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Research Article

Sustainable National Logistics Performance In Indonesia

Ferdy Trisanto Kurniawan[1], Idris Gautama So[2], Prasadja Ricardianto[3], Atong Soekirman[4]
[1,3,4] *Trisakti Institute of Transportation and Logistics, Jakarta, Indonesia*
[2]*Bina Nusantara University, Jakarta, Indonesia*
ferdytk@yahoo.com, igautama@binus.edu, ricardianto@gmail.com, a.soekirman@gmail.com

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ABSTRACT

The main problem of logistics in Indonesia is the high cost of logistics which reaches 14.1% of the National GDP and the decline in the Logistics Performance Index from 3.15 to 3.00. The purpose of the study was to determine and analyze the performance of sustainable national logistics in Indonesia, especially in the West and Central Indonesia regions, so that the research location was carried out at four International Hub Ports, namely Belawan Port, Medan, Tanjung Priok Port, Jakarta, Tanjung Perak Port, Surabaya, and Soekarno Hatta Port, Makassar. This study uses a combined method, namely qualitative data analysis through Focus Group Discussion with six competent sources in the field of logistics which were analyzed using the Nudist In Vivo 12 Application and quantitative data analysis through distributing questionnaires to 160 logistics actors respondents in four sample ports and analyzed using SEM with Lisrel 10.2. The results of the study indicate that the management of transportation costs and information technology, logistics costs, infrastructure and Trade Hubs have a positive effect on sustainable logistics performance in Indonesia. The conclusion obtained is that all independent variables affect national logistics performance, information technology as an intervening variable has a greater influence than the direct relationship between transportation costs and national logistics performance. Meanwhile, if the trade hub becomes an intervening variable, it has a smaller influence compared to the direct relationship between infrastructure and national logistics performance and Trade Hub with national logistics performance. The recommendations given include repairing and increasing port infrastructure as a trade hub to improve connectivity of the national logistics backbone and hinterland, utilizing information technology to improve the performance of transportation cost management in order to encourage logistics performance.

Keywords: logistics cost management, trade hub, port infrastructure, logistics performance, sustainable, information technology.

INTRODUCTION

The performance of the National Logistics System in Indonesia has not been able to fulfill the Vision of the National Logistics System Development Blueprint, which is marked by the logistics performance, namely the 2023 LPI Score has decreased from 3.15 to 3.00, down from 46th to 61st. Other problems with port logistics performance in Indonesia in big cities that are still experiencing problems such as expensive logistics costs and externalities such as congestion, exhaust emissions, road damage and the challenges of pandemics/disease outbreaks, the security conditions of neighboring countries, the level of pollution in industrial cities and the development of technology 5.0 will disrupt national logistics performance and require an adaptive, effective and efficient logistics strategy. National logistics performance is expected to provide a social impact on the surrounding community from positive and negative externalities to fulfill the Social Development Pillar, provide a positive impact on the regional and national economy as a form of fulfillment of the Economic Development Pillar, and not to fulfill the Environmental Development Pillar, Sustainable logistics is closely related to port development which means building and changing coastal areas so that coastal development at the construction and operational stages causes a decrease in sea water quality, air quality, changes in current patterns, abrasion and sedimentation and disruption of biota life around the pier. This concept means that the port in its management and operations pays attention to social, economic and environmental aspects, not just profit or benefits in its business (Karimpour, 2021)

The identified problems are still temporary based on several facts and previous research results in other countries, namely 1) The current condition of the National Logistics System Performance in Indonesia has not been able to meet the Vision of the National Logistics System Development Blueprint, namely a Logistics System that is integrated and connected globally to improve competitiveness and people's welfare in 2025, 2) The 2023 LPI Score decreased from

3.15 to 3.00, down from 46th to 61st, while this decrease occurred in the variables of International Shipments, Logistics Quality And Competence, Tracking & Tracing, and Timeliness, 3) The performance of port logistics in Indonesia such as 4 (four) major cities that are still experiencing problems such as expensive logistics costs and a decline in the logistics performance index, and 4) The challenges of the Pandemic / disease outbreak, the security conditions of neighboring countries, the level of pollution in industrial cities and the development of technology 4.0 will disrupt national logistics performance requiring an adaptive, effective and efficient logistics strategy. The government has issued a National Logistics Ecosystem (NLE) policy, a policy that involves all regulatory parties involved in logistics activities, including the government, BUMN, private actors and academics. The implementation of the policy has been implemented in 14 major ports, namely Belawan, Pekanbaru, Palembang, Lampung, Merak, Batam, Tanjung Priok, Pontianak, Tanjung Emas, Balikpapan, Tanjung Perak, Samarinda, Juanda Airport, Kendari, and Makassar. The National Maritime Institute (2021) explains that there are two main problems in the implementation of NLE in the regions, namely 1) Infrastructure and Informatics (IT) and a culture of digitalization have not been built in the areas targeted for NLE implementation and 2) There is no large application or Super apps that accommodate all logistics services.

Sustainable logistics policies and activities are expected to have a dual impact nationally and spillover effects on all sectors of the national economy according to research results in several countries, namely (Guo et al, 2020), (J. Chen et al, 2019) in China, (Munim & Schramm, 2018) in Europe, (Tsekeris, 2016) in Greece and (Hayaloglu, 2015) In general, the purpose of the research is to conduct a study and analysis of sustainable national logistics performance in Indonesia to obtain recommendations for improvement policies that improve sustainable national logistics performance. Meanwhile, specifically this study aims to examine and analyze 1) The influence of Transportation Cost Management variables on sustainable national logistics performance in Indonesia directly and through Information Technology variables as an intervening factor, 2) The influence of Warehousing Cost Management variables on sustainable national logistics performance in Indonesia, 3) The influence of Inventory Cost Management variables on sustainable national logistics performance in Indonesia, 4) The influence of Administration Cost Management variables on sustainable national logistics performance in Indonesia, and 5) The influence of Infrastructure Facilities variables on sustainable national logistics performance in Indonesia directly and through Trade Hubs as an intervening factor.

The benefits of this research are expected to enrich the treasury of scientific development related to sustainable national logistics performance in Indonesia, input for the government as evaluation material for Presidential Regulation of the Republic of Indonesia No. 26 of 2012 concerning the Blueprint for the Development of the National Logistics System and policy improvements and program optimization as well as increasing the performance of sustainable national logistics in Indonesia.

THEORETICAL FRAMEWORK

a. Transportation Cost Management

Logistics costs are greatly influenced by several cost variables including transportation costs. Banomyong et al (2019) research explains that transportation costs are all costs incurred due to goods delivery activities, while the USAID Study (2022) explains transportation costs as the availability of supporting infrastructure and connectivity infrastructure, Smooth traffic between industrial areas, Vehicle or transportation performance (age of trucks and ships) Inefficiency of activities at the port, No return cargo (Imbalance cargo), Rupiah exchange rate, there are still many extortions in land transportation such as trucks. In addition, transportation costs are also interpreted as the price paid to transportation providers (Minken & Johansen, 2019). Transportation cost management is related to the availability of supporting infrastructure and connectivity infrastructure, Smooth traffic, Vehicle performance and the level of inefficiency at the port, in addition to the absence of return cargo, the high rupiah exchange rate, and extortion will also affect transportation costs. Transportation costs are greatly influenced by distance and time factors due to the determination of the location of warehouses, factories and markets (Somuyiwa et al, 2010).

b. Warehouse Cost Management

In addition to transportation costs, there are warehousing costs which are explained in several studies, namely the USAID Study (2022) in its research concluded that warehousing and inventory costs are a unit with the understanding of the availability of infrastructure related to warehousing, data and information related to the availability and demand for goods, prices, transportation, completely and in real time. In addition, Rodrigue (2020) concluded that Warehousing Costs are fixed costs for owning or renting warehouse space, including maintenance and utilities and the amount varies according to the number, size of facilities and labor and does not depend on the amount of inventory handled. Based on the definition of warehousing costs according to the experts above, the definition of warehousing costs can be synthesized as costs that cover all warehousing activities in a company. Effective and efficient Warehouse Management can help companies reduce costs and increase profits. Warehousing costs use two dimensions, namely rental costs and operating costs.

c. **Inventory Cost Management**

Other logistics cost variables related to warehousing costs are inventory costs, which Rodrigue (2020) defines as inventory costs including the costs of storing goods in inventory (capital costs, labor, warehousing, depreciation, insurance, taxation, and obsolescence) as well as physical handling of goods, including tasks such as packaging and labeling. Heizer (2020) explains that the Company sets four points related to inventory variables, namely Inventory to store raw materials that have been purchased but not yet processed, raw materials that have undergone a change in shape but are not yet perfect, inventory used to maintain machine equipment and production processes, and ending inventory where a product has been finished and is waiting to be shipped. The the USAID Study (2022) divides the dimensions of Inventory Costs into two, namely: Data availability, namely data availability refers to the extent to which relevant and accurate data is available to support decisions related to inventory management. In the context of supply chain and inventory management, available data can include information about stock levels, product demand, lead times, and others. And Inventory costs include all costs associated with storing stock in a warehouse or other storage facility, including costs for storage space, insurance, damage, loss of value of goods, and capital costs tied up in the form of inventory. Based on the definition of inventory costs according to the experts above, the definition of inventory costs can be synthesized as costs that affect all production activities and determine the level of service that the company is able to provide and manage effectively and efficiently because they are related to the cost of storing inventory that may be damaged, lost or expired. Inventory costs use two operational dimensions, namely data availability and inventory costs.

d. **Administrative Cost Management**

The last component of logistics costs is administrative costs which in the USAID Study (2022) describe the problem of administrative costs including conventional-based administration (no paperless), Service standards, which are time-limited, and extortion on transportation. In addition, Rodrigue (2020) concluded that administrative costs include managerial overhead such as customer service, receiving and processing orders, and managing the workforce. They also include information technology such as computer equipment and software and divide the dimensions of Administrative Costs into two, namely overhead costs and workload.

e. **Infrastructure**

Port Infrastructure Facilities are defined by Hausman et al (2013) explaining that the infrastructure in question is the development of new port infrastructure or expansion of existing ones. Currently, the role of ports is not only limited to cargo handling but also includes providing better logistics service performance to meet the increasing demand for global supply chains. In addition,

Lim et al (2019) conveyed that investment in port infrastructure, and attracting foreign investment will improve the port's economic growth which will increase the economic benefits of the supply chain and stakeholders, thus making their operating costs efficient. Investment in port infrastructure, and attracting foreign investment will improve the port's economic growth which will increase the economic benefits of the supply chain and stakeholders, thus making their operating costs efficient. The concept of a sustainable port is currently starting to be developed considering the negative impacts of port construction, development and operations on the surrounding environment. Port activities use vehicles and transportation for local transfers, and store cargo in warehouses and storage, and provide maritime services to call ships through tugboats, pilots, and tugboats, most of these activities depend on fossil fuels and consume energy, so that these operations create externalities to the environment and society (employees, society, community, customers).

In the same category, the interaction of the transport chain with the port causes various ecological, environmental and social impacts, such as the activities of ships, land trucks, trains and locomotives. Liquid bulk carriers can pose a risk of oil spills, while cruise ships produce large amounts of waste and garbage. Problems like this will cause environmental damage if not monitored, controlled and handled sustainably. Bjerkan & Seter (2019) explained that there is not much research available on Sustainable Port Infrastructure so that to address port sustainability in future research so that port decision makers can choose and prioritize tools or technologies: increasing the use of empirical data, port involvement, and understanding actors and processes in port decision making. Another study with a sample of 248 International Ports by Le & Nguyen (2023) looked for the relationship between Green Port Development and the variables Environmental Regulation, Foreign capital, cooperation from the parties involved, Inconsistent criteria, Lack of technical progress, and Lack of initial capital, concluding that cooperation between the parties involved and foreign capital have the most important role in the development of environmentally friendly ports in developing countries, followed by environmental regulations. Meanwhile, the lack of initial capital and lack of technological progress have a negative impact on the development of environmentally friendly ports in these countries.

f. **Technology**

Technology in logistics management enables total cost reduction, improves collaboration with suppliers and

customers, increases visibility and traceability of products and information, and supports decision making for all agents in the supply chain, including end consumers (Cano et al, 2021). Globalization and digitalization processes have provided a way to save logistics costs that can be achieved by utilizing innovative ways of working. Lower costs mean greater competitive advantage for companies and higher profits (Lazarov et al, 2023). Logistics service quality Logistics companies are supported by logistics digitalization technology which is implemented in such a way that customers provide precise and accurate information to the company and logistics digitalization can save time and increase work speed to be more efficient in delivering logistics service activities (Ricardianto, 2023). Dian Fauzan (2024) in his research concluded that soft competency, infrastructure, technology and inventory management affect logistics performance. The use of Information Technology in Logistics Management has an impact on reducing costs, especially transportation and driving logistics performance (Cano et al, 2021). Globalization and digitalization processes have provided a way to save logistics costs that can be achieved by utilizing innovative ways of working. Lower costs mean greater competitive advantage for companies and higher profits (Lazarov et al, 2023). The development and development of the industry in Indonesia continues and is faced with global competition. The development of this industry also occurs in the port logistics industry. The impact of technological changes that occur in the logistics system at the port has a fairly positive impact on workers, because it makes it easier for workers to operate the port and be able to compete globally and can contribute to a decrease in productivity (Ninvika, 2023).

g. **Trade Hub**

Ports are expected to be the main center of international trade in addition to being a transfer of activities, playing a crucial role in the movement of global goods. The role of ports as international trade hubs is increasingly significant due to increasing trade volumes, technological advances, and changes in global trade policies. Classical economic theory states that ports are central points in the global trade network that enable cost and time efficiency in the distribution of goods (Stopford, 2009). In the context of logistics, ports function as points of consolidation and de-consolidation of goods, reducing logistics costs through economies of scale (Rodrigue, 2020) . Trade hubs are also centers of economic and industrial activity, creating employment opportunities and supporting economic growth in the surrounding areas. Therefore, efficient management and development of trade hubs are essential to support sustainable economic growth and improve overall logistics performance (Zhang, 2019). The development of information and communication technology has significantly changed port operations. The digitalization of port processes, such as the use of automated terminal management systems and blockchain for supply chain management, has increased efficiency and transparency (Notteboom et al, 2020). This technology allows ports to manage the flow of goods more effectively, reduce waiting times, and increase competitiveness. Changes in global trade policies, namely free trade agreements and protectionist policies, have greatly affected the role of ports as international trade hubs. Major ports in Asia and Europe have adapted to these changes through increased capacity and infrastructure development (Merk, 2018).

Dimensions of Trade Hubs according to the United Nations Conference on Trade and Development (UNCTAD) (UNCTAD, 2021), namely: 1) Accessibility, which assesses the extent to which a trade hub can be accessed by various modes of transportation, such as sea, land, and air. Good accessibility facilitates the movement of goods and improves logistics efficiency, 2) Infrastructure, including the quality and capacity of physical facilities available at the trade hub, such as docks, terminals, loading and unloading equipment, and storage facilities. Good infrastructure is important to support trade and logistics activities, 3) Logistics Services are closely related to assessing the availability and quality of logistics services provided at the trade hub, including shipping, warehousing, and supply chain management services.

Efficient services can improve trade performance, and 4) Sustainability by considering sustainability aspects in trade hub operations, including reducing environmental impacts and implementing environmentally friendly practices. This is important to support responsible and sustainable trade.

h. **National Logistic Performance**

Logistics performance is generally related to the process of activities that are effective, efficient, innovative, quality, provide benefits and multiple benefits from a logistics activity (Hausman et al, 2013). Logistics performance also plays an important role in facilitating the transportation of goods to international markets. Inefficient logistics services hinder trade by incurring additional costs in terms of both time and money (Korinek & Sourdin, 2011) . Logistics services play an important role, and the challenge of providing effective logistics support is increasing as countries move to more complex and higher value-added fragmented manufacturing and production processes (Mangan & Lalwani, 2016). For developing countries, logistics improvement depends on their infrastructure, customs procedures, logistics skill levels, and regulations. Mentzer and Konrad (1991) define logistics performance as the effectiveness and efficiency in carrying out logistics activities . Langley and Holcomb (1992) expand this definition by adding logistics differentiation as a key element of logistics performance because the value received by customers from logistics activities also serves as an indicator of logistics performance. They argue that logistics can create value through efficiency, effectiveness, and differentiation. Later, Smith (2000) extended Langley and Holcomb (1992) to define logistics performance as a second-order construct consisting of logistics efficiency, effectiveness, and

differentiation to strengthen the previous theory.

This study aims to examine and analyze 1) The influence of the Transportation Cost Management variable on Sustainable National Logistics Performance in Indonesia, directly and through the Information Technology variable as an intervening variable. 2) The influence of the Warehouse Cost Management variable on Sustainable National Logistics Performance in Indonesia. 3) The influence of the Inventory Cost Management variable on Sustainable National Logistics Performance in Indonesia. 4) The influence of the Administrative Cost Management variable on Sustainable National Logistics Performance in Indonesia. 5) The influence of the Infrastructure Facility variable on Sustainable National Logistics Performance in Indonesia, directly and through Trade Hubs as an intervening variable.

METHODS

The research location is at the center of port logistics activities in the West Indonesia region, namely Belawan Port Medan. The Port of Tanjung Priok in Jakarta, the Port of Tanjung Perak in Surabaya, and the Port of Soekarno Hatta Makassar with a research year span between 2023-2024. Data for quantity analysis sourced from the questionnaire, BPS Indonesia, Ministry of Transportation, Regional Government, Organization Logistics on Harbor Belawan Medan, Harbor Cape Priok Jakarta, Harbor Cape Silver Surabaya, and Soekarno Hatta Port Makassar. The research area in Western Indonesia is because according to BPS data (2023) most port activities in Indonesia are carried out in 25 strategic ports located in 21 provinces, most of which are in the West and Central Indonesia regions. The total export value in 2023 from 25 Strategic Ports carried out from seven International Hub Ports is $USS.250,619.20 (Million). The export value from four research ports, namely Belawan Port, Tanjung Priok, Tanjung Perak and Makasar Port in 2023 is $USS. 124,876.10 (Million) or 50% of the total export activities from seven International Ports. While the total import value in 2023 to 25 Strategic Ports included in seven International Hub Ports is $USS. 221,886.2 (Million). The import value at four research ports, namely Belawan Port, Tanjung Priok Port, Tanjung Perak and Makasar Port in 2023 is $USS. 194,642.5 (million) or 87.72% of the total export activities of seven International Ports. Data collection methods are divided into Observation and Questionnaire. Observation is used with conducting observations/surveys at the Belawan Port location, Tanjung Priok, Cape Silver, And Makassar For see pattern distribution And facility existing infrastructure. Meanwhile, the questionnaire was conducted on 160 respondents in 4 location research (40 respondents multiplied by four locations) this number has fulfilled the minimum requirements of several theoretical bases, namely that the number sampling in study based on on theory : 1) Size sample Which worthy around 30 – 500 respondents and 2) Amount sample based on amount category times 30, And 3) For analysis with multivariate, amount sample minimum ten times variables (Sugiyono, 2019).

Data analysis uses two methods, namely Quantitative Analysis to find the relationship between variables using a questionnaire analyzed using the SEM Statistical Method with Lisrel 10.2 Software. In this analysis, each independent variable will be analyzed to see the magnitude of the influence. While the second analysis is Qualitative Analysis through FGD with FGD result data analyzed by NVivo Software. The structural analysis model framework in this study is formed by eight latent variables, namely Transportation cost management (X1), Warehouse cost management (X2), Inventory cost management (X3), Administration cost management (X4), and Infrastructure (X5), 2 intervening variables, namely Trade hub (Z1) and Information Technology (Z2) and 15 manifest variables, namely Transportation costs are influenced by fixed costs (X.11) and variable costs (X.12), Warehouse rental costs at the port must have an impact on the company's ability to store and manage goods (X.21), Warehouse operating costs at the port determine the level of service provided by logistics companies to their customers (X.22), Availability of good and complete data at the port greatly supports more effective logistics management (X.31), Controlled and measurable inventory costs in the warehouse increase customer satisfaction and logistics performance (X.32), Controlling overhead costs such as administration costs determines the level of efficiency and productivity of logistics performance (X.41), Balanced and well-distributed workload helps increase labor productivity in the logistics process (X.42), Cooperation between government, private sector and infrastructure service providers can improve logistics performance in infrastructure connectivity (X.51), Ports must have the potential to improve operational efficiency and overall logistics performance (X.52), The smoothness of economic activities in ports is closely related to efficient infrastructure and logistics performance (Z.11), The important role of infrastructure and logistics performance in facilitating regional and international trade must increase regional economic competitiveness and international trade growth (Z.12), The application of information technology in ports needs to improve efficiency, cost-effectiveness of transportation, be environmentally friendly and improve logistics performance (Z.21), National Logistics Performance must have an impact on price disparities and ensure the availability of basic necessities in the region (Y.1) and National Logistics Performance must encourage national and international maritime markets and economic growth (Y.2).

Hypothesis Which developed in study This is 1) It is suspected that there is a direct influence between Transportation Cost Management and Information Technology (H1), It is suspected that there is a direct influence between information technology and sustainable national logistics performance in Indonesia (H2), It is suspected that there is a direct influence between Transportation Cost Management and sustainable national logistics performance in

Indonesia (H3), It is suspected that there is a direct influence between Warehousing Cost Management and sustainable national logistics performance in Indonesia (H4), It is suspected that there is a direct influence between Inventory Cost Management and sustainable national logistics performance in Indonesia (H5), It is suspected that there is a direct influence between Administration Cost Management and sustainable national logistics performance in Indonesia (H6), It is suspected that there is a direct influence between infrastructure facilities and sustainable national logistics performance in Indonesia (H7), It is suspected that there is a direct influence between infrastructure facilities and Trade Hubs (H8), It is suspected that there is a direct influence between Trade Hubs and sustainable national logistics performance in Indonesia (H9), It is suspected that there is an indirect influence between Transportation Cost Management and sustainable national logistics performance in Indonesia through information technology as a mediation/intervenor (H10), It is suspected that there is an indirect influence between infrastructure facilities and sustainable national logistics performance in Indonesia through Trade Hubs as a mediation/intervenor (H11).

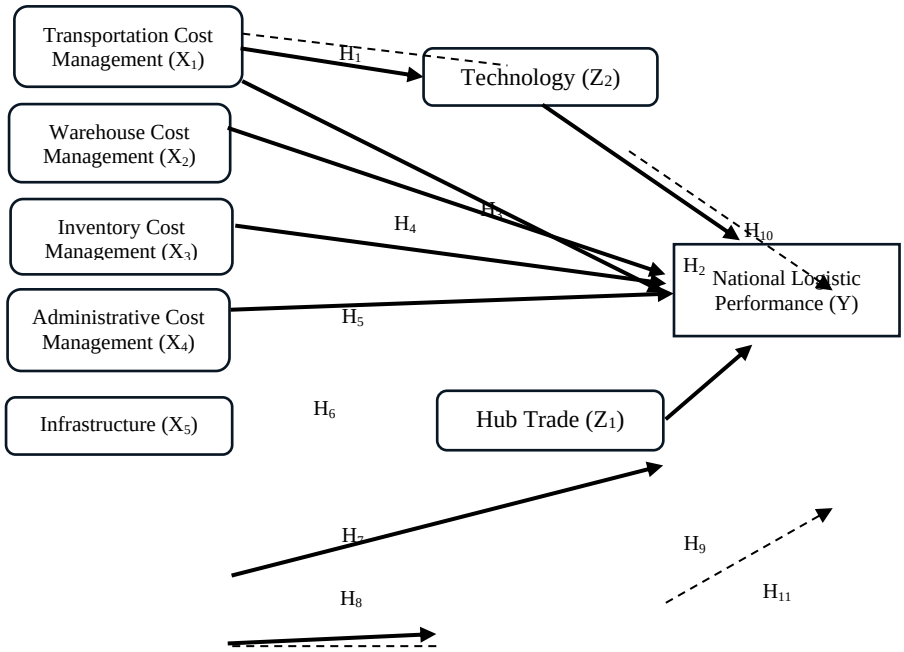

Figure 1. Structural Equation Modeling Framework

Source : Results Analysis, 2024

RESEARCH AND DISCUSSION RESULTS

i. Results of Logistics Performance

Performance against ASEAN countries can be seen in Figure 2, which has decreased from 2016-2023. The six LPI components are Customs, Infrastructures, International Shipments, Service Quality, Tracking and Tracing and Timeliness

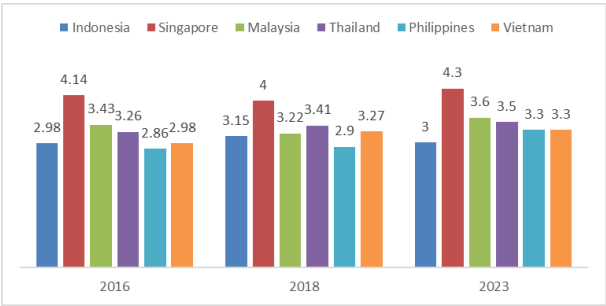

Figure 2. Development of Logistics Performance

Source: (World Bank, 2023)

Bappenas (2022) explains that the decline occurred in four assessment components, namely International Shipments, Logistics Quality and Competence, Tracking Tracing, and Timeliness. The cause of the decline in the four

components is high logistics costs and the use of technology in logistics activities. The Indonesian government through the Ministry of Planning/Bappenas conducted a baseline calculation of logistics costs to obtain the right logistics cost management method according to Figure 3.

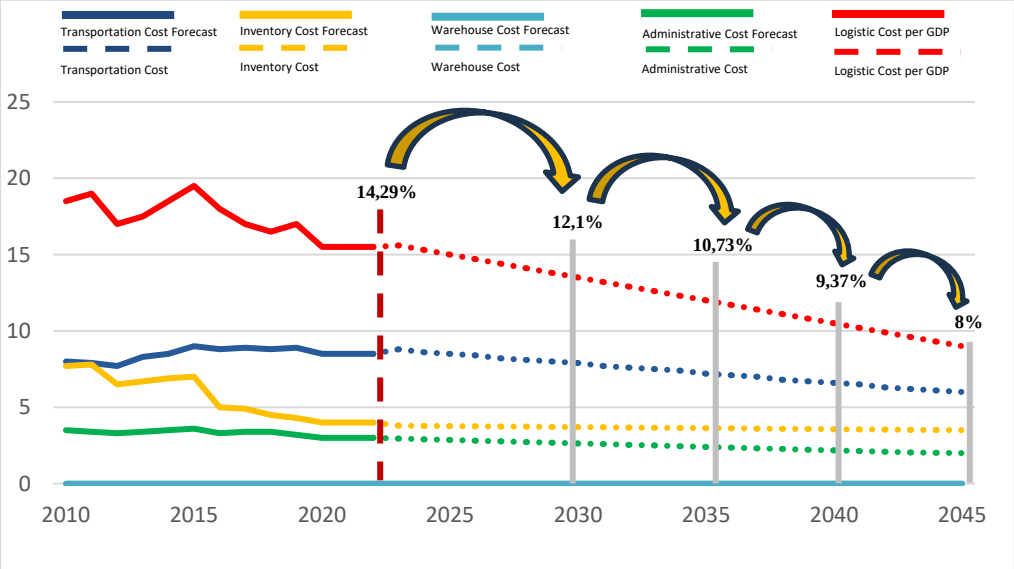

Figure 3. Milestone of Logistic Cost Reduction Target

Source: (Bappenas, 2022)

The development of Indonesia's export value in 2023 was US$258,797.2 million, a decrease compared to 2022 of US$291,979.1 million. The export value in 2023 consisted of the oil and gas sector of US$15,922.6 million and the non-oil and gas sector of US$242,874.6 million.

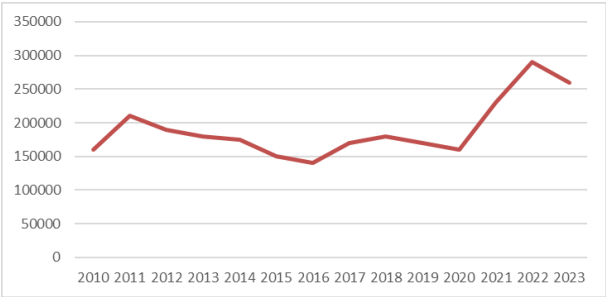

Figure 4. Development of Indonesia's Export in the last 10 years

Source: BPS Indonesia, 2023

Mark import Indonesia year 2023 as big as US$.221,886.2 million, experience decline compared to 2022 amounting to US$237,447.10 million. The import value in 2023 consists of oil and gas sector amounting to US$35,830.5 million and non-oil and gas sector amounting to US$186,055.7 million.

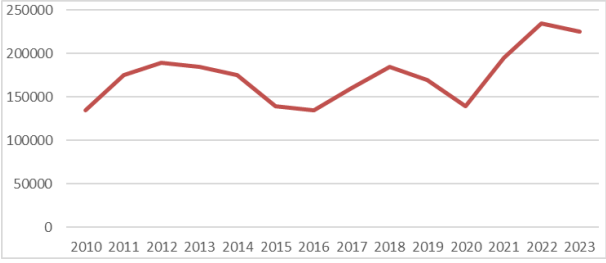

Figure 5. Development of Indonesia's Imports in the last 10 years

Source: BPS Indonesia, 2023

Mark export the biggest according to five harbor main Year 2023 in unit mark FOB (US$. Million) that is Cape Priok (54,715.8), Cape Silver (17,519), Dumai (13,236), Belawan (8,855), Kuala Tanjung is not yet operational, Banjarmasin (9,983.5). Meanwhile, five province with the largest number of foreign cruise ship visits in 2022 that is Kalimantan East (103,353,781 GT), DKI Jakarta (95,999,175 GT), Kalimantan South (78,998,006 GT), Java East (3,295,086 GT), Banten (50,958,574 GT).

j. Validity and Reliability Test Results

Validity Test is used to measure the validity of a questionnaire (Ghozali, 2005). According to Sekaran et al (2013) If valid then the question items in the questionnaire are able to reveal something that is to be measured in the questionnaire. A true reflective indicator is a good measure for its construct, each indicator must have a high correlation with its construct . In Lisrel 10.2 software, Validity is tested using the Construct cross loading value compared to the loading value of the intended construct must be greater than each other construct loading value.

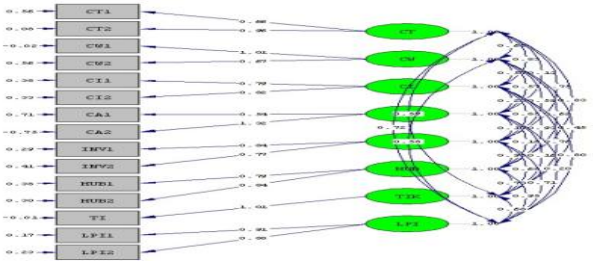

Figure 6. Cross Loading Value

Source: Research results (2024)

From the cross-loading results in Figure 6, it shows that the loading value of each indicator item against its construct is > 0.5 so it can be concluded that all constructs or latent variables are valid. The results of the analysis are seen in Table 1.

Table 1. The CR and AVE Values from the Analysis Results

VARIABLES	CR	AVE	CR>0.7 - AVE>0.5
CT	0.804	0.679	Fulfil
CW	0.822	0.714	Fulfil
CI	0.785	0.646	Fulfil
CA	1,011	1,020	Fulfil
INV	0.787	0.649	Fulfil
HUB	0.796	0.661	Fulfil
ICT	1,000	1,000	Fulfil
LPI	0.889	0,800	Fulfil

Source: Research results (2024)

k. Goodness of Fit (GoF)

GoF is used to describe the overall level of model feasibility or to find out whether the data to measure the relationship between variables is good or not. There are two indicators used in this test, namely the coefficient of determination and the model suitability test.

1. **Coefficient of determination** used to see how much the independent variable contributes to explaining its relationship with the dependent variable. The coefficient of determination is done by looking at the R-Squared statistical value for each variable relationship. R- Squared is also known as the coefficient of determination. This is a good model for linear regression analysis. The R^2 coefficient value is expected to be between 0 and 1. The R square value criteria approaching 0.67 are considered strong, 0.33 as moderate, and 0.19 as weak (Rahadi, 2023). The R-Square value of the 15 research variables is above 0.5 (> 50%). several R-Square latent variables that form the National Logistics Performance model have values > 50%, namely

a) Trade Hub Infrastructure Facilities , → R^2 = 0.982

b) Technology Transportation Cost Management , → R^2 = 0.557

c) Logistics Performance Technology , →R^2 = 0.678

d) Hub Trade →Logistics Performance, R^2 = 0.781

e) PBT, PBG, PBI, PBA, INFRA, HUB, IT →Lognas, R^2 = 0.772

2. **The results of model fit** using several indicators according to the results in Appendix II include, Standardized Root Mean Square Residual (SRMR), Normed Fit Index (NFI) and RMS theta. To obtain a suitable model, it must meet a value, namely SRMS <0.08; NFI <0.90. Based on the output in Figure 8, it is obtained that the P Value RMSEA value is 0.000 <0.05, the ECVI value consists of Expected of 1.758 and Saturated of 3.412 <from Independence of 14,399, NFI, RFI and GFI values> 0.7, so it can be concluded that the model formed has met the suitability criteria so that the model can be used and is good at describing the relationship between variables.

The formation of the SEM Lisrel 10.2 model can be tested with two relationships, namely direct effect and indirect effect. The relationship between variables is significant if the p-value of the T-Statistic is less than the 5% significance level. Analysis of the relationship using Lisrel 10.2 can be seen in Figure 1 that all relationships have a P Value <0.05 which means it can be accepted including the Hypothesis that was built.

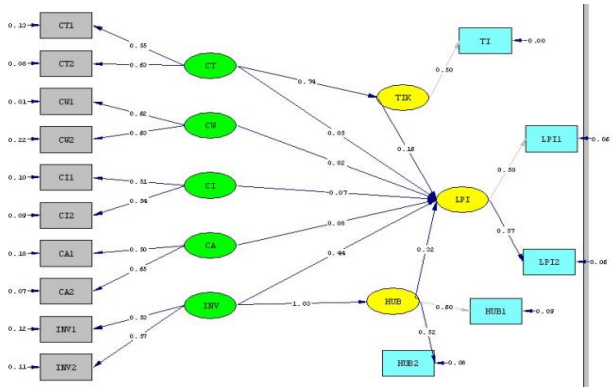

Figure 7. SEM Lisrel 10.2 Model

Source: Analysis results (2024)

Based on the results of the Focus Group Discussion of six Stakeholders divided into three, namely: Regulators, Academics and Implementers, namely 2 Regulatory Informants from the Coordinating Ministry for Economic Affairs and the Ministry of Trade. For the academic category represented by Bina Nusantara University and Logistics of ITL Trisakti. Furthermore, for the Implementer category represented by logistics actors. Logistics problems were mentioned by all Stakeholders based on the results of the FGD with the issue of emphasis related to Logistics performance problems, namely Logistics Costs, Connectivity, Illegal Levies and Regulation. While Stakeholder Expectations related to improving logistics performance by utilizing digital technology or technology 4.0, utilizing multimodal transportation and improving regulations.

d. Discussion

1. Hypothesis test results:

H_1: Transportation Cost Management has a positive and significant effect on Information Technology of 0.74, which means that if this variable increases by one unit, Information Technology will directly increase by 74%.

H_2: Information Technology has a positive and significant effect on sustainable national logistics performance in Indonesia by 0.27, which means that if this variable increases by one unit, Indonesia's Logistics Performance will directly increase by 27%.

H_3: Transportation Cost Management has a positive and significant effect on sustainable national logistics performance in Indonesia by 0.05, which means that if transportation cost management increases by one unit, Indonesia's logistics performance will directly increase by 5%. This theme is in accordance with the results of the analysis that logistics cost management affects information technology at the port

H_4: Warehouse Cost Management has a positive and significant effect on sustainable national logistics performance in Indonesia by 0.02 and is positive. This means that if the management of warehousing costs increases by one unit, Indonesia's Logistics Performance will increase directly and indirectly by 2%. The results of this study support the results of research by Pohit et al (2019), Solakivi et al (2018), Somuyiwa et al (2010).

H_5: Inventory Cost Management has a positive and significant effect on sustainable national logistics performance in Indonesia by 0.07 and is positive. This means that if the management of inventory costs increases by one unit,

Indonesia's logistics performance will increase directly and indirectly by 7%. Inventory costs has a significant impact on LPI scores. High costs indicate inefficiencies in the supply and distribution chain, which negatively impact overall logistics performance.

H_6: Administrative Costs Management has a positive and significant effect on sustainable national logistics performance in Indonesia by 0.08 and is positive. This means that if the management of administrative costs increases by one unit, Indonesia's Logistics Performance will increase directly and indirectly by 8%.

H_7: Infrastructure Facilities have a positive and significant effect on sustainable national logistics performance in Indonesia by 0.44 and are positive. This means that if the variable increases by one unit, Indonesia's Logistics Performance will increase directly by 44%.

H_8: Infrastructure facilities have a positive and significant effect on Trade Hubs in Indonesia of 1.00 positive, which means that if the variable increases by one unit then the Trading Hub Performance will increase by 100%.

H_9: The Trade Hub has a positive and significant effect on sustainable national logistics performance in Indonesia by 0.43, which means that if the variable increases by one unit, then the sustainable national logistics performance in Indonesia will increase by 43%.

H_{10}: If the Information Technology variable intervenes in the management of Transportation Costs, namely as a mediator, it will have a positive and significant effect on the Performance of sustainable national logistics in Indonesia by 16% for every increase in one unit. This finding shows *the novelty* of the study, namely that in addition to strengthening the results of previous studies, it also shows that the use of information technology provides a very significant change in logistics performance compared to transportation costs, which is 11% greater without logistics cost intervention. In the future, the Government needs to implement policies by utilizing and developing Information Technology to improve Logistics Performance and reduce Logistics Costs. The results of this study support the results of research by Lazarov et al (2023) and Sezer & Abasiz (2017).

H_{11}: If the Trade Hub intervenes with Infrastructure as a mediating variable, it will have a positive and significant influence on sustainable national logistics performance in Indonesia only. by 32%. This is in contrast to research by Rodrigue (2020) in Europe, Lee & Cullinane (2016) in Singapore, and Bottasso et al (2018) in America.

2. Some suggestions related to the high logistics costs, especially transportation costs in Indonesia , which were conveyed by the resource persons in the FGD, namely :

a. The function of multimodal transportation or intermodal is not optimal where the railway mode is not optimally utilized by entrepreneurs and the government and optimizes land transportation. As well as the function of sea transportation as *a backbone* that is not running.

b. Connectivity between sea transportation as *a backbone* and land transportation as *a feeder* is not running due to infrastructure limitations and weak use of technology.

c. Several regulations that hinder the delivery of goods, both at the central and regional government levels.

d. The use of technology that is not yet massive and not yet integrated and simplified. So it seems to utilize technology but the technology makes the service inefficient .

e. Digitalization and Simplification need to be developed with the existence of an institution that coordinates in the field.

f. Coordination and collaboration functions must be carried out by all *stakeholders* in the field.

g. There is cargo mapping, port space management and use of technology that provides savings , efficiency and effectiveness.

3. The results of the study related to the relationship between transportation cost management and national logistics performance with information technology as a mediator showed a significant positive relationship of 16%. Information technology plays a role in logistics transportation costs, including 1) Operational Efficiency which helps optimize operational processes in the logistics sector. 2) Better Data Management, namely by using sophisticated information systems, companies can collect, store, and analyze data related to shipping and inventory. 3). Automation and Error Reduction of various processes, such as ordering, scheduling, and shipping. 4). Visibility and Transparency, namely technologies such as the Internet of Things (IoT), companies can monitor the condition of goods in real time, such as temperature and humidity, and 5) Cloud-based systems and digital platforms enable better collaboration between various stakeholders

4. Another finding that shows *the novelty* is that infrastructure facilities have a positive and significant influence on trade hubs in Indonesia of 1.00 positive, which means that if the variable increases by one unit, then the

performance of the trade hub will increase by 100%, meaning that changes to the quality of infrastructure will drive a 100% change in the trade hub at the port.

CONCLUSION AND RECOMMENDATIONS

The conclusion of this study is that sustainable logistics performance must refer to the long-term capability of a logistics system where the logistics system or process must be effective and efficient by reducing negative impacts on society, the economy, and the environment and also paying attention to technological innovation. In addition, the variables that most influence national logistics performance based on the results of the analysis are the variables of trade hubs, infrastructure, and information technology. While the variable that has the least influence on national logistics performance is warehousing cost management, and if information technology becomes an intervening variable, the relationship between transportation cost variables and national logistics performance is greater than the direct relationship between transportation costs and national logistics performance. Another conclusion is that if the trade hub becomes an intervening variable between infrastructure and national logistics performance, the relationship between variables is smaller than the direct relationship between infrastructure and national logistics performance and trade hubs with national logistics performance. Some of the problems of logistics performance presented in the FGD include high Indonesian logistics costs due to suboptimal connectivity functions, massive illegal levies on transportation, regulations that are not yet supportive, suboptimal backbone functions, geographical conditions, load imbalances, equitable development, and suboptimal logistics management patterns in terms of time and handling of goods. This is due to weak planning, single sub mission is not optimal, facilities are not standardized throughout the region, technology utilization is not massive due to infrastructure limitations, overlapping regulations, utilization functions are not running optimally and there is no cargo and container zoning. The main novelty of this study is related to the results of the study with trade hubs as intervening variables for infrastructure and national logistics performance, which is different from Rodrigue (2020) research in Europe, Lee & Cullinane (2016) in that infrastructure more directly affects logistics performance compared to trade hubs as mediation.

The recommendation from the results of this study is for the government to focus on improving and enhancing port infrastructure and encouraging the performance of trade hubs to improve national logistics performance, by making improvements in several aspects, namely the massive and integrated use of technology and simplification so that it has an impact on the efficiency of transportation system services, Infrastructure through service efficiency by utilizing existing technology and trade hubs, and The need to form an agency/unit that carries out the function of coordinating logistics implementation which includes IT implementation coordinators, trade hubs and other logistics activities so that it can encourage the performance of trade hubs and logistics performance.

In addition, the government also made improvements to other research variables that had positive but not too significant values such as administrative cost management, warehouse cost management and inventory cost management using information technology variables such as transportation cost management, and immediately stipulated a regulation/rule related to the policy of utilizing integrated information technology and involving all stakeholders in the logistics process in Indonesia which is a development of the current NLE System. The results of the study related to IT variables provide a significant influence on transportation cost management on sustainable logistics performance, which can be used as a basis for improving the performance of NLE which has currently been implemented, namely Building information technology (IT) infrastructure and encouraging a digitalization culture for logistics communities throughout the Port, especially those targeted for NLE implementation, Simplifying applications at the Port by building Portalization as Superapps so that logistics actors do not use many applications that can be confusing. The main discussion of the results of this study is that the Trade Hub function in Indonesia has not been effective in driving national logistics performance. The results of the SEM analysis show that the influence of infrastructure facilities on national logistics performance is 44% more effective than the influence of infrastructure facilities on national logistics performance with the trade hub variable as a mediator. The results of this study contradict the research of Rodrigue (2020) in Europe, Lee & Cullinane (2016) in Singapore, and Bottaso et al (2018) in America which show that Trade Hub interventions on Port infrastructure are more effective in driving logistics performance than without a Trade Hub. The Trade Hub problem was expressed by 4 stakeholders from academics, regulators and implementers that the ideal Trade Hub greatly influences national logistics performance, but the problem that occurs is that the Trade Hub in Indonesia has not been able to develop because there is no unit as a coordinator in the field that is able to drive the Trade Hub and until now there has been no Port in Indonesia that is able to develop a trade hub.

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