ANALYSIS OF PERFORMANCE AND CONNECTION COSTS ON THE NGEMPLAK SIMONGAN ROAD SECTION

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Abstract. Traffic congestion is caused by an imbalance between the increase in vehicle ownership and the growth of available road infrastructure and the effective capacity of existing road sections is smaller than the planned road capacity due to roadside obstacles.The phenomenon of traffic jams is an interesting thing to study, as is the traffic jam caused by the influence of factory activities on Jalan Ngemplak Simongan. This can result in obstruction of traffic flow and reduced levels of road service so that road users who only pass through this place receive negative impacts in the form of longer travel times which ultimately lead to external costs in the form of additional vehicle operational costs (BOK).

Key words: factors causing congestion, road performance, congestion costs

1. Introduction

Traffic jams are something that cannot be solved partially. In short, the root of the transportation problem is a mistake in prioritization in planning and not following up with the development of existing transportation facilities and infrastructure. Starting from the root of the transportation problem, a possible solution is to prioritize the planning of public transportation infrastructure and facilities, which are the main factors that shape a city's progress. **[1]**

Lack of awareness and discipline of drivers, passengers and the surrounding community is also one of the causes of current traffic problems. For example, drivers who pick up and drop off passengers haphazardly, passengers who stop buses haphazardly and traders who sell on the road are contributors to traffic problems. **[2]**

Traffic congestion is caused by an imbalance between the increase in vehicle ownership and the growth of available road infrastructure and the effective capacity of existing road

sections is smaller than the planned road capacity due to roadside obstacles. Obstacles on the side of the road are often related to social and economic activities, namely parking on the road because there are shops that do not provide parking spaces, public transport facilities that drop off passengers at any place and people passing by to cross which causes road capacity to suffer. decline. **[3]**

The phenomenon of traffic jams is an interesting thing to study, as is the traffic jam caused by the influence of factory activities on Jalan Ngemplak Simongan. This can result in obstruction of traffic flow and reduced levels of road service so that road users who only pass through this place receive negative impacts in the form of longer travel times which ultimately lead to external costs in the form of additional vehicle operational costs (BOK).**[4]**

The city of Semarang is also experiencing the above problems, especially the increasing distribution of congestion nodes both in the city center and on the outskirts of the city, one of which is Jalan Simongan. Traffic jams on Simongan Road are caused by the presence of many factories. Therefore, researchers are interested in conducting further research on the influence of factory activities on traffic performance on the Simongan road section. **[5]**

2. Method

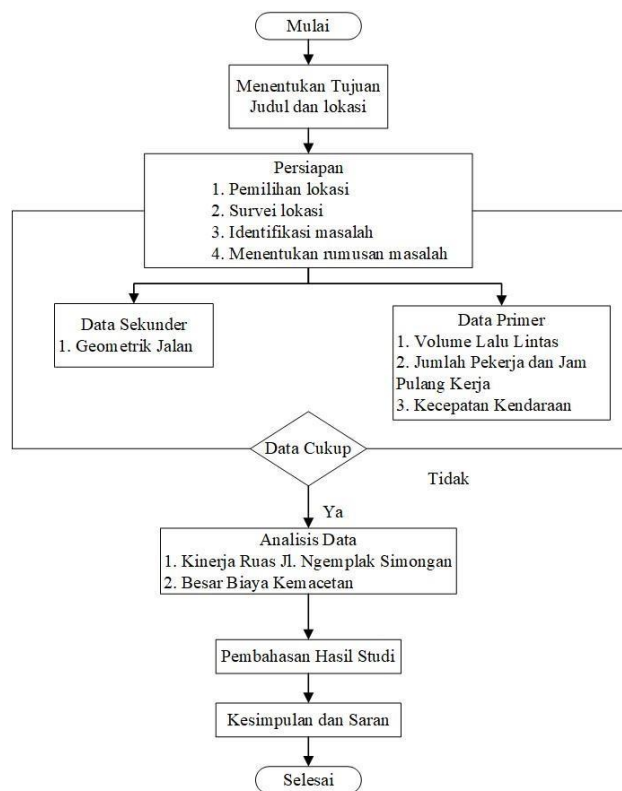In general, this research is carried out through several stages such as:

Figure 2.1 research flow chart
Source: researcher, 2023

The research location was carried out along the Ngemplak Simongan road for 400 meters. In this research, primary data and secondary data were used, data collection was obtained from literature studies and direct surveys.

a. Primary data collection
   Primary data is data obtained directly from field surveys, this data is in the form of traffic volume survey data and factory data.
b. Secondary data collection

Secondary data is data or information obtained in a structured or structured format, inthe form of publications or brochures through other parties (institutions or agencies). Secondary data can be in the form of environmental conditions in the form of road segment characteristics.

3. Results and Discussion

The units calculated for calculating vehicle operating costs are:

1) Economic Price of Vehicles Representative of Study Area (In Rupiah)

Vehicle type	Brand and model	Price	Price (Without Tires)
Sedan	Toyota Camry VA/T	238,700,000	238,204,000
Utilities	Mitsubishi Colt T120ss Pick-Up Flat Deck 1.5L MPI M/T	142,200,000	110,500,000
Small Bus	Mitsubishi FE 71	510,300,000	256,420,000
	Mini bus		(Without Tires)
Big Bus	Isuzu ELF NHR 55 BLX	570,000,000	261,600,000
Light Truck	Toyota 110 ST 4X2 M/T	308,000,000	278,450,000
Medium Truck	Isuzu Elf NLR 55 T	271,700,000	266,300,000
Heavy Truck	Mitsubishi Fuso FN 527 M	1,012,000,000	1,006,545,600

2) Fuel Cost Calculation

Cost	Gasoline (liter)	Diesel (liter)
Economic Price	10,000	6,800

3) Calculation of Economic Costs of Lubricating Materials

Vehicle type	Lubricant brand	Price (Rp./liter)
Sedan	CASTROL ENGINE OIL Magnatec 10 W/40 1 liter	55,000
Utilities	Mesran SAE 40 1 L SE	30,500
Small Bus	Mesran B30/B40	30,500
Big Bus	Mesran B30/B40	30,500
Light Truck	Mesran B30/B40	30,500
Medium Truck	Mesran B30/B40	30,500
Heavy Truck	Mesran B30/B40	30,500

4) Calculation of the Economic Price of Representative Vehicle Tires (In Rupiah)

Vehicle type	Vehicle brand	Tire Size	Price (Rp)

Sedan	Toyota Camry V A/T Lux	185/55 R15	780,000
Utilities	Mitsubishi Colt T120ss Flat Deck Pick-Ups 1.5L MPI M/T	175/70 R13	380,000
Small Bus	Mitsubishi FE 71 Minibus	750-16-14 PR	692,000
Big Bus	Isuzu ELF NHR 55 Microbus E2	900-16-14-PR	175,500 0
Light Truck	Toyota 110 ST 4X2 M/T	700-16-14-PR	1,200,00 0
Medium Truck	Isuzu Elf NLR 55T	750-16-14-PR	1,350,00 0
Heavy Truck	Mitsubishi Fuso FN 527 AD	1000-20-16-PR	1,363,60 0

Source of Researcher Analysis

The analysis used in this research is external cost analysis. To see the analysis indetail, it can be seen as follows:

1. External Cost Analysis

   External costs is an additional transportation cost borne by other road users who are not directly involved with on street parking activities around Jalan Simongan. The additional transportation costs are the difference from existing transportation costs (road sections with on-street parking) and the transportation costs reviewed are Vehicle Operating Costs (BOK) using the equations from the HDM-VOC model.

2. Vehicle Speed Data

   From the survey results along Simongan Road, there are certain points that become congested, especially during peak hours. The point of congestion.

   The traffic jams that occur along Simongan Road are certainly very detrimental to road users. Road users who use this road must reduce their speed from the normal limit or even stop occasionally (haltingly) to wait for vehicle congestion to occur. This will of course increase the normal travel time to get to the location of the activity. Apart from that, with traffic jams, road users experience losses in vehicle operational costs. As the travel time increases, the

vehicle operational costs that will be incurred to complete a journey will also increase.

The increase in vehicle operational costs caused by increased travel time is a very detrimental waste. From the results of a survey conducted on the problem of traffic jams on Jalan Simongan. The most visible indicator is a decrease in speed.

The speed of a vehicle passing through a road section depends on the length of the track and the duration of the journey. The greater the congestion encountered, the longer the travel time will naturally be, resulting in lower speeds on that road section. Speed is defined as the change in distance divided by a unit of time. Delay is time lost due to reduced speed from normal limits due to obstacles that disrupt traffic flow.

The following is an analysis of vehicle speed passing through Jalan Simongan with an analysis of travel speed.

Table 4.12 Average Speed on Wednesday

North direction	
Time	Speed
10.00 – 11.00	40.32
16.00 – 17.00	5.24
Direction: South	
Time	Speed
10.00 – 11.00	40.32
16.00 – 17.00	5.24

Source: Analysis, 2023

FromThe results of the speed analysis above show that there are twodifferences in speed, namely maximum speed and minimum speed.

3. Calculation of Additional BOK

As explained in the research methodology, the calculation of additional vehicle operating costs (BOK) that occurs due to a decrease in speed in this study usesthe HDM-VOC model.

The calculation of additional vehicle operational costs as congestion costs is divided into 3 groups, namely calculation of vehicle operational costs (BOK) with ideal speed conditions, BOK at Existing Speed and Calculation of BOK Difference (BOK Every hour). The detailed steps for calculating congestion costs are explained in the following sub-chapter:

a.   Looking for Fuel Consumption Costs

$$KBBM = (\alpha+\beta1/VR+\beta2xVR2+\beta3xRR+\beta4xFR+\beta5xFR2+\beta6xDTR+\beta7xA+\beta8xSA$$
$$+\beta9xBK+\beta10xBKxAR+\beta11xBKxSA)/1000$$
$$= 81.12/1000$$
$$= 0.08114 \text{ liters/km}$$
$$= 0.08114 \text{ x fuel price}$$
$$= 0.08114 \text{ x Rp. } 10,000.00$$
$$= \text{Rp. } 811.4 \text{ /km x } 0.4 \text{ km}$$
$$= \text{Rp. } 324.56 \text{ /0.4 km}$$

b.   Looking for Oil Consumption Costs

The calculation takes 1 (one) sample for the Sedan vehicle type. It can be seen in table 2.7. Typical recommended values of JPOi, KPOi and OHOi.

$$\text{Koi} \quad = OHKi + OHOi \text{ x KBBMi}$$
$$= 0.00175 + (0.0000021 \text{ x } 324.56)$$
$$= 0.002431576 \text{ liters/km}$$
$$= 0.002431576 \text{ liter/km x oil price}$$
$$= 0.002431576 \text{ liter/km x Rp. } 55,000.00$$
$$= \text{Rp. } 133.73 \text{ /km x } 0.4 \text{ km}$$
$$= \text{Rp. } 53.49 \text{ /0.4 km}$$

c.   Looking for Parts Costs

The calculation took 1 (one) sample of the Sedan vehicle type. It can beseen in table 2.8. Obtained:

$$\text{Bpi} \quad = Pi \text{ x HKBi/1,000,000}$$
$$= (0.534284212 \text{ x Rp. } 682,550,000)/1000000$$
$$= \text{Rp. } 364.68 \text{ /km}$$
$$= \text{Rp. } 364.68 \text{ /km x } 0.4 \text{ km}$$
$$= \text{Rp. } 145,872 \text{ /0.4 km}$$

d.   Looking for Maintenance Personnel Wage Costs (BUi)

The calculation took 1 (one) sample of the Sedan vehicle type. It can beseen in table 2.9.

$$\text{Jail} \quad = JPi \text{ x UTP/1000}$$
$$= (54.74835884 \text{ x } 15000)/1000$$
$$= (54.74835884 \text{ x } 15000)/1000$$
$$= \text{Rp. } 821.23$$

e.   Looking for Tire Consumption Costs

The calculation took 1 (one) sample of the Sedan vehicle type. It can beseen in table 2.12

$$\text{BBi} \quad = KBi \text{ x HBj/1000}$$
$$= (0.07463 \text{ x Rp. } 585,000)/1000$$
$$= \text{Rp. } 43.66$$

Table 4.13 Types of Vehicles for Calculating Ideal Speed BOK

Transportation type	BOOK (Rp/km)
sedan	1361.2
utilities	1360.7
small bus	1367.4

light truck	1365.3
TOTAL	5454.6

Source: Analysis Data, 2023

So the total vehicle operational costs experienced by private vehicle users traveling at a speed of 60 km/hour on the Nemplak Simongan road are IDR. 1,388,812 /0.4 km per vehicle.

You can see the table of vehicle operational costs at existing speeds as follows

Table 4.14 Types of Vehicles for Calculating Existing Speed BOK

	North direction				
O'clock	Sedan (Rp/km)	Utilities (Rp/km)	small bus (Rp/km)	light truck (Rp/km)	Total (Rp/km)
10.00 - 11.00	1398.4	1387.2	1487.8	1477.8	5,751.2
16.00 - 17.00	2190.5	2188.7	2198.3	2199.8	8,777.3
	Direction: south				
O'clock	Sedan (Rp/km)	Utilities (Rp/km)	small bus (Rp/km)	light truck (Rp/km)	Total (Rp/km)
10.00 - 11.00	1396.6	1389.9	1498.2	1482.6	5,767.3
16.00 - 17.00	2194.4	2189.1	2219.9	2227.8	8,831.2

Source : Analysis Data, 2023

From the analysis of the table above, it can be seen that the total BOK at the existing speed in the north direction at 10.00-11.00 is IDR. 5,751.2 and at 16.00-17.00 Rp. 8,777.3. Meanwhile, the total for the South direction at 10.00-11.00 is IDR. 5,767.3 and at 16.00- 17.00 Rp. 8,831.2.

Table 4.15 Difference in Hourly Congestion Costs at Peak Hours

O'clock	Speed (km/h)	Vehicle operating costs (Rp/km)	Speed (km/h)	Vehicle operatingcosts (Rp/km)	Congestion Charges (Rp/km)
10.00 – 11.00	40.32	5,767.3	60	5454.6	313
16.00 – 17.00	5.24	8,831.2	60	5454.6	3,376.4

Source : analysis data, 2023

Based on the analysis of congestion costs above, it can be seen that the loss due to congestion per day is IDR. 1.844,7/0,4 ⇒ Rp.4.611,75/km per private vehicle.

4. Conclusion

The addition of vehicle operational costs from the total additional BOK which consists of fuel consumption costs, oil consumption costs, spare parts costs, maintenance personnel wages costs and tire consumption costs is IDR. 1.844,7/0,4 ⇒ Rp.4.611,75/km which must be borne by motorists affected by traffic jams.

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