- Create credible and nationally recognized professional certification bodies to improve the competency standards of logistics HR.

Strengthening Public-Private Partnerships (PPP):

- Encourage more PPP projects in the development and management of logistics infrastructure with a clear legal framework, fair risk allocation, and a long-term commitment from all parties.
- Simplify the land acquisition process and ensure fair and timely compensation to avoid the frequent delays in PPP projects.

Empowerment of Domestic Freight Forwarders:

- Support the development of national Multimodal Transport Operators (MTO) and freight forwarders so they can become stronger and more competitive supply chain integrators. This can be done by facilitating access to capital, technology transfer, and improving managerial capacity.
- Encourage freight forwarders to continue to innovate and offer comprehensive value-added services, in line with the development of the digital economy.

By implementing these recommendations in an integrated and sustainable manner, it is hoped that Indonesia can overcome the existing logistics problems, increase the efficiency of multimodal transport and freight forwarding, and strengthen national economic competitiveness in the global market.

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