A Model Study of the Routine Maintenance of Primary Arterial Roads in Makassar City

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Abstract: Road maintenance here is the activity of maintaining, repairing, adding or replacing existing physical buildings so that their functions can still be maintained or improved for a longer time.The growth of road length which tends to be constant from year to year also causes the level of saturation of several main roads in Makassar City to increase.In this work, the authors have conducted a model study of the Routine Maintenance of Primary Arterial Roads in Makassar City. This work was focused on primary arterial roads in the city of Makassar consisting of 12 roads. In this study, data analysis was performed using analysis regression. Key result showed that the wide road variable and road average daily traffic / ADT affect the magnitude of the routine maintenance budget for the following year.

Keywords: ADT, Road maintenance, Routine maintenance, Regression analysis.

I. INTRODUCTION

The development of the road network in a country is something that greatly influences the development of the country [1]. The road network as the pulse of national development is the first and foremost priority in the development of a country and is also an infrastructure for the community to carry out activities [2]. Indonesia as a developing country, has experienced a rapid increase in the intensity of socio-economic activities along with the economic progress that has taken place [3]. Community activities along with the increasing population in an area are the main factors for generating travel needs so that ultimately there is a need for a level of efficiency, security, and comfort in traveling [4]. Increasing the number of movements that occur will also demand the quality and quantity of infrastructure that must be balanced [5].

Roads are infrastructure built by the government to facilitate regional development. Roads are assets that must be managed and functioned optimally. The highway is one of the infrastructures that will accelerate the growth and development of an area and will open social, economic and cultural relations between regions. In the Republic of Indonesia law no. 38 of 2004 [5] concerning road infrastructure, stated that roads have an important role in realizing the development of the nation's life. So this road is needed by the community in carrying out their daily activities.

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Roads are formed over several layers of pavement. The pavement layer on the road will experience a decrease in service levels. The decline in the level of road service was marked by damage to the pavement layer, the damage that occurred also varied in each segment along the road section and if left for a long period of time, it will worsen the condition of the pavement layer so that it can affect the safety, comfort and smoothness of the traffic [6].

Road maintenance here is the activity of maintaining, repairing, adding or replacing existing physical buildings so that their functions can still be maintained or improved for a longer time. Maintenance the road is divided into routine maintenance and periodic maintenance. [7]. Improvement is the handling of roads to improve road services in the form of structural and geometric improvements in order to achieve the level of service in accordance with the plan [8].

In the implementation of construction practices, several different estimates are needed based on their intended use and designation [9]. In the early stages of planning a routine road maintenance project, such as when preparing a project budget, it is clear that estimates are not possible based on the calculation of the quantity (volume) of the work because the description and specifications of the work have not been arranged [10]. However, the project owner (owner) requires an estimated cost in order to prepare the project budget [10].

Along with the need for efficiency, it is necessary to develop techniques for making a simple cost estimation model to analyze the amount of road maintenance financing. The important thing in the cost estimation model in the early stages of project planning is that it must be fast, easy to use, accurate and produce estimates that can be accounted for [9,10].

Makassar is located on the west coast of South Sulawesi Province. The growth of road length which tends to be constant from year to year also causes the level of saturation of several main roads in Makassar City to increase. Regular road maintenance financing is funded by the National Budget (BudgetState Revenues and Expenditures). Every year a routine road work program is made by PPK 21 Makassar City. The amount of funding for routine road maintenance is affected by the number of work items due to road damage. Routine road maintenance activities made by PPK 21 Makassar City include road maintenance, road pavement, and road PPLK. Thus, in this work, the authors have conducted a model study of the Routine Maintenance of Primary Arterial Roads in Makassar City.

II. METHODOLOGY

Research Location

This research includes primary arterial roads in the city of Makassar consisting of 12 roads, which are Jl. Perintis Kemerdekaan (12.5km), Jl. UripSumoharjo (4.9km), Jl. G. Bawakareng (1.11km), Jl. Masjid Raya (1.22km), Jl. Bulusaraung (0.657km), Jl. Ahmad Yani(0.7km),JlRiburane (0.23km),Jl Nusantara (1.94km), Jl Veteran Utara (2.07km), Jl Veteran Selatan (2.15km), Jl Sultan Alauddin (3.7km) and Jl. A. P. Pettarani (4.3km).

Data Source

Data used in this study came from several sources, namely: Public Works Agency, Central Makassar National Road Implementation VI and SNVT Implementation of the Makassar Metropolitan National Road.

Research Variable

This study involved two independent variables and one dependent variable. As an independent variable includes: wide road and ADT road. While variable bound in this study is the 2013 road routine maintenance budget.First, the area of the road is the amount of road length multiplied by the width of the road in each primary arterial road segment in Makassar City. Second, the average daily traffic (ADT) is to state the volume of two-way traffic that passes through one point on average in one day, usually calculated throughout the year. Third, the amount of the routine road maintenance budget in 2013 was the total amount of the maintenance budget that was released in 2013.

Data Analysis Method

In this study, data analysis was performed using analysis regression. They are Simple Regression Equations, Equations of Multiple Linear Regression.

III. RESULT AND DISCUSSION

There are several factors that influence the amount of routine road maintenance financing. In this study the relevant factors used are the maintenance budget in 2013 as variable Y, data of road length and data of road width multiplied to the area of the road as a variable X1, and ADT data path as variable X2 as seen in Table 1. The data will be used in regression analysis. Regression analysis is calculated using an excel program to get the equation model $\hat{Y}$.

Table. 1 Length, Width, Width and LHR of Primary Arterial Roads

No	Road Name	Road Length (m)	Road Width (m)	Road Area(m^2)	average daily traffic (ADT)
1.	Jl. PerintisKemerdekaan	12510	24	300240	19.095
2.	Jl. UripSumoharjo	4943	20	98860	6.379
3.	Jl. G. Bawakareng	1110	18	19980	181.212
4.	Jl. Masjid Raya	1224	16	19584	122.533
5.	Jl. Bulusaraung	675	14	9450	102.492
6.	Jl. Ahmad Yani	700	18	12600	143.458
7.	Jl. Riburane	230	24	5520	84.094
8.	Jl. Nusantara	1942	20	38840	45.543
9.	Jl. Veteran Utara	2074	24	49776	16.441
10.	Jl. Veteran Selatan	2158	24	51792	11.031
11.	Jl. Sultan Alauddin	3702	20	74040	8.529
12	Jl. A. P. Pettarani	4370	34	148580	9.702
	Total	35638	232	829262	731.414

Based on the results of multiple regression analysis presented in Table 2, Table 3, Table 4 between pairs of road wide variable data (X1), road LHR variable (X2) with 2013 maintenance budget variable (Y) obtained regression coefficient value b = 3402.964, coefficient c = 304334.914 and intercept or constant value of 2434630.836. The pattern of the relationship between the length of the road with the routine maintenance budget for 2013 can be described in the regression equation, namely $\hat{Y} = -2434630.836 + 3402.964 X_1 + 304334.914 X_2$.

To find out whether the regression equation model can be used to draw conclusions or whether the regression equation is significant or not, it can be tested using analysis of variance (F-test).The calculation results obtained Fcount value of 14.36202754 while Ftable (0.05) (2: 9) is 4.256. It turns out that the calculation results show that Fhit = 14.36202754>Ftab = 4.256 which means that it is statistically very significant.

Multiple regression equations $\hat{Y} = 2434630.836 + 3402.964 X_1 + 304334.914 X_2$ has the meaning: if the area of the road (X1) = 0 and daily traffic / LHR road (X2) = 0, the amount of routine maintenance budget for the following year is reduced by Rp. 2,434,630,836, and each road increase of 1 m2 will increase routine maintenance budget for the following year. In the amount of Rp. 3,402,964, and every increase in road LHR of 1 pcu / day will increase the routine maintenance budget for the following year of Rp. 304,334,914.The influence between the width of the road and the ADT of the road to the maintenance budget for the next year can also be seen from the probability value (P-Value). Based on the results of data analysis, the significant value of F is 0.001582372 smaller than 0.05 or 5%.

This proves that the wide road variable and road LHR affect the magnitude of the routine maintenance budget for the following year. Other analysis can be seen from Adjusted R Square of0.708408866. This means that 70.84% of the variation in the size of the routine maintenance budget for the following year can be explained by variations in road width and road LHR, while the rest (100% - 70.84%) or 29.16% are explained by other variables that were not observed in this study.

The results of the analysis show that there is a fairly high correlation between the width of the road and the LHR of the road to the amount of the routine maintenance budget for the following year. Thus, it can be obtained a picture that the road is getting wider and road LHR, the larger the routine maintenance budget needed on the road, so that the equation model above can be used.

Table. 2 Regression analysis using the Area Factor and Road ADT

Regression Statistics	
Multiple R	0.872596949
R Square	0.761425436
Adjusted R Square	0.708408866
Standard Error	171186718.4
Observations	12

Table. 3 ANNOVA Results 1

	df	SS	MS	F	Significance F
Regression	2	8.41755E+17	4.20878E+17	14.36202754	0.001582372
Residual	9	2.63744E+17	2.93049E+16		
Total	11	1.1055E+18			

Table. 4 ANNOVA Results 2

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95.0%	Lower 95%	Upper 95.0%
Intercept	-2434630.836	110553822.4	-0.022022132	0.982910823	-252524751.6	247655489.9	-252524751.6	247655489.9
Road Area (m^2)	3402.964086	729.5125477	4.664709465	0.00117736	1752.692055	5053.236118	1752.692055	5053.236118
ADT	304334.914	992233.4764	0.306717039	0.76603635	-1940253.147	2548922.975	-1940253.147	2548922.975

The amount of the budget difference between the 2013 routine maintenance budget made by PPK 21 Makassar City and the budget based on the estimation model resulting from the regression analysis can be stated in table 5.

Table. 5 Budget Difference Estimation

No	Road Name	Budget 2013 from PPK 21 Kota Makassar	Budget based on the Estimation Model	Difference
1.	Jl. PerintisKemerdekaan	Rp 1,188,494,909.62	Rp 1,025,082,581.65	Rp 163,412,327.97
2.	Jl. UripSumoharjo	Rp 254,578,641.24	Rp 335,923,751.16	Rp 81,345,109.92
3.	Jl. G. Bawakareng	Rp 148,493,129.85	Rp 120,705,730.04	Rp 27,787,399.81
4.	Jl. Masjid Raya	Rp 114,995,579.84	Rp 101,500,087.84	Rp 13,495,492.00
5.	Jl. Bulusaraung	Rp 40,793,763.84	Rp 60,915,273.78	Rp 20,121,509.94
6.	Jl. Ahmad Yani	Rp 41,993,974.84	Rp 84,101,994.74	Rp 42,108,019.90
7.	Jl. Riburane	Rp 13,797,328.48	Rp 41,942,471.18	Rp 28,145,142.70
8.	Jl. Nusantara	Rp 154,957,849.47	Rp 143,596,819.27	Rp 11,361,030.20
9.	Jl. Veteran Utara	Rp 320,425,154.47	Rp 171,954,879.85	Rp 148,470,274.62
10.	Jl. Veteran Selatan	Rp 320,438,702.47	Rp 177,168,803.56	Rp 143,269,898.91
11.	Jl. Sultan Alauddin	Rp 336,393,982.06	Rp 252,116,502.60	Rp 84,277,479.46
12	Jl. A. P. Pettarani	Rp 85,776,309.94	Rp 506,130,430.46	Rp 420,354,120.52

IV. CONCLUSION

Based on the results of data analysis obtained in this study, it can be concluded as follows.

1. Model of the amount of routine maintenance financing based on relevant factors resulting from this regression analysis, namely: $\hat{Y} = -2434630.836 + 3402.964\ X_1 + 304334.914\ X_2$

2. Regression analysis carried out using road and ADT broad variables of the road to the 2013 routine road maintenance budget to predict the amount of routine maintenance budget for the coming year.

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