

Analysis of the Influence of Container Integrated Depot Location on Transportation Costs with Distance Traveled and Travel Time as Intervening Variables

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Abstract: Logistics is a system that requires coordination in maintaining a smooth supply chain and providing support to the industry, while the factors that affect this smooth running are the aspects of distance, time and cost. In addition, to support the implementation of logistics, it is necessary to optimize the location of facilities, in this case in the form of depots and garages in an area. One of the areas that has the potential to optimize the placement of the location is the Bekasi Regency Industrial Estate. This study aims to analyze the influence of the location of integrated depots on cost, distance and time with variations in the influence of several variables directly or indirectly. This study uses the weighting method to select the potential location (the location of the integrated depot) then the linear regression method to be able to identify the direct effect between related variables and for the indirect effect between certain variables, the path analysis method is used. Data collection is carried out by obtaining primary data in the form of observations and interviews with respondents and secondary data in the form of data obtained from related institutions, both the Government and Business Entities. The output of this study is the value of the direct influence of the integrated depot location variables on each variable (distance, time cost), distance and time on cost and the value of the indirect effect on the integrated depot location variable on costs through distance and time.

Keywords: Location, Distance, Time, Cost, Depot, Container, Garage.

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I. INTRODUCTION

Logistics plays an important role in maintaining this smooth supply chain so that it can ensure that goods can be produced, distributed, sold efficiently and the availability of goods in the market can be maintained and provide support to the industry. Logistics is also an economic driver with goods distribution services that prioritize cost efficiency, in this case efficient logistics ensures that products are available in the right place and time can increase customer satisfaction. A good logistics system also manages the return process quickly and easily for customers. In the logistics system, it is known as macro logistics and micro logistics (Government of the Republic of Indonesia, 2012), where macro logistics is organized by the government/state which is then referred to as the national logistics system. The scope of macro logistics facilitates corporations (micro logistics) to make profits and to increase the nation's competitiveness and people's welfare. So that macro logistics is focused on aspects of regulation, policy and development of the provision of logistics

infrastructure, such as distribution network infrastructure, transportation, information, and financial networks. One of the macro logistics management policies can be seen at the Port of Tanjung Priok.

The Port of Tanjung Priok as one of the main distribution centers in Indonesia is experiencing various logistical challenges, especially in the movement of goods from and to the port. The movement of freight trucks that have not been properly integrated causes congestion and delays in the distribution process. Data from DPP Atrindo in 2021 shows that the total movement of container vehicles/trucks from factories/warehouses, garages, and depots in the Greater Jakarta area to Tanjung Priok Port was 20 movements and vice versa consisted of 6 movements carrying full containers and 14 empty containers. The data shows that there is an imbalance in logistics flows, with significant differences between the movement of full containers and empty containers, which leads to inefficiencies in distribution. Data from several depots in the

area around Tanjung Priok Port such as PT. TPN, INKOPAL and PT. BSK has an average distance of about 77.3 km to the Indotaisei industrial area in the Karawang area.

In 2024, DPP Atrindo also revealed data related to the length of the *turn round* time for transportation activities in the export process, which is 12-24 hours from normal conditions which should be 8 hours. Transportation activities for the current export process consist of 60 to 120 minutes of travel from the garage to the container depot and in it takes 60 to 120 minutes to lift on the container, then the container is taken to the warehouse / factory which lasts 120 to 180 minutes on the way to then stuffing in the warehouse / factory with a duration of 120 to 240 minutes which is then carried out the cargo to the port with a travel time of 180 to 300 minutes minutes and spent 120 to 300 minutes at the port and finally returned to the garage with an empty load for 60 to 120 minutes of travel.

The areas that currently have massive logistics movements are the agglomeration areas of Jakarta, Bogor, Depok, Tangerang and Bekasi (Jabodetabek). The agglomeration area includes 3 provinces with movement centers in the megapolitan area of Jakarta and has modal nodes in the form of stations, airports and ports for the transfer of commodities/goods. This can be shown in the data from the 2020 report on the Capital Share of Freight Transportation in Jabodetabek by BPTJ found that 99% of highway transportation is more dominating than rail road transportation, in this case movement on the highway leads to TanjungPriok Port. Along with the implementation of these logistics services, there are various challenges that continue to be a concern, including costs and travel time.

The challenges as explained in the previous description are caused by the location of service facilities such as depots and garages which are currently not appropriate because they are not integrated with service distribution centers so that they cannot accommodate the potential amount of travel demand. In order to overcome these problems, a strategy is needed to optimize the location of the container integrated depot. Industrial areas in Bekasi Regency have great potential as an alternative location for the development of integrated depots to improve logistics distribution efficiency and reduce transportation costs. Based on data from JUTPI 2 in October 2019 regarding data on the distribution of goods transportation to Tanjung Priok Port, it is stated that the eastern region of Greater Jakarta has massive movements, precisely in the Industrial Estate of Bekasi regency. Thus, this study aims to analyze the influence of container integrated depot location on transportation costs by considering mileage and travel time as intervening variables.

Based on this background, the problems identified in this study include traffic congestion around Tanjung Priok Port which causes inefficiencies in the distribution of goods, the location of depots, garages, and factories/warehouses that are not integrated so as to extend distances and travel times, the length of turn-around time in the export process which has an impact on increasing logistics costs, and the potential

of the industrial estate of Bekasi Regency as an alternative location for integrated depots to reduce costs and travel time. This study aims to analyze the influence of integrated depot location on mileage, travel time, and transportation costs, as well as how the role of distance and travel time in mediating these influences.

Some previous studies that took the topic of the location of container depots and truck garages as well as the influence of logistics services based on mileage, travel time and transportation costs were (Veres, S., & Bányai, T, 2023) using the FLP method, this study only focused on models that can provide a Design that takes into account investment and operational costs with special emphasis on the question of how to estimate the average transportation distance in distribution networks with unknown structures. (Adeleke, O. J., & Ali, H, 2020) using distance and demand point variables, where the focus of this study is on the proposed model with efficiency direction as considerable reductions are obtained for the total number of activated collection sites and allocated containers. (Zheng, Z, 2021) and (Nong, T. N.-M, 2021) conducted research with a focus on maximizing facility locations based on optimizing capacity, cost and human resources.

The purpose of the research conducted by the author is to find out whether the location of the integrated depot has a direct effect on the distance traveled, find out whether the location of the integrated depot has a direct effect on the travel time, find out whether the location of the integrated depot has a direct effect on the cost of transportation, find out whether the distance traveled has a direct effect on the cost of transportation, find out whether the travel time has a direct effect on the cost of transportation, To find out whether the location of the integrated depot has an indirect effect on the cost of transportation through the mileage, and to find out whether the location of the integrated depot has an indirect effect on the cost of transportation through travel time.

This study sees that a well-chosen integrated depot location will provide significant advantages to logistics efficiency through several lines of influence. A strategic location not only reduces distance and travel time but also directly and indirectly reduces transportation costs, thus providing more efficient and cost-effective operational results. In this case, the location of the integrated depot has a direct indication of the influence on travel time, mileage, and transportation costs. In addition, travel time and distance traveled also indicate their influence on transportation costs. The indirect influence indicated by the variables of the location of the integrated depot on transportation costs through distance traveled and also travel time.

The hypotheses contained in this study include the allegation that the location of the integrated depot has a direct effect on the mileage, the allegation that the location of the integrated depot has a direct effect on the travel time, the allegation that the location of the integrated depot has a direct effect on the transportation cost, the allegation that the distance traveled has a direct effect on the transportation cost,

the allegation that the travel time has a direct effect on the transportation cost, The allegation that the location of the integrated depot has an indirect effect on the cost of transportation through the distance traveled, The allegation that the location of the integrated depot has an indirect effect on the cost of transportation through travel time.

II. RESEARCH METHODS

A. Data Collection Methods

The data collected in this study consisted of secondary data and primary data. Primary data as intended is obtained by direct observation in the field either by conducting surveys or by providing questionnaires to the industry, while secondary data is obtained by institutional survey, in which case the researcher coordinates with relevant stakeholders to obtain the necessary data. The institutions that will be used as references in secondary data needs are the Central Government, namely the Ministry of Transportation and the Ministry of ATR, the Regional Government, namely the Bekasi Regency Transportation Office, Business Entities in the Tanjung Priok Port Area and the Industrial Estate in the Bekasi Regency area. Observation and recording of the research object, namely in the Industrial Estate of Bekasi Regency. Observations were made to find information on traffic conditions, especially the operational impact of container trucks, the location of industrial areas and the movement of container trucks. In this study, interviews were conducted through questionnaires with industry and government institutions. Interviews are intended to obtain data on the themes and objects of the research.

This questionnaire matrix and instrument grid are designed to measure the influence of integrated depot location, mileage, and travel time on transportation costs in the context of logistics. Each statement uses a 5-point Likert scale to assess respondents' perceptions of the efficiency of the depot location, its impact on distance, time, and operational costs. This data aims to provide insight into the factors that affect transportation costs in Bekasi Regency, especially to Tanjung Priok Port.

In this case, the variables are described in more detail, including facility location variables as researched (Church, R., Scaparra, M. P., & Middleton, R. S, 2022), mileage variables as per Von Thünen's theory (1826) and research (Tanaka, K., 2010), travel time variables based on Taiichi Ohno's Just-In-Time (JIT) theory and time conservation theory and research by major (Tavasszy, L. A., Behdani, B., & Konings, R., 2012), transportation cost variables as Weber (1909) Transportation Cost theory and research (De Winter, S., Macharis, C., & Pekin, E., 2009).

In addition, there are 15 operational dimensions including the variable Integrated depot location which refers to the place where container storage facilities and truck garages are integrated. The existence of this location affects the efficiency of transporting goods to the port. The operational dimensions of this variable are Proximity to main road access, Ease of access to ports and Influence on the

company's operational efficiency. Mileage refers to the distance that a transport vehicle must travel to carry goods from an integrated depot to a port. Long mileage can affect the cost and travel time. The operational dimensions of this variable are the distance between the depot and the port, the obstacles that arise due to the long mileage, the efficiency of the travel route. Travel time refers to the duration it takes for a transport vehicle to travel from an integrated depot to a port. Factors such as congestion and road conditions affect travel time. The Operational Dimensions of this variable are Duration of the trip, Congestion and obstacles during the trip, Effect of travel time on productivity. Freight charges refer to the costs incurred in transporting goods from an integrated depot to a port. These costs are affected by mileage, travel time, and operational efficiency. The operational dimension of this variable is the operational cost of the vehicle, the effect of mileage on costs, the effect of travel time on costs.

There are 4 variables according to the description of the variables above and 15 operational dimensions as the validity and reliability will be tested before data collection in the field. Validity shows the extent to which a measuring device measures what it wants to measure as Taherdoost, H., (2016) & Mohamad, M. M., Sulaiman, N. L., Sern, L. C., & Salleh, K. M., (2015). The steps taken in this validity test use the product moment correlation technique. The reliability test aims to identify the level of consistency of the measuring tool used p using the *statistical alpha cronbach instrument* technique (Kennedy, I., 2022). The location chosen is an industrial estate in Bekasi Regency considered to be able to represent a massive movement as described in the introduction.

B. Sampling

As data obtained from the Technical Plan Book for Dryport Needs in Greater Jakarta issued by the BPTJ of the Ministry of Transportation in 2021, it is explained that in Bekasi Regency as of 2021 there are 11 areas. For the population, 7 companies/factories are determined, while for research, the number of samples to be used to fill out the questionnaire is at least between 30 to 40 people, in relation to the population, 7 companies/factories are determined, then from each company/factory a minimum of 5 people are taken as samples. In this case, the sampling method used is random sampling.

In this study, the respondent population consisted of individuals who worked in companies selected as the object of the study. A total of 7 main companies have been selected as analysis units, with each company contributing 5 respondents, bringing the total number of respondents to 35 people. As the data obtained, there is a list of 35 companies that are part of the same group of companies as the parent company. This is due to the organizational structure in the logistics industry, where one group of companies can have several business entities with different specializations but still be under the same management. Therefore, this study still focuses on the 7 main companies that have been pre-determined, with respondents coming from various units within the group of companies.

C. Data Processing

From the primary data obtained from the results of the survey in the field, data processing will then be carried out using the help of *Microsoft excel* to obtain the parameter data needed in the process of the analysis stages by using the approach of the Weighting, *Linear Regression and Path Analysis* method using the help of the SPSS 23.0 application. The two methods will be used as parameters in identifying the location of integrated facilities, measuring the direct influence between variables and the indirect influence between variables.

D. Data Analysis

This study uses several assessment parameter approaches where the parameters used include Integrated Facility Location, Distance Traveled, Travel Time and Transportation Time and subsequently the output results will be used as material for recommendations for proposals in the logistics service improvement model.

III. RESULTS AND DISCUSSION

A. Identification of Integrated Depot Locations

In this case, there is an area location in the east of Greater Jakarta, namely Bekasi regency, which has quite good potential as an integrated depot location as described in the background of this research. Some alternative locations are identified based on several criteria that refer to several references, both books and research journals, to then be weighted as a step in choosing the best alternative. The basis for determining the criteria is a. proximity criteria to the port of Tanjung Priok (Rodrigue, J-P., Comtois, C., & Slack, B., 2020); b. Accessibility Criteria (Ambrosino, G., Nelson, J. D., & Romanazzo, M., 2021); c. Land Availability Criteria (Farahani, R. Z., SteadieSeifi, M., & Asgari, N., 2010); d. Operational Cost Criteria (Ballou, R. H., 2004); e. Traffic Congestion Criteria (Faturechi, R., & Miller-Hooks, E., 2014).

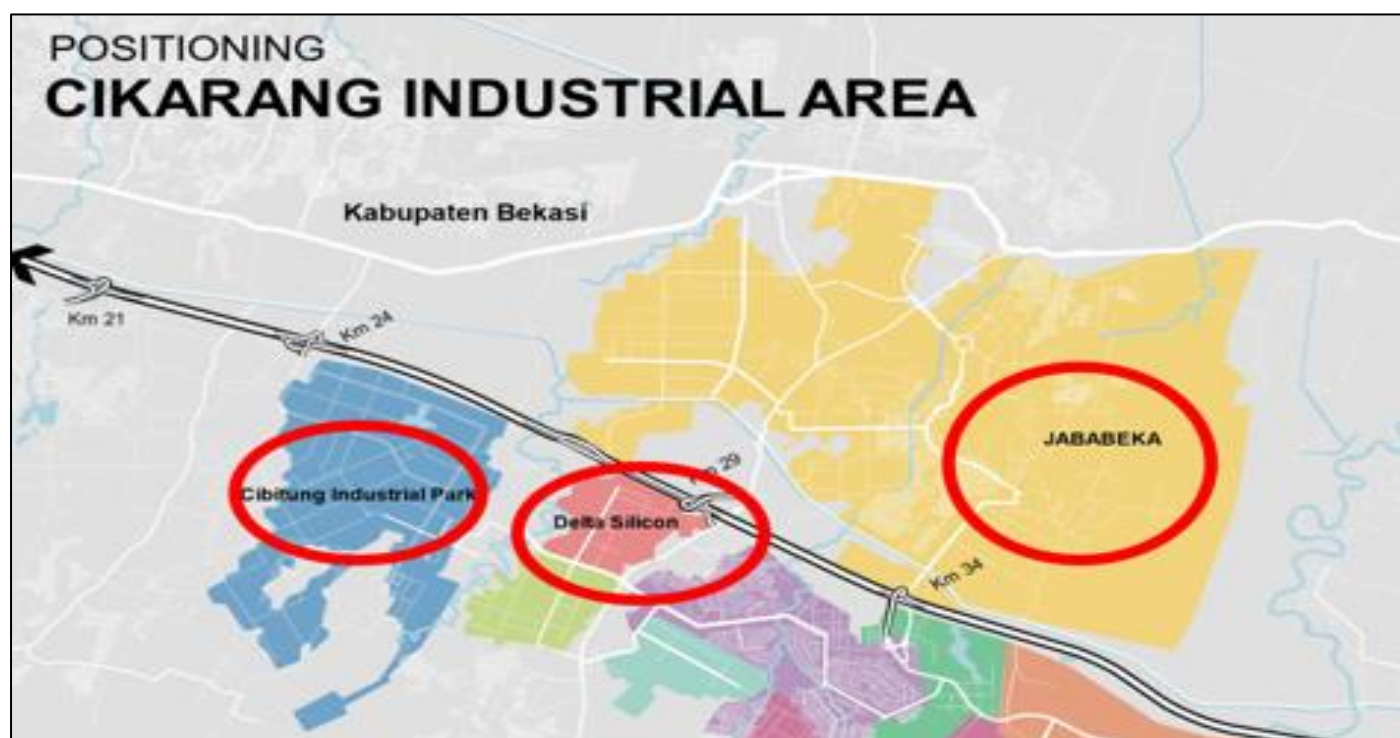


Fig 1 Proposed Potential Location of an Integrated Depot

To determine the optimal location of the integrated depot from three alternative locations (Jababeka II Industrial Estate, Cikarang; Delta Silicon, Lippo Cikarang; and Cibitung Industrial Park), an assessment was carried out using the criteria

mentioned above. The results of determining the optimal location of the integrated depot from the weighting approach are as follows:

Table 1 Final Results of Potential Location Assessment

Criterion	Weight	Cibitung Industrial Esta
Proximity to the Port	30%	5 (25 km)
Accessibility	25%	3
Land Availability	20%	5
Operating Costs	15%	4
Congestion and Traffic	10%	4
Total Score	100%	4.3

Cibitung Industrial Park (highest score): strategic area of Bekasi Regency, a distance of about 25 km from Tanjung Priok Port. Located on the main route of West Java logistics transportation. This ease of access allows logistics vehicles to reach ports and other industrial areas in a relatively short time, thereby increasing the efficiency of goods distribution.

B. Validity and reliability tests

The implementation of validity and reliability tests involves 30 respondents as Sugiyono (2014), in order to obtain a distribution of measurement values that are close to normal, the number of respondents for the questionnaire test with validity and reliability tests is at least 30 respondents. The location chosen is the Cibitung Industrial Park area as the selected location from the analysis results. The calculations in the validity and reliability tests were carried out using the help of SPSS 23.0 software. Based on the results of the validity and reliability test, it can be concluded that all attributes or indicators are valid because r calculation exceeds the r of the table of 0.3061 and are reliable with a value above 0.60 so that the attributes/indicators in the research instrument can be continued to be distributed the questionnaire.

C. Analysis of the Direct Influence of Integrated Depot Location on Mileage (Hypothesis 1)

The analysis of the direct influence of the location of the integrated depot on the distance was carried out by processing the data resulting from the questionnaire by combining or with the average value of several questions in the travel time category. In this case, the Integrated Depot Location (X1) as an independent variable and Distance Traveled, Time and Transportation Cost (Y) as a dependent variable. As the value of aggregation / processing of the average value is followed by analysis through linear management, the linear management is used to determine the influence between one or more independent variables (predictors) and one dependent variable (response variable). In linear regression, the influence between independent and dependent variables is assumed to be linear. In this case, linear regression is highly used for quantitative data generated from the Likert scale after aggregation, such as the average score for each variable. The SPSS results in the summary model table showed an R value of 0.313, which indicates a correlation between the location of the depot and the distance traveled. An R -squared value of 0.098 indicates that about 9.8% of the variability in mileage can be explained by the location of the depot, while the remainder (90.2%) is explained by other factors not included in the model. Next, the F Test in the ANOVA table shows an F value of 3.592 with a significance (p -value) of 0.067. In this case, in the model, there is a significant influence between the location of the depot and the distance traveled. With the regression equation $Y = 2.652 + 0.340X$.

D. Analysis of the Direct Influence of Integrated Depot Location on Travel Time (Hypothesis 2)

As with the SPSS result, the correlation coefficient with $R = 0.350$ shows that the independent variable has an influence on the dependent variable, but the influence is not

very strong. The value of R Square = 0.122 indicates that 12.2% of the variation in the dependent variable can be explained by the independent variable. The remaining 87.8% of the variation was influenced by other factors that were not included in this regression model. This indicates that the model has a low level of explainability, despite significant influence. Next, the P -value for $F = 0.039$ (< 0.05) with a confidence level of 95%. Indicates overall that independent variables make a significant contribution in explaining variations in dependent variables. So that. This regression model can be used to explain the influence between the variables being tested. The regression equation obtained was $Y = 2.959 + 0.302X$.

E. Analysis of the Direct Influence of Integrated Depot Location on Transportation Costs (Hypothesis 3)

As the results of the analysis through SPSS, the value of $R = 0.418$ shows that there is a positive influence between the independent variable (X) and the dependent variable (Y), with the strength of influence being in the medium category. The value of R Square = 0.174 indicates that 17.4% of the variation in the dependent variable (Y) can be explained by the independent variable (X). This suggests that despite the influence, the model's ability to explain variations in dependent variables is still limited. The results of the ANOVA test showed a value of $F = 6.967$ with a P -value = 0.013 which was smaller than 0.05. This indicates that the overall regression model is significant at a 95% confidence level. In addition, the significance of the independent variable X to Y in the Coefficient table is $P = 0.013$ which is also smaller than 0.05. This confirms that X individually has a significant influence on Y. Based on these results, it can be concluded that changes in X are statistically affected by changes in Y and support the hypothesis of this study. The regression equation obtained was $Y = 2.830 + 0.308X$.

F. Analysis of the Direct Influence of Mileage on Transportation Costs (Hypothesis 4)

As shown in the results table in SPSS, the correlation coefficient with $R = 0.340$ indicates that the independent variable has an influence on the dependent variable, but the effect is not very strong. The value of R Square = 0.116 indicates that 11.6% of the variation in the dependent variable can be explained by the independent variable. The remaining 88.4% of the variation was influenced by other factors that were not included in this regression model. This indicates that the model has a low level of explainability, despite significant influence. Next, the P -value for $F = 0.046$ (< 0.05) with a confidence level of 95%. Indicates overall that independent variables make a significant contribution in explaining variations in dependent variables. So that. This regression model can be used to explain the influence between the variables being tested. The regression equation obtained was $Y = 3.114 + 0.231X$.

G. Analysis of the Direct Influence of Travel Time on Transportation Costs (Hypothesis 5)

The results of the regression analysis showed that the value of $R = 0.407$ which described the positive influence with

moderate strength between the independent variable X and the dependent variable Y. The coefficient of determination (R^2 Square=0.166) showed that 16.6% of the variation in Y could be explained by the X variable, while the remaining 83.4% was explained by other factors outside the model. The value of $F=6.565$ with $P\text{-value}=0.015$ from the ANOVA table shows that the overall regression model is significant at a confidence level of 95%. This means that the model used is good enough to describe the influence between variables X and Y. In other words, the independent variable X together makes a significant contribution in explaining the dependent variable Y. Furthermore, the significance value $P=0.015$ from the Coefficient table shows that the independent variable X individually has a significant influence on the dependent variable Y. This indicates that the hypothesis that X affects Y is acceptable. The equation of the regresi obtained is $Y=2.619+0.348X$.

H. Analysis of the Indirect Influence of Integrated Depot Location on Transportation Costs Through Mileage (Hypothesis 6)

A statistical approach based on path analysis is used to evaluate these indirect influences. This analysis involves an intermediary effect (mediator), namely Mileage. A linear regression analysis has been carried out between the

Integrated Depot Location and the Mileage (Hypothesis 1), between the Mileage and the Transportation Cost (Hypothesis 4) and between the Integrated Depot Location to the Transportation Cost (Hypothesis 3) shown in the coefficient table of SPSS analysis results. The results of the analysis showed that there was a correlation between the location of the integrated depot and the distance traveled with an indication that the change in the location of the depot directly had a significant influence on the distance traveled.

The correlation between the distance traveled to the cost of transportation, as well as the location of the integrated depot to the cost of transportation, was also found to have a correlation. This indicates that the location of the depot significantly affects the mileage, the change of fixed location can have a direct impact on the cost of transportation through other factors, such as operational efficiency and transportation time. In addition, longer mileage tends to increase transportation costs, both through fuel consumption and driver working time, thus reinforcing the influence between these variables. The influence of n regarding the indirect influence of the Integrated Depot Location on Transportation Costs Through Mileage is illustrated in the following figure:

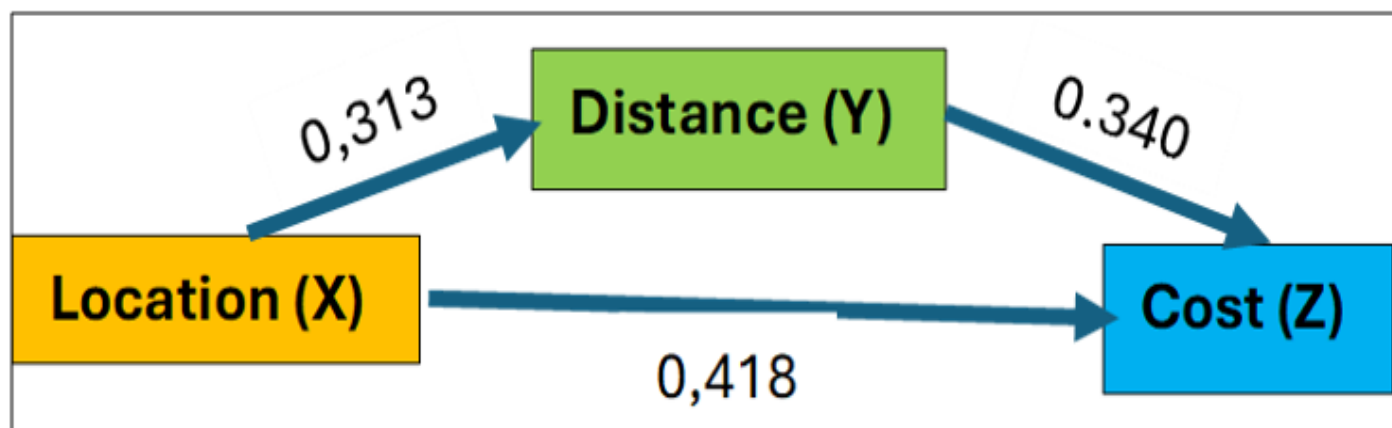


Fig 2 Indirect Influence of Integrated Depot Location on Transportation Costs Through Mileage

As shown in the picture, it is known that the direct influence given by X to Z is 0.418, while the indirect effect of X through Y to Z is the multiplication between the beta value of x to y and the beta value of y to z is $= 0.313 * 0.340 = 0.106$. then the total influence given by X to Z is the direct influence plus the indirect influence which in this case $= 0.418 + 0.106 = 0.524$. As the result of the calculation, the value of indirect influence is greater than the value of direct influence which in this case can be interpreted that indirectly the Depot Location (X) through the Mileage (Y) has a significant influence on the Transportation Cost (Z).

I. Analysis of the Indirect Influence of Integrated Depot Location on Transportation Costs through Travel Time (Hypothesis 7)

This analysis involves travel time as a mediator. To test the indirect effect, the same as the previous analysis by applying several linear regression steps that have been carried

out previously, namely the regression between the Integrated Depot Location and the Travel Time (Hypothesis 2), between the Travel Time and the Transportation Cost (Hypothesis 5) and between the Integrated Depot Location to the Transportation Cost (Hypothesis 3) shown in the coefficient table of the SPSS analysis results.

The results of the analysis showed that there was a strong influence between the location of the integrated depot and transportation costs through the intervening variable of travel time. This is reflected in the significant coefficient values in the SPSS result coefficient table. These findings confirm that the location of integrated depots not only affects transportation costs directly but also through travel time as an intermediate variable. This means that the presence of depots in strategic locations tends to reduce travel time, which ultimately contributes to transportation cost efficiency.

The strong correlation between these variables gives an idea that travel time is an important factor in explaining the influence between the location of the depot and transportation costs. Travel time efficiency can reflect the accessibility and smooth traffic around the depot, so the shorter the travel time, the lower the cost incurred. These results support the

importance of depot location planning that pays attention to the travel time aspect to maximize overall logistics efficiency. The influence of the indirect influence of the Integrated Depot Location on Transportation Costs Through Travel Time is depicted in the following chart:

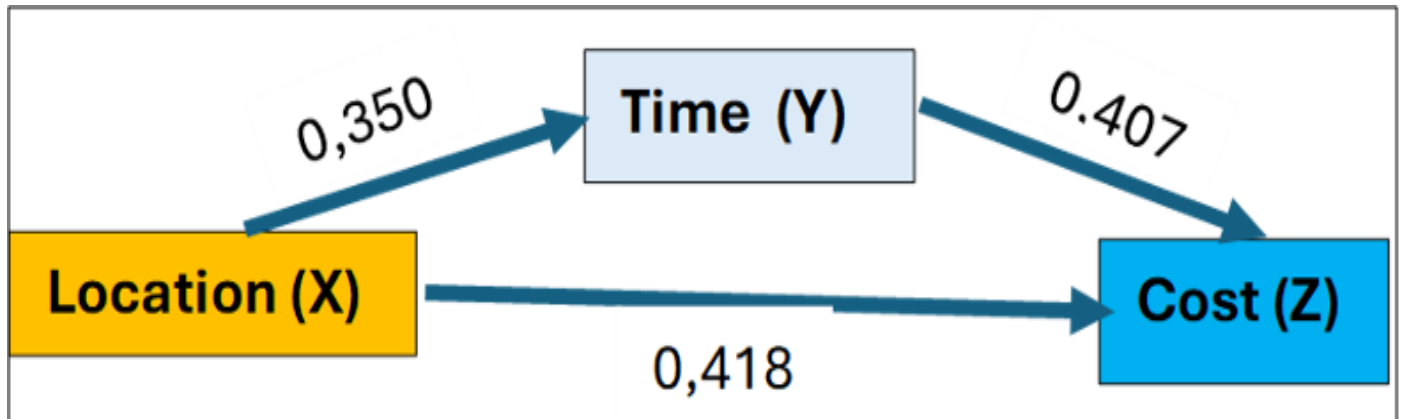


Fig 3 The indirect influence of the location of the integrated depot on transportation costs through travel time.

As the results of the SPSS analysis and also the indirect influence chart, it is known that the direct influence given by X to Z is 0.418 (beta value). while the indirect effect of X through Y to Z is the multiplication between the beta value of x to y and the beta value of y to z is $= 0.350 * 0.407 = 0.142$. then the total influence given by X to Z is a direct influence plus an indirect influence which in this case $= 0.418 + 0.142 = 0.560$. As the result of the calculation, the value of indirect influence is greater than the value of direct influence,

which in this case can be interpreted that indirectly the location of the Depot (X) through the travel time (Y) has a significant influence on the Transportation Cost (Z).

J. All Variable Model Path Diagram

As described in the analysis of each hypothesis proof in the previous section, the overall value of the influence of each variable for all hypotheses tested can be described as follows:

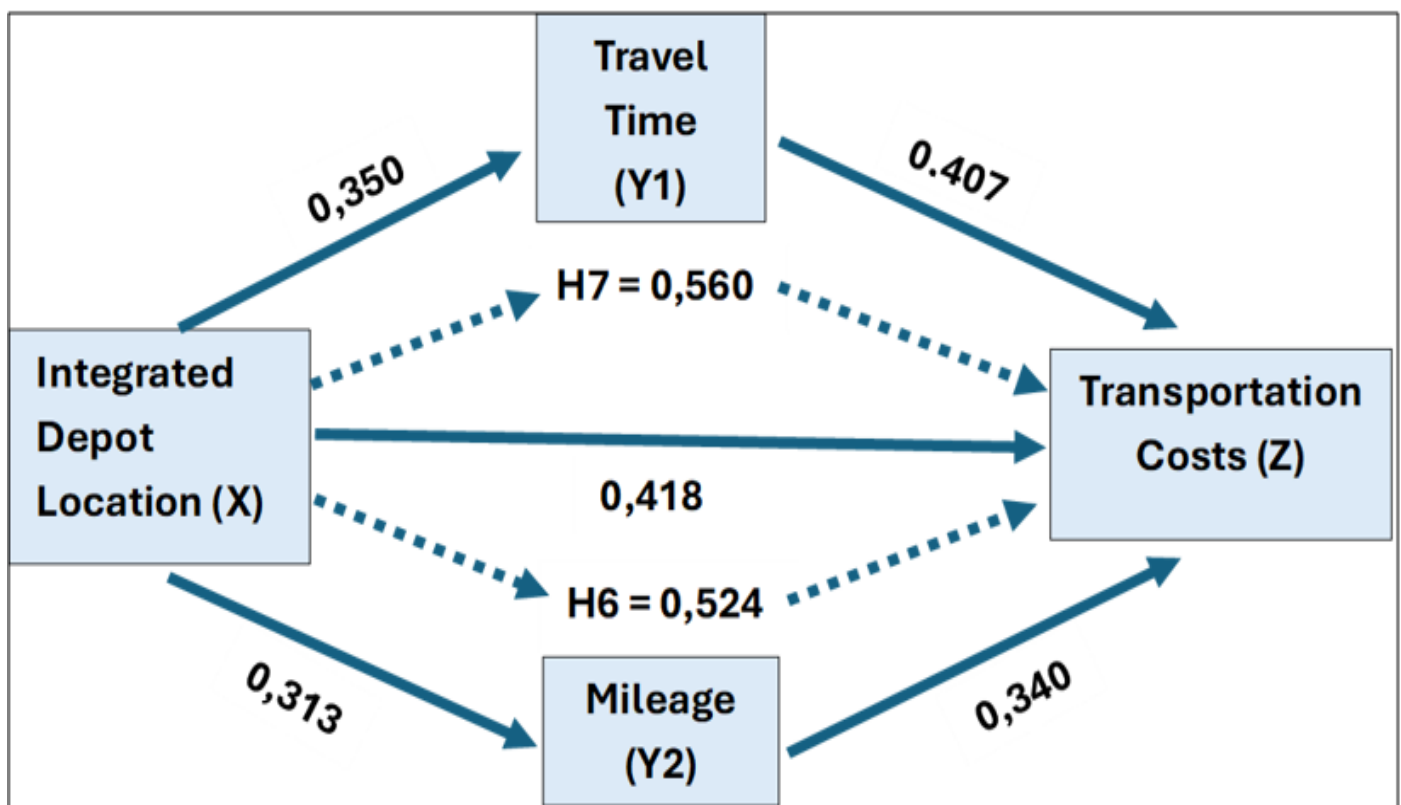


Fig 4 Model path diagram of the whole hypothesis test

As the figure shows, there is an influence on each variable with other variables, both directly and indirectly, the amount of which is indicated on the line showing each hypothesis starting from hypotheses 1 to 7.

IV. CONCLUSION

Based on the analysis that has been carried out, this study reveals that the location of the facility, in this case the Integrated Container Depot, has a direct and indirect influence on several other variables such as distance, time and cost. In this case, there are several potential areas/areas and in this case through the weighting analysis, Cibitung Industrial Park was selected with the highest score because it has advantages in terms of proximity to Tanjung Priok Port, land availability, and operational costs. This location has the closest distance to the port (25 km), adequate supporting infrastructure, and there is still a lot of land area sufficient for the construction of an integrated depot. Overall, the results of this study make an empirical contribution in understanding the influence between several variables. There were 15 questions used in the questionnaire and previously tested for validity and reliability with valid and reliable results overall. As for the proof of hypotheses, the hypothesis as a whole is proven both for direct and indirect influence.

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