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Generalized Cost Model to Determine Suitable Inland Transportation Method

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Abstract

Multimodal inland transportations has been a logistics answer used widely especially in the USA and Europe. However, Indonesia has a different geographical condition, being an archipelago countries, so far Indonesia relies heavily on combination of trucking and sea freight transportation. This often creates problem with road congestion. This paper is hoped to be able to answer whether or not multimodal inland transportation can be applied widely in Indonesia, especially in the main Java Island. In this study, the generalized transportation cost model has been used to determine in which routes can we use multimodal transportation instead of road transportation. The result suggest that Jakarta-Surabaya, Serang-Surabaya and Bandung-Surabaya should use multimodal transportation while Semarang-Surabaya and Yogyakarta-Surabaya should use road transportation

Keywords: Multimodal transportation, logistics, generalized transportation cost

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Abstrak

Transportasi darat multi moda telah banyak digunakan di Amerika dan Eropa sebagai jawaban dari kebutuhan logistik mereka. Namun halnya Indonesia memiliki kondisi geografi yang berbeda, dimana Indonesia merupakan negara kepulauan sementara Eropa dan Amerika memiliki lebih banyak daratan. Saat ini Indonesia lebih menitik beratkan kepada penggunaan truk sebagai moda transportasi darat untuk kemudian dihubungkan dengan kapal untuk menuju pulau berikutnya, namun hal ini mengakibatkan kemacetan. Riset ini diharapkan bisa menjawab pertanyaan apakah jalur transportasi darat di Indonesia bisa ditempuh dengan multi moda. Riset ini menggunakan pendekatan *generalised transportation cost* untuk menentukan rute mana yang sebaiknya menggunakan transportasi multi moda. Hasilnya menyarankan untuk rute Jakarta-Surabaya, Serang-Surabaya dan Bandung-Surabaya sebaiknya menggunakan transportasi multi moda, sementara rute Semarang-Surabaya dan Yogyakarta-Surabaya sebaiknya menggunakan transportasi darat.

Kata kunci : transportasi multi moda, logistik, *generalized transportation cost.*

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CHAPTER 1
INTRODUCTION

1.1 Background

1.1.1 Overview

Indonesia is a maritime country, consisting of thousands of island, and spreading all the way from Sumatra to Irian Jaya. Logistic has long been a challenge for Indonesia, unlike many other countries which only have several islands and can easily be connected with road or train Indonesia face a greater challenge.

To understand current transportation condition in Indonesia, table 1.1 shows the estimation on goods transportation market in Indonesia. From that table we can see that there is a clear domination on the road usage to transfer goods around Indonesia. In comparison railway transportation only have 0.62% of the market share. The big gap should ideally be reduced by combining railway transportation with road transportation. This is expected to have an impact on reducing the load on the road and hopefully increasing the transportation efficiency.

Table 1. 1 National Transportation Market Estimation *(Lubis, Isnaeni, Sjafruddin, & Dharmowijoyo, 2005)*

Mode	1000 tons/year	%
Roads	2514.51	90.34%
Railroad	17.25	0.62%
Rivers	28.00	1.01%
Straits	27.40	0.98%
Sea	194.81	7.00%
Air	1.37	0.05%

According to World Economic Forum, in 2014-2015, Indonesia's rank quality of overall infrastructure in transportation is 72 out of 144 (World Economic Forum, 2014). The following graphs will show Indonesia's value related to infrastructure based on World Economic Forum.

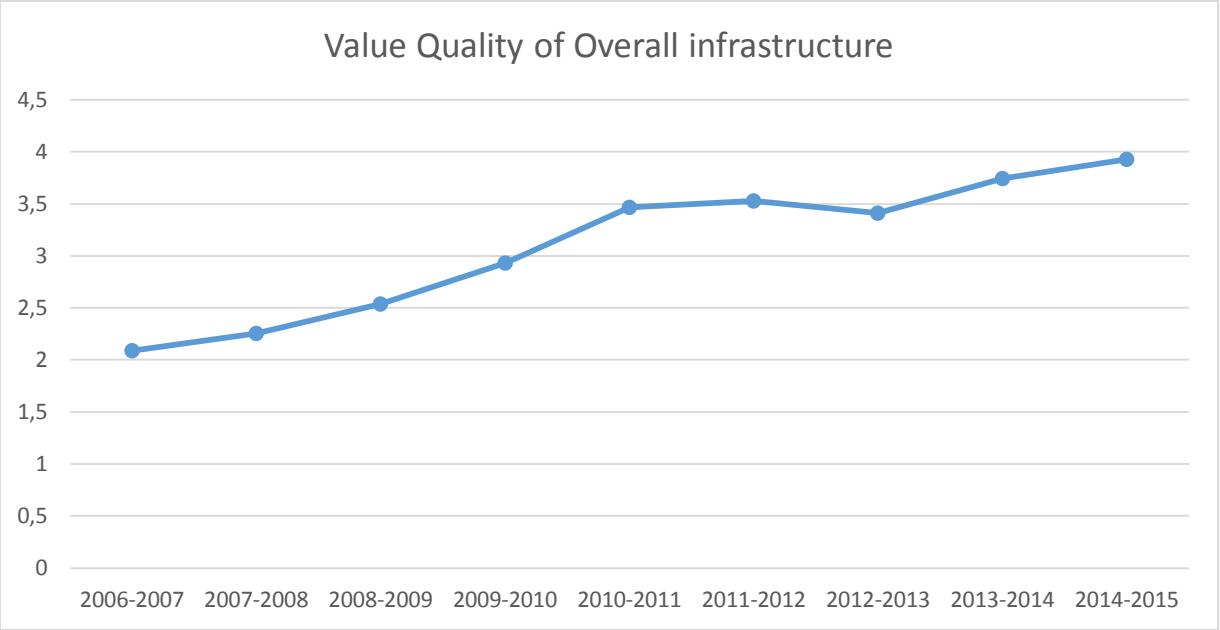

Figure 1.1 Indonesia Value Quality of Overall Infrastructure *(World Economic Forum, 2014)*

We can see from all the graphs that although it is small, but Indonesia is improving each year. Figure 1.1 shows the overall score in Infrastructure, while the details is given on the three next figures. Figure 1.2 shows railroad value in Indonesia and finally Figure 1. *3* shows the quality of road infrastructure in Indonesia.

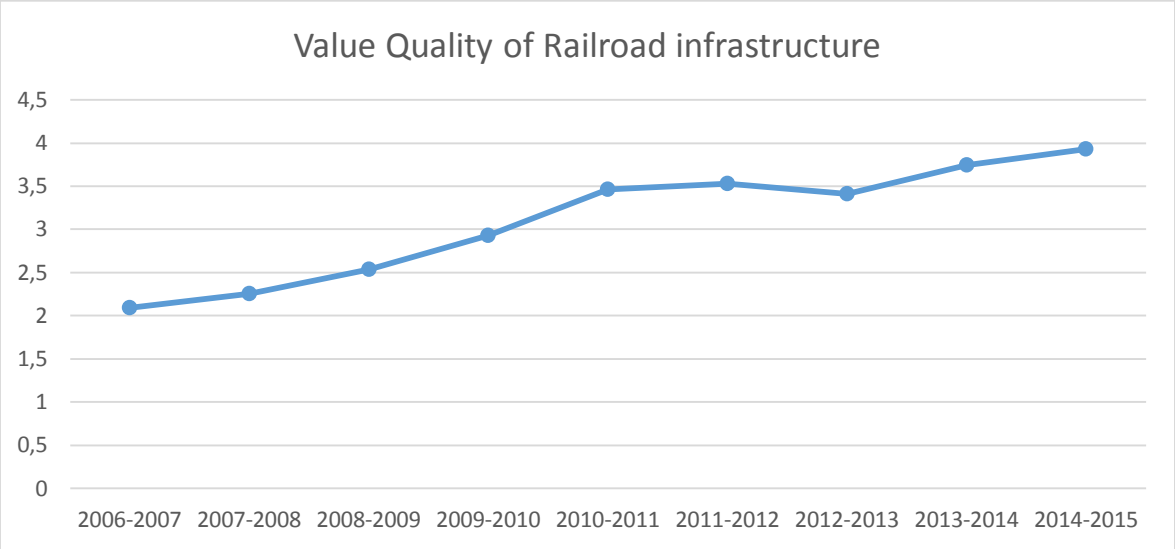

Figure 1.2 Indonesia Value Quality of Railroad Infrastructure *(World Economic Forum, 2014)*

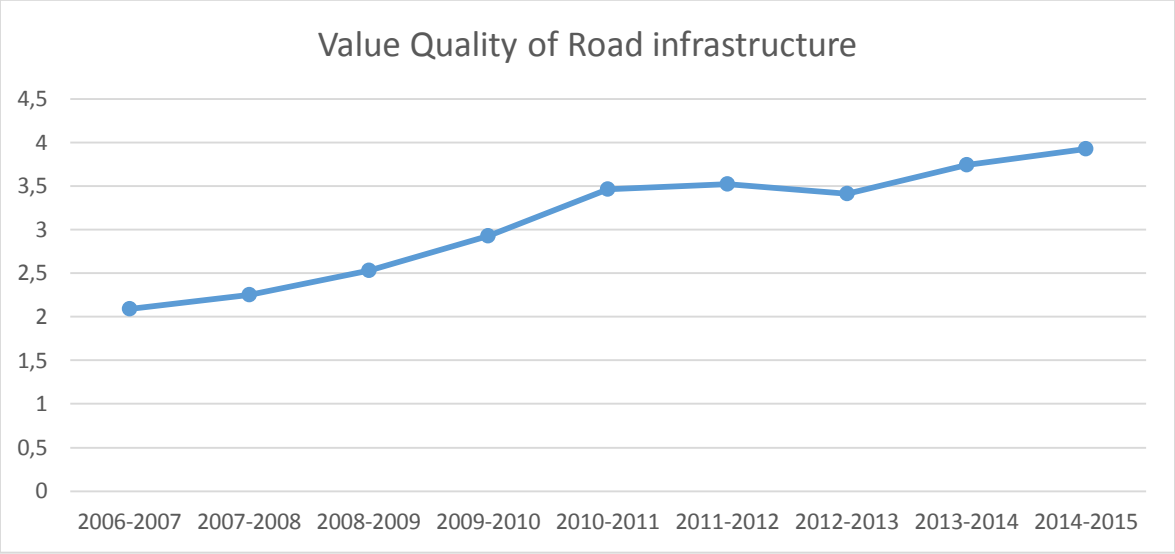

Figure 1. 3 Indonesia Value Quality of Road Infrastructure *(World Economic Forum, 2014)*

Both figure 2 and 3 shows that based on international quality standard, Indonesia has just barely score above 50%, which is just under 4 points out of 7. However, when comparing the usage between road and railway, Indonesia relies more heavily

on using road transportation. In results, traffic jam, especially in big cities in Java island is a common problem. With that in mind, come the question, can railway transportation be combined with road transportation to make logistics system in Indonesia more efficient, and will it be worth it seeing that Indonesia is an archipelago countries which means there is only a short distance that can be travelled through land in comparison with through sea.

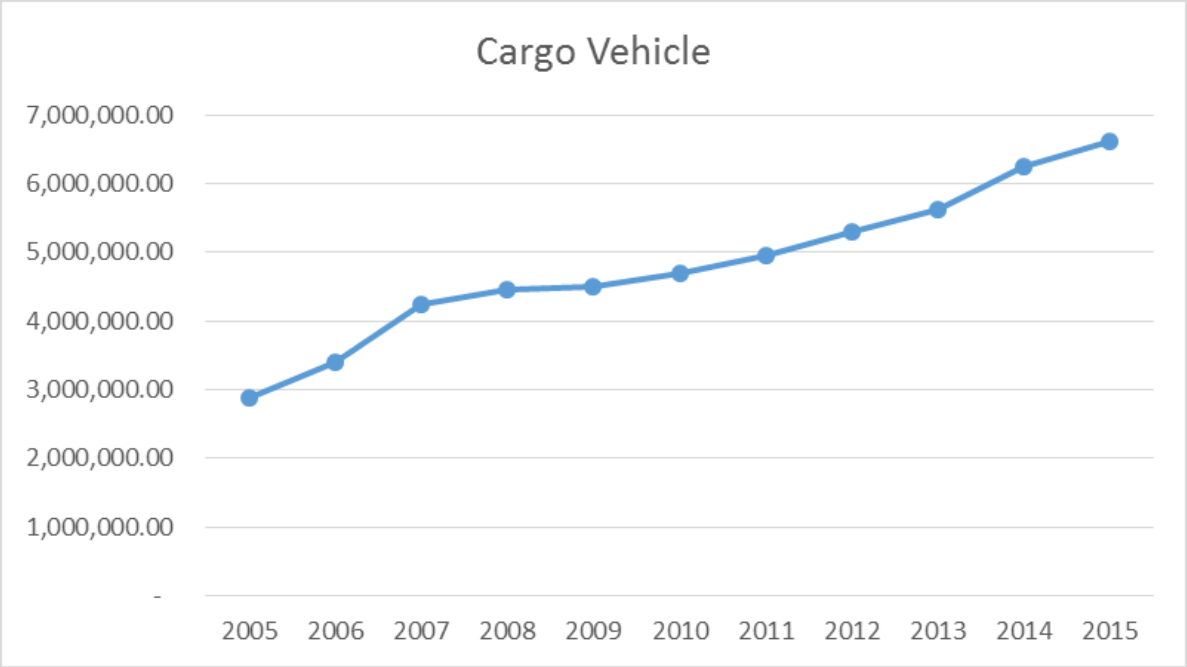

Figure1.4 Cargo Vehicle Number in Indonesia (source:BPS)

Figure 4 shows the massive growth in cargo vehicle number in the past decade. With the large demand in transporting goods, the need to have cargo vehicle is also increasing. Unfortunately when not met with suitable infrastructure growth, this demand can create a lot of negative impact, such as accident and traffic jam. Figure 5 shows that along with the high vehicle growth, there is also growth in the amount of accident that happen. This is because of all growth are centralized in road transportation therefore increasing the risk of accident.

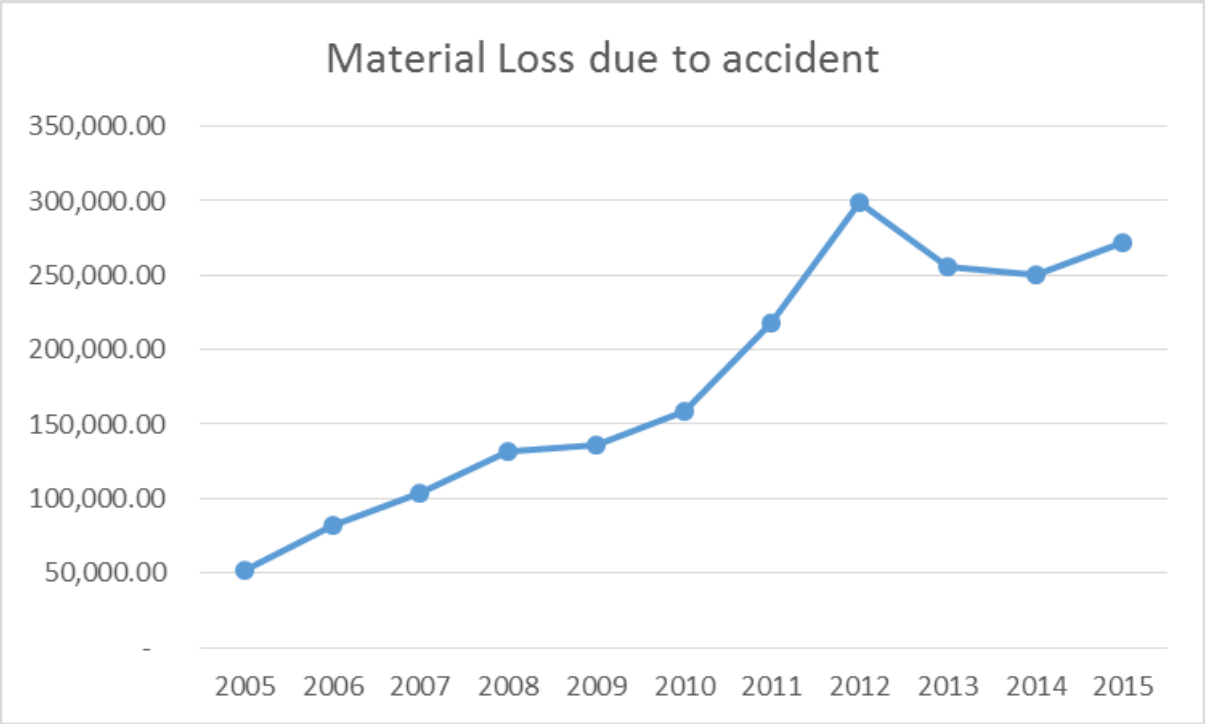

Figure 1. 5Material Loss due to Accident (source: BPS)

There are several points of consideration that seems to be in favour of introducing multi modes land transportation. The invention of containers is one of a way to improve logistics condition. Container eases movement from one mode to another, by standardizing the shape, it simplifies transhipment, reducing transportation cost and optimising the use of transportation mode (Nasution, 2004). Implementing that idea in Indonesia, container eases the movement from trucking to railway transportation, and also from inland travel to sea travel.

Furthermore, Indonesia has try to improve their logistics system, the first one is introducing sea highway concept. Introduced in 2015, sea highway concept is Indonesia's government commitment to improve both sea ports around Indonesia and procuring new vessels. Secondly, after long construction process starting on 2011, Indonesia's government has open double railway track between Surabaya and Jakarta on March 2015. The double tracks enable a more frequent railway transportation, because the scheduling becomes more flexible as the train can travel in parallel.

1.2 Problem Statement

Based on the background, the question being faced is whether or not intermodal transportation can compete with the current road transportation. In many countries combining the use or rail and road transport seems to be the answer to a more efficient transportation system, but the question is, is it applicable to Indonesia, which clearly has different geographical condition compared to the other countries. What kind of cost model that can be used to compare between road transportation and multi modal transportation? With smaller land, will it be worthwhile to have multi modes transportation?

1.3 Research Objectives

This research is expected to provide answers to the following questions:

- Calculating the different cost and value that each option has
- Determining under which conditions will it be worthwhile to introduce multi modes transportations.

1.4 Scope of Study

The limitations and assumptions in this research is as following:

- The research area is Java Island, Indonesia
- The routes that will be researched are Java Provinces' capitals which include Jakarta, Yogyakarta, Bandung, Semarang and Serang, towards Surabaya
- The cargo carried in this research is limited to cargo that can be carried using dry containerized cargo, with the assumption of 10 Tonnage/1 20'dry container worth. Container eases movement from one mode to another, by standardizing the shape, it simplifies transhipment, reducing transportation cost and optimising the use of transportation mode (Nasution, 2004). The usage of 20'container should ease the

handling process, and hence optimizing the purpose of intermodal transportation, which is to reduce total transportation cost.

- The condition, both referring handling and transportation, calculated in this research is assumed to be the ideal condition; we are not taking into account various anomalies that may happen such as facility breakdown, accident that may happen or force major.

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CHAPTER 2
LITERATURE REVIEW

2. 1. Transportation

2.1.1 Intermodal Transport

Intermodal transport is when goods are being transferred from one place to another using two or more transportation mode but without handling the goods itself when changing the modes (UN/ECE, 2001). With current development where the transportation volume is getting higher and the road is getting congested, a lot of player in the transportation industry is looking more and more towards intermodal transport as an option (Bontekoning & Priemus, 2004).The use of intermodal transportation is hoped to combine different strengths each modes own.

However, according to (Janic, 2007) intermodal transportation has not lived up to expectation. A failing implementation of the policies is suggested to be the reason behind it.

One of the main tool to support intermodal transport is container. Container made the transfer from one freight model to another so much more efficient (Muller, 1995) said. This is because container enables uniformed handling method from one mode to another.

There are 3 components of intermodal transport network which are pre-and post-haulage (PPH), Intermodal terminals and long-haul shipment (Hanssen, Mathisen, & Jorgensen, 2012)

2.1.2 Road Transportation

Trucking transportation service is the most widely used land transportation method in Indonesia. There are several reasons that supports this method choice, according to

(Ballou, 2003) because trucker only need to fill one trailer to start a shipment, trucking owns a service advantage in the small-shipment market.

However, trucking is not without its problem. There are road restrictions that will imply to road transportation, several area may have limitation due to safety restrictions, while some area might be prone to traffic jams, affecting transportation lead time.

2. 2. Transportation Cost

Transportation cost is currently the most commonly used method to compare one transportation method to the other. Transportation cost consist of both freight cost and terminal handling cost. Usually the following equation is used to calculate transportation cost.

TC = Freight Cost + Terminal Handling cost.

However, this equation does not include the time aspect which is an important point of consideration in logistics business. Some cargo has higher time value than other, and that cannot be captured using this equation.

2. 3. Generalized Transport Costs

The model that will be used in this thesis is generalized transport cost as explained by (Hanssen, Mathisen, & Jorgensen, 2012) in their journal.

$$G(D) = P(D) + HT(D)\ where \frac{\partial P}{\partial D}, \frac{\partial T}{\partial D} > 0 => \frac{\partial G}{\partial D} > 0 \qquad (1)$$

There are several elements that determine the general cost (G), which are the cost (P) or the transport service price, and the product of time (T) needed for transport and cost per hour (H). The model also assume that there is a positive correlation between P,T and G with the transport distance (D), meanwhile H is independent of the transport distance.

Different with freight cost calculation method, this model also take the time needed to complete the transportation process into consideration. As mentioned by (Bowersox, Closs, & Cooper, 2010) the fundamental logistics performance is determined by cost, speed and consistency. For that reason, it is also important to include lead time in the model to get a better accuracy on the logistics performance for each transportation model.

2.3.1. Pecuniary Cost / Price and transport distance

Pecuniary cost or the price is related to the freight transport price. Typical freight cost consist of transportation cost, terminal cost and handling cost. In the case of unimodal transport, this price will consist of freight cost of one transportation mode, whilst in the case of intermodal transport, there will be several transportation mode involved. Although each transportation mode has the same cost component, but each component weigh differently for different mode, for example according to (Rodrigue, Slack , & Notteboom, 2013) the terminal cost is highest in sea transportation, and lowest in road transportation.

$$P_t = \beta_{0t} + \beta_{1t} D(truck) and\ P_r = \beta_{0r} + \beta_{1r}(Rail) \quad (2)$$

Where

$$\beta_{0t}, \beta_{1t}, \beta_{0r}, \beta_{1r} > 0$$

2.3.2. Time Cost and transport distance

Time cost per hour is independent of transportation mode and distance. It is actually calculated from the deterioration cost per hour, which means it is decided by the carried cargo value, this will then combined with the time needed to complete the route.

$$HT_t = \gamma_{0t} + \gamma_{1t} D(truck) and\ HT_r = \gamma_{0r} + \gamma_{1r}(Rail) \quad (3)$$

2.3.3. Generalized transport cost and transport distance ρ

In the generalized cost, transport distance is an independent part. Equation below will show the threshold when will one transportation method is more preferable than the other.

$$GW_t = \rho_{0t} + \rho_{1t} D(truck) and\ GW_r = \rho_{0r} + \rho_{1r} D \quad (4)$$

2. 4. Route Information

As mentioned in the scope of study, the routes that this research looked at are Java Provinces' capitals which are Jakarta, Yogyakarta, Bandung, Semarang and Serang, towards Surabaya

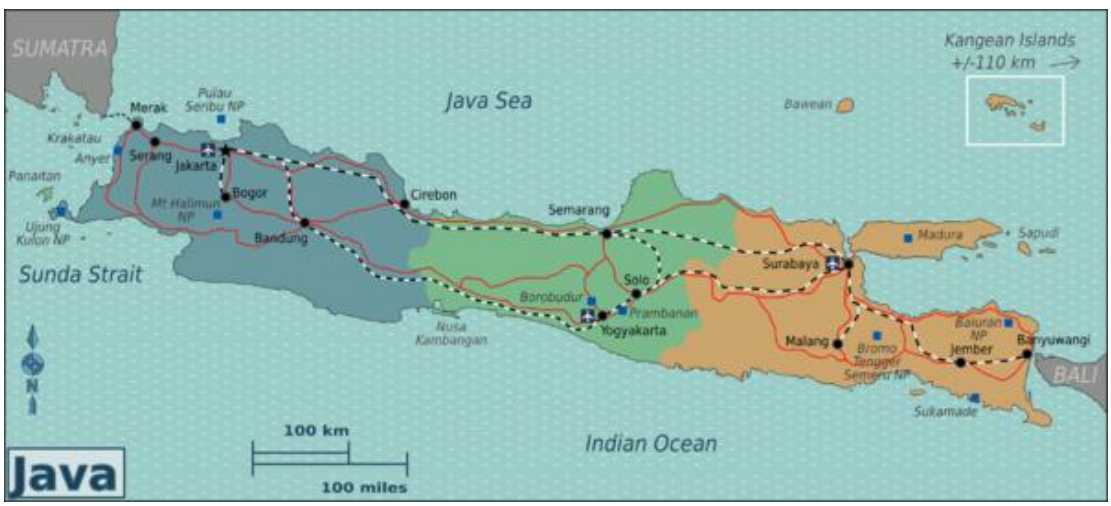

Figure 2. 1 Transportation Map of Java

As shown by Figure 2.1, there are two major roads, connecting Java to Surabaya, the northern route and southern route. Same applies to the railroad, where there are two major routes, northern and southern. For the purpose of this research the route taken will be the closest route.

2. 5. Cost Component

For the two different inland transportation mode, there are different cost component. For trucking there is transportation cost and handling cost. For intermodal, there will be two different transportation costs, train cost for the long haul transportation and trucking cost for the short haul transportation. On top of that there will also be handling cost not only in the origin and destination, but also in the transit hub.

2. 6. Research Positioning

There have been several researches regarding intermodal transportation. The following table 2.1 is hoped to show this research position in comparison with the other related research.

The first research mentioned is the base of generalized transportation cost model based on the journal by Hanssen, Mathisen, Jorgensen, the different being is the research area. The previous research is based in Norway to Continental Europe whereas this research will be based on Java island, Indonesia which is significantly smaller in size.

The second research is based in Surabaya and mentioned about intermodal transportation between railway and vessel. The different angle this research is hoped to achieve is by comparing trucking as inland transportation method with combined trucking and railway transportation.

Table 2. 1Research Positioning

Author	Lubis, Isnaeni, Sjafruddin, Dharmowidjoyo	Hanssen, Mathisen, Jorgensen	Widyanie (this research)
Year	2005	2012	2016
Title	Multimodal Transport In Indonesia: Recent Profile And Strategy Development	Generalized Transport Cost in Intermodal Freight Transport	Generalized Transport Cost Model in Determining Suitable Inland Transportation Method
Objective	Reports on Indonesia multimodal transportation supply and demand.	Presenting a model for analyzing the generalized transport cost to transport aquaculture products from Norway to Continental Europe	Determining whether or not intermodal inland transportation can compete with current road transportation in Indonesia
Method	Benchmarking	Generalized Transport Cost Model	Generalized Transport Cost Model
Output	initial benchmarking of the existing multimodal transport performance	Long-haul distance is required to make intermodal transport preferable	Conditions in which intermodal transportation can be used in Indonesia

CHAPTER 3
RESEARCH METHODOLOGY

This chapter elaborates the research steps that have been used in this research. Generally this research has gone through a literature review process, data collection, and data analysis.

3.1 Literature Review

At this stage literature review has been done. The literature review consist of finding the suitable cost model to compare road transportation with intermodal transportation as well as basic knowledge in intermodal road transportation.

Past researches are also being studied during the literature review stage to find the knowledge gap that this research is going to cover.

3.2 Data Collection

There will be several data needed for this research. The first data is the routes for inland transportation; this will be the basis of which routes will be selected to be compared between road transportation and intermodal transportation. As per this research limitation, the route will be between various Java province's capitals to Surabaya. Table 3.1 shows the routes chosen for this research

Secondly, the data that will be needed is distance and cost data for each method of transportation and route. These data will be then calculated using the general cost model to be then analysed. The distance data will be gathered from PT KA Logistic as PT. Kereta Api Indonesia distribution and train based logistics service, and PT.X's road assessment survey data. The same goes with the cost data which also will be gathered from two different source, Kalog for intermodal cost and a logistic company for trucking cost.

Table 3. 1 Routes used in this research

From	To
Serang	Surabaya
Jakarta	Surabaya
Bandung	Surabaya
Semarang	Surabaya
Yogyakarta	Surabaya

Figure 3. 1 Map of Java Island

Figure 3. 1 shows the map of Java, in it is the location of each capital of province in Java. With Serang being the farthest from Surabaya, and Solo being the closest.

3.3 Data Analysis

After all the data is collected, it will be then analysed using general cost model. The model combines the two important aspects in logistics, transportation cost and lead time needed for transportation.

The general cost model which combines price, time and distance, the three key aspects in logistic is formulized as follows:

$$G(D) = P(D) + HT(D)\ where \frac{\partial P}{\partial D}, \frac{\partial T}{\partial D} > 0 => \frac{\partial G}{\partial D} > 0 \quad (5)$$

There are several elements that determine the general cost (G), which are the cost (P) or the transport service price, and the product of time (T) needed for transport and cost per hour (H). The model also assume that there is a positive correlation between P,T and G with the transport distance (D), meanwhile H is independent of the transport distance.

Different with freight cost calculation method, this model also take the time needed to complete the transportation process into consideration. As mentioned by (Bowersox, Closs, & Cooper, 2010) the fundamental logistics performance is determined by cost, speed and consistency. For that reason, it is also important to include lead time in the model to get a better accuracy on the logistics performance for each transportation model.

After both the road transportation general cost and intermodal general cost has been found, then the results will be compared towards each other to see on what condition it will be worth it to use intermodal transportation. Figure 3. 2 show this research's methodology in a flowchart.

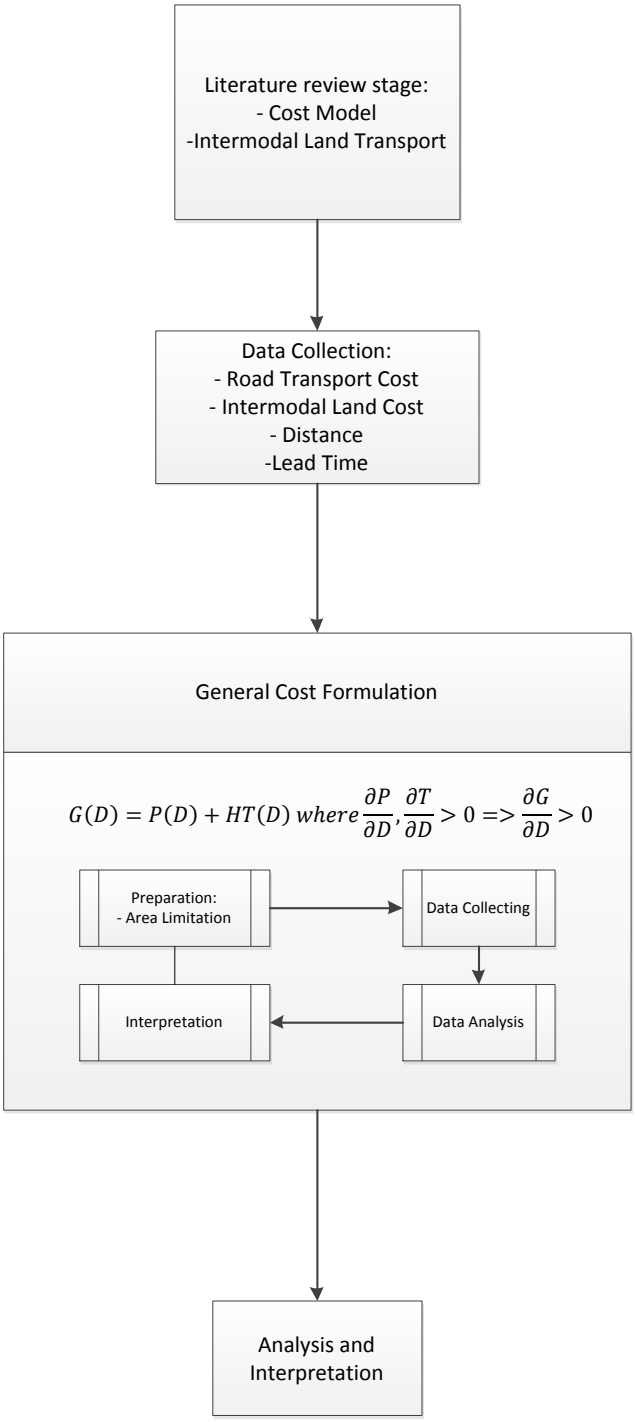

Figure 3. 2 Methodology of Research

CHAPTER 4
DATA COLLECTION

This chapter will elaborate the data collected by this research. The data collected are intermodal cost, lead time and distance, and also trucking cost, lead time and distance. There will be two main source for this data collection, one is KA Logistic, a rail based logistic company operated by Indonesia railway company and the other will be PT.X, one of the leading national logistic provider concentrating on providing integrated logistics solution for energy sector company.

4.1 Cost Data

There are two sources for cost data in this research. The intermodal cost was provided by KA Logistics (KALOG), whilst the trucking cost is taken from another logistics service, PT.X. The cost components for each inland method are different. To compare the business competitiveness between the two methods, the cost data in this research are the selling cost for each method.

4.1.1 Intermodal Cost

From all the big cities in Java, only Jakarta and Surabaya can handle containerised shipment as the train depo are equipped with suitable tools to handle containers. Furthermore, only Serang has no train station. For this research purpose, the cargo will be carried to Jakarta station and then sent via trucking from Jakarta to Serang.

Although Bandung has a train station, it cannot handle containerised cargo. In effect, if there is a containerised cargo from Bandung, where it has to be sent all the way from Bandung to Jakarta first, to be then sent using cargo train to Surabaya. As shown in table 4.1 this option, with total cost of 15,508,000 rupiah is still cheaper than sending the cargo without the container directly from Bandung to Surabaya which cost 26,669,000 rupiah.

The rest of the cities, Yogyakarta and Semarang each has a train station, however due to the limited infrastructure they cannot handle containerised cargo. In effect, this created a much higher handling cost upon transferring from trucking to train and vice versa because instead of lifting one container box, Kalog has to spent extra effort and time to lift each cargo and transferring them. This in effect raises the labour cost and handling cost. This is reflected to the rate given by Kalog to their customer.

Table 4.1 shows the price data collected from KA Logistics, and it also shows the different pricing options each city may have. This research is using the cheapest possible option for each routes. For example for Serang there are two options, although both are through Jakarta, one is using less than container load worth pricing, the other pricing is if we are sending a whole container worth. The chosen price is the cheaper full container worth of 8,900,000 rupiah instead of 27,668,000 rupiah.

Table 4. 1Intermodal Cost (Source: PT.KAI)

Route		Door to Door	Station to Station			Trucking Cost (intercity)	Note	Total Cost	Chosen Intermodal Route
Origin	Destination	20' container	10 Kg Cap	per kilos	Station to Station				
Serang	Surabaya	5,800,000	N/A	N/A	N/A	3,100,000	Trucking from Serang to Jakarta Train from Jakarta to Surabaya	8,900,000	V
		N/A	50,000	2,600	26,024,000	1,644,000		27,668,000	
Jakarta	Surabaya	5,800,000	N/A	N/A	N/A	N/A		5,800,000	V
		N/A	50,000	2,600	26,024,000	1,644,000		27,668,000	
Bandung	Surabaya	N/A	50,000	2,500	25,025,000	1,644,000		26,669,000	
		5,800,000	N/A	N/A	N/A	9,708,000	Trucking from Bandung to Jakarta Train from Jakarta to Surabaya	15,508,000	V
Semarang	Surabaya	N/A	50,000	2,100	21,029,000	1,644,000		22,673,000	V
Yogyakarta	Surabaya	N/A	50,000	2,100	21,029,000	1,644,000		22,673,000	

4.1.2 Trucking Cost

Different with intermodal cost, the only handling needed in trucking method is when putting the container on top of the trailer and off the trailer. However, as each trailer can only carry one box at a time, the fuel cost is significantly higher than train that can carry many boxes at one time.

Another reason why trucking is currently preferable is because of the flexibility. Cargo can be picked up anywhere and anytime and there is no need to transfer the cargo to a terminal such as station or port. Table 4. *2* Unimodal-Trucking Cost (Source: PT.X) shows the trucking cost from various origins to Surabaya. Because of the flexibility generally the trucking cost is also divided into areas in each city. The cost data received is taken from one city centre to the next.

Table 4. 2 Unimodal-Trucking Cost (Source: PT.X)

Origin	Destination	20' container
Serang	Surabaya	16,750,000.00
Jakarta	Surabaya	12,500,000.00
Bandung	Surabaya	14,500,000.00
Semarang	Surabaya	6,300,000.00
Jogjakarta	Surabaya	6,800,000.00

4.2 Lead Time Data

The intermodal lead time data is provided by Kalog. One of the immediate thing we can gather from table 4.3 is that the handling time between Jakarta, Serang, Bandung is shorter than Yogyakarta and Semarang. This is because Jakarta can handle containerised cargo, thus creating a quicker handling time than Yogyakarta and Semarang in which the handling has to be done manually by each cargo instead of handling one container. However, in compensation, the trucking time from Bandung and Serang is longer than Yogyakarta and Semarang, this is because the container has to be first sent to Jakarta prior sending them via train to Surabaya.

On the other hand, table 4.4 shows the total time for unimodal transportation, there were no extra handling time created by transferring from one transportation mode to the other. If we compare the time needed from one city to the other, the shorter the distance the less significant time difference can be seen from unimodal and intermodal transportation.

Table 4. 3 Intermodal Lead Time Data

Route		Train Travel	Transhipment		Total Lead Time (Hrs)	Total Lead Time (Hrs)	Cut Off
Origin	Destination	Lead Time (hrs)	Handling	Trucking			
Serang	Surabaya	12	10	6	28.00	2 days	14.30
Jakarta	Surabaya	12	10	4	26.00	2 days	14.30
Bandung	Surabaya	12	10	9	31.00	2 days	13.00
Semarang	Surabaya	5	14	3	22.00	1 days	14.30
Yogyakarta	Surabaya	6	14	3	23.00	1 days	13.00

Table 4. 4 Unimodal-Trucking Lead Time Data

Route		Trucking
Origin	Destination	Lead Time (hrs)
Serang	Surabaya	72
Jakarta	Surabaya	60
Bandung	Surabaya	55.2
Semarang	Surabaya	24
Yogyakarta	Surabaya	24

4.3 Distance Data

The distance travelled by intermodal transportation will consist of the distance from pick up area to the station, distance between station when using train and distance from the station to Surabaya's warehouse. For the purpose of this research, Surabaya warehouse will be set at PT. X's location, located 8.7km away from Pasar Turi's station.

The station to station distance data is gathered from Kalog's data. For Serang, Jakarta and Bandung, all cargo are sent to Jakarta's station first, to be then sent to Surabaya using train, thus the distance between stations are the same, 725km. For this research the origin's warehouse to station distance is taken from the nearby industrial area to the station. PT.X's is regularly conducting road assessment survey around that area, gathering information from distance, obstacle that may occur, and road condition.

Table 4. 5 Intermodal Distance

Route		Intermodal Travel	Warehouse to Station	Station to Station	Station to warehouse
Origin	Destination	Distance (km)	Distance (km)	Distance (km)	Distance (km)
Serang	Surabaya	850	116.3	725	8.7
Jakarta	Surabaya	763	29.3	725	8.7
Bandung	Surabaya	887.9	154.2	725	8.7
Semarang	Surabaya	314	23.3	282	8.7
Yogyakarta	Surabaya	328	8.3	311	8.7

Table 4.6 shows the trucking distance between each route, the data is gathered from PT.X's road assessment survey. Because this method is using only one mode, the distance is direct trucking distance between one city to another.

Table 4. 6 Unimodal - Trucking Distance

Route		Trucking
Origin	Destination	Distance (km)
Serang	Surabaya	850
Jakarta	Surabaya	763
Bandung	Surabaya	770
Semarang	Surabaya	314
Yogyakarta	Surabaya	328

4.4 Cargo Value Data

For cargo value data, this research is using data sourced from PT.X for one of their mining customer. The typical cargo being sent by mining company is general non-perishable high value cargo.

The cargo value data will be used to calculate time value for the generalized cost model. Table 4.7 shows the cargo value data collected during 2016. Cargo value is given as average value per teus (twenty feet equivalent unit) being sent on each commercial vessel schedule.

Table 4. 7 Cargo Value Data (source: PT.X)

IN VESSEL	VESSEL NAME	Average Value per teus (US DOLLAR)
IN 248 B	KM TANTO EXPRESS	$15,315.61
IN 248 A	KM LUMOSO GEMBIRA	$31,865.55
IN 242 B	KM LUMOSO GEMBIRA	$233,182.43
IN 241 B	KM TANTO BERKAT	$106,306.89
IN 241 A	KM TANTO DAMAI	$47,999.28
IN 239 B	KM TANTO RAYA	$52,670.00
IN 238 A	KM TANTO TANGGUH	$81,715.53
IN 237 A	KM TANTO TERANG	$207,964.62
IN 236 B	KM ARMADA SENADA	$26,573.23
IN 236 A	KM TANTO JAYA	$49,637.11
IN 235 E	KM TANTO LESTARI	$99,940.94

Table 4. 8 Cargo Value Data (source: PT.X) Continue

IN VESSEL	VESSEL NAME	Average Value per teus (US DOLLAR)
IN 235 C	KM LUMOSO SELAMAT	$23,320.00
IN 235 A	KM TANTO TANGGUH	$20,838.94
IN 233 B	KM LUMOSO SELAMAT	$6,051.24
IN 230 B	KM LUMOSO SELAMAT	$37,526.29
IN 230 A	KM TANTO DAMAI	$29,930.28
IN 229 C	KM TANTO BERKAT	$65,133.65
IN 229 A	KM TANTO RAYA	$56,239.87
IN 228 B	KM TANTO SAKTI 2	$69,960.65
IN 228 A	KM TANTO BERKAT	$435,881.29
IN 227 B	KM TANTO SENANG	$9,772.50
IN 223 A	KM MADISON	$6,276.32
IN 221 B	KM BALI TABANAN	$49,192.94
IN 221 A	KM BALI GIANYAR	$7,216.82
IN 219 A	KM ORIENTAL PACIFIC	$11,904.75
IN 216 F	KM ARMADA SETIA	$28,882.07
IN 216 E	KM ARMADA SENADA	$71,373.98
IN 216 C	KM HIJAU SEGAR	$19,607.26
IN 216 B	KM BALI KUTA	$9,880.00
IN 216 A	KM PRATIWI	$10,640.00
IN 215 E	KM PAHALA	$10,032.00
IN 215 C	KM MERATUS SPIRIT	$20,153.19
IN 215 B	KM TITANIUM	$19,537.91
IN 215 A	KM ARMADA SENADA	$52,030.00
IN 214 B	KM PAHALA	$146,150.05
IN 214 A	KM ORIENTAL RUBY	$32,140.46
IN 213 C	KM PULAU LAYANG	$74,239.23
IN 213 B	KM LUZON	$75,235.35
IN 213 A	KM PAHALA	$33,705.64
IN 212 E	KM HIJAU MUDA	$4,913.22
IN 212 C	KM PRATIWI INDAH	$32,272.63
IN 212 B	KM ORIENTAL SAMUDRA	$117,608.30
IN 212 A	KM TITANIUM	$9,443.16
IN 211 F	KM PULAU NUNUKAN	$16,543.17
IN 211 E	KM PRATIWI	$11,607.36
IN 211 C	KM VERTIKAL	$10,928.85
	Average Value per Teus	**$ 55,509.50**

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CHAPTER 5
DATA ANALYSIS

This chapter will analysed the data collected by this research. All the data gathered from this research will be calculated, and the result will be shown and discussed in this chapter.

5.1 Data Analysis

The generalized model consists of two main parts, pecuniary cost and transportation cost. To ease the analysis process, we are going to break down the calculation steps into the three components first, which are pecuniary cost (P), Handling Cost (H) and Time cost (T).

$$G(D) = P(D) + HT(D)\ where \frac{\partial P}{\partial D}, \frac{\partial T}{\partial D} > 0 => \frac{\partial G}{\partial D} > 0 \quad (6)$$

The first step is calculating the pecuniary cost which is the transportation cost, this is different for trucking and train cost. The pecuniary cost will then be increased according to the distance travelled. Table 5.1 will show the calculation process for all routes using both truck and train.

$$P_t = \beta_{0t} + \beta_{1t} D(truck) and\ P_r = \beta_{0r} + \beta_{1r}(Rail) \quad (7)$$

Where

$$\beta_{0t}, \beta_{1t}, \beta_{0r}, \beta_{1r} > 0$$

Table 5. 1 Transportation Cost for each routes and transportation mode

Origin	Destination	Trucking Cost (Rupiah/KM)	Truck Speed (Km/H)	Time of Delivery (Hour/Km)	Time Cost (Rupiah/KM)	Distance Cost (Rupiah/KM)
Serang	Surabaya	19,705.88	11.81	0.08	14,516.24	34,222.12
Jakarta	Surabaya	16,382.70	12.72	0.08	13,476.19	29,858.89
Bandung	Surabaya	18,831.17	13.95	0.07	12,285.39	31,116.55
Semarang	Surabaya	20,063.69	13.08	0.08	13,098.51	33,162.21
Jogjakarta	Surabaya	20,731.71	13.67	0.07	12,539.43	33,271.14

Origin	Destination	Train Cost (Rupiah/KM)	Train Speed (Km/H)	Time of Delivery (Hour/Km)	Time Cost (Rupiah/KM)	Distance Cost (Rupiah/KM)
Serang	Surabaya	12,275.86	25.89	0.04	6,618.51	18,894.38
Jakarta	Surabaya	8,000.00	27.88	0.04	6,145.76	14,145.76
Bandung	Surabaya	21,390.34	23.39	0.04	7,327.64	28,717.98
Semarang	Surabaya	80,400.71	12.82	0.08	13,369.46	93,770.17
Jogjakarta	Surabaya	72,903.54	13.52	0.07	12,673.83	85,577.37

To calculate the transportation cost for trucking, first we determine the cost of trucking itself which is how much it will cost to move a cargo using a truck for each kilometre. For example, for Serang, it will cost 19,705.88 rupiah/km. This then added with the time cost for example for Serang is 14,516.24 rupiah, which is calculated from calculated from the deterioration cost per hour for the length of the shipment to make the total of 34,222.12 rupiah. The same is then done with train cost.

The next step is calculating time and handling cost. The calculation process will be using the following calculation.

$$HT_t = \gamma_{0t} + \gamma_{1t} D(truck) and\ HT_r = \gamma_{0r} + \gamma_{1r}(Rail) \quad (8)$$

Since all the cargo that is being carried is assumed to have the same value, their cost over the time which is affected by cargo value and interest rate is the same.

Meanwhile for handling cost, only Jakarta station have the facility to handle container, this in effect cut down the handling time to 10 hours in comparison with other stations that although has lower volume, hence less queuing time, but the handling process has to be done to each cargo, creating longer handling time of 14 hours. Table 5.2 shows the calculation for Time value and Handling cost for each routes.

Table 5. 2 Time and Handling cost for each routes

Origin	Destination	Commodity	Project Time (Days)	Average Value (Rupiah)	Depreciation Cost (Rupiah/Hour)	Interest of Rate (Rupiah/Hour)	Total Time Cost (Rupiah/Hour)
Serang	Surabaya	General Cargo	180	721,623,510.83	167,042.48	4,329.74	171,372.22
Jakarta	Surabaya	General Cargo	180	721,623,510.83	167,042.48	4,329.74	171,372.22
Bandung	Surabaya	General Cargo	180	721,623,510.83	167,042.48	4,329.74	171,372.22
Semarang	Surabaya	General Cargo	180	721,623,510.83	167,042.48	4,329.74	171,372.22
Jogjakarta	Surabaya	General Cargo	180	721,623,510.83	167,042.48	4,329.74	171,372.22

Origin	Destination	Commodity	Handling Cost (Rupiah)	Handling Time (Hours)	Time Cost Loading (Rupiah)	Total Cost (Rupiah)
Serang	Surabaya	General Cargo	396,000	10	1,713,722	2,109,722
Jakarta	Surabaya	General Cargo	396,000	10	1,713,722	2,109,722
Bandung	Surabaya	General Cargo	396,000	10	1,713,722	2,109,722
Semarang	Surabaya	General Cargo	396,000	14	2,399,211	2,795,211
Jogjakarta	Surabaya	General Cargo	396,000	14	2,399,211	2,795,211

To be able to determine the total time cost, the depreciation rate is first calculated by dividing cargo value of 721,623,510.83 rupiah into the cargo expiry time, which for this research is assumed to be 180 days making it 167,042.48 rupiah. Then interest rate is added into it, with the interest rate assumed to be 6% of Rp 721,623,510.83 making it 4,329.74 rupiah. The total time cost is 171,972.22 rupiah.

To calculate total handling cost, we added the actual handling cost of 396,000 rupiah with the cost incurred due to the time taken to handle the cargo, for example for Serang is 10 hours times 171,372.22 rupiah, making it 1,713,722.20 rupiah. Adding both cost together making the total handling cost to 2,109,722.20 rupiah.

After finding out each cost component, then the generalized cost will be calculated for each routes using the following formulae.

$$G(D) = P(D) + HT(D)\ where \frac{\partial P}{\partial D}, \frac{\partial T}{\partial D} > 0 => \frac{\partial G}{\partial D} > 0 \quad (9)$$

The transition cost in multimodal transportation will be started when the cargo enter the station, which vary in distance for each city depending on the average distance between industrial area to the station. Table 5.3 will remind us the distance at each city to the nearest eligible station.

Table 5. 3 Distance data

Route		Intermodal Travel	Warehouse to Station	Station to Station	Station to warehouse
Origin	Destination	Distance (km)	Distance (km)	Distance (km)	Distance (km)
Serang	Surabaya	850	116.3	725	8.7
Jakarta	Surabaya	763	29.3	725	8.7
Bandung	Surabaya	887.9	154.2	725	8.7
Semarang	Surabaya	314	23.3	282	8.7
Yogyakarta	Surabaya	328	8.3	311	8.7

From table 5.3 we can gather that the distance from warehouse at Serang to station at Jakarta is 116.3km, within Jakarta itself is 29.3km, from Bandung to Jakarta 154.2, within Semarang 23.3 and within Yogyakarta is 8.3 km.

The generalized transportation cost for Serang to Surabaya both for trucking and multimode, which is the combination between trucking and train is shown by Table 5. 4. From table 5.4 we can see that on the multimode transportation, the transition happened at 116.3 km when the cargo arrives at Jakarta's station and again at 841.3 km when the cargo arrive at Surabaya station.

Table 5. 4 Serang generalized transportation cost

Serang-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
1	34,222.12	1	34,222.12
10	342,221.17	10	342,221.17
20	684,442.35	20	684,442.35
30	1,026,663.52	30	1,026,663.52
40	1,368,884.70	40	1,368,884.70
50	1,711,105.87	50	1,711,105.87
60	2,053,327.05	60	2,053,327.05
70	2,395,548.22	70	2,395,548.22
80	2,737,769.40	80	2,737,769.40
90	3,079,990.57	90	3,079,990.57
100	3,422,211.75	100	3,422,211.75
110	3,764,432.92	110	3,764,432.92
116.3	3,980,032.26	116.3	3,980,032.26
120	4,106,654.10	120	4,049,941.45
140	4,791,096.45	140	4,427,828.96
150	5,133,317.62	150	4,616,772.72
160	5,475,538.80	160	4,805,716.47
170	5,817,759.97	170	4,994,660.22
180	6,159,981.15	180	5,183,603.98
190	6,502,202.32	190	5,372,547.73
200	6,844,423.50	200	5,561,491.49
210	7,186,644.67	210	5,750,435.24
220	7,528,865.85	220	5,939,378.99
230	7,871,087.02	230	6,128,322.75
240	8,213,308.20	240	6,317,266.50
250	8,555,529.37	250	6,506,210.26
260	8,897,750.55	260	6,695,154.01
270	9,239,971.72	270	6,884,097.77
280	9,582,192.90	280	7,073,041.52
290	9,924,414.07	290	7,261,985.27
300	10,266,635.25	300	7,450,929.03
310	10,608,856.42	310	7,639,872.78
320	10,951,077.60	320	7,828,816.54
330	11,293,298.77	330	8,017,760.29
340	11,635,519.95	340	8,206,704.04
350	11,977,741.12	350	8,395,647.80

Table 5. 5 Serang generalized transportation cost (Continue)

Serang-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
360	12,319,962.30	360	8,584,591.55
370	12,662,183.47	370	8,773,535.31
380	13,004,404.65	380	8,962,479.06
390	13,346,625.82	390	9,151,422.81
400	13,688,847.00	400	9,340,366.57
410	14,031,068.17	410	9,529,310.32
420	14,373,289.35	420	9,718,254.08
430	14,715,510.52	430	9,907,197.83
440	15,057,731.70	440	10,096,141.58
450	15,399,952.87	450	10,285,085.34
460	15,742,174.05	460	10,474,029.09
470	16,084,395.22	470	10,662,972.85
480	16,426,616.40	480	10,851,916.60
490	16,768,837.57	490	11,040,860.36
500	17,111,058.75	500	11,229,804.11
510	17,453,279.92	510	11,418,747.86
520	17,795,501.10	520	11,607,691.62
530	18,137,722.27	530	11,796,635.37
540	18,479,943.45	540	11,985,579.13
550	18,822,164.62	550	12,174,522.88
560	19,164,385.80	560	12,363,466.63
570	19,506,606.97	570	12,552,410.39
580	19,848,828.15	580	12,741,354.14
590	20,191,049.32	590	12,930,297.90
600	20,533,270.50	600	13,119,241.65
610	20,875,491.67	610	13,308,185.40
620	21,217,712.85	620	13,497,129.16
630	21,559,934.02	630	13,686,072.91
640	21,902,155.20	640	13,875,016.67
650	22,244,376.37	650	14,063,960.42
660	22,586,597.55	660	14,252,904.17
670	22,928,818.72	670	14,441,847.93
680	23,271,039.90	680	14,630,791.68
690	23,613,261.07	690	14,819,735.44
700	23,955,482.25	700	15,008,679.19

Table 5. 6 Serang generalized transportation cost (Continue)

Serang-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
710	24,297,703.42	710	15,197,622.95
720	24,639,924.60	720	15,386,566.70
730	24,982,145.77	730	15,575,510.45
740	25,324,366.95	740	15,764,454.21
750	25,666,588.12	750	15,953,397.96
760	26,008,809.30	760	16,142,341.72
770	26,351,030.47	770	16,331,285.47
780	26,693,251.65	780	16,520,229.22
790	27,035,472.82	790	16,709,172.98
800	27,377,694.00	800	16,898,116.73
810	27,719,915.17	810	17,087,060.49
820	28,062,136.35	820	17,276,004.24
830	28,404,357.52	830	17,464,947.99
840	28,746,578.70	840	17,653,891.75
841.3	28,791,067.45	841.3	17,678,454.44
841.3	28,791,067.45	841.3	17,678,454.44
850	29,088,799.87	850	17,976,186.86
860	29,431,021.05	860	18,318,408.03
870	29,773,242.22	870	18,660,629.21
880	30,115,463.40	880	19,002,850.38
890	30,457,684.57	890	19,345,071.56
900	30,799,905.75	900	19,687,292.73
910	31,142,126.92	910	20,029,513.91
920	31,484,348.10	920	20,371,735.08
930	31,826,569.27	930	20,713,956.26
940	32,168,790.45	940	21,056,177.43
950	32,511,011.62	950	21,398,398.61
960	32,853,232.79	960	21,740,619.78
970	33,195,453.97	970	22,082,840.96
980	33,537,675.14	980	22,425,062.13
990	33,879,896.32	990	22,767,283.31
1000	34,222,117.49	1000	23,109,504.48

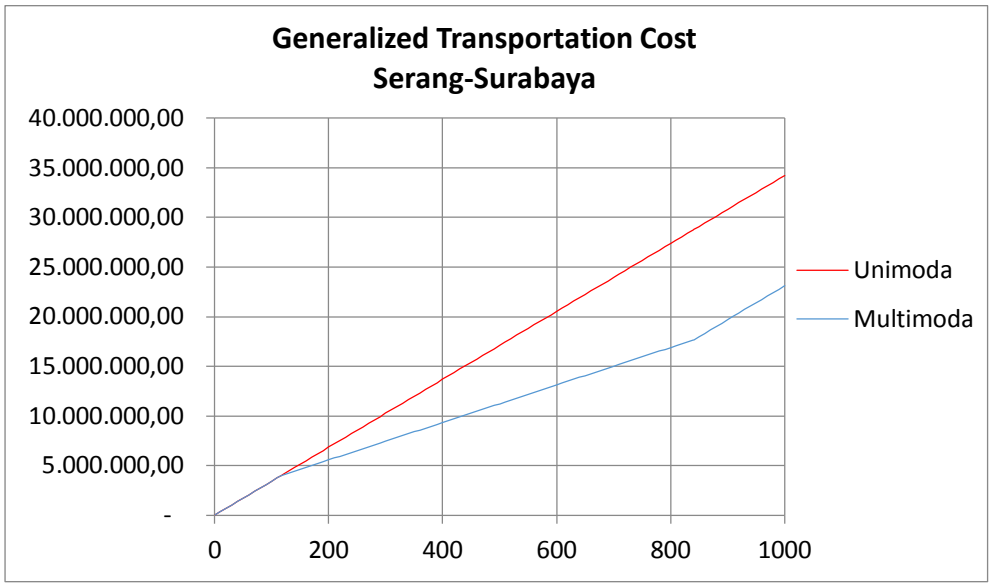

Figure 5. 1 Serang's generalized transportation comparison chart

To ease the comparison process, figure 5.1 shows the calculation result in line graph. We can see the growing gap between trucking cost and multimode, which is combination between trucking and train transportation cost. This graph shows that for Serang to Surabaya route, it will be worth using multimode transportation, by connecting the cargo to train at Jakarta's train station.

Table 5. 7 Jakarta's generalized transportation cost

Jakarta-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
1	29,858.89	1	29,858.89
10	298,588.90	10	298,588.90
20	597,177.80	20	597,177.80
29.3	874,865.48	29.3	874,865.48
30	895,766.71	30	884,767.52
50	1,492,944.51	50	1,167,682.76
60	1,791,533.41	60	1,309,140.39
70	2,090,122.31	70	1,450,598.01
80	2,388,711.22	80	1,592,055.64
90	2,687,300.12	90	1,733,513.26
100	2,985,889.02	100	1,874,970.88
110	3,284,477.92	110	2,016,428.51
120	3,583,066.82	120	2,157,886.13
130	3,881,655.73	130	2,299,343.76
140	4,180,244.63	140	2,440,801.38
150	4,478,833.53	150	2,582,259.00
160	4,777,422.43	160	2,723,716.63
170	5,076,011.33	170	2,865,174.25
180	5,374,600.24	180	3,006,631.87
190	5,673,189.14	190	3,148,089.50
200	5,971,778.04	200	3,289,547.12
210	6,270,366.94	210	3,431,004.75
220	6,568,955.84	220	3,572,462.37
230	6,867,544.75	230	3,713,919.99
240	7,166,133.65	240	3,855,377.62
250	7,464,722.55	250	3,996,835.24
260	7,763,311.45	260	4,138,292.87
270	8,061,900.36	270	4,279,750.49
280	8,360,489.26	280	4,421,208.11
290	8,659,078.16	290	4,562,665.74
300	8,957,667.06	300	4,704,123.36

Table 5. 8 Jakarta's generalized transportation cost (Continue)

Jakarta-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
310	9,256,255.96	310	4,845,580.99
320	9,554,844.87	320	4,987,038.61
330	9,853,433.77	330	5,128,496.23
340	10,152,022.67	340	5,269,953.86
350	10,450,611.57	350	5,411,411.48
360	10,749,200.47	360	5,552,869.10
370	11,047,789.38	370	5,694,326.73
380	11,346,378.28	380	5,835,784.35
390	11,644,967.18	390	5,977,241.98
400	11,943,556.08	400	6,118,699.60
410	12,242,144.98	410	6,260,157.22
420	12,540,733.89	420	6,401,614.85
430	12,839,322.79	430	6,543,072.47
440	13,137,911.69	440	6,684,530.10
450	13,436,500.59	450	6,825,987.72
460	13,735,089.49	460	6,967,445.34
470	14,033,678.40	470	7,108,902.97
480	14,332,267.30	480	7,250,360.59
490	14,630,856.20	490	7,391,818.21
500	14,929,445.10	500	7,533,275.84
510	15,228,034.00	510	7,674,733.46
520	15,526,622.91	520	7,816,191.09
530	15,825,211.81	530	7,957,648.71
540	16,123,800.71	540	8,099,106.33
550	16,422,389.61	550	8,240,563.96
560	16,720,978.51	560	8,382,021.58
570	17,019,567.42	570	8,523,479.21
580	17,318,156.32	580	8,664,936.83
590	17,616,745.22	590	8,806,394.45
600	17,915,334.12	600	8,947,852.08
610	18,213,923.02	610	9,089,309.70
620	18,512,511.93	620	9,230,767.33
630	18,811,100.83	630	9,372,224.95
640	19,109,689.73	640	9,513,682.57
650	19,408,278.63	650	9,655,140.20

Table 5. 9 Jakarta's generalized transportation cost (Continue)

Jakarta-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
660	19,706,867.53	660	9,796,597.82
670	20,005,456.44	670	9,938,055.44
680	20,304,045.34	680	10,079,513.07
690	20,602,634.24	690	10,220,970.69
700	20,901,223.14	700	10,362,428.32
710	21,199,812.04	710	10,503,885.94
720	21,498,400.95	720	10,645,343.56
730	21,796,989.85	730	10,786,801.19
740	22,095,578.75	740	10,928,258.81
750	22,394,167.65	750	11,069,716.44
754.3	22,522,560.88	754.3	11,130,543.21
754.3	22,522,560.88	754.3	11,130,543.21
760	22,692,756.55	760	11,300,738.89
770	22,991,345.46	770	11,599,327.79
780	23,289,934.36	780	11,897,916.69
790	23,588,523.26	790	12,196,505.59
800	23,887,112.16	800	12,495,094.50
810	24,185,701.07	810	12,793,683.40
820	24,484,289.97	820	13,092,272.30
830	24,782,878.87	830	13,390,861.20
840	25,081,467.77	840	13,689,450.10
850	25,380,056.67	850	13,988,039.01
860	25,678,645.58	860	14,286,627.91
870	25,977,234.48	870	14,585,216.81
880	26,275,823.38	880	14,883,805.71
890	26,574,412.28	890	15,182,394.61
900	26,873,001.18	900	15,480,983.52
910	27,171,590.09	910	15,779,572.42
920	27,470,178.99	920	16,078,161.32
930	27,768,767.89	930	16,376,750.22
940	28,067,356.79	940	16,675,339.12
950	28,365,945.69	950	16,973,928.03
960	28,664,534.60	960	17,272,516.93
970	28,963,123.50	970	17,571,105.83
980	29,261,712.40	980	17,869,694.73
990	29,560,301.30	990	18,168,283.64
1000	29,858,890.20	1000	18,466,872.54

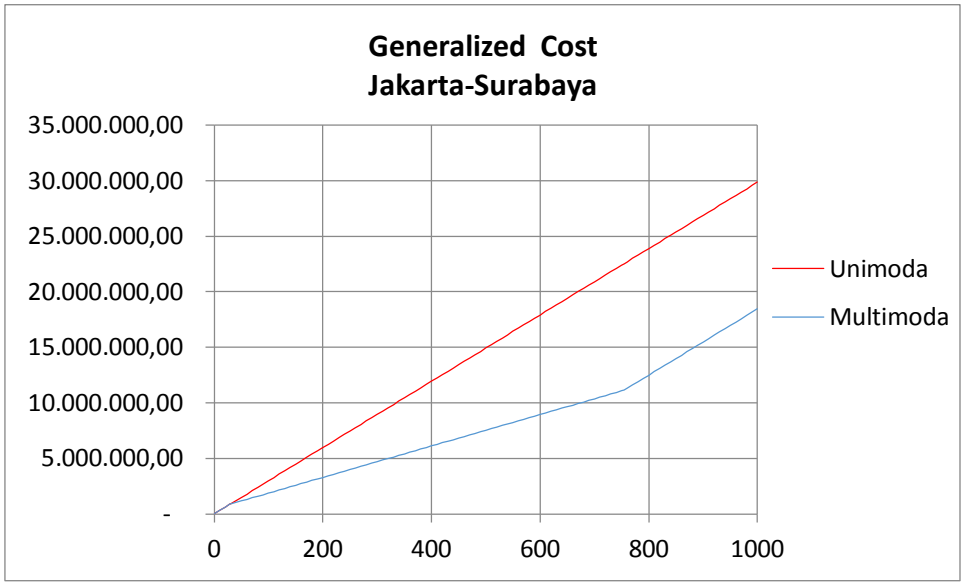

Figure 5. 2Jakarta's generalized transportation comparison chart

The generalized transportation cost for Jakarta to Surabaya both for trucking and multimode, which is the combination between trucking and train is shown by table 5.5Table 5. *4*. From table 5.5 we can see that on the multimode transportation, the transition happened at 29.3 km when the cargo arrives at Jakarta's station and again at 754.3 km when the cargo arrive at Surabaya station.

To ease the comparison process, figure 5.2 shows the calculation result in line graph. We can see the growing gap between trucking cost and multimode, which is combination between trucking and train transportation cost. This graph shows that for Jakarta to Surabaya route, it will be worth using multimode transportation, by connecting the cargo to train at Jakarta's train station.

Table 5. 10 Bandung's generalized transportation cost

Bandung-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
1	31,116.55	1	31,116.55
10	311,165.54	10	311,165.54
20	622,331.08	20	622,331.08
30	933,496.62	30	933,496.62
40	1,244,662.16	40	1,244,662.16
50	1,555,827.70	50	1,555,827.70
60	1,866,993.24	60	1,866,993.24
70	2,178,158.78	70	2,178,158.78
80	2,489,324.32	80	2,489,324.32
90	2,800,489.86	90	2,800,489.86
100	3,111,655.40	100	3,111,655.40
110	3,422,820.94	110	3,422,820.94
120	3,733,986.48	120	3,733,986.48
130	4,045,152.02	130	4,045,152.02
140	4,356,317.56	140	4,356,317.56
150	4,667,483.10	150	4,667,483.10
154.2	4,798,172.62	154.2	4,798,172.62
155	4,823,065.87	155	4,821,147.01
160	4,978,648.64	160	4,964,736.93
170	5,289,814.18	170	5,251,916.78
180	5,600,979.72	180	5,539,096.63
190	5,912,145.26	190	5,826,276.47
200	6,223,310.80	200	6,113,456.32
210	6,534,476.34	210	6,400,636.16
220	6,845,641.88	220	6,687,816.01
230	7,156,807.42	230	6,974,995.86
240	7,467,972.96	240	7,262,175.70
250	7,779,138.50	250	7,549,355.55
260	8,090,304.04	260	7,836,535.39
270	8,401,469.58	270	8,123,715.24
280	8,712,635.12	280	8,410,895.09

Table 5. 11 Bandung's generalized transportation cost (Continue)

Bandung-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
290	9,023,800.66	290	8,698,074.93
300	9,334,966.20	300	8,985,254.78
310	9,646,131.73	310	9,272,434.62
320	9,957,297.27	320	9,559,614.47
330	10,268,462.81	330	9,846,794.32
340	10,579,628.35	340	10,133,974.16
350	10,890,793.89	350	10,421,154.01
360	11,201,959.43	360	10,708,333.85
370	11,513,124.97	370	10,995,513.70
380	11,824,290.51	380	11,282,693.55
390	12,135,456.05	390	11,569,873.39
400	12,446,621.59	400	11,857,053.24
410	12,757,787.13	410	12,144,233.08
420	13,068,952.67	420	12,431,412.93
430	13,380,118.21	430	12,718,592.78
440	13,691,283.75	440	13,005,772.62
450	14,002,449.29	450	13,292,952.47
460	14,313,614.83	460	13,580,132.31
470	14,624,780.37	470	13,867,312.16
480	14,935,945.91	480	14,154,492.01
490	15,247,111.45	490	14,441,671.85
500	15,558,276.99	500	14,728,851.70
510	15,869,442.53	510	15,016,031.54
520	16,180,608.07	520	15,303,211.39
530	16,491,773.61	530	15,590,391.24
540	16,802,939.15	540	15,877,571.08
550	17,114,104.69	550	16,164,750.93
560	17,425,270.23	560	16,451,930.77
570	17,736,435.77	570	16,739,110.62
580	18,047,601.31	580	17,026,290.47
590	18,358,766.85	590	17,313,470.31
600	18,669,932.39	600	17,600,650.16
610	18,981,097.93	610	17,887,830.00
620	19,292,263.47	620	18,175,009.85
630	19,603,429.01	630	18,462,189.70

Table 5. 12 Bandung's generalized transportation cost (Continue)

Bandung-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
640	19,914,594.55	640	18,749,369.54
650	20,225,760.09	650	19,036,549.39
660	20,536,925.63	660	19,323,729.23
670	20,848,091.17	670	19,610,909.08
680	21,159,256.71	680	19,898,088.93
690	21,470,422.25	690	20,185,268.77
700	21,781,587.79	700	20,472,448.62
710	22,092,753.33	710	20,759,628.46
720	22,403,918.87	720	21,046,808.31
730	22,715,084.41	730	21,333,988.16
740	23,026,249.95	740	21,621,168.00
750	23,337,415.49	750	21,908,347.85
760	23,648,581.03	760	22,195,527.69
761.3	23,689,032.55	761.3	22,232,861.07
761.3	23,689,032.55	761.3	22,232,861.07
770	23,959,746.57	770	22,503,575.09
780	24,270,912.11	780	22,814,740.63
790	24,582,077.65	790	23,125,906.17
800	24,893,243.19	800	23,437,071.71
810	25,204,408.73	810	23,748,237.25
820	25,515,574.27	820	24,059,402.79
830	25,826,739.81	830	24,370,568.33
840	26,137,905.35	840	24,681,733.87
850	26,449,070.89	850	24,992,899.41
860	26,760,236.43	860	25,304,064.95
870	27,071,401.97	870	25,615,230.49
880	27,382,567.51	880	25,926,396.03
890	27,693,733.05	890	26,237,561.57
900	28,004,898.59	900	26,548,727.11
910	28,316,064.13	910	26,859,892.65
940	29,249,560.74	940	27,793,389.27
950	29,560,726.28	950	28,104,554.81
960	29,871,891.82	960	28,415,720.35
970	30,183,057.36	970	28,726,885.89
980	30,494,222.90	980	29,038,051.43
990	30,805,388.44	990	29,349,216.97

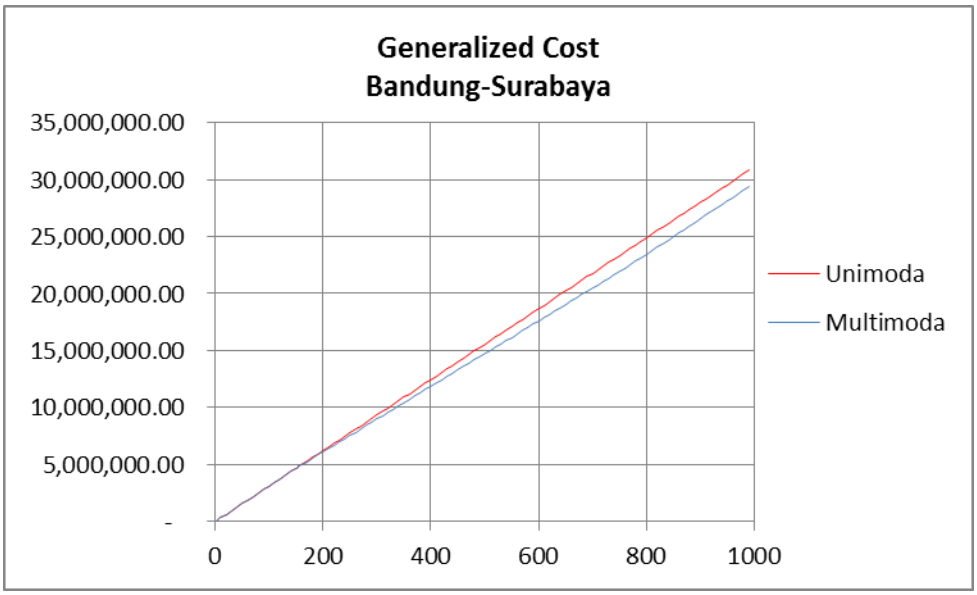

Figure 5. 3 Bandung's generalized transportation comparison chart

The generalized transportation cost for Bandung to Surabaya both for trucking and multimode, which is the combination between trucking and train is shown by table 5.6Table 5. *4*. From table 5.6 we can see that on the multimode transportation, the transition happened at 154.2 km when the cargo arrives at Jakarta's station and again at 761.3 km when the cargo arrive at Surabaya station.

To ease the comparison process, figure 5.3 shows the calculation result in line graph. We can see the although narrow, but growing gap between trucking cost and multimode, which is combination between trucking and train transportation cost. This graph shows that for Bandung to Surabaya route, it will be worth using multimode transportation, by connecting the cargo to train at Jakarta's train station.

Table 5. 13 Semarang's generalized transportation cost

Semarang-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
1	33,162.21	1	33,162.21
10	331,622.08	10	331,622.08
20	663,244.16	20	663,244.16
23.3	772,679.44	23.3	772,679.44
24	795,892.99	24	838,318.57
30	994,866.24	30	1,400,939.61
40	1,326,488.32	40	2,338,641.34
50	1,658,110.40	50	3,276,343.07
60	1,989,732.48	60	4,214,044.80
70	2,321,354.56	70	5,151,746.53
80	2,652,976.63	80	6,089,448.27
90	2,984,598.71	90	7,027,150.00
100	3,316,220.79	100	7,964,851.73
110	3,647,842.87	110	8,902,553.46
120	3,979,464.95	120	9,840,255.20
130	4,311,087.03	130	10,777,956.93
140	4,642,709.11	140	11,715,658.66
150	4,974,331.19	150	12,653,360.39
160	5,305,953.27	160	13,591,062.12
170	5,637,575.35	170	14,528,763.86
180	5,969,197.43	180	15,466,465.59
190	6,300,819.51	190	16,404,167.32
200	6,632,441.59	200	17,341,869.05
210	6,964,063.67	210	18,279,570.79
220	7,295,685.74	220	19,217,272.52
230	7,627,307.82	230	20,154,974.25
240	7,958,929.90	240	21,092,675.98
250	8,290,551.98	250	22,030,377.71
260	8,622,174.06	260	22,968,079.45
270	8,953,796.14	270	23,905,781.18
280	9,285,418.22	280	24,843,482.91

Table 5. 14 Semarang's generalized transportation cost (Continue)

Semarang-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
290	9,617,040.30	290	25,781,184.64
300	9,948,662.38	300	26,718,886.38
305.3	10,124,422.08	305.3	27,215,868.29
305.3	10,124,422.08	305.3	27,215,868.29
310	10,280,284.46	310	27,371,730.67
320	10,611,906.54	320	27,703,352.75
330	10,943,528.62	330	28,034,974.83
340	11,275,150.70	340	28,366,596.91
350	11,606,772.78	350	28,698,218.99
360	11,938,394.85	360	29,029,841.07
370	12,270,016.93	370	29,361,463.15
380	12,601,639.01	380	29,693,085.23
390	12,933,261.09	390	30,024,707.31
400	13,264,883.17	400	30,356,329.39
410	13,596,505.25	410	30,687,951.46
420	13,928,127.33	420	31,019,573.54
430	14,259,749.41	430	31,351,195.62
440	14,591,371.49	440	31,682,817.70
450	14,922,993.57	450	32,014,439.78
460	15,254,615.65	460	32,346,061.86
470	15,586,237.73	470	32,677,683.94
480	15,917,859.81	480	33,009,306.02
490	16,249,481.89	490	33,340,928.10
500	16,581,103.97	500	33,672,550.18
510	16,912,726.04	510	34,004,172.26
520	17,244,348.12	520	34,335,794.34
530	17,575,970.20	530	34,667,416.42
540	17,907,592.28	540	34,999,038.50
550	18,239,214.36	550	35,330,660.57
560	18,570,836.44	560	35,662,282.65
570	18,902,458.52	570	35,993,904.73
580	19,234,080.60	580	36,325,526.81
590	19,565,702.68	590	36,657,148.89
600	19,897,324.76	600	36,988,770.97
610	20,228,946.84	610	37,320,393.05

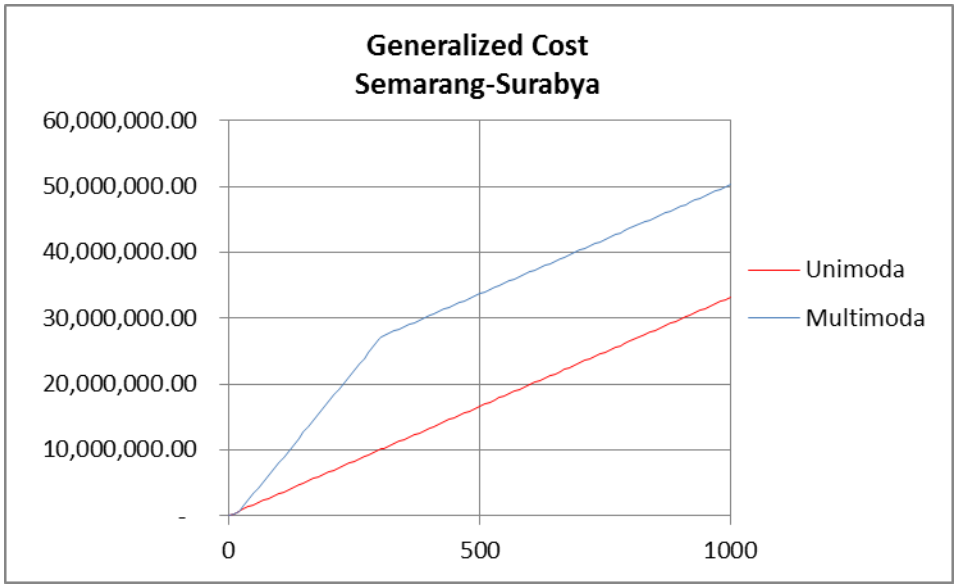

Figure 5. 4 Semarang's generalized transportation comparison chart

The generalized transportation cost for Semarang to Surabaya both for trucking and multimode, which is the combination between trucking and train is shown by table 5.7Table 5. *4*. From table 5.7 we can see that on the multimode transportation, the transition happened at 23.3 km when the cargo arrives at Semarang's station and again at 305.3 km when the cargo arrive at Surabaya station.

To ease the comparison process, figure 5.4 shows the calculation result in line graph. We can see that the multimode cost is much higher than the one mode transportation cost which in this case is trucking. For that reason, it will not be worth using multimode transportation, by connecting the cargo to train at Semarang's train station.

Table 5. 15 Yogyakarta's generalized transportation cost

Jogjakarta-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
1	33,271.14	1	33,271.14
8.3	276,150.45	8.3	276,150.45
9	299,440.24	9	336,054.60
10	332,711.38	10	421,631.97
20	665,422.76	20	1,277,405.64
30	998,134.14	30	2,133,179.31
40	1,330,845.52	40	2,988,952.97
50	1,663,556.90	50	3,844,726.64
60	1,996,268.28	60	4,700,500.31
70	2,328,979.67	70	5,556,273.98
80	2,661,691.05	80	6,412,047.64
90	2,994,402.43	90	7,267,821.31
100	3,327,113.81	100	8,123,594.98
110	3,659,825.19	110	8,979,368.65
120	3,992,536.57	120	9,835,142.32
130	4,325,247.95	130	10,690,915.98
140	4,657,959.33	140	11,546,689.65
150	4,990,670.71	150	12,402,463.32
160	5,323,382.09	160	13,258,236.99
170	5,656,093.47	170	14,114,010.66
180	5,988,804.85	180	14,969,784.32
190	6,321,516.24	190	15,825,557.99
200	6,654,227.62	200	16,681,331.66
210	6,986,939.00	210	17,537,105.33
220	7,319,650.38	220	18,392,878.99
230	7,652,361.76	230	19,248,652.66
240	7,985,073.14	240	20,104,426.33
250	8,317,784.52	250	20,960,200.00
260	8,650,495.90	260	21,815,973.67
270	8,983,207.28	270	22,671,747.33
280	9,315,918.66	280	23,527,521.00

Table 5. 16 Yogyakarta's generalized transportation cost (Continue)

Jogjakarta-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
290	9,648,630.04	290	24,383,294.67
300	9,981,341.42	300	25,239,068.34
310	10,314,052.80	310	26,094,842.00
319.3	10,623,474.39	319.3	26,890,711.52
319.3	10,623,474.39	319.3	26,890,711.52
320	10,646,764.19	320	26,914,001.31
330	10,979,475.57	330	27,246,712.69
340	11,312,186.95	340	27,579,424.07
350	11,644,898.33	350	27,912,135.45
360	11,977,609.71	360	28,244,846.84
370	12,310,321.09	370	28,577,558.22
380	12,643,032.47	380	28,910,269.60
390	12,975,743.85	390	29,242,980.98
400	13,308,455.23	400	29,575,692.36
410	13,641,166.61	410	29,908,403.74
420	13,973,877.99	420	30,241,115.12
430	14,306,589.37	430	30,573,826.50
440	14,639,300.76	440	30,906,537.88
450	14,972,012.14	450	31,239,249.26
460	15,304,723.52	460	31,571,960.64
470	15,637,434.90	470	31,904,672.02
480	15,970,146.28	480	32,237,383.41
490	16,302,857.66	490	32,570,094.79
500	16,635,569.04	500	32,902,806.17
510	16,968,280.42	510	33,235,517.55
520	17,300,991.80	520	33,568,228.93
530	17,633,703.18	530	33,900,940.31
540	17,966,414.56	540	34,233,651.69
550	18,299,125.94	550	34,566,363.07
560	18,631,837.32	560	34,899,074.45
570	18,964,548.71	570	35,231,785.83
580	19,297,260.09	580	35,564,497.21
590	19,629,971.47	590	35,897,208.59
600	19,962,682.85	600	36,229,919.97
610	20,295,394.23	610	36,562,631.36

Table 5. 17 Yogyakarta's generalized transportation cost (Continue)

Jogjakarta-Surabaya			
Distance (180 Day Time Cost)	Unimoda Cost Distance (180 Day Time Cost)	Distance (180 Day Time Cost)	Multimoda Distance (180 Day Time Cost)
620	20,628,105.61	620	36,895,342.74
630	20,960,816.99	630	37,228,054.12
640	21,293,528.37	640	37,560,765.50
650	21,626,239.75	650	37,893,476.88
660	21,958,951.13	660	38,226,188.26
670	22,291,662.51	670	38,558,899.64
680	22,624,373.89	680	38,891,611.02
690	22,957,085.28	690	39,224,322.40
700	23,289,796.66	700	39,557,033.78
710	23,622,508.04	710	39,889,745.16
720	23,955,219.42	720	40,222,456.54
730	24,287,930.80	730	40,555,167.93
740	24,620,642.18	740	40,887,879.31
750	24,953,353.56	750	41,220,590.69
760	25,286,064.94	760	41,553,302.07
770	25,618,776.32	770	41,886,013.45

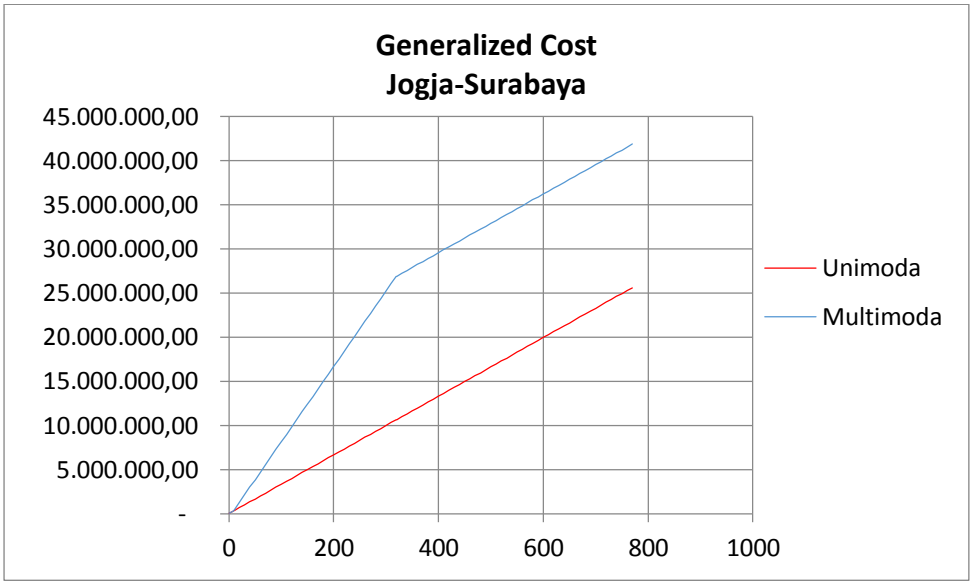

Figure 5. 5 Yogyakarta's generalized transportation comparison chart

The generalized transportation cost for Yogyakarta to Surabaya both for trucking and multimode, which is the combination between trucking and train is shown by

table 5.8Table 5. *4*. From table 5.8 we can see that on the multimode transportation, the transition happened at 8.3 km when the cargo arrives at Yogyakarta station and again at 319.3 km when the cargo arrive at Surabaya station.

To ease the comparison process, figure 5.5 shows the calculation result in line graph. We can see that the multimode cost is much higher than the one mode transportation cost which in this case is trucking. For that reason, it will not be worth using multimode transportation, by connecting the cargo to train at Yogyakarta's train station.

5.2 Sensitivity Analysis

Based on this research analysis with current pricing, for both Semarang-Surabaya and Yogyakarta-Surabaya routes the multimode cost is much higher than trucking mode transportation cost. This research then used goal-seek function to find the suitable train transportation cost on which the overall generalized cost for multimode transportation will be at least the same with using one transportation mode (trucking).

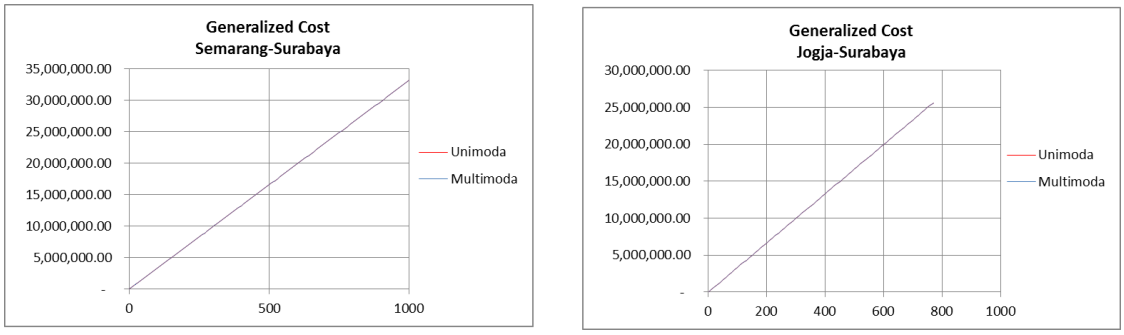

Figure 5. 6 Generalized cost chart comparison for Semarang-Surabaya and Yogyakarta-Surabaya with new train pricing

To be able to find the balanced cost as shown by figure 5.6, the train cost from Semarang to Surabaya should be 3,937,554 rupiah whilst the train cost from Yogyakarta to Surabaya should be 4,764,761 as opposed to current cost of

21,029,000. Table 5.9 shows the comparison cost between current train transportation cost and the proposed train transportation cost.

Table 5. 18 Train transportation cost comparison

Route		Current Train Transportation Cost	Proposed Train Transportation Cost
Origin	**Destination**	**20' container/equivalent**	**20' container**
Serang	Surabaya	5,800,000	5,800,000
Jakarta	Surabaya	5,800,000	5,800,000
Bandung	Surabaya	5,800,000	5,800,000
Semarang	Surabaya	21,029,000	3,937,554
Yogyakarta	Surabaya	21,029,000	4,761,762

Currently, the reason on such high train transportation cost for Semarang-Surabaya and Yogyakarta-Surabaya route is due to the fact that there is no containerized pricing availability on those routes, this is because Semarang and Yogyakarta cannot handle containerized cargo, hence all the price and handling process are given in loose cargo form.

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CHAPTER 6
CONCLUSION

6.1 Conclusion

a. This research shows that under current pricing, when sending cargo with the following routes, it will be better to use combination of trucking and train transportation:
    - Serang-Surabaya
    - Jakarta- Surabaya
    - Bandung – Surabaya

    On the other hand, when sending cargo with the following routes, it will be better to use trucking transportation:
    - Semarang -Surabaya
    - Yogyakarta - Surabaya
b. To match trucking generalized transportation cost and therefore encouraging business owner to try multimode transportation, the train cost from Semarang to Surabaya should be less than 3,937,554 rupiah whilst the train cost from Yogyakarta to Surabaya should be less than 4,764,761 as opposed to current cost of 21,029,000

6.2 Suggestion

For future research, it is suggested to expand this research by analysing how Indonesia, specially Semarang and Yogyakarta can reduce the cost of sending containerized cargo to the desired pricing to encourage business user to use train instead of road transportation. Furthermore, future research can also elaborate other options such as combining sea and road.

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Appendix 1

Semarang-Surabaya			
Distance	Unimode Generalized Cost	Distance	Multimode Generalized Cost
1	33,162.21	1	33,162.21
10	331,622.08	10	331,622.08
20	663,244.16	20	663,244.16
23.3	772,679.44	23.3	772,679.44
25	829,055.20	25	829,055.20
30	994,866.24	30	994,866.24
40	1,326,488.32	40	1,326,488.33
50	1,658,110.40	50	1,658,110.42
60	1,989,732.48	60	1,989,732.51
70	2,321,354.56	70	2,321,354.60
80	2,652,976.63	80	2,652,976.69
90	2,984,598.71	90	2,984,598.78
100	3,316,220.79	100	3,316,220.87
110	3,647,842.87	110	3,647,842.96
120	3,979,464.95	120	3,979,465.05
130	4,311,087.03	130	4,311,087.14
140	4,642,709.11	140	4,642,709.23
150	4,974,331.19	150	4,974,331.32
160	5,305,953.27	160	5,305,953.41
170	5,637,575.35	170	5,637,575.50
180	5,969,197.43	180	5,969,197.59
190	6,300,819.51	190	6,300,819.68
200	6,632,441.59	200	6,632,441.77
210	6,964,063.67	210	6,964,063.86
220	7,295,685.74	220	7,295,685.95
230	7,627,307.82	230	7,627,308.04
240	7,958,929.90	240	7,958,930.12
250	8,290,551.98	250	8,290,552.21
260	8,622,174.06	260	8,622,174.30
270	8,953,796.14	270	8,953,796.39
280	9,285,418.22	280	9,285,418.48
290	9,617,040.30	290	9,617,040.57
300	9,948,662.38	300	9,948,662.66
305.3	10,124,422.08	305.3	10,124,422.37

Distance	Unimode Generalized Cost	Distance	Multimode Generalized Cost
310	10,280,284.46	310	10,280,284.75
320	10,611,906.54	320	10,611,906.83
330	10,943,528.62	330	10,943,528.91
340	11,275,150.70	340	11,275,150.98
350	11,606,772.78	350	11,606,773.06
360	11,938,394.85	360	11,938,395.14
370	12,270,016.93	370	12,270,017.22
380	12,601,639.01	380	12,601,639.30
390	12,933,261.09	390	12,933,261.38
400	13,264,883.17	400	13,264,883.46
410	13,596,505.25	410	13,596,505.54
420	13,928,127.33	420	13,928,127.62
430	14,259,749.41	430	14,259,749.70
440	14,591,371.49	440	14,591,371.78
450	14,922,993.57	450	14,922,993.86
460	15,254,615.65	460	15,254,615.94
470	15,586,237.73	470	15,586,238.02
480	15,917,859.81	480	15,917,860.09
490	16,249,481.89	490	16,249,482.17
500	16,581,103.97	500	16,581,104.25
510	16,912,726.04	510	16,912,726.33
520	17,244,348.12	520	17,244,348.41
530	17,575,970.20	530	17,575,970.49
540	17,907,592.28	540	17,907,592.57
550	18,239,214.36	550	18,239,214.65
560	18,570,836.44	560	18,570,836.73
570	18,902,458.52	570	18,902,458.81
580	19,234,080.60	580	19,234,080.89
590	19,565,702.68	590	19,565,702.97
600	19,897,324.76	600	19,897,325.05
610	20,228,946.84	610	20,228,947.13
620	20,560,568.92	620	20,560,569.20
630	20,892,191.00	630	20,892,191.28
640	21,223,813.08	640	21,223,813.36
650	21,555,435.15	650	21,555,435.44
660	21,887,057.23	660	21,887,057.52
670	22,218,679.31	670	22,218,679.60

Distance	Unimode Generalized Cost	Distance	Multimode Generalized Cost
690	22,881,923.47	690	22,881,923.76
700	23,213,545.55	700	23,213,545.84
710	23,545,167.63	710	23,545,167.92
720	23,876,789.71	720	23,876,790.00
730	24,208,411.79	730	24,208,412.08
740	24,540,033.87	740	24,540,034.16
750	24,871,655.95	750	24,871,656.24
760	25,203,278.03	760	25,203,278.32
770	25,534,900.11	770	25,534,900.39
780	25,866,522.19	780	25,866,522.47
790	26,198,144.27	790	26,198,144.55
800	26,529,766.34	800	26,529,766.63
830	27,524,632.58	830	27,524,632.87
840	27,856,254.66	840	27,856,254.95
850	28,187,876.74	850	28,187,877.03
860	28,519,498.82	860	28,519,499.11
870	28,851,120.90	870	28,851,121.19
880	29,182,742.98	880	29,182,743.27
890	29,514,365.06	890	29,514,365.35
900	29,845,987.14	900	29,845,987.43
910	30,177,609.22	910	30,177,609.50
920	30,509,231.30	920	30,509,231.58
930	30,840,853.38	930	30,840,853.66
940	31,172,475.45	940	31,172,475.74
950	31,504,097.53	950	31,504,097.82
960	31,835,719.61	960	31,835,719.90
970	32,167,341.69	970	32,167,341.98
980	32,498,963.77	980	32,498,964.06
990	32,830,585.85	990	32,830,586.14
1000	33,162,207.93	1000	33,162,208.22

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Appendix 2

Yogyakarta-Surabaya			
Distance	**Trucking Generalized Cost**	**Distance**	**Multimode Generalized Cost**
1	33,271.14	1	33,271.14
8.3	276,150.45	8.3	276,150.45
9	299,440.24	9	299,440.24
10	332,711.38	10	332,711.37
20	665,422.76	20	665,422.72
30	998,134.14	30	998,134.06
40	1,330,845.52	40	1,330,845.40
50	1,663,556.90	50	1,663,556.74
60	1,996,268.28	60	1,996,268.08
70	2,328,979.67	70	2,328,979.43
80	2,661,691.05	80	2,661,690.77
90	2,994,402.43	90	2,994,402.11
100	3,327,113.81	100	3,327,113.45
110	3,659,825.19	110	3,659,824.79
120	3,992,536.57	120	3,992,536.14
130	4,325,247.95	130	4,325,247.48
140	4,657,959.33	140	4,657,958.82
150	4,990,670.71	150	4,990,670.16
160	5,323,382.09	160	5,323,381.50
170	5,656,093.47	170	5,656,092.85
180	5,988,804.85	180	5,988,804.19
190	6,321,516.24	190	6,321,515.53
200	6,654,227.62	200	6,654,226.87
210	6,986,939.00	210	6,986,938.21
220	7,319,650.38	220	7,319,649.56
230	7,652,361.76	230	7,652,360.90
240	7,985,073.14	240	7,985,072.24
250	8,317,784.52	250	8,317,783.58
260	8,650,495.90	260	8,650,494.92
270	8,983,207.28	270	8,983,206.27
280	9,315,918.66	280	9,315,917.61
290	9,648,630.04	290	9,648,628.95

Distance	Trucking Generalized Cost	Distance	Multimode Generalized Cost
310	10,314,052.80	310	10,314,051.63
319.3	10,623,474.39	319.3	10,623,473.18
319.3	10,623,474.39	319.3	10,623,473.18
320	10,646,764.19	320	10,646,762.98
330	10,979,475.57	330	10,979,474.36
340	11,312,186.95	340	11,312,185.74
350	11,644,898.33	350	11,644,897.12
360	11,977,609.71	360	11,977,608.50
370	12,310,321.09	370	12,310,319.88
380	12,643,032.47	380	12,643,031.26
390	12,975,743.85	390	12,975,742.64
400	13,308,455.23	400	13,308,454.02
410	13,641,166.61	410	13,641,165.40
420	13,973,877.99	420	13,973,876.79
430	14,306,589.37	430	14,306,588.17
440	14,639,300.76	440	14,639,299.55
450	14,972,012.14	450	14,972,010.93
460	15,304,723.52	460	15,304,722.31
470	15,637,434.90	470	15,637,433.69
480	15,970,146.28	480	15,970,145.07
490	16,302,857.66	490	16,302,856.45
500	16,635,569.04	500	16,635,567.83
510	16,968,280.42	510	16,968,279.21
520	17,300,991.80	520	17,300,990.59
530	17,633,703.18	530	17,633,701.97
540	17,966,414.56	540	17,966,413.36
550	18,299,125.94	550	18,299,124.74
560	18,631,837.32	560	18,631,836.12
570	18,964,548.71	570	18,964,547.50
580	19,297,260.09	580	19,297,258.88
590	19,629,971.47	590	19,629,970.26
600	19,962,682.85	600	19,962,681.64
610	20,295,394.23	610	20,295,393.02
620	20,628,105.61	620	20,628,104.40
630	20,960,816.99	630	20,960,815.78
640	21,293,528.37	640	21,293,527.16
650	21,626,239.75	650	21,626,238.54

Distance	Trucking Generalized Cost	Distance	Multimode Generalized Cost
670	22,291,662.51	670	22,291,661.31
680	22,624,373.89	680	22,624,372.69
690	22,957,085.28	690	22,957,084.07
700	23,289,796.66	700	23,289,795.45
710	23,622,508.04	710	23,622,506.83
720	23,955,219.42	720	23,955,218.21
730	24,287,930.80	730	24,287,929.59
740	24,620,642.18	740	24,620,640.97
750	24,953,353.56	750	24,953,352.35
760	25,286,064.94	760	25,286,063.73
770	25,618,776.32	770	25,618,775.11

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