Transport Demand Model Ferry Cross at The Bira-Pamatata in South Sulawesi

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Abstract—The demand increase and passenger vehicles each year may result in unequal supply both the means (capacity vessels) as well as the port infrastructure, giving rise to become delayed transportation service or the transport waiting time at the port.

This study aims to: 1) determine the sustainability of the transport of passenger and vehicle fleet operating at the route Bira-Pamatata, 2) determine the magnitude of the number of passenger and vehicles in 2013-2017. Data collected included observations on the ship, and the office Bulukumba and Selayar ASDP. Then the data were analyzed by using multiple linear regressions. The multiple regression models as follows:

\[ Y = -1683.71 \text{ (intercept)} + 0.09574309 \text{ (population)} - 0.089066929 \text{ (labor)} + 0.011984206 \text{ (agricultural produce)} - 0.36184763 \text{ (industry)} - 9.694425881 \text{ (business permit)}. \]

## Keywords—demand transportation, crossing Bira-Pamata

### I. INTRODUCTION

Transportation is a sector of activity that is very important in human life. Transportation is a system consisting of facilities and infrastructure, where transportation services with safety guarantees will provide certainty and tranquility for the traveler or for the owner of the goods, so that the socio-economic activities of the community can be protected [6].

The development of sea transportation as a national transportation system is directed to be able to drive national development and regional development, especially in the Eastern Indonesia region by prioritizing the regularity of ship visits which can stimulate the growth of trade and development activities in general [3]. But the development of transposition is strongly influenced by various factors, namely: geographical, economic, political and social factors, as well as the nature and level of human life, so that it is said that transportation is the cause and effect of the progress of human civilization. The development of sea transportation is increasingly needed, so that efforts to increase it must continue to be carried out so that the installation is in line with the targets set and truly beneficial for people who need it in the area.

One of the supporting facilities in the development of sea transportation is ferry, which is a type of transport that connects certain regions regularly and regularly according to a predetermined time between two road systems, or connects two places in one province or with the nearest

province that has social relations a very close, cultural and economic environment separated by waterways of no more than 200 nautical miles, with a shipping frequency of at least once in two days, prioritizing passenger and vehicle transportation [3].

South Sulawesi is one of the regions in Indonesia that relies on sea transportation as a link between its regions, because most of its territory is in the form of islands. In connection with the condition of the region, the South Sulawesi Government is currently seeking the development of shipping crossings. There are three pioneering crossings currently being developed and based in Bira (Bulukumba Regency), the trajectories are Bira-Pamatata (Selayar), Bira-Tondasi (Muna Regency) and Bira-Reo (West Manggarai Regency), (Ministry of Transportation, 2009) The crossing service is expected to spur the rate of growth and development of remote island groups.

Bira-Pamatata crossing transportation in South Sulawesi is served by one unit of ferry ro-ro KMP. Bonto Haru with a capacity of 1053 GRT/359 NRT. The number of passengers is 400 people and vehicle load is 22 units, operating speed is 9 knots. Cruise distance 18 nautical miles with 2 hours travel time. The current condition of shipping frequency every day is 1 time, so that sometimes it is overloaded compared to the volume of the ship. Based on preliminary data obtained that the growth of vehicles of all classes or types of vehicles from the year (2004-2010), at the port of Bira by 25% per year, and at the port of Pamata by 25% per year (PT. ASDP Bulukumba, 2010). While passenger transportation in the Bira port increased by an average of 14.2% per year and at the port of Pamata increased by 14.2% per year. This increase has an impact on the unbalanced demand for passenger and vehicle transportation with the availability of facilities (vessel capacity) as well as port infrastructure which results in delays or the waiting time for transport at the port.

This condition can be overcome by determining or predicting transportation demand in the next few years. It is expected that by using forecasting models, multiple linear regression and testing the regression model as well as analyzing the performance of the ship will be obtained the number of ships that will sail both ports in a certain time. To plan the suitability between the demand for passenger and vehicle transportation based on the availability of transportation facilities and the capacity at the Bira-Pamatata crossing port in South Sulawesi, the problem is
whether passenger and vehicle transportation in the Bira-Pamatata is crossing appropriate (optimal) Passenger and vehicle transportation until 2017? The purpose of this study was to determine the suitability of passenger and vehicle transportation with the current fleet, and find out the amount of passenger and vehicle demand at the Bira-Pamatata crossing in 2017.

II. LITERATURE REVIEW

A. Understanding of Transportation

Transportation is an applied science that involves various branches of science (multi discipline). At the macro level, transportation science encompasses science, economics, social and regional development. While at the micro level, the science of transportation includes engineering sciences, civil engineering, architecture, mechanics, which are supported by other basic sciences. The modes of transportation can be grouped according to the media or places where the movement is carried out, namely: (1) land transportation namely roads and railways; (2) sea or water transportation namely sea, river, lake and crossing; (3) air transportation; and (4) multimodal transportation, which is a combination of sea, air and land transportation modes. Each mode of transportation has its own characteristics and has a transportation network consisting of a network of infrastructure and service networks. The sea transportation network consists of infrastructure and service networks, namely commercial and non-commercial (pioneer) sea transportation network, then the infrastructure network consisting of nodes (sea ports) and traffic spaces in the form of shipping lanes [4 and 7].

B. Functions and Benefits of Transportation

Transportation functions according to [4 and 6] can be divided according to their fields, namely:

- Transportation in the economy is expanding the coverage area of goods and services that can be consumed in an area, thus enabling the use of cheaper or higher quality sources
- Transportation in the social is that it allows patterns of specialization and human activity, this provides more location choices for places of residence and places to carry out various activities, in accordance with the wishes or needs of humans themselves.
- Transportation in politics, namely transportation and communication allows the implementation of a wider area of government can be carried out by the government, by uniform laws and regulations or legislation, so as to enable interaction in the community and this greatly affects the economic, social and political structure of the community.
- Transportation in the environment is generally considered that this role is negative as is the use of natural resources and environmental pollution.

C. Crossing Vehicle

Decree of the Minister of Transportation No. KM 32 of 2001 stated that crossing is a water channel in the sea, strait, river and/or lake that is designated as crossing, crossing serves as a link between the nodes on the road network and / or railway network that is determined by paying attention to the development of networks and / or networks of existing railway lines that are capable of being planned, arranged in a single national transportation order. Crossing functions can be classified into functions:

- Cross-border crossings between countries that connect nodes to road networks and / or rail networks between countries.
- Crossing between provinces that connects nodes to the road network and rail network between provinces.
- Crossings between districts/cities in the province that connect nodes to the road network and / or railroad network between districts/cities in the province.
- Crossing in districts/cities that connect nodes to road networks or rail networks in districts/cities.

D. Hinterland Port

The development and growth of a port is determined by the extent of its service area. The service area of a port can be divided into 2 (two), namely the back service area and the service area going forward, according to [7]. Of the two regions, the hinterland service area is the main consideration in port development. This is because knowing the hinterland area will cause the need for goods from outside the area to be known. In addition, the determination of the region of Ireland is very difficult because of the frequent changes of temporary that are needed not the region but the amount of goods and passengers entering the port.

E. Research Framework

The condition of the Bira-Pamatata crossing transport in South Sulawesi, each year experiences an increase in the flow of vehicles and passengers as explained in the background. To find a solution to the problem, it is necessary to analyze the movement of passengers and the flow of vehicle transport in both ports, both existing as a basis for analyzing forecasting. Furthermore, socio-economic data such as population, the amount of agricultural and plantation production, the number of industries, the number of workers, the number of trade permits, are very influential on the flow of passengers and vehicles. So that in calculating the demand for passenger and vehicle transportation, it is necessary to analyze the demand model for the next five years based on the type or class of vehicles, as well as the large number of passengers [5] With this result will affect the determination of ship capacity, and the frequency of shipping at the port of Bira-Pamatata. Based on the results of the forecasting as well, later the forecast will be for the number of passenger growth in the port of Bira-Pamatata and the number of transportation growth in the port of Bira-Pamatata and the influence of the number of ships that will serve both ports in
a certain time, in this case will be recommended in the final conclusion of this paper.

III. RESEARCH METHOD

A. Location and Time of Research

This research was carried out for approximately three months, namely May-July 2017, with research locations at the Bira port of Bulukumba Regency and the port of Pamata, Selayar Regency.

B. Data Analysis Method

Quantitative data analysis is used by using equations such as:

- Passenger and Transport Growth Analysis

To see the growth of passengers and transportation in the port of Bira-Pamatata from 2010 to 2017 formulations were used

\[ P_n = P_0 (1 + i)^n \]  

Where:

- \( P_n \) = number of passengers / transportation year \( n \)
- \( P_0 \) = Number of passengers / transportation in the beginning of the year
- \( i \) = Percentage of passenger growth / annual transportation
- \( n \) = time period in years

- Passenger Transport Analysis

According to [8] the potential of passenger transportation will be predicted by using multiple linear regression, where \( Y \) is the fixed variable (number of passengers or number of vehicles) until 2017, while the independent variable is \( X \).

\[ Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + \varepsilon \]  

\( i = 1,2,3,4,5 \)

Where:

- \( Y_i \) = Number of passengers and vehicles
- \( b_0 \) = Intersep
- \( X_1 \) = Total population
- \( X_2 \) = Labor
- \( X_3 \) = Plantation / agriculture
- \( X_4 \) = Industry
- \( X_5 \) = Trade Permit

The equation model obtained for each predicted (total load) was tested by the F test, namely: by comparing the F value with the value F Statistic at the real level of 0.01 and 0.05, or comparing the probability value of each \( X_i \) factor on the computer output with the desired level of real level. [9] claims based on F value it can be seen whether \( X_i \) variable has a real relationship with variables not free \( Y \) with the following criteria:

If F statistic > F table, then there is at least one \( X_i \) variable (population, labor, plantation/agriculture, industry and trade permit) which has a significant effect on \( Y \) (number of passengers and vehicles).

If F statistic < F table there is generally no \( X_i \) variable (population, labor, plantation / agriculture, industry and trade permit) which significantly affects \( Y \) (Number of passengers and vehicles) [9].

- Ship Technical Performance Analysis

The technical performance of ships serving the Bira-Pamatata trajectory is assessed based on the operating time and the average Load Factor per year. In terms of time, the operational performance of crossing vessels is measured based on:

a) The ratio of total operating time to calendar time, which is using the following equation :

\[ \frac{W_{op}}{W_{calendar}} \]

where is:

- \( W_{op} \) = operating time
- \( W_{calendar} \) = calendar time

b) The value of Load Factor (LF), obtained by using the following equation

- Performance load factor

\[ LF = \frac{Productivity per year}{load capacity per year} \]

- Ideal load factor :

\[ LF = \frac{Productivity per year}{load capacity per year \text{ without waiting time}} \]

Furthermore, the operating pattern is evaluated so that the frequency, amount and capacity of the fleet are optimal for the demand for cargo in the next five years. The important factors in the operation:

- Duration :

\[ t_s = \frac{s \times 2}{V_s} \]

Where is:

- \( t_s \) = duration
- \( s \) = cruise distance (miles)
- \( V_s \) = speed (mile/an hour)

- The Number of Cargo per Trip
\[
MT = \frac{V}{f}
\]

Where is:
\[
MT = \text{the number of cargo}
\]
\[
V = \text{load volume}
\]
\[
F = \text{Frequency}
\]

• The Frequency of Shipment
\[
f = \frac{T \times 60 \times 24}{h}
\]
\[
F = \text{the frequency of shipment}
\]
\[
T = \text{effective time of operating the ship}
\]
\[
H = \text{headway}
\]

IV. RESULTS

Based on the results of data processing using multiple linear regression it turns out that the independent variables simultaneously have no significant effect on the variable Y (vehicle), where the significance of 6.9% is greater than \( \alpha = 5\% \). Likewise, partial testing also shows that the independent variables: population (X1), labor (X2), agriculture (X3), industry (X4), and business license (X5) have a P value of more than 5%, so that it can be said that the number of vehicles (class II-VII) from the port of Bira (Bulukumba) to the port of Pamatata was not affected by independent variables. Whereas in the port of Pamatata to the port of Bira, based on the results of data processing using multiple linear regression it turns out that simultaneously the independent variables are the number of population (X1), number of labor (X2), number of agricultural products (X3), number of industries (X4) and number of Permits Enterprises (X5) significantly affect the variable Y (vehicle), where the significance is 2.9% smaller than \( \alpha = 5\% \). However, after partial testing or one by one of the five variables showed that only one independent variable was the number of agricultural products (X3) which had a significant effect of 2.9% (P value of 2.9%) or (2.9% < \( \alpha = 5\% \)). This explains that agricultural products from Selayar Regency will change the number of vehicles to the Bulukumba area. In other words, more and more agricultural products increase the number of vehicles from Babatere to Bira Port will also increase.


\[
Y = -1683.71 + 0.09574309 \times (\text{population}) - 0.089066929 \times (\text{labor}) + 0.011984206 \times (\text{agricultural produce}) - 0.36184763 \times (\text{industry}) + 9.694425881 \times (\text{business permit})
\]

Based on the results of processed data using multiple linear regression turned out to be simultaneously independent variables namely the number of population (X1), the number of workers (X2), the number of agricultural products (X3), the number of industries (X4) and the number of business licenses (X5) significantly affect variable Y (number of passengers), where the significance is 0.13% or (0.13% < \( \alpha = 5\% \)). Partial testing also shows that the independent variable (X) has a significant effect because P-value is smaller than 5%. This explains that if the population increases, the number of workers, the amount of agricultural produce, the number of industries and the number of trading business licenses in Selayar Regency, it will affect the number of passengers from Pamatata port to Bira Port. By looking at the R-square value - 0.999999324 or 99.99% and r-square (adj) = 99.99% indicates that the model is very real at 95% confidence level, meaning the population, labor, agricultural products, industry and trade permits can explain the relationship to the number of passengers, thus it can be seen that the results of multiple linear regression on the number of passengers in Pamatata Port are appropriate. To predict the number of passengers in the next five years, from 2013-2017 from Pamatata Port to Bira Port, with the equation \( Y = -1683.71 + 0.09574309 \times (\text{population}) - 0.089066929 \times (\text{labor}) + 0.011984206 \times (\text{agricultural produce}) - 0.36184763 \times (\text{industry}) + 9.694425881 \times (\text{business permit}) \), A linear line occurs between the line fits (fits) with the forecasts (approximate) line, ie there will be passenger growth in Pamatata Port to Bira Port from 2013-2017. However, passenger growth is still occurring each year, this can be seen in the actual line. To predict the number of vehicles in the next five years, from 2013-2017 from Pamatata Port to Bira Port, it is found that the most significant agricultural yields on vehicle demand.

Likewise the results of processed data using multiple linear regression analysis, it can be seen that the contribution of agricultural products is large enough to influence the number of vehicles transported. Based on the data of agricultural products and the number of vehicles transported that were processed using computer calculations, it was found that agricultural yields significantly affected with a smaller value of 5%, even below 1%. Then from the R-Squared value (coefficient of determination) of 0.976287434 or 97.63% indicates that the contribution of agricultural products is large enough to influence the number of vehicles transported and the remaining 2.37% is influenced by other things or other variables.

V. CONCLUSIONS AND RECOMMENDATIONS

The results showed that: 1) population, 2) labor, 3) results plantation, 4) commerce, and 5) industry, providing no significant effect on the demand for the number of vehicles and passengers at the port of Bira. In contract, the port Pamatata a significant influence on the number of vehicles and passengers demand. After testing multiple linear regression variable X simultaneously significantly
influence the significance of variable Y which at 2.9% <, but only a partial test of the independent variables that influence agriculture with P-value of 2.9% (2.9%<). The capacity conformity of ships unloading the have been operating seen from the magnitude of the load factor on the flow of passengers and freight vehicles. By calculating the operational performance of the ships per year as many as 316 days per year outside the docking time. Where the transport capacity of the vehicles Group IV and VI by 22 units with a load factor of 20.196 units per year and passenger capacity of 400 people with a load factor 367.200 people per year. Based on the prediction of transport and passenger vehicles in 2013 to 2017 showed a significant increase so as to meet the compliance operation by performing schedule optimization ship to 4 trips per day and increase the efficiency of sailing time, use of time at the port of departure and arrival to 6 hours.

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