Conference Paper

Comparison of Selection of Sea Transportation Modes To Simeulue Port

Shanty Katharina Sinaga

Lecturer of Politeknik Transportasi Sungai, Danau & Penyeberangan Palembang

Abstract

The islands of Simeulue and Aceh are located in the South Indian Ocean part of Aceh, and maritime transportation is vitally important to these island communities. The users of sea transportation want a quick, affordable and comfortable service, and a convenient departure schedule. However, currently the services provided fall short of these goals, with long delays, despite the high levels of competition which should encourage service improvements. This study assesses the considerations which go into customer decisions to choose between the different providers. The results show that travel was predominantly made for recreational purposes (48%) of for trade (42%).

Keywords: Mode; Ferry; Pioneer Ship.

Corresponding Author:
Shanty Katharina Sinaga
shantykatharina@yahoo.com

OPEN ACCESS

1. Introduction

1.1. Modeling Concepts

The notion of mode selection modeling is a model that provides a description of how the public's perception of the basis for choosing the type of mode used, this can be influenced by factors of public transport services such as routes, tariffs, safety comfort, satisfaction, and others. The mode selection model aims to determine the proportion of people who use each mode of transportation. This process is carried out with the intention of calibrating the mode selection model in the base year by knowing the independent variables that affect the mode choice and after the calibration process the model can be used to predict the mode selection with the value of the free variable for the future. This mode choice is very difficult to model, even though only two modes are used (public or private). (Tamin, & Ofyar, Z. (2003). Transportation planning and modeling. Bandung: Bandung Institute of Technology. p. 22) Mode selection also takes into account movements that use more than one mode in travel (multimodal), so it can be said that the mode selection modeling is the weakest and difficult part of the four stages of the transportation planning model.

In the scope of identification of the problems studied, it can be identified from the determinants of choosing the type of transportation or mode and the factors that influence the choice, where factors that can affect the choice of mode can be grouped into three, among others: (RL, Aritonang. (2005). Customer satisfaction. Gramedia. Jakarta. p. 12)

1. Characteristics of Road Users

   The following factors are believed to greatly influence the choice of mode, namely the availability or ownership of personal vehicles, ownership of driving licenses (SIM).

2. Movement characteristics: The choice of mode will also be greatly influenced by the purpose of the movement, the time when the movement occurs, the distance of the movement.

1.2. Passenger Transportation System

The passenger transportation system is basically formed from a set of main hardware consisting of infrastructure and facilities. Furthermore, the two hardware component systems are operated with an operating system or software system which consists of components such as tariffs. (Idwan Santoso (1996) "Public Transport Infrastructure Planning", Center for Transportation and Communication Studies, Bandung Institute of Technology. p. 15)

The components of public transport infrastructure and facilities include:

1. Passenger transportation infrastructure components, including:

2. Mode network system, Port.

3. Components of passenger transportation facilities include:

4. Type of ship used, dimensions and ship design.

From the components mentioned above, it is important to prepare good infrastructure, so that passenger transportation services as a whole have good and proper behavior. The aspects involved in structuring public transport include: patterns of movement needs, operating systems, and service levels. System setupPoor passenger transportation can add to the existing problems such as: overlapping modes, the number of fleets is too large, level low service, long travel time.

1.3. Model Selection of Sea Transportation Passenger Transport Mode

Mode selection is an important model in public transport marine transportation planning. This is due to the key role of public transport in increasing the efficiency and effectiveness of the movement system in a marine transportation system. (Op.Cit) This marine transportation mode selection model is used to calculate the distance traveled and the cheapest cost of the trip along with the mode used. This can be done if there are various types of crossing ships heading to their destination, such as types of ships (especially ferries and pioneer ships), as well as other public transportation, (fast boats, cargo ships, oil tankers). The issue of modal choice can be said to be the most important stage in marine transportation planning and policy. This concerns the efficiency of movement in the archipelagic area, the space that the island must provide for marine transportation infrastructure, and the many choices of marine transportation modes that can be chosen by local and foreign residents and tourists. **(Op.Cit)**

1.4. Selection of Sea Transportation mode

According to Fidel Miro, the sea transportation mode selection stage is the development of the origin-to-destination (travel distribution) and trip generation models, because at the trip distribution stage we determine the number of trips to each origin and destination zone, so at this mode selection stage we try determine the fastest and cheapest mode by understanding the traveler who uses various forms of sea transportation for a particular origin and destination. (Milatia Kusuma-Moemin. (2015). Importance of Port Service Management. http://jurnalmaritim.com/2015/04/pentingnya-mana\Manajemen-pelayanan-di-pelabuhan/ accessed on 18 October, 2020)

This mode choice stage is a stage in the marine transportation planning process which is tasked with determining travel charges or knowing the number (in terms of proportions) of people and goods that will use or choose the various available sea transportation modes to serve a particular point of origin for a certain destination, for the sake of some. the purpose of a particular trip. To get the results of the calculation of travelers using two truly proportional modes of sea transportation, several stages of analysis are carried out, namely: (Cahyaningrum. (2012). Analysis of Customer or Customer Satisfaction Against Postal Services. http://repository.uksw.edu/bitstream/123456789/1823/3/T1_\162007041_BAB{%}\20II.pdf accessed on 18 October, 2020)

1. The first stage, identifies several factors that are assumed to directly influence the behavior of travelers in making the choice of sea transportation mode to use for travel.

2. Comparison of the satisfaction value of travelers for several choice of modes and alternative routes of sea transportation used through linear regression analysis to obtain the satisfaction rate (yutility) using each of these modes of transportation.

3. Comparison of probability probability of each alternative choice of sea transportation mode that will be used through several comparisons of choice of modes such as. By experimenting with the satisfaction value of each mode of sea transportation that we have obtained in the second stage.

4. Finally, only the proportion (in%) of opportunity or market share of each sea transportation mode to be selected from a number of potential users, certain modes as an estimate, and absolute figures are obtained.

1.5. Factor that Really Affect the Choice of Mode of Transportation

Mode selection comparison aims to determine the proportion of people who will use each mode. This process is carried out with the intention of calibrating this mode selection comparison on the basis of knowing the independent variables (attributes) that affect the mode choice. After the comparison process is carried out, it can be used to predict the choice of mode by using the value of the free variable (attribute) for the future.

1.6. Features of Sea Transportation Mode Facilities

These can be grouped into two categories. The first quantitative factors such as:

1. Travel time, waiting time at the ship stopping point, and time during moving.

2. Transportation costs, (Fares, Fees, etc.).

3. The second factor is qualitative which is quite difficult to calculate, including comfort and safety, reliability and regularity.

1.7. City or Zone Features

Some of the characteristics that can influence the choice of transportation are the distance to the port itself. This comparison of sea transportation choices must be considered by consumers. It is easy to see how the concept of combined costs can also be used to represent several factors.

1.8. Regression Equations

According to Tamin (2000), regression methods are widely used in transportation modeling. In the use of regression analysis, regression techniques are used for rating options. Data processing is carried out to obtain a quantitative relationship between a set of attributes and respondents. This relationship is expressed in the form of a linear equation as follows:

$$y = a + b1x1 + b2x2 + ... + bnxn \qquad (2.1)$$

where: y = Dependent variable

$x1, x2,..., xn\ a$ = Independent variables (cost, travel time and waiting time) = regression constant

$b1, b2,..., bn$ = Model parameters

The regression method most commonly used is regression analysis, both linear and non-linear. If the dependent variable is discrete, linear analysis is not feasible for two reasons (Al-Ghamdi, 2002), namely:

1. The dependent variable in the linear regression method must be continuous

2. Dependent variables in the linear regression method can accommodate negative values.

1.9. Binomial Ratio Logit Model

According to Tamin, the binomial logit model is a method used to model mode selection which consists of only two alternatives. The quantitative parameters that are often used are travel costs and travel times. The binomial logit model is largely determined by one's perception in comparing travel costs and travel times when choosing a mode. In this study, the binomial logit ratio model will be used, because the travel time data varies greatly. By using linear regression analysis, the values of A and B can be obtained so

that the value α and β can be obtained as follows: α = -A and β = -B. The values of A and B are obtained using method (2.2) to equation (2.3) as follows:

$$B = \frac{N \sum_{i=1}^{N}(X_i Y_i) - \sum_{i=1}^{N}(X_i)\sum_{i=1}^{N}(Y_i)}{N \sum_{t=1}^{N}(X_i)^2 - (\sum_{i=1}^{N} X_i)^2} \tag{2.2}$$

$$A = \overline{Y} - B\overline{X} \tag{2.3}$$

With this model, the proportion of P1 to mode 1 is expressed by the following Equation 2.4:

$$P_1 = \frac{1}{1 + \alpha \left(\frac{C_1}{C_2}\right)^{\beta}} \tag{2.4}$$

Seen that value α = 1 always guarantees the value of P1 = 0.5 if the value of C1 / C2 = 1. In fact, this does not always have to happen because there are other factors that also influence the choice of mode. By simplifying equations 2.5 and 2.7, Equation (2.2) can be rewritten into equation (2.6)

$$P_1 = \left[1 + \alpha \left(\frac{C_1}{C_2}^{\beta}\right)\right] = 1 \tag{2.5}$$

$$P_1 = P_1 \alpha \left(\frac{C_1}{C_2}^{\beta}\right) = 1 \tag{2.6}$$

$$P_1 \alpha \left(\frac{C_1}{C_2}^{\beta}\right) = 1 - P_1 \tag{2.7}$$

$$\frac{1 - P_1}{P_1} = \left(\frac{C_1}{C_2}\right)^{\beta} \tag{2.8}$$

Equation (2.6) can then be rewritten in logarithmic form such as in Equation (2.7).

$$\log = \left(\frac{1 - P_1}{P_1}\right) = \log \alpha + \beta \log \frac{C_1}{C_2} \tag{2.9}$$

We have data for P1, C1, and C2 so the unknown parameter is the value and . This value can be calibrated using linear regression analysis with the left side of equation (2.7) acting as the dependent variable and log (C1 / C2) as the independent variable so that is the slope of the regression line and log is the intercept.

Assuming Yi = and Xi =, the nonlinear equation (2.7) can be rewritten in the form of a linear equation. By using linear regression analysis, the values of A and B can be obtained so that the values $\log \left(\frac{1 - P_1^i}{P_1^i}\right)$ $\log \left(\frac{C_1^i}{C_1^i}\right)$ and can be obtained as follows: = 10A and = B.

1.10. Population and Sample

According to Miro, one of the most popular methods used is the method of random withdrawal whose goal is none other than so that all objects at each level can have a population, and thus have the same chance of being selected. The number of samples for this method is usually set at 10% of the population as follows:

$$n = \frac{N}{1 + Ne2} \qquad (2.10)$$

Where:

n = Sample size N = Population size

e = Percent leeway in inaccuracy due to tolerable or desirable sampling errors, for example 10%.

2. Research Methods

To get the results of a good planning, a good method must be used. In this planning the planning method will be described in each planning step. (Miro, F. (2005). Transportation Planning for Students, Planners, and Practitioners. Erlangga. Jakarta)

2.1. Method of collecting data

Data collection is a system procedure and must pay attention to defined lines. This is intended to avoid unused data because the information obtained is not relevant to its needs. All data required in this study can be grouped into primary data and secondary data. The data collection method in this research is in 2 (two) ways:

2.1.1. Primary data

Primary data is data obtained directly from the object of research. Primary data is difficult to analyze to be used as thoughts in the future, so the data needs to be simplified in the real conditions in the field, namely by a modeling. Primary data is collected in three ways, namely:

1. Interview

Is one of the many data collection techniques whose implementation can be done directly by asking the respondent, namely passengers of ferries and pioneer ships using a questionnaire that has been prepared in advance.

2. Observation

Is direct observation of events that occur found in the field. This incident was recorded about the situation in the port environment of Meulaboh and Labuhan Haji which the author wanted to know through observations, namely: the number of passengers using ferries and pioneer ships.

3. Documentation

Is a technique that can be used in qualitative research. Documentation is data collection in the form of pictures, photographs, the results of which can be used as attachments or additional research data needed.

2.1.2. Secondary data

Secondary data is data obtained in ready-made form (available) through publications and information issued from various organizations or agencies from companies or other agencies, namely Location Map, Provincial Map, Departure Schedule, Number of Fleets, Passenger Fares List.

2.2. Location and Time of Research Survey

The location of the survey is precisely where the ferry and pioneer ships stop, namely at the port of Labuhan Haji and the port of Ujung Karang, Meulaboh, West Aceh. Meanwhile, the survey time is one week for ferries and two weeks for pioneer ships.

2.3. Number of Samples

The number of samples was obtained from the population, the average number of ferry passengers, 75 passengers and 60 passengers, for the Perintis vessel for $\pm$ 15 days (2 weeks), using linear regression methods and Binomial Logit: The calculation of the number of samples can be seen in formula (2.10) on page 13.

2.4. Data analysis method

Analysis of the data in this study using linear regression analysis and binomial logit analysis (Setyosari, Punaji. (2010). Educational Research and Development Methods. Jakarta: Golden. p. 33). The value of this formula is obtained from working with Microsoft Excel to analyze data. From this program, a form of modeling will be obtained in the choice of transportation modes, with the following analysis steps:

1. Identification of various factors that influence the behavior of travelers including:

    (a) Travel characteristic factors (purpose of travel, travel time)

    (b) Traveler characteristics factor

    (c) Factors Characteristics of the transportation system (related to the performance of transportation system services) such as convenience, ease of reaching destinations and timeliness.

2. Modeling the traveler's satisfaction score associated with the variables that have a strong relationship with the traveler's behavior using the linear regression formula (2.1) can be seen on page 10.

3. Modeling the probability (probability / likelihood) of each mode choice used to get the proportion of opportunities for each selected mode of transportation.

2.5. Linear Regression Analysis

Linear-regression analysis is a statistical method that can be used to study the relationship between the nature of the problem being investigated. Linear regression analysis model can model the relationship between one or more variables. In this model there is dependent dependent change (y) which has a functional relationship with one or more independent changes (xi), to obtain this linear equation can be seen in formula (2.1), page 10.

2.6. Binomial difference logit model analysis

In this study, to obtain a mode selection model used the binomial logit method which can be solved using linear regression estimation. The quantitative parameters that are often used are travel costs and travel times. The binomial logit difference model is largely determined by one's perception in comparing the cost of travel and the time of

travel when choosing a mode. To get the binomial logit model equation, the difference can be seen in Equations (2.2), (2.3).

3. Results and Discussion

3.1. Trip/Travel

3.1.1. Travel Characteristics

1) Based on the purpose of the trip

Based on the purpose of the trip, the ferry mode is dominated by recreational destinations by 44%, trading by 25.3%, work / work 13.3% and continuing education by 17.3%, while the pioneer ship mode is also dominated by trading by 41.7. % of official goals amounted to 16.7%, recreation goals by 20% and continuing education by 21.7%. (WouterJacobs. (2015). The Role of Port Infrastructure and Logistics in Global Networks.http://www.iss.nl/fileadmin/ASSETS/iss/Documents/DevISSues/Jacobs_WEB.pdf accessed on 18 October, 2020) For more details, see the table below.

TABLE 1: Purpose of the trip

Purpose of Travel	Ferry Mode		Pioneer Ship Mode	
	amount	Percentage	amount	Percentage
Service / work	10	13.3	10	16.7
Trade	19	25.3	25	41.7
Recreation	33	44	12	20
Continue education	13	17.3	13	21.7

3.1.2. Characteristics of the Doer of the Trip

1) Based on work

Based on work, the ferry mode is dominated by trade by 46.7%, civil servants by 13%, self-employed 20%, and housewives by 20%, while the pioneer ship mode is also dominated by trading by 55%, self-employed 23.3%, civil servants at 8.3%, and housewives at 13.3%. For more details, see the table below:

3.1.3. Transportation System Characteristics

1) Based on Cost

<div align="center">TABLE 2: Occupation</div>

Profession	Ferry Mode		Pioneer Ship Mode	
	amount	Percentage	amount	Percentage
Civil servants / police and TNI	10	13	5	8.3
entrepreneur	15	20	14	23.3
Trade	35	46.7	33	55
Housewife	15	20	8	13.3

Based on cost, the ferry mode, namely adult executive class is 16%, adult VIP class is 37.3%, and adult economy class dominates ferry passengers with a percentage of 46.7%, while the pioneer ship mode is Economy class by 55%, the executive class is 18.3%, and the VIP class is 26.7%. For more details, see the table below:

<div align="center">TABLE 3: Costs</div>

Class	Fees / Rates Ferry (Rp)	Qty 12	% 16	Class Executive	Fees / Rates ship Pioneer (Rp)	Qty	%
Executive	66,000				80,000	11	18.3
VIP	56,000	28	37.3	VIP	70,000	16	26.7
Economy	44,000	35	46.7	Economy	50,000	33	55

2) Based on Travel Time

Based on the ferry travel time during the crossing, which is 540 minutes (9 hours), the waiting time is invalid because different waiting times are 15 minutes, 20 minutes, 30 minutes, 35 minutes, 40 minutes, 45 minutes and 55 minutes. The time for the pioneer ship during the crossing is 600 minutes, the waiting time is invalid because the waiting time varies, some are 20 minutes, 30 minutes, 30 minutes, and 40 minutes. For more details, see the table below:

<div align="center">TABLE 4: Travel time</div>

Ferry Travel Time	Pioneer Ship Travel Time	
540 minutes (9 hours)	600	Minute (10 hours)

3.1.4. Number of Opportunities / Probabilities for Ferry & Pioneer Ships

A modal selection survey was carried out in several corridors with origin and destination zones served by two modes of transportation (ferry and pioneer ship). There are two Origin zones and One

$X1$ = travel time while in the vehicle (in minutes)

X2 = waiting time (minutes)

X3 = vehicle operating costs (unit of money)

X4 = port cost (unit of money)

Time value X1 = 2 units of money or minutes

Time value X2 = 4 units of money or minutes

Destination zone with Independent Variables:

4. Result and Discussion

The following is the application of the logit binomial in modeling the mode choice between ships (ferries) and ships (pioneers). Detailed description of the difference logit binomial model.

a. The waiting time value is assumed to be twice the time while in the vehicle. This makes sense because humans generally don't like to wait. Table 5. shows the data from the corridor survey results, data on the percentage of modal choice and operating costs.

Asal	Asal	Tujuan	ANGKUTAN KAPAL FERI				ANGKUTAN KAPAL PERINTIS					CKf	CKp
Meulaboh	Labuhan Haji	Simeulue	Waktu Tempuh (Menit)	Waktu Tunggu (Menit)	Biaya Tarif penumpang g perorang (RP.ribu)	Biaya Pelabuhan (RP.ribu)	Waktu Tempuh (Menit)	Waktu Tunggu (Menit)	Biaya Tarif penumpang g perorang (RP.ribu)	% dengan Angkutan kapal Feri	% dengan Angkutan Kapal Perintis		
			X1	X2	X3	X4	X1	X2	X3				
A	A	A	540	30	66	2	600	15	80	29,20%	70,80%	1268	1340
			540	55	66	2	600	25	80	29,70%	70,30%	1368	1380
			540	60	66	2	600	30	80	30,00%	70,00%	1388	1400
B	B	B	540	65	56	2	600	40	70	30,20%	69,80%	1398	1430
			540	75	56	3	600	45	70	30,70%	69,30%	1439	1450
			540	80	56	5	600	55	70	31,00%	69,00%	1461	1490
C	C	C	540	85	44	2	600	30	50	31,20%	68,80%	1466	1370
			540	95	44	3	600	45	50	31,70%	68,30%	1507	1430
			540	120	44	5	600	20	50	33,00%	67,00%	1609	1330

Note:

Information:

Ckf = (2.X1) + (4.X2) + X3 + X4 = ferry fare

Ckp = (2.X1) + (4.X2) + X3 = the cost of the pilot ship

By using linear regression analysis, the values of A and B can be obtained, so that the values of α and β can be obtained as follows: α = -A and β = -B. Table 4.6 shows the calculation of linear regression analysis for the binomial-logit-difference model.

TABLE 5: Calculation of the linear regression analysis method for the binomial difference logit model

Ckf kapal feri	Ckp kapal perintis	% Moda KF P1	% Moda KP P2	Ckp-Ckf (Xi)	Log e((1-P)/P) (Yi)	XiYi	Xi2	exp(A+BXi)	P=1/(1+exp(A+BXi))
1368	1380	29,70%	70,30%	12	0,8616	10,3395	144	1,0004	0,4999
1388	1400	30,00%	70,00%	12	0,8473	10,1676	144	1,0004	0,4999
1398	1430	30,20%	69,80%	32	0,8378	26,8093	1024	1,0004	0,4999
1439	1450	30,70%	69,30%	11	0,8142	8,9560	121	1,0004	0,4999
1461	1490	31,00%	69,00%	29	0,8001	23,2035	841	1,0004	0,4999
1466	1370	31,20%	68,80%	-96	0,7908	-75,9154	9216	1,0004	0,4999
1507	1430	31,70%	68,30%	-77	0,7676	-59,1047	5929	1,0004	0,4999
1609	1330	33,00%	67,00%	-279	0,7082	-197,5836	77841	1,0004	0,4999
		S		-356,0000	6,4276	-253,1278	95260		
		B = (N.∑(XiYi) -(∑Xi.∑Yi)) / (N.∑Xi2 - (∑X1)2)							0,0004
		A (rata-rata Y) + B (rata -rata X)							0,8219
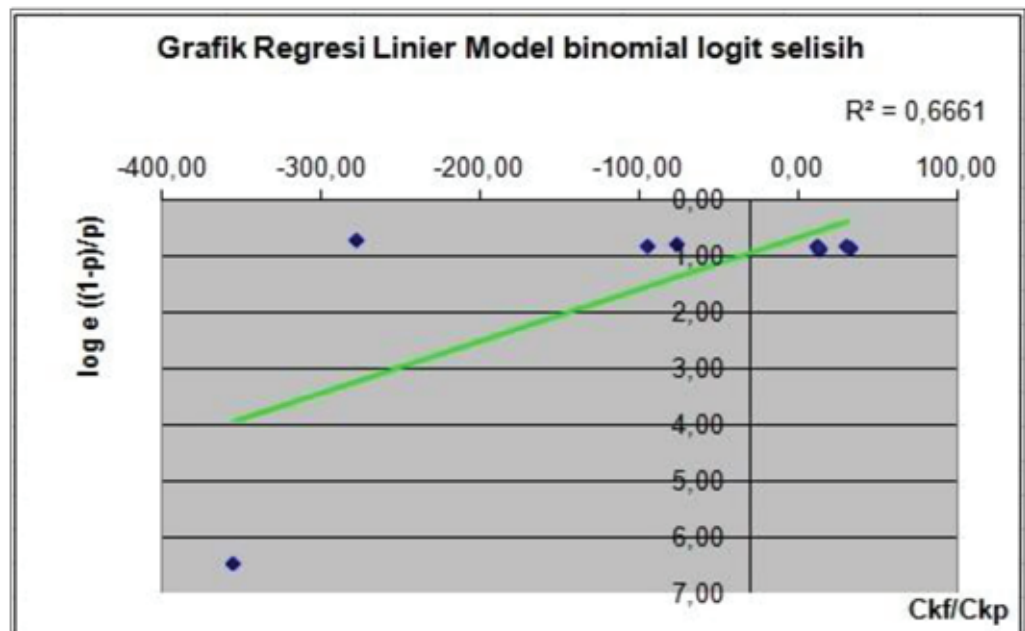
1. From the observations on the behavior of the traveler, the results obtained

   The characteristics of passenger ferries and pioneer vessels in the choice of mode are as follows:

   (a) Ferry Mode

Respondents of passengers using the ferry mode were dominated by recreational travel destinations, namely 44%, trade destinations, 25.3%, official destinations 13.3%, continuing education, 17.3%, while ferry waiting time was 60 minutes. (1 hour), the reason for choosing the ferry mode is due to the low cost factor, namely executive class of 66,000, business class of 56,000 and economy class of 44,000

(b) Pioneer Ship Mode

Respondents of passengers using pioneer ships were dominated by recreational travel destinations, namely 20%, trade destinations, 41.7%, service destinations 16.7%, continuing education goals 21.7%, while ship waiting time was 2 weeks (15 days). The reason for choosing the pioneer ship mode was due to the relatively cheap tariff factors, namely 80,000, 70,000 and 50,000

2. Modeling the satisfaction score of travelers for several alternative transportation options through linear regression analysis model is R2 = 0.6661.

5. Conclusion

The results of the analysis are highly recommended as input for service providers such as PT. ASDP and PT. Pelayaran (PELNI) to see their market share as a basis for consideration to estimate the number of ships / fleets they should provide in the future.

1. The results of the analysis can also be suggested to have various alternative investment plans in the transportation sector and the determination of government policies in the transportation sector.

2. For compilers and students it is useful as a means of developing knowledge and knowledge that has been learned in theory in college.

References

[1] Santoso, I. (1996). *Public Transport Infrastructure Planning*. Bandung: Center for Transportation and Communication Studies.

[2] Aritonang, R. L. (2005). *Customer Satisfaction*. Jakarta: Gramedia.

[3] Setyosari, P. (2010). *Educational Research and Development Methods*. Jakarta: Golden.

[4] Tamin, M. and Ofyar, Z. (2003). *Transportation Planning and Modeling*. Bandung: Bandung Institute of Technology.

[5] Cahyaningrum. (2012). *Analysis of Customer or Customer Satisfaction Against Postal Services*. Retrieved October 10, 2020 from http://repository.uksw.edu/bitstream/123456789/1823/3/T1_162007041_BAB{%}20II.pdf.

[6] Miro, F. (2005). *Transportation Planning for Students, Planners, and Practitioners*. Jakarta: Erlangga.

[7] Kusuma-Moemin, M. (2015). *Importance of Port Service Management*. International Journal of Marketing Studies; Vol. 7, No. 6; 2015, p. 145-154, Retrieved from August 21, 2020, http://jurnalmaritim.com/2015/04/pentingnya-manaManajemen-pelayanan-di-pelabuhan/.

[8] WouterJacobs. (2015). *The Role of Port Infrastructure and Logistics in Global Networks*. Retrieved from August 21, 2020, http://www.iss.nl/fileadmin/ASSETS/iss/Documents/DevISSues/Jacobs_WEB.pdf