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Port Performance as a Mediation of the Influence of Infrastructure and Superstructure Quality in Realizing Efficient and Effective Logistic Cost Ports

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ABSTRACT

Objective: This study aims to test, analyze, and explain the effect of Port Performance as mediation effect of Quality of infrastructure and Quality of Superstructure on Port Logistic Cost.
Method: This study uses quantitative approach. Population of this research is N=167 shipping line companies. Research data collection method uses survey method using questionnaire. Collected data were analyzed using Importance Performance Analysis and Structural Equation Modeling.
Results: The results of empirical analysis can be concluded that quality of infrastructure and superstructure quality has significant effect on port performance. In addition, port performance has significant effect on port logistics costs. Meanwhile, infrastructure quality and superstructure quality have no significant effect on port logistics costs. However, if mediated by port performance, effect of infrastructure quality and superstructure quality on port logistics costs is significant. Based on the results of the IPA analysis, this study also provides information that most of indicators are in quadrant II. This shows that the performance of these indicators is very good. Therefore, PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch must maintain this performance.
Originality: The novelty in this study lies in port performance as a mediation effect of infrastructure quality and superstructure quality on port logistics costs.

1. Introduction.

Efficiently regulated ports equipped with sufficient facilities will provide benefits for industry and trade. the facilityincludes the transportation system and infrastructure used to carry out loading and unloading as well as boarding and boarding of passengers from ships to other modes of transportation. Road access for proper transportation is urgently needed for port users. Supporting facilities such as barges and small boats are also needed to help smooth port activities.

This shows that areas with complete and good infrastructure usually have more advanced levels of social welfare, port performance and economic growth (Department of Public Works, 2006). Thus, investment in infrastructure significantly influences development (World Bank, 2004). The World Bank also states that investment in infrastructure has greater benefits than investment in other forms of capital.

Other supporting facilities besides infrastructure, namely the superstructure also plays an important role in the smooth handling of loading and unloading at the port. Ironically, there are still many ports in Indonesia that have weak infrastructure and superstructure quality. Ports in Indonesia generally have relatively short dock lengths, shallow pond depths and old port facilities. As a result, only small and medium ships can dock, while large ships choose to dock at the ports of Hong Kong, Malaysia and Singapore, which have a deeper pool depth of at least 16 meters. This condition causes export and import activities in Indonesia to still depend on other countries.

The weak quality of port facilities has been one of the trig-

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gers for high logistics costs in Indonesia. This happens because the loading and unloading process takes a long time, namely 20-25 days. As a result, loading and unloading activities are expensive compared to shipping costs. Indonesia must be able to create efficient ports and other transportation to increase competitiveness. Thus, port revitalization is the best choice that can be made, starting from quality improvement, to modernizing port facilities.

Logistics costs in Indonesia is high when compared to developed countries and other ASEAN countries because the quality of infrastructure and logistics systems is still inadequate. Lack of adequate human resources and low port performance are also the causes of high logistics costs. An increased level of performance, which comes from adequate infrastructure and systems, will minimize the logistics costs incurred.

Based on the conditions of Indonesian ports related to cost logistics that have been described above, the purpose of this study is to test, analyze, and explain the effect of Port Performance as a mediation effect of Infrastructure Quality and Superstructure Quality on Port Logistic Cost. This research was conducted in depth on the condition of Port Logistics Performance and Costs at PT. Port of Indonesia (Pelindo) II Tanjung Priok Branch. The novelty of this research is to develop a Port Logistic Cost concept or model by Ballou (1998) which involves Infrastructure Quality and Superstructure Quality which is more comprehensive and implementable at PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Port Branch.

2. Literature Review.

2.1. Infrastructure Quality.

Based on the publication of the World Development Report (World Bank, 1994), infrastructure has a role in increasing economic growth. This means that regions with sufficient levels of infrastructure availability have higher economic growth. Infrastructure development programs in several countries identified that in outline the program's targets were implemented in the medium term with a focus on increasing basic needs and human connectivity, from water, electricity, energy, to transportation.

Infrastructure, which is the driving wheel of economic growth, can be seen as a locomotive for national and regional development. Infrastructure also has an important influence on improving the quality of life and human welfare, including increasing the value of consumption, increasing labor productivity and access to employment, as well as increasing real prosperity and realizing macroeconomic stability, namely fiscal sustainability, credit market development, and its impact on labor market (Sukma, 2015). Thus, the quality of infrastructure can be interpreted as all the basic structures and facilities, both physical and social, needed for the operational activities of a company that have added value and meet or exceed expectations.

2.2. Superstructure Quality.

Quality according to Crosby (1979) is conformity with requirements which include availability, delivery, reliability, maintainability, and cost effectiveness. According to Juran (1962) quality is conformity with the purpose and benefits. Goetsch & Davis (1994) quality is a state of dynamic conditions related to products, services, people, processes, and the environment that meet or exceed what is expected. Superstructure quality is additional facilities or equipment needed to support smooth activities at the port in accordance with the objectives and benefits of a company, so that products, services, process people and the environment can meet or exceed what is expected.

There are two types of port facilities, namely infrastructure and superstructure. Infrastructure is a basic facility, while superstructure is an additional facility at the port. Superstructure facilities are additional equipment needed for the smooth handling of ship cargo at ports such as warehouses/stacking yards, loading and unloading equipment, road networks, and so on. Superstructure is the equipment construction structure that supports port activities in waters and or land. The main tools for land and floating applications are Container Crane (CC), Rubber Trade Gantry (RTG), Top Loader, Head Truck, and Chasis, while floating equipment consists of tugboats and Pandu boats (Purwanto, 2018).

2.3. Port Performance.

Port performance or port performance is the achievement of output or level of service success, use of port facilities and equipment in a certain period of time. Port performance is reflected in the following aspects. First, ports attract 90 percent of the world's cargo transportation and international trade, due to their large volumes and lower costs compared to other modes of transportation. Second, ports are a key element in the international trade supply chain, and port efficiency is relevant to country competitiveness (Sanchez et al., 2003). Third, increasing environmental awareness can trigger demand for transportation by ship because water transportation consumes relatively less fuel compared to other modes of transportation such as rail and road (Wu & Dunn, 1995). Final, Ports serve as an economic catalyst in terms of income and jobs. A World Bank study shows that the ratio of direct income from port operations to indirect income from port-related activities is 1:5, and the ratio of direct port employment to indirect employment is approximately 1:9. (Feng et al., 2012).

2.4. Port Logistic Cost.

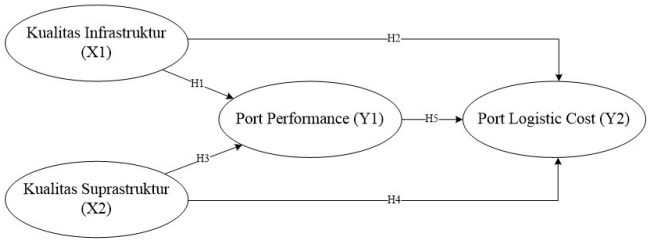
In general, logistics costs include all costs required for the transportation, storage and handling of materials required for production to the distribution, handling and delivery of finished products from producers to consumers (Bokor, 2012), where current and future profitability will be maximized by the cost-effective realization of each activity (Bartolacci et al., 2012). Therefore, the total cost of logistics needs to be clearly identified in order to understand the level of resources required to operate the logistics system (Abdallah et al., 2012). In addition, identifying the total logistics costs accurately is useful in evaluating the trade-offs between each logistics activity cost in order to optimize the use of available resources.

3. Research methods.

This study uses a quantitative approach. This approach is a type of research whose specifications are systematic, planned and structured. The location of this research will be carried out at PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch in accordance with the formulation of the problem and the objectives to be achieved. The population of this research is all companies that have used the services of PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch, thus the population of this study is N = 167 shipping line companies. The sampling technique used is saturated sampling technique or commonly referred to as saturated sampling. This technique is a non-probability sampling where all members of the population are used as samples

The research data collection method uses a survey method using a questionnaire research instrument with a Likert scale. The research variables are Infrastructure Quality, Superstructure Quality, Port Performance and Port Logistic Cost. The data collected in this study will be analyzed using Importance Performance Analysis (IPA) and Structural Equation Modeling (SEM).

Figure 1: Research Hypothesis Model.



Source: Author.

4. Results and Discussion.

4.1. Validity and Reliability Test Results.

This study uses a path analysis approach to estimate model parameters. Before estimating parameters, it is necessary to check the validity and reliability of each questionnaire item on each variable. A questionnaire is declared valid if the statement items in the questionnaire can show a measurement of the questionnaire. The minimum requirement for the questionnaire to be valid is if the corrected item-total r has a minimum value or is greater than the critical r (0.3). Reliability is the reliability of the instrument which shows the extent to which a measure can provide consistent results when repeated measurements are made under the same conditions with the same measuring device. Statement items are said to be reliable if they show a Cronbach Alpha (α) value > 0.60 (Solimun et al., 2017).

Table 1: Validity and Reliability Test Results.

Variable	Indicator	Correlation coefficient	Conclusion	*Cronbach Alpha*	Decision
Infrastructure Quality (X1)	X1.1	0.448	Valid	0.663	Reliable
	X1.2	0.457	Valid		
	X1.3	0.598	Valid		
	X1.4	0.431	Valid		
	X1.5	0.520	Valid		
	X1.6	0.390	Valid		
	X1.7	0.415	Valid		
	X1.8	0.643	Valid		
Superstructure Quality (X2)	X2.1	0.462	Valid	0.845	Reliable
	X2.2	0.454	Valid		
	X2.3	0.575	Valid		
Port Performance (Y1)	Y1.1	0.445	Valid	0.796	Reliable
	Y1.2	0.610	Valid		
	Y1.3	0.645	Valid		
	Y1.4	0.409	Valid		
	Y1.5	0.576	Valid		
	Y1.6	0.445	Valid		
	Y1.7	0.495	Valid		
	Y1.8	0.587	Valid		
Port Logistic Cost (Y2)	Y2.1	0.546	Valid	0.658	Reliable
	Y2.2	0.524	Valid		
	Y2.3	0.434	Valid		
	Y2.4	0.404	Valid		
	Y2.5	0.396	Valid		
	Y2.6	0.604	Valid		
	Y2.7	0.625	Valid		

Source: Author.

From the table it can be seen that the correlation value of all corrected items-total is above 0.3 so that it is said that all items have fulfilled validity. Furthermore, the table also shows that the Cronbach's alpha value of the four research variables is worth more than 0.6. From these results, the questionnaire can be declared reliable, so that the data can be used for data analysis at a later stage.

4.2. Importance-Performance Analysis (IPA).

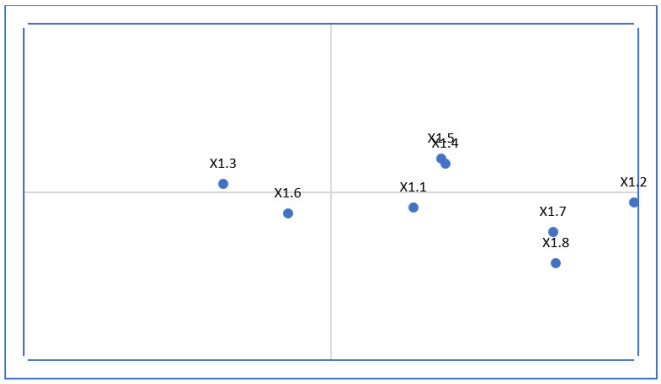
IPA was first proposed by Martilla & James (1977) to measure the level of importance and performance of a service attribute. This measurement is done from the customer perspective. The importance level shows the expectation from the customer. Meanwhile, the level of performance shows the perception of the empirical state received by the customer.

Following are the results of the importance-performance analysis for each research variable.

1. Infrastructure Quality (X1)
   Figure 2 shows that on the Cartesian chart, there is one indicator that is in quadrant I, namely X1.3. This shows that Mooring buoy (X1.3) is very important for respondents, but the level of performance is quite low, so that PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch needs to focus efforts on improving this indicator. While the Wharf (X1.4) and Warehouse (X1.5) indicators are included in quadrant II. This shows very good performance, so it must be maintained.
   Based on Figure 2, there is one indicator in Quadrant III, namely the Accumulation Field (X1.6) which has a low level of importance and performance. However, there is no need to worry about this considering that the Accumulation Field indicator is not considered very important.

Therefore, the available resources can be used to improve the performance of other more important indicators.

Figure 2: IPA Diagram of Infrastructure Quality Variable (X1).

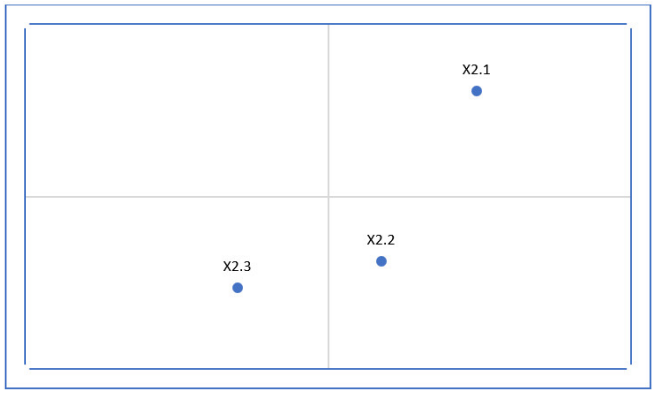


Source: Author.

In quadrant IV there are four indicators, namely Shipping Channels (X1.1), Wave Retention (X1.2), Terminals (X1.7) and Roads (X1.8). The four indicators show an unimportant position but their performance is relatively high. Customers are satisfied with the performance of these indicators, but the excessive use of resources needs to be reconsidered.

2. Superstructure Quality (X2)

Figure 3: IPA Diagram of Superstructure Quality Variable (X2).

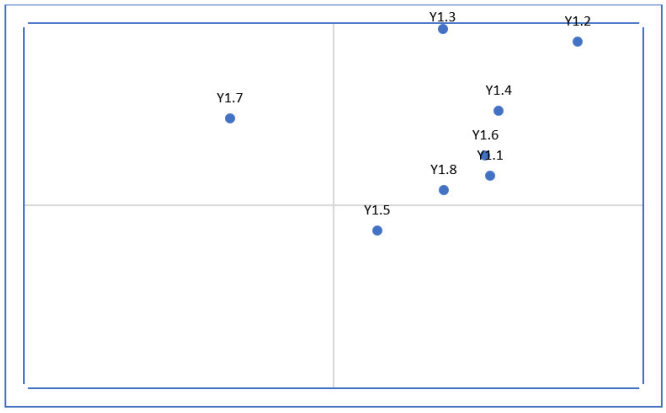


Source: Author.

Figure 3 shows that there is one indicator each in quadrants II, III, and IV. Indicators in quadrant II areLoading and Unloading Equipment(X2.1), this shows that the performance is very good, so it must be maintained. Meanwhile, the indicator in quadrant III is Illumination (X2.3), indicatingindicators have a low level of importance and their performance is also low. Thus, even though performance is low, there is no need to worry about this considering that these indicators are not considered very important. Available resources can be used to improve the performance of other more important indicators. The indicators in quadrant IV areFloating Device (Guide Means) (X2.2), showingless important indicators, but relatively high performance. Customers are satisfied with performance, but resource overuse needs to be considered.

3. Port Performance.

Figure 4: Port Performance (Y1) Variable IPA Diagram.

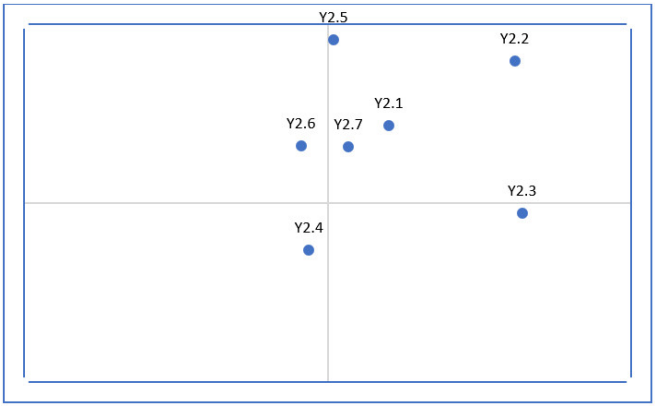


Source: Author.

Figure 4 shows that there is one indicator each in quadrants I and IV. The indicator in quadrant I is Shipside (Y1.7), where Shipside is very important for respondents, but the level of performance is quite low, so that PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch needs to focus efforts on improving this indicator. The indicator in quadrant IV is Online Service (Y1.5), which showsless important indicators, but relatively high performance. Customers are satisfied with performance, but resource overuse needs to be considered. While there are six indicators in quadrant II, namely Time (Y1.1), *Flexibility* (Y1.2), *Accessibility* (Y1.3), *reliability* (Y1.4), Safety (Y1.6) and Terminal (Y1.8). This shows that the performance of these indicators is very good, so it must be maintained.

4. Port Logistic Cost.

Figure 5: IPA Diagram of Variable Port Logistic Cost (Y2).



Source: Author.

Based on Figure 5, there is one indicator each in quadrants I, III, and IV. Quadrant I shows the Port Due indicator (Y2.6), where this indicator is very important for respondents, but the level of performance is quite low, so that PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch needs to focus efforts on improving this indicator. The indicator in quadrant III is Handling Fee (Y2.4), which showsThis indicator has a low level of importance and its performance is also low. Thus, even though performance is low, there is no need to worry about this considering that these indicators are not considered very important. Available resources can be used to improve the performance of other more important indicators.

In quadrant IV there are indicators*Documentation Fee*(Y2.3), where this indicator is less important, but its performance is relatively high. Customers are satisfied with performance, but resource overuse needs to be considered. While in quadrant II there are four indicators, viz *Charge Handling Terminals (THC)* (Y2.1), *Less Than Container Load (LCL) Charges* (Y2.2), *Storage Fee* (Y2.5), and *Ocean Freight* (Y2.7). It showsthe performance of these indicators is very good, so it must be maintained.

4.3. SEM-WarpPLS analysis.

The results of the WarpPLS SEM analysis are presented in the following table.

Table 2: Inner Hypothesis Testing Results of SEM WarpPLS Model.

Hypothesis	Influence Between Variables			Coefficient	*p-values*	Decision
H1	Infrastructure Quality	→	*Port Performance*	0.404	< 0.01	Significant
H2	Infrastructure Quality	→	*Port Logistic Cost*	0.052	0.35	Not significant
H3	Superstructure Quality	→	*Port Performance*	0.410	< 0.01	Significant
H4	Superstructure Quality	→	*Port Logistic Cost*	0.097	0.07	Not significant
H5	*Port Performance*	→	*Port Logistic Cost*	0.796	< 0.01	Significant

Source: Author.

Table 2 presents the results of testing the inner model of the Warppls SEM analysis as follows.

1. Infrastructure quality affects port performance with a path coefficient of 0.404 and a p-value <0.01 (less than 0.05). This shows that there is a significant influence of infrastructure quality on port performance. Considering that the path coefficient is positive, it can be concluded that the better the infrastructure quality, the port performance will increase.
2. Infrastructure quality affects port logistics costs with a path coefficient of 0.052 and a p-value of 0.35 (more than 0.05). This shows that there is no significant effect of infrastructure quality on port logistics costs. Considering that the path coefficient is positive, the better the infrastructure quality, the port logistics cost will not be significantly more efficient and effective.
3. Superstructure quality affects port performance with a path coefficient of 0.410 and a p-value <0.01 (less than 0.05). This shows that there is a significant effect of superstructure quality on port performance. Considering that the path coefficient is positive, it can be concluded that the better the quality of the superstructure, the port performance will increase.
4. Superstructure quality has an effect on port logistics cost with a path coefficient of 0.097 and a p-value of 0.07 (more than 0.05). This shows that there is no significant effect of superstructure quality on port logistics costs. Considering that the path coefficient is positive, the better the quality of the superstructure, the port logistics cost will not be significantly more efficient and effective.
5. *Port performance*effect on port logistics costs with a path coefficient of 0.796 and a p-value <0.01 (less than 0.05). This shows that there is a significant effect of port performance on port logistics costs. Considering that the path coefficient is positive, it can be concluded that the higher the port performance, the more efficient and effective the port logistics cost will be.

The influence of indirect variables on infrastructure quality and superstructure quality port logistics costs with port performance as a mediating variable is presented in Table 3 below.

Table 3: Results of Estimation and Indirect Effect Test.

Mediation Effects	**coefficient**	**p-values**
Infrastructure Quality (X1) → Port Performance(Y1) → Port Logistic Cost(Y2)	0.322	0.04
Superstructure Quality (X2) → Port Performance(Y1) → Port Logistic Cost(Y2)	0.327	0.04

Source: Author.

Based on the table above, it can be defined that the Infrastructure Quality variable (X1) has a significant positive effect on the variablePort Logistic Cost(Y2) mediated byportPerformance (Y1). Because the p-value <0.05, the statistical hypothesis states that the variableportPerformance (Y1) is able to mediate the Infrastructure Quality variable (X1) andPort Logistic Cost(Y2) of 0.322.

Based on the table above, it can be defined that the Superstructure Quality variable (X2) has a significant positive effect on the variablePort Logistic Cost(Y2) mediated byportPerformance (Y1). Because the p-value <0.05, the statistical hypothesis states that the variableportPerformance (Y1) is able to mediate the Superstructure Quality variable (X2) andPort Logistic Cost(Y2) of 0.327.

Conclusions.

Based on the results of the empirical analysis, it can be concluded that the quality of the infrastructure and the quality of the superstructure have a significant effect on port performance. In

addition, port performance has a significant effect on port logistics costs. Meanwhile, infrastructure quality and superstructure quality have no significant effect on port logistics costs. However, if mediated by port performance, the effect of infrastructure quality and superstructure quality on port logistics costs is significant. This shows that good quality infrastructure and superstructure quality are followed by high port performance, thus realizing an effective and efficient port logistics cost.

Based on the results of the IPA analysis, this study also provides information that most of the indicators are in quadrant II. This shows that the performance of these indicators is very good. Therefore, PT. Pelabuhan Indonesia (Pelindo) II Tanjung Priok Branch must maintain this performance.

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