Engineering and Technology Journal e-ISSN: 2456-3358
Volume 04 Issue 04 April- 2019, Page No.-578-584
DOI:10.31142/etj/v4i4.03, I.F. - 4.449

Study of the Choice of Freight Transportation Modes between Trucks and River Transportation on Banjarmasin – Muara Teweh Route

Dedy Alpajar [1], Muhammad Arsyad[2], Utami Sylvia Lestari[3]

[1]Graduate Student, Magister Study Program of Civil Engineering, Lambung Mangkurat University, Banjarmasin, Indonesia
[2,3]Study Program of Civil Engineering, Lambung Mangkurat University, Banjarmasin, Indonesia

Abstract: Transportation is a fundamental factor in the life of a nation and state, has a function as a driver and support for development. Users of transportation services are the wider community who need transportation services. The existence of competition between the two modes of transportation in terms of mode choice, namely between cargo ships and trucks by users of transportation services is strongly related to the socio-economic conditions of the users of transport services, characteristics and all attributes in the related modes of transportation. There is a general description of the transportation mode choice. Transporting freight using cargo ships from Banjarmasin to Muara Teweh can be reached in a relatively long time at a cheap rate compared to using truck transportation which can be reached in a shorter time but requires expensive rate. Therefore, it is necessary to conduct research on the behavior of users of transport services that influence the probability of choosing the transportation modes. The results of the analysis obtained the formulation of the value of the model of Logit (P_{ship}) = -0.281 x $X1_{ship}$ + (- 0.000281 x $X2_{ship}$) and Logit (P_{truck}) = 1.3049 + (- 0.281 x $X1_{truck}$) with moderate correlation rate. The model is the best mode choice model with a value of RsqAdj = 0.05398, which means that overall, the independent variables used have moderate relationship according to the Rsquare value if it is at intervals of 0.05 to 0.20. By looking at the original results and modeling results which are the best selection models with RsqAdj = 0.05398 which are at intervals of 0.05 to 0.20, then there is a relationship with the moderate level which affects the non-independent variable (y). All independent variables have a *P*-Value value of < 0.05, meaning that the selected attribute is valid for use. Judging from the cost attribute and time attribute that have algebraic marks (-), which means an increase in rates will reduce the tendency to choose the mode concerned. Likewise, an increase in time will reduce the tendency of transport service users to choose the mode being reviewed.

Keywords: Freight Transportation, Mode Choice, Logit Model, Time, Cost

I. INTERODUCTION

The city of Muara Teweh is located on the outskirts of the Barito River, where the people use the river as a means of transportation to transport building materials and food logistics needs to areas that do not yet have land routes. Muara Teweh is North Barito Regency. This is due to the supporting natural factors, namely the existence of rivers that are quite large and long and can be navigated, so that there are many activities of freight transportation that still use the river as a transportation route. For example, rivers are used as a route to transport mining products, forest products, basic needs and building materials.

To meet the needs of these transportation equipment, a mode of transportation of freight which is appropriate for the community is needed. In determining the transportation of freight, the user will consider matters relating to the modes he uses. In this case, the factor of choice has an important role that is closely related to the conditions, characteristics and reliability of the modes concerned. Then a model is needed to model movements that are sensitive to the movement attributes that influence the choice of the mode.

This research was conducted to identify factors that influence the choice of freight transportation modes between cargo ships and trucks, for the Banjarmasin-Muara Teweh route and obtain a mode choice model that can explain the probability of choosing the mode of freight transportation between river transportation and trucks, for the Banjarmasin-Muara Teweh, Banjarmasin - Muara Laung and Banjarmasin - Puruk Cahu routes.

In terms of choice of modes, there are several obstacles that need to be anticipated, one way is to improve the service of cargo ship and trucks so that transport service users have a preference (level of choice) that is balanced between the ships and trucks as an alternative transportation of freight from Banjarmasin to Muara Teweh. The existence of competition between the two modes of transportation in terms of modes of transportation choice, namely between cargo ships and trucks by users of transportation services is strongly related to the socio-economic conditions of users of transportation services, characteristics and all attributes in the mode concerned. There is a general description of the choice of modes of using cargo ships from Banjarmasin - Muara Teweh. It can be reached in a relatively long time with a cheap rate compared to using trucks, which can be

reached quickly but requires expensive rate.

In connection with the problems above, the authors are interested in conducting research on the behavior of users of transportation services that affect the probability of choosing the transportation modes, so that efforts can be made to improve services for the transportation modes concerned, especially cargo ships and trucks. The main problem in this research is about how the characteristics of users of transportation services in choosing transportation modes are, how to form a mode of choice model between cargo ships and trucks using the binomial logit model and the effect caused when there are changes in time and cost attributes on the probability of choosing a transportation mode.

This study aims to analyze the characteristics of users of transportation services in choosing transportation modes and to analyze and form a mode choice model using the binomial logit model and to analyze the effect when there are changes in the time and cost attributes of the mode choice probability. This study is expected to be useful to provide an overview of the variables that affect the decision making of transportation service users in selecting transportation modes. It can also be a basis for the owners of freight and services so that their services are in accordance with the expectation of transportation service users. Therefore, their mobility is more efficient and effective.

II. LITERATURE REVIEW

Public roads Economic growth is related to transportation, because as a result of economic growth, a person's mobility increases and the need for movement also increases beyond the available transportation infrastructure capacity [1]. It can be concluded that transportation and economy are closely related. On one side, transportation can encourage an increase in economic activities where economic growth increases, transportation problems will arise, due to traffic congestion, so additional transportation routes are needed to help with the high economic activity.

Transportation in the broadest sense must be studied in the form of a system study consisting of various interrelated components. The system is known as a whole transportation system (macro) which can be broken down into several smaller (micro) transportation systems, each of which is interrelated and influences each other [1]. Mode choice or the choice of transportation modes is the stage of modeling to get the level of tendency of the trip maker using modes chosen as means of transportation and/or comparison of movements that are interested in each available mode. The mode choice model is needed to develop a rational transportation system [2]. To the create a freight transportation model, it is necessary to have data that can explain the behavior of a research system [3].

The analysis of the estimated coefficient parameters used the logit method. The data used to analyze is the data obtained from the results of field surveys that directly influence the choice of freight transportation modes. Especially in this study, data analysis was done by using transportation planning software, by trial and error, so that the best formula model could be obtained. According to Radam et.al. [4], the conditions for obtaining the best model formula are as follows:

- The P-value approaches 0 (<0.05) to illustrate that the evaluated attributes are valid for use;
- The attribute algebraic signs, especially for travel time and travel cost are negative (-) to describe the fact that if the travel time is longer, the probability of choice is smaller, as well as the cost;
- The value of RSQUARE is to describe the relationship between independent and dependent variables in the utility equation as shown in Table 1.

Table 1. Correlation coefficient guidelines [4]

Value of pseudo r2	Value of R2	correlation coefficient interval |r|	Level of relationship
<0.014	<0.04	0.00-0.199	Very weak
0.014	0.04	0.20 – 0.399	Weak
0.05	0.16	0.4 – 0.699	Moderate
0.21	0.49	0.7 – 0.899	Strong
0.403	0.81	0.9 – 1.000	Very strong

The previous studies mostly discussed the choice of passenger transportation modes using the binomial logit model. However, this study discusses the choice of transportation modes for freight transport where the method used is the binomial logit model because it only chooses two alternative modes namely river transportation mode (ships) and land transportation mode (trucks). The following are several previous studies using the binomial logit method.

The disaggregate logit model can be used in the mode choice for long distance travel using land, air and sea transportation [5]. The purpose of the trip using bus modes is mostly for non-vacation trip and the reason for choosing the bus mode is because of the ease / mobility factor. The purpose of using train mode are mostly for vacation affairs and the reason for choosing the train mode is because of convenience [6]. Travel agents in the mode of cars and airplanes with Kotabaru to Banjarmasin route are captive passenger groups, which shows that they are not very sensitive to changes in costs and time [7]. The application of service factors to either land or river modes significantly influences the probability of mode choice [8]. If the difference between the cost of public transportation and private transportation is getting bigger, then the chances of choosing private transportation are getting bigger, so that subsidies for public transportation are needed [9]. The

probability of choosing an airplane mode increases along with the smaller tariff difference applied between aircraft modes and rental car modes [10]. Variables that influence the choice of bus mode and train mode are time, so the longer the travel time the lower the mode of choice [11]. The probability of choosing an airplane mode increases with the smaller fare difference applied between modes of airplane and car mode [12]. Based on previous research, it can be ascertained that the binomial logit model can be used in this study.

III. RESEARCH METHOD

The approach method used was the binomial logit model which is a mode choice model specifically used to model mode choices consisting of two alternative modes. While the data collection techniques used in this study were basically a combination of two basic methods, namely survey questionnaires and interview surveys. The questionnaire sheets were immediately taken by survey staff to each respondent so that it was expected to further clarify the intentions contained in the questionnaire. In addition, surveyors also acted as interviewers.

The questionnaire was created using a stated preference technique with partial replica design, which consisted of several options/choices offered to respondents. Stated preference questionnaire consists of several service attributes, namely factors of travel costs, travel time, capacity/carrying capacity of the mode and the level of safety of the mode in carrying freight (risk of damage to freight).

The variables chosen as the hypothesis of this study about mode choice factors are:

1. Travel distance
2. Travel time
3. Cost
4. Type of freight shipped
5. Amount of freight shipped
6. Accuracy of arrival time (on time)
7. Service factors
8. Safety factors (risk of damage to freight)
9. Warranty if there is damage to freight / insurance.

Data analysis was carried out in accordance with the method of binomial logit model approach with stated preference technique using the LIMDEP (Limited Dependent Variable Models) program which is an econometric computer program which contains mathematical statistical applications to analyze models by crossing each data section and accommodate a discrete choice model.

IV. DATA ANALYSIS

Accident Travel Time and Existing Cost Data

The modes of land and river transportation analyzed were trucks as land transportation mode and ships as river transportation mode, with the route analyzed were from Banjarmasin to Muara Teweh, Banjarmasin to Muara laung and Banjarmasin to Puruk Cahu.

For land transportation modes, namely trucks, there are lower costs and upper costs where the lower costs are the transportation costs according to purpose, while the upper costs are costs when the amount of freight is less than the vehicle's carrying capacity. The cost of the route studied was not based on the size of distance or per kilometer, but based on the current cost. Therefore, it might happen that if a route has closer distance, it may cost more that a route which has longer distance. Travel time in this study is the time when the mode used for transportation starts from the place of origin to the destination. Travel time was fast and slow depending on distance, traffic conditions and road conditions for routes from Banjarmasin to Muara Teweh and from Banjarmasin to Muara Laung and Puruk Cahu. It also depended also on the road and weather. Travel time and cost of truck transportation are shown in Table 2 and Table 3.

Table 2. Data of Travel Time and Cost for Truck

No	ROUTE	DISTANCE	TRAVEL TIME (Hour)	
			FAST	SLOW
1	BANJARMASIN - MUARA TEWEH	415	10	12
2	BANJARMASIN - MUARA LAUNG	480	11	13
3	BANJARMASIN - PURUKCAHU	500	12	14

Table 3. Data of Travel Time and Cost for Ship

No	ROUTE	DISTANCE	TRAVEL TIME (Hour)	
			FAST	SLOW
1	BANJARMASIN - MUARA TEWEH	440	48	50
2	BANJARMASIN - MUARA LAUNG	500	54	56
3	BANJARMASIN - PURUKCAHU	530	60	62

Design of Survey Form

The survey form used for the analysis of the choice between land and river transportation modes was designed with the experimental design method using the SPPS software tool with the following steps:

First Step:

Determining the attributes of each alternative mode that was analyzed and given initials in the form of Orthogonal Code values for the choice of attributes to be combined as in Table 4.

Table 4. Draft of Alternative Attributes and Initial of Orthogonal Code (OC)

ATTRIBUTE	ALTERNATIVE	SHIP	OC	TRUCK	OC
COST		LOWER	-1	LOWER	-1
		MIDDLE	0	MIDDLE	0
		UPPER	1	UPPER	1
TRAVEL TIME		DOUBLE DUMPING ENGINE	-1	SLOW	-1
		MOTOR ENGINE	0	AVERAGE	0
		DOUBLE MOTOR ENGINE	1	FAST	1

Second Step:

Determination of combinations and correlations to choices done using the orthogonal design method using the SPSS program obtained nine combinations of questions along with their tables (Orthogonal Code) as in Table 5.

Table 5. Combinations of Attribute Choice Questions

Combination of question	Cost of Ship	OC	Travel time of ship	OC	Cost of Truck	OC	Travel time of truck	OC
1	Lower	-1	Slow	-1	Lower	-1	Slow	-1
2	Upper	1	Slow	-1	Upper	1	Slow	-1
3	Lower	-1	Average	0	Lower	-1	Average	0
4	Standard	0	Slow	-1	Standard	0	Slow	-1
5	Upper	1	Fast	1	Upper	1	Fast	1
6	Upper	1	Average	0	Upper	1	Average	0
7	Standard	0	Average	0	Standard	0	Average	0
8	Lower	-1	Fast	1	Lower	-1	Fast	1
9	Standard	0	Fast	1	Standard	0	Fast	1

Third Step:

By inputting the cost and travel time according to the data in Table 2 and Table 3, it is obtained, according to the explanation, the result in table 6 which will be used as the chosen design format according to Table 7, Table 8, and Table 9 between land transportation modes in the form of trucks and river transportation modes in the form of ships with the routes from Banjarmasin to Muara Teweh and from Banjarmasin to Muara Laung and Puruk Cahu.

Table 6. The Explanation of Scenario

SCENARIO	SHIP	CHOICE (√)	TRUCK
1	Travel time using ships is slow because it uses a double dumping engine with a low		Slow travel time with low cost
2	Travel time by ship is slow because it uses a double dumping engine with a high		Slow travel time with high cost
3	The travel time by ship is average because it uses a motor engine with a low		Average travel time with low cost
4	Travel time by ship is slow because it uses a double dumping engine with		Slow travel time with standard cost
5	Travel time by ship is fast because it uses a double motor engine with high cost		Fast travel time with high cost
6	Travel time by ship is average because it uses a motor engine with high cost		Average travel time with high cost
7	Travel time by ship is average because it uses motor engine with a standard cost		Average travel time with standard cost
8	Travel time by ship is fast because it uses double motor engine with a low cost		Fast travel time with low cost
9	Travel time by ship is fast because it uses a double motor engine with standard cost		Fast travel time with standard cost

There is a format of the scenario design for each land and river transportation made based on the order of routes.

Table 7. Format of the Route Choice Design from Banjarmasin to Muara Teweh

SCENARIO	SHIP		TRUCK	
	TRAVEL TIME (HOUR)	COST (IDR)	TRAVEL TIME (HOUR)	COST (IDR)
1	50	IDR 175,000.00	12	IDR 300,000.00
2	50	IDR 225,000.00	12	IDR 350,000.00
3	49	IDR 175,000.00	11	IDR 300,000.00
4	50	IDR 200,000.00	12	IDR 325,000.00
5	48	IDR 225,000.00	10	IDR 350,000.00
6	49	IDR 225,000.00	11	IDR 350,000.00
7	49	IDR 200,000.00	11	IDR 325,000.00
8	48	IDR 175,000.00	10	IDR 300,000.00
9	48	IDR 175,000.00	10	IDR 325,000.00

Table 8. Format of the Route Choice Design from Banjarmasin to Muara Laung

SCENARIO	SHIP		TRUCK	
	TRAVEL TIME (HOUR)	COST (IDR)	TRAVEL TIME (HOUR)	TRAVEL TIME (HOUR)
1	56	IDR 250,000.00	13	IDR 350,000.00
2	56	IDR 300,000.00	13	IDR 400,000.00
3	55	IDR 250,000.00	12	IDR 350,000.00
4	56	IDR 275,000.00	13	IDR 375,000.00
5	54	IDR 300,000.00	11	IDR 400,000.00
6	55	IDR 300,000.00	12	IDR 400,000.00
7	55	IDR 275,000.00	12	IDR 375,000.00
8	54	IDR 250,000.00	11	IDR 350,000.00
9	54	IDR 275,000.00	11	IDR 375,000.00

Table 9. Format of the Route Choice Design from Banjarmasin to Puruk Cahu

SCENARIO	SHIP		TRUCK	
	TRAVEL TIME (HOUR)	COST (IDR)	TRAVEL TIME (HOUR)	COST (IDR)
1	62	IDR 275,000.00	14	IDR 400,000.00
2	62	IDR 325,000.00	14	IDR 450,000.00
3	61	IDR 275,000.00	13	IDR 400,000.00
4	62	IDR 300,000.00	14	IDR 425,000.00
5	60	IDR 325,000.00	12	IDR 450,000.00
6	61	IDR 325,000.00	13	IDR 450,000.00
7	61	IDR 300,000.00	13	IDR 425,000.00
8	60	IDR 275,000.00	12	IDR 400,000.00
9	60	IDR 300,000.00	12	IDR 425,000.00

Data Distribution

Field surveys were carried out on respondents using transportation services, where the number of samples collected was 214 samples with the aim of exceeding the minimum required number of samples. It aimed to get samples that meet the requirements for use later after being examined. As a result, samples that met the requirements and could be used were 214 samples. The characteristic of the respondents was building material and groceries shop owners.

Table 10 is a recapitulation form of survey results.

Table 10 Recapitulation Form of Survey Result on Land Transportation

NO	TRAVEL DISTANCE	TRAVEL TIME	RATE PER TON	TYPE OF FREIGHT	TRANSPORT CAPACITY	SERVICE LEVEL	INSURANCE	SECURITY FACTORS	ACCURACY OF ARRIVAL TIME	The reason you choose the mode of transportation?
	x1	x2	x3	x4	x5	x6	x7	x8	x9	x10
1	1	3	3	2	3	1	1	1	1	3
2	1	1	3	2	3	1	1	1	1	3
3	1	1	2	2	3	2	1	1	1	4
4	1	2	2	2	2	2	2	2	1	3
5	1	3	3	1	2	2	2	2	1	3

Then, the utility calculation was done by using the LIMDEP program tool where the use of this program utility equation that can describe the existing data was done by "trial and error" until the best utility equation simulation was obtained with the following conditions:

The absolute value of P-value is close to 0 (<0.05) to illustrate that the attributes reviewed are valid for use. The value of RSQUARE is (0.05 - 0.20) describing the utility equation as having a strong relationship between independent and non-independent variables. The value of Attributes in particular Time and Cost are (-) to describe the reality that when the travel time is longer, the probability of choice will be smaller. This is also applied to cost.

The following are the results of "trial and error" to get the best utility equation shown in Table 11.

Table 11. Result of "trial and error" to get best utility equation

Trial and error	Independen Variabel		Model in the program		Indikator
	Truck	ship	truck	ship	
1	- time - distance	- time - cost - distance - ser - safety factors - accuracy of arrival time - reason to choose	U truck = Truck + time*x1 + Dist * x3	U ship = time*x1 + cost*x2 +Dist * x3 + ...+rson*x10	The RsqAd value from the LIMDEP program: RsqAdj = 0.05170 P_value : some are legible
2	- time - distance	- time - cost - distance	U truck = Truck + time*x1 + Dist * x3	U ship = time*x1 + cost*x2 +Dist * x3	The RsqAd value from the LIMDEP program: RsqAdj = 0.05341 P_value : some are legible
3	- time - distance	- time - cost	U truck = Truck + time*x1 + Dist * x3	U ship = time*x1 + cost*x2	The RsqAd value from the LIMDEP program: RsqAdj = 0.05341 P_value : non are legible
4	- time	- time - cost	U truck = Truck + time*x1	U ship = time*x1 + cost*x2	The RsqAd value from the LIMDEP program: RsqAdj = 0.05398 P_*value* : legible

Information:

Value of RsqAdj = moderate relationship, which is 0.05 – 0.20

All P-value < 0.05 = qualified

The algebraic signs of time (-) and cost (-) = qualified.

Table 12. Parameter (ship and truck transportation modes) of LIMDEP result

Variable	Coefficient	Standard Error	|b/St.Er.|	P[|Z|>z]
TIME	-0.281156795	2.79E-02	-10.068	0
COST	-2.81E-05	2.57E-06	-10.946	0
ATRUCK	1.304,947,360	0.487041	2.679	0.0074

After obtaining the mode choice model as above, the probability of choosing both modes and their sensitivity to changes in the value of variables / attributes included in the equations can be known.

The utility equation from the calculation results using the Limdep application resulted in a trail error that was included into the same binominal logit function. The general equation of $P_1 = \frac{e^{(U1)}}{e^{(U1)}+e^{(U2)}}$ with the binominal logit mode choice model obtained:

$$P_{Ship} = \frac{e^{logit(P_{Ship})}}{e^{logit(\text{ship})}+e^{logit(P_{Truck})}}$$

$$P_{Truck} = 1 - P_{Ship}$$

So that if the parameters of the trial error using the Limdep program are included into the binominal Logit model equation, it is obtained that:

Logit (P_{ship}) = -0.281 x X_{1Ship} + (- 0.000281 x X_{2Ship})

Logit (P_{truck}) = 1.3049 + (- 0.281 x X_{1Truck})

The model is the best mode choice model with the value of Rsquare = 0.05569 and RsqAdj = 0.05398 which means that the overall free variable used has a strong enough relationship according to the Rsquare value if it is at intervals of 0.05 to 0.20. Hence, it describes the moderate relationship affected the dependent variables (y) and all independent variables have a P-Value of < 0.05, meaning that the selected attribute is valid for use. Viewing from the cost attribute and time attribute, they have algebraic marks (-) which means that the increase in the cost will reduce the tendency to choose the relevant transportation mode. Likewise, the increase in time will reduce the tendency to use or choose the mode being reviewed.

In which x1 is the attribute value of the travel time of each mode (hour), x2 is an attribute value of the travel cost of each mode (IDR). From the equation above, it can be seen that the attributes that will affect the calculation for the two modes of transportation are only the travel time attributes.

Based on the results of the calculation of the binominal Logit model for the factor of the travel cost with Banjarmasin to Muara Teweh route at the same tariff between truck and ship transportation modes, which was IDR.350,000.00 with a difference in cost of IDR.0 (zero rupiah), the mode choice of truck is still dominant. The probability value of truck transportation was 0.9999999997 and the value of the ship was 0.0000000003. This shows that the probability value between the two modes is inversely proportional. So, it cannot be used in calculation of analysis.

From the data obtained, it is known that respondents preferred to use land transportation because the travel time needed to deliver commodity freight is faster even though the ratio of the cost of river transportation is relatively lower. Although the costs are relatively high, land transportation modes will still be chosen because it has become the dominant mode of transportation used by the community. The turnover of commodity freight transported by land is more dominant because on average, there are available roads on land routes from one area to another. Turnover of transactions and storage of freight and other commodities will be fulfilled so that the possibility of the supply of freight will be more affordable. From the results of the research and calculations above, we can draw conclusions and assume the equation obtained that the attributes that can be competed for both modes is the travel time attribute. The shift in the choice of transportation modes which was initially more dominant in river transport than land transportation was due to the development and opening of land routes between provinces and between districts to the sub-districts and villages. The above conditions lead to a shift in the choice of transportation. Therefore, if the balance the choice between river and land transportation modes wants to be reached, it is necessary to do a more in-depth study of more detailed characteristics so that a balanced transport model will be obtained.

Under normal conditions, it was found that there was a tendency to choose trucks compared to ships with a percentage of almost 99%. The balance condition that people will change their choice to use ships will be possible if the travel time on land becomes longer than by ship. This can happen if the location of destination is easier to access by ship.

Table 13. Sensitivity of Travel Time Effects (Banjarmasin – Muara Teweh)

TRAVEL TIME (Hour)			UTILITY		PROBABILITY	
SHIP	TRUCK	DIFFERENCE	SHIP	TRUCK	SHIP	TRUCK
10	**32.1**	**22.1**	**-7.73**	**-7.72**	**0.5**	**0.5**
13	32.1	19.1	-8.58	-7.72	0.3	0.7
16	32.1	16.1	-9.42	-7.72	0.15	0.85

From the calculation of the binominal Logit model for the travel time factor with the Banjarmasin route to Muara Teweh with travel time of 10 hours for ships and 32.1 hours for trucks, and with a difference in travel time of 22.1 hours, the choice of ship mode will be dominant. The probability of trucking is 0.5 and ships are 0.5. This shows that the probability values of the two modes are balanced, so it can be used in the calculation of analysis.

From Table 13, sensitivity is seen when there is a difference in travel of 22.1 hours faster by using a ship than using a truck. Then, the probability of choice will show the balance of choice, noting that the cost of using a ship is the cost at normal condition

V. CONCLUSION

The results of the analysis study of the choice of freight transportation mode between trucks and river transportation of Banjarmasin - Muara Teweh route are as follows:

The characteristics of transportation users in choosing transportation modes are that most of the respondents who chose land transportation mode had a reason because it travels faster than using a ship. The logit model for the choice of transportation modes obtained is as follows:

$$P_{Ship} = \frac{e^{logit(P_{Ship})}}{e^{logit(P_{Ship})} + e^{logit(P_{Truck})}}$$

$$P_{Truck} = 1 - P_{Ship}$$

with,

Logit $_{(Pship)}$ = -0.281 x X_{1ship} + (- 0.000281 x X_{2ship})

Logit $_{(Ptruck)}$ = 1.3049 + (- 0.281 x X_{1Truck})

The above equation illustrates that the cost attribute in both types of transportation modes does not affect the choice of transportation mode. The attribute that is very influential in choosing the type of transportation mode is the travel time, which means that the users of freight transportation services prioritize fast travel time without considering the cost.

On the probability of mode choice, changes in cost attributes do not significantly influence the choice of freight transportation mode. The attribute that can be competed between the two modes of transportation is the travel time attribute, where in normal conditions, it is found that the users of freight transportation services tend to choose truck transportation with a percentage of 99%. The equilibrium condition of the users of freight services will switch to river transportation (ship) mode will be possible if the travel time on land is longer than the travel time on the river (by ship). This can happen if the location reached by using a truck is further or cannot be reached by land transportation (truck) and it is easier to use river transportation (ship).

REFERENCES

1. Tamin, O. Z., 2000, *Perencanaan Pemodelan & Rekayasa Transportasi*, ITB, Bandung.
2. Warpani, S., 1990, *Merencanakan Sistem Pengangkutan*, Penerbit ITB, Bandung.
3. Ortuzar,J.D. dan Willumsen, L.G.,1994, *Modelling Transportation*, Second Edition, John Wiley & son Ltd., Chichester: West Sussex, England.
4. Radam, Iphan F.; Mulyono, Agus T.; & Setiadji, Bagus H., 2015, Influence Of Service Factor In The Model Of Public Transport Mode: A Banjarmasin – Banjarbaru Route Case Study, *Journal International Journal for Traffic and Transport Engineering*, 5 (2), 108-119.
5. Karno, A.; Radam, Iphan F.; Akpinar, M.V.; & Örnek, M., 2004, Analysis of Intercity Transport Mode Choice From Banjarmasin City: Dissagregat Logit Model, *Journal of Faculty of Engineering and Architecture*, 19 (2), 59-68.
6. Simanjuntak, Erwin, 2009, *Analisa Pemilihan Moda Transportasi Bus Angkutan Kota dan Kereta Api Rute Medan Tanjung Balai terhadap Kenaikan BBM*, Tesis, Universitas Sumatera Utara, Medan.
7. Noor, Muhammad, 2010, *Permodelan Pemilihan Moda Perjalanan Transportasi Darat dan Udara di Kabupaten Kotabaru*, Tesis, Program Studi Magister Teknik Sipil, Univ. Lambung Mangkurat, Banjarmasin.
8. Radam, Iphan F., 2010, Influence of Service Factor in Mode Choice Between River Moda and Land Moda in Banjarmasin, *Jurnal Dinamika Teknik Sipil*, 10 (1), 34-40.
9. Widiarta, Ida B.P., 2010, *Analisis Pemilihan Moda Transportasi Perjalanan Kerja (Studi Kasus: badung, Bali)*, Universitas Udayana, Denpasar.
10. Kondrat, Bertho K., 2013, *Permodelan Pemilihan Moda Perjalanan Transportasi Darat dan Udara di Kabupaten Murung Raya Kalimantan Tengah*, Tesis, Program Studi Magister Teknik Sipil, Univ. Lambung Mangkurat, Banjarmasin.
11. Laurentia, A.N. dan Syafi'i, 2013, *Permodelan Pemilihan Moda Angkutan Antara Moda Angkutan Antar Kota Bus dan Kereta Api*, e-Jurnal Matriks Teknik Sipil, Universitas Sebelas Maret, Solo.
12. Inayatullah, 2016, *Analisis Pemilihan Moda Transportasi Darat dan Udara di Kabupaten Paser*, Banjarmasin, Tesis, Program Studi Magister Teknik Sipil, Univ. Lambung Mangkurat, Banjarmasin.