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Analysis Public Transportation City of Dili to Improve Service with Users Characteristics

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ABSTRACT

Many public transport drivers in City of Dili do not apply various regulations from the government. Located on Becora-Baidi, Becora-Bidau, and Tasi Tolu-Bidau Road. This causes congestion and traffic accidents, and impact on economy. The purpose of study is to determine the trip generation model and its factors, city transportation service performance, and how to formulate TDM concept in public transport. The survey conducted was daily volume of public transport, questionnaires, and interviews 2020. Looking for value of angkot generation with instrument test and multiple regression (IBM SPSS 22). To analyze services used parameters and Severy Index. Then, concept of Transportation Demand Management (TDM) with Guttman Scale. After analyzing, the trip generation value, Y = -1,3920 + 0,0275.X1 + 0,4958.X2 + 0,1734.X3 – 0,0601. X4 - 0,0657.X5 - 0,0001.X6 - 0,0193.X7 - 0,7670.X8 + 0,8801.X9 + 0,6721.X10 + 0,1058.X11, positive value is factor that most influences the respondent's decision to trips using public transportation: gender (X1), age (X2), job (X3), duration of trip (X9), number of passengers (X10), and waiting time for public transportation (X11). However, in service level is still "low" category. Then, for TDM concept gets 87% in 51%-99% range. Means that angkot users agree, if TDM concept is propose to the government of Dili City, and public transportation will be better in the future.

Keywords: Trip Generation, Public Transportation Mode, Public Transportation Services, Transportation Demand Management, TDM.

INTRODUCTION

Population movement activities result in the generation of transportation, which affects the capacity of the traffic network on the main route roads. At this time, the existing city transportation services in City of Dili have not shown any good service according to demand.

Figure 1. Urban Transport Modes in Dili City Route 02 (Becora-Bidau Road). Source: author's documentation

Thus, this causes a decrease in the quality of city transportation services, and often harms city transportation users, other vehicle users, and also impacts the economy of the surrounding community. The basis of this research is also reviewed from several previous studies, one of which is research from the case study of Kajang City, Selangor Malaysia uses the binary logic method. To carry out road repairs and increase parking costs will reduce congestion on roads, and also contribute to reducing pollution and increasing safety.

Then, improve public transportation facilities such as Wi-Fi and cell phone chargers, schedule information for each lane, with a GPS system, special discounts during peak hours especially for young people (Abdulrazzaq et al., 2020). One of the previous studies was the case study of the Nicolau Lobato-Kolmera Corridor, Timor Leste with the TDM concept of shift mode and time shift methods. The simulation results show that the TDM scenario in the form of a vanpool is considered more effective in improving services than the carpool and flextime scenarios (Gomes, 2017).

One of the previous studies is a case study of Delhi, India with questionnaire distribution and multiple regression analysis on public transportation such as rickshaws. The result is for the development of an organized infrastructure for rickshaw transportation and planning a step forward towards structuring non-motorized vehicles (Saiyad et al., 2020).

This study also uses a questionnaire method and analysis of the SPSS application based on previous research, such as research on the Jabodetabek Commuter Train service in the Bogor-Tanah Abang route, at Bogor and Manggarai Stations. Where the research was conducted through a questionnaire survey, then tested for validity, reliability, importance performance analysis, and normality testing using SPSS software. The results show that train managers need to increase the number of toilets at Bogor Station, add first aid kits at Bogor and Manggarai Stations, increase the number of waiting seats at Manggarai Station, add stairs for platforms whose height is not the same as floor trains at Manggarai Station, and to improve performance. Security officers and user awareness about the use of priority passenger seats (Dwiatmoko, 2020).

And a study that discusses the evaluation of passenger satisfaction on the Commuter Line service for the Tanah Abang-Serpong route, with bivariate correlation analysis and Linear Regression using the SPSS program (Widyaningsih, 2017).

In this study, an analysis will be carried out with several methods for the purpose, namely:

1. Find out what the value of the city transport generation model is and what factors influence it.
2. How much is the assessment of the performance of city transportation, specifically the 3 route routes in Dili City that have been operating for several years.
3. How to formulate the concept of TDM in urban transportation, based on user perceptions.

Figure 2. Route Map of the Angkot Vehicle Area to be Researched. Source: Google Maps 2020

LITERATURE REVIEW

Parameters Of The Public

Transportation is the act of moving people and goods from one place (origin) to the other (destination) using vehicles (Warpani, 2002). Parameters of the public and city transportation:

1. Load Factor is the ratio or percentage of passengers transported to seats (K Morlok, 1991). By using the formula:

$F = M/S.100$ …….....… (1)

F = Load factor

M = passengers transported

S = seat provided

2. The number of operating fleets can be formulated by (Marsudi, 2006):

$\Sigma_{fleet} = (\Sigma_{operating\ vehicle}/\Sigma_{available\ vehicles}) .100$ (2)

3. Frequency is the number of vehicles that pass per unit time, operating for a

certain time or for 1 hour (K Morlok, 1978).

4. Headway is the time between one vehicle and another consecutive vehicle behind it on the same route. To avoid the bunching effect, the minimum headway is set at 1 minute (Asikin, 2001). By using the formula:

H= 60 / Q ….....……(3)
H = Headway (minute)
Q = number of vehicles in 1 hour

5. Travel speed is the speed of the vehicle from the start of the route to the end point of the route (K Morlok, 1978), and is formulated:

V= S/t ……..…….……(4)
V = travel speed (km/hour)
S = route length (km)
t = travel time (hours)

6. Service time is the time during which the vehicle in a route is still operating (Marsudi, 2006). Then, waiting time is the time required by passengers while waiting for city transportation (K Morlok, 1978):

Wt = 0,5.H ……(5)
Wt = waiting time
H = Headway (minute)

7. Travel time is the time required by public transport to cover the length of the route, from the starting point to the end point, in minutes (Marsudi, 2006).

Trip Generation And TDM

Trip generation is a modeling step that estimates the amount of movement attracted to a land use or zone. Traffic movement is a land use function that results in traffic movement (Tamin, 2008). Transportation Demand Management (TDM) includes all methods that can improve the utilization of existing transportation facilities and means, more efficiently by regulating or minimizing the use of motorized vehicles, by influencing travel behavior which includes: frequency, destination, mode and time of travel (Broaddus et al., 2010). The general objective of transport demand management is to maximize the efficiency of the urban transportation system by limiting the unnecessary use of private vehicles and encouraging more effective, healthy and environmentally friendly modes of transportation such as public transport and non-motorized vehicles (Broaddus et al., 2010).

Sampling Method

The sampling method with a non-probability sample approach is through the convenience sampling method, namely when the respondents who will be sampled are at the research location and want to be interviewed. The sample size is taken, referring to the Slovin formula (Umar, 2003) according to the formula:

$$n = \frac{N}{1+(N\,x\,e^2)} \quad \text{……..(6)}$$

n = Sample size
N = Population size
e = Percentage of allowance for inaccuracy, due to tolerable sampling error (could be 1 - 10%).

Validity

Validity relates to a variable measuring what should be measured (Sugiarto & Sitinjak, 2006). Basis of decision making for validation test (2-sided test with sig. 0.05); If the value of $r_{arithmetic} > r_{table}$, then the data is declared valid. If the value of $r_{arithmetic} < r_{table}$, then the data is declared invalid.

r_{tabel} = α and df =n-2 ……(7)
α = 0.05, with confidence is 95%.
n/N = Number of Samples.
df = Degrees of Free.

Reliability

According to the researcher (Sugiyono, 2016) states that the reliability test is the extent to which the measurement results using the same object will produce the same data. The basis for making decisions in reliability testing (Sujarweni, 2014) are as follows: If the Cronbach Alpha

(a)>0.60 then the questionnaire is declared reliable or consistent. If the Cronbach Alpha (a)<0.60 then the questionnaire is declared unreliable or inconsistent.

Chi Square

The chi square test is a statistical technique that is useful for testing data normality, analyzing data in the form of frequencies, and determining the size or size of the relationship, compatibility or significant difference of the analyzed variables (Susilawati et al., 2017). The basis for making decisions in the chi square test based on the table values (Santoso, 2014) are as follows:

α untuk X^2.α and df ……...……(8)
α = 0.05, with confidence is 95%.
df = df value at SPSS output or;
df = degrees of freedom → (b-1)(k-1).
b = number of rows
k = number of columns

If the value of chi $square_{count}$>chi $square_{table}$, then the variables are stated to have a relationship. If the value of chi $square_{count}$<chi $square_{table}$, then the variables are declared to have no relationship.

Regression

Regression analysis is the development of simple linear regression which in fact shows that several independent variables simultaneously affect the dependent variable (Walpole & Myers, 1995):

Y = A+B1.X1+B2.X2+...+BZ.XZ …(9)
Y = dependent variable
A = regression constant
X1 ... Xz = independent variable
B1 … Bz = regression coefficient

Severity Index

The Severity Index is an analysis used to assess public perceptions of the condition and the level of public transportation services in this study, namely the calculation of the probability value of performance perceptions obtained based on the results of respondents' answers (Anastasia et al., 2015). Severity Index (SI) is calculated by the following formula:

$$SI = \frac{\sum ai.xi}{4.\sum respondent} . 100\% \quad \text{……(10)}$$

ai= Weighting given to the level of performance of city transportation.
xi= Frequency or number of respondents who provide answers to the performance indicators of urban transportation.

The classification of the results of the SI analysis of the perception rating scale is as follows:

Very Low / Small (VL/VS)= 0.00 ≤SI ≤12.5
Low / Small (L/S) = 12.5 ≤SI ≤37.5
Moderate (M) = 37.5 ≤SI ≤62.5
Height / Large (H/L) = 62.5 ≤SI ≤87.5
Very High / Large (VH/VL) = 87.5 ≤SI ≤10

Guttman scale

Guttman scale research is research if you want to get a firm answer to a problem that is asked, and it is always made in multiple choices, namely "yes and no", for the assessment of answers, for example, for positive answers, the score is 1. While the negative answer is given a score is 0. Thus if the answer to the question is agree the score is 1 and disagree is given a score of 0.

If the score is converted in a logical proportion, it can be justified for the answer to agree the score is 1 = 1 x 100% = 100%, and disagree the score is 0 = 0 x 0% = 0% (Kasim, 2014). The formula is as follows:

$$GS = \frac{\bar{x}}{\sum respondent} . 100\% \quad \text{……(11)}$$

GS = Guttman Scale
x = Total weighted average
R = Frequency or number of respondents who gave answers

Table 1. Guttman Scale Interpretation

Value Range	Suitability Level
0	Not Appropriate
0,01 – 0,49	Approaching No Match
0,50	Somewhat Appropriate
0,51 – 0,99	Approaching the Match
1	Fit

source: (Kasim, 2014)

MATERIALS & METHODS

This type of research design is descriptive quantitative. Sources of data use, namely primary data by direct observation of the field, distributing questionnaires and interviewing respondents for the required data. The city transportation volume data survey was conducted in November 2020 in the 4th week. Observation of road routes is carried out in conjunction with a survey of the volume of urban transportation. The city transportation in study is the one with the main routes within the city of Dili, that is red public transport in route 01 on Becora-Balide road, green public transport in route 02 on Becora-Bidau road, and blue public transport in route 10 on Tasi Tolu-Bidau road. The survey was conducted for two weeks from Monday to Sunday, alternate days, with three sessions from 06.00 - 09.00, 11.00-13.00, 16.00-1800 Dili time.

For the distribution of questionnaires distributed to people who often use public transportation, bias such as regular workers, students, and college students. The number of haunted rights/questionnaires distributed was 300 sheets, because the City of Dili with an area of ± 372 km2, has a population of 283,130 people (Timorleste.gov.tl., 2020), using equation (6) with an error of 6%. And secondary data obtained based on studies of reports, journals or data from related agencies with demographics and area area both online (via the official website) and offline (coming to the office).

There are a number of variables included in the questionnaire to be used in this study, including: Gender (X1), Age (X2), Job (X3), Salary (X4), Location of Origin (X5), Location of Destination (X6), Type of Activity (X7), Origin-Destination Distance (X8), Length of Trip (X9), Total of Passengers in Public Transport When Up (X10), Waiting Duration for Public Transport (X11), and Total of Trips in a Week (Y), these variables are for characteristic indicators journeys.

The indicator variables for city transportation services are: Public transportation routes (P1), timeliness of Public transportation (P2), changes in Public transportation (P3), Public transportation capacity (P4), cleanliness of Public transportation (P5), utilization of Public Transportation (P6), Public Transport Travel Duration (P7), Public Transport Waiting Duration (P8), and Transfer Public Transport (P9). Then, the indicator variables for offering the TDM concept include: Public Transportation Schedule (T1), Public Transportation Stop Position (T2), Public Transportation Payments With E-Money (T3), Online Map Offering (T4), Stop Button Procurement (T5), and Procurement of Suggestion Boxes (T6).

The data analysis method in this study includes three targets that have their own data input and data analysis techniques, the first is descriptive statistical analysis with multiple linear regression using the IBM SPSS Ver.22 application, to identify and perform instrument testing on the characteristics of public transport users. In order to obtain a trip generation model on the Becora-Baidi, Becora-Bidau, and Tasi Tolu-Bidau Roads, City of Dili. Second, analysis using the parameters of the transportation agency in Indonesia, and analysis of the Severy Index, to determine the level of service for public transportation that has been operating for a long time, according to the perceptions of public transport users. And third, is the use of the Guttman Scale method in analyzing offers related to the TDM concept to deal with congestion, and improving public transport services on the three main routes of the City of Dili road.

RESULT AND DISCUSSION

From the results of the identification of respondents' answers, the characteristics of respondents who use public transportation modes are; male (60%), aged between 20-50 years (49%), have a job as a student (43.7%), have a monthly income of less than Rp 2,000,000. (50%), original location is home (49%), destination location to school (37%), doing educational activities (47.3%), origin-destination distance is less

than 5 km to 10 km (40%), length of trip duration between 6-12 minutes (40%), the number of passengers in an angkot when boarding is between 5-11 people (50%), waiting time for an angkot to arrive can be up to more than 30 minutes (40%), and making angkot trips <3 times-12 times (40%).

Instrument Test

For validity testing, using equation (7) the value of df = 300-2 = 298 with a significance value of 5%. The result is 11 variables X, there is one variable in the questionnaire which shows invalid results, namely the X11 variable (Waiting Duration for Public Transport). Due to the value of $r_{count} < r_{table}$, so the variable is not valid. This means that the question item regarding the waiting duration for an public transport cannot be used to measure the number of times an public transport user travels.

For reliability testing, 12 variables (X and Y) in the questionnaire as a whole were declared reliable or consistent. Due to the value of Cronbach alpha (a) of 0.759 > 0.60 so that the variable is reliable. This means that if all the question items in the questionnaire are obtained in accordance with reality, no matter how many times the data is collected, the results will remain the same or consistent.

For the chi square test using equation (8) with $X^2\alpha = X^2.0.05$ and df = 2, 4, and 8 (from SPSS app.). The result is 11 variables X in the questionnaire as a whole stated to have a relationship, the value of chi $square_{count}$> chi $square_{table}$. This means that all question items in the questionnaire have a relationship with the Y variable.

Trip Generation

Using equation (9), the regression value in the model for the generation of angkot trips on three routes in the City of Dili, Timor Leste based on respondents perceptions is Y = -1.3920 + 0.0275.X1 + 0.4958.X2 + 0.1734 . X3 – 0.0601. X4 - 0.0657.X5 - 0.0001.X6 - 0.0193.X7 - 0.7670.X8 + 0.8801.X9 + 0.6721.X10 + 0.1058.X11. From the results of the regression analysis obtained a generation model, where the positive value is the factor that most influences the respondent's decision on the frequency of travel using angkot transportation modes, that is gender (X1), age (X2), job (X3), length of trip (X9), total of passengers in public transport when up (X10), and waiting duration for public transport (X11).

Public Transport Performance Assessment

Knowing the magnitude of the assessment of the performance of city transportation, especially in this study, namely on 3 routes in City of Dili which have been operating for several years. By using parameter indicators referring to equations (1) to (5) and shown in table 2. Overall, the average performance of public transport is still in the "good" category.

In measuring the assessment of public transport performance, respondents' perceptions refer to equation (10), namely the analysis of the severity index. With the example of item P1:

$$SI = \frac{(2\,x\,53) + (1\,x\,247)}{4\,x\,300}\,.100\% = 29\%$$

This means that the level of satisfaction is low/small (12.5 ≤SI=29 ≤37.5). For the results of the calculation of the level of satisfaction on items P2 = 30%, P3 = 46%, P4 = 30%, P5 = 31%, P6 = 42%, P7 = 31%, P8 = 30%, and P9 = 43% (table 4). So that the average level of user satisfaction with the performance of public transportation is in the "low" category.

Table 2. City of Dili Public Transport Performance Assessment Based on Parameters

Desc.	Service Indicator		Count Result	Unit	Assessment
Eq. (1)	Load factor in peak hours	=(18/10).100	**180**	%	Not Good
	Load factor outside peak hours	=(9/10).100	**90**	%	Moderate
Eq. (2)	Vehicle operating	Route 01 = (86/86).100	**100**	%	
	Vehicle operating	Route 02 = (68/68).100	**100**	%	Good
	Vehicle operating	Route 10 = (216/216).100	**100**	%	
Eq. (3)	Headway	Route 01 = 60 / 39 vehicle/hour	**1,55**	minute	
	Headway	Route 02 = 60 / 55 vehicle/hour	**1,08**	minute	Good
	Headway	Route 10 = 60 / 81 vehicle/hour	**0,74**	minute	
Eq. (4)	Travel speed	= 5 / (9/60)	**33,33**	km/hour	Good
Eq. (5)	Waiting time (Survey)	Route 01 = 0,5 . 1,55	**0,78**	minute	
	Waiting time (Survey)	Route 02 = 0,5 . 1,08	**0,54**	minute	Good
	Waiting time (Survey)	Route 10 = 0,5 . 0,74	**0,37**	minute	
	Waiting Time (questionnaire results)		**> 30**	minute	Not Good
-	frequency (questionnaire results)	Route 01	**39**	vehicle/hour	
	frequency (questionnaire results)	Route 02	**55**	vehicle/hour	Good
	frequency (questionnaire results)	Route 10	**81**	vehicle/hour	
-	Service time	Interview result	**12**	hour	Not Good
-	Travel time	questionnaire results	**6-12**	minute	Moderate

Source: Analysis Results, 2021

The standard values used in table 2 are standard values for the parameters of public transport service regulations in Indonesia which can be seen in table 3, considering that the standard of public transport services in the State of Timor Leste is not yet fully available.

Table 3. Indicators of Public Transport Service Performance Standards

No.	Service Indicator	Unit	Assessment		
			Not Good 1	Moderate 2	Good 3
1	Load factor in peak hours	%	> 100	80 - 100	< 80
2	Load factor outside peak hours	%	> 100	70 - 100	< 70
3	Travel speed	km/hour	< 5	5 - 10	> 10
4	Headway	minute	> 15	10 - 15	< 10
5	Travel time	minute	> 12	6 - 12	< 6
6	Service time	hour	< 13	13 - 15	> 15
7	frequency	vehicle/hour	< 4	4 - 6	> 6
8	Vehicle operating	%	< 82	82 - 100	100
9	Waiting Time	minute	> 30	20 - 30	< 20

Source: Keputusan Direktur Jenderal Perhubungan Darat Nomor: SK.687/AJ.206/DRJD/2002

Table 4. Service Performance Assessment by Respondents to Public Transportation

question items	the frequency of answers agree	the frequency of answers disagree	number of respondents	*Severity Index (SI)*	satisfaction level
P1	53	247	300	29	Low/Small
P2	61	239	300	30	Low/Small
P3	246	54	300	46	Moderate
P4	60	240	300	30	Low/Small
P5	67	233	300	31	Low/Small
P6	204	96	300	42	Moderate
P7	66	234	300	31	Low/Small
P8	57	243	300	30	Low/Small
P9	218	82	300	43	Moderate

Source: Analysis Results, 2021

Transportation Demand Management (TDM)

From the distribution of questionnaires, regarding the offer of the TDM concept for public transport modes. The answers obtained from 300 respondents are the frequency of agreeing answers from items T1 = 248, T2 = 235, T3 = 251, T4 = 274, T5 = 272, and T6 = 287.

The average frequency of agreeing answers is 261.17, which is then analyzed with the calculation of the Guttman Scale equation (11).

SG = 261.17/300 . 100% = 87% ~ 0.87

The results obtained of 0.87 according to table 1 are in the range of 0.51 - 0.99, so it can be said that the TDM concept offered to public transport to users is close to right. This means that public transport users agree if the TDM concept is proposed to the City of Dili Government, so that public transport modes can a better public transportation than before.

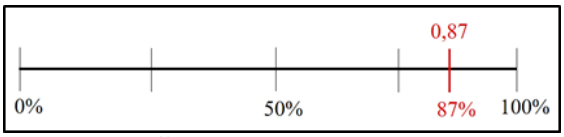

Figure 3. TDM Offer Percentage With Guttman Scale. Source: Analysis Results, 2021

CONCLUSION

Based on all the brief analysis above. So, the conclusions in this study include the following:

1. The value of the public transport trip generation model on three routes within the City of Dili, Timor Leste is Y = -1.3920 + 0.0275.X1 + 0.4958.X2 + 0.1734 . X3 – 0.0601. X4 - 0.0657.X5 - 0.0001.X6 - 0.0193.X7 - 0.7670.X8 + 0.8801.X9 + 0.6721.X10 + 0.1058.X11. With the influencing factors, that is gender (X1), age (X2), job (X3), length of trip (X9), total of passengers in public transport when up (X10), and waiting duration for public transport (X11).
2. The assessment of the performance of public transportation based on the results of the service user respondents' assessment is still relatively low, because the Severity Index value is mostly below 37.5%. However, if viewed from the parameters, it is still classified as a good service category. So that this matter can be paid more attention by the government or managers of public transportation modes. So that the performance of public transportation can be improved again, and the larger negative impacts caused by public transportation modes can be prevented and corrected.
3. The formulation of the TDM concept in urban transportation based on user perceptions obtained 87% in the range of 0.51-0.99, so it is said that the category is close to the Guttman scale. This means that public transport users agree if the TDM concept is submitted to the Dili City Government like Public Transportation Schedule, Public Transportation Stop Position, Public Transportation Payments With E-Money, Online Map Offering, Stop Button Procurement, and Procurement of Suggestion Boxes.

SUGGESTIONS

Suggestions that can be given to complete and support this research are:

1. Given the limitations of the study, further research can be conducted on the transportation system related to supply characteristics that are influenced by price/cost, as well as on the effect of demand characteristics that are influenced by land use and population, so that efforts to deal with the problem of public transportation in Dili City can be handled, more comprehensively and from various influencing aspects.
2. For users, it is necessary to arrange departure times personally, so that users such as students and private employees can be served optimally when the public transportation has a fixed schedule.
3. For the government, it is better to provide subsidies for urban transportation, and make new policies or regulations on road traffic, including Minimum Service Standards for urban route transportation, and enforcement of laws that violate traffic.
4. For public transportation operators, improve their services in terms of security such as route stickers, safety issues such as closing the angkot doors while the vehicle is running, facilities such as suggestion boxes/information numbers, convenience matters such as equipping the public transportation with air conditioning, and other things.
5. From the results of the study, it was concluded that City of Dili Transportation did not meet the Minimum Service Standards (MSS) for Transportation, and considering that Dili City did not have a policy regarding MSS, the researchers proposed or proposed Modern Public Transport Service Standards.

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