

## Analysis on The Disadvantages of Road Users Due to Traffic Jam in Medan

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**Abstract:** Traffic jam in Medan harms road users economically in wasting fuel and time. Traffic jam is caused a lot of vehicles which are imbalanced with the addition of stretches of road and in the improvement of transportation management system, either its facility or its public utility. The research was done in Medan, North Sumatera, from May until July by analyzing the disadvantage of road users due to traffic jam in Medan, using a survey method. The research was focused on class I vehicles which got stuck in the seven main stretches of road: Jalan Putri Hijau, Jalan Gatot Subroto, Jalan Jamin Ginting, Jalan Setia Budi, Jalan Brigjend Katamso, Jalan Sisingamangaraja, and Jalan Yos Sudarso. The result of the survey was processed by using BOK (vehicle operational cost, pacific consultant international (PCI). The result of the research showed that the motorcycle fuel wasting due to traffic jam per day was 0.189 liters/1,000 km/vehicle, while the amount of automobile fuel wasting was 0.95677 liters/km/vehicle. The loss of time caused by traffic jam in motorcycles due to traffic jam was 35.6 minutes per day while in automobile was 48.5 minutes per day.

**Keywords:** Disadvantage, Traffic Jam, Fuel Wasting

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### I. Introduction

Cities in Indonesia continue to experience growth along with increased economic growth from various sector lines, one of which is Industry. The development of the industrial sector also encouraged the development and growth of other sectors such as transportation. The impact of economic growth has led to increased human mobility in order to maximize productivity. Increasing mobility of people to travel requires adequate facilities and facilities. Based on data from the North Sumatra Central Statistics Agency, the total population of the city of Medan in 2015 was 2.2 million with an area of 265.0 km<sup>2</sup> with a population density of 8,342 people/km<sup>2</sup>. This condition certainly requires adequate facilities to accommodate all activities properly. Along with the increasing population growth coupled with the welfare of the community will also have an impact on the growth of motorized vehicles which are increasing every year, both motorcycle vehicles, passenger cars, trucks and buses and others.

In big cities both in developed and developing countries experiencing the same problems including Medan experiencing the same problem which is also the flood of motor vehicles. Some things that cause congestion in developing country cities according to Alan Black (1995) are:

a)First is urbanization, the migration of people from an area to urban areas increases community mobility, making traffic more congested resulting in urban congestion.

b)Second is the division of urban areas. According to him the community has different needs and activity goals, each spread around the urban areas. With the division of the concentration of each other far apart such as; workplaces and schools in one place, a place to stay in another place, vacation activities in a different place, by itself will create an increase in the duration of the trip.

c)Third is to combine demand and supply. Urban communities with diverse travel needs and destinations make it difficult for governments to find solutions to make travel more effective and efficient, including in providing adequate transportation.

d)Fourth is supply creates demand. Very often the development of transportation is carried out based on the wishes of the government or other parties who are not service users. This has led to policies that have been carried out by the government that have not been effective or even have no use at all (or just spent the budget).

Losses experienced by road users by congestion can be in the form of material such as, as more fuel is spent; and non-material such as, the more time needed to travel to cause stress, and others. There are at least 3 impacts of loss due to traffic (Warpani, 2017):

a) Congestion; resulting in a waste of time and money, waste of fuel, vehicle wear, mental tension. Avoiding long lines of vehicles at various intersections which often results in road users crashing into traffic signs making traffic congestion worse and seem chaotic.

b) Insurance; Includes accident insurance (death, disability, injuries), material (damage to vehicles and other materials), loss of work, other traffic disorders.

c) Environment; regarding the cost of environmental improvement, disaster prevention due to the construction of transportation infrastructure, compensation for 'destruction' of the environment and others.

The traffic congestion in the city of Medan is getting worse as if it were a scene every day and the highway became an arena for a race of speed between fellow road users. Nationally, the period of 2011-2015 the growth rate of the number of motor vehicles was high, amounting to 9.13%. The increase in the number of motorized vehicles was quite high at 9.48% per year, followed by passenger vehicles, goods and buses respectively at 9.0 percent, 7.45 percent and 1.80 percent per year.

Motorcycle is the type of vehicle most widely used by the public. This can be seen from the proportion of motorbikes that is much greater compared to other types of vehicles that is 86%, then passenger cars only by 8%, trucks/goods and bus cars respectively 5% and 1%. Based on the composition of motorized vehicles, motorcycles dominate vehicles in the city of Medan. Motorcycle vehicles are the choice for the community to carry out daily mobility which is considered quite effective and efficient. This is due to the characteristics of these types of vehicles, namely smaller capacity, easier, more efficient in terms of time and cost.

**Table 1. Number of Motorized Vehicles in Medan City in 2005-2017**

Year	Passenger Car	Bus Car	Truck Car	Motorcycle	Total
2005	226.043	28.160	116.221	1.864.980	2.285.404
2006	240.066	28.616	172.999	2.113.772	2.555.453
2007	257.729	29.228	180.384	2.429.571	2.896.912
2008	279.996	29.507	189.857	2.805.368	3.304.728
2009	297.922	29.978	194.946	3.091.510	3.613.876
2010	327.467	29.978	203.452	3.478.230	4.039.127
2011	356.931	71.112	217.254	3.924.007	4.569.304
2012	386.144	71.590	231.750	4.292.933	4.982.417
2013	416.405	71.900	242.445	4.584.431	5.315.181
2014	441.191	71.087	249.919	4.795.755	5.558.952
2015	470.280	72.317	258.060	5.022.752	5.824.720
2016	482.445	72.551	360.221	5.223.521	6.022.678
2017	488.091	72.990	366.887	5.749.912	6.298.676

Source: BPS North Sumatra Processed

## II. Literature Review

### 2.1 Transportation

Transportation has an important role as a means of community mobility to and from a certain place to support the needs of social interaction. To be able to maximize the mobility of the people, adequate, safe, comfortable, efficient and more affordable transportation is needed. This is a basic requirement for an urban society. Failure to properly build the mode of transportation will affect the mobility of people's lives such as the higher cost and more time wasted.

The definition of transportation comes from the Latin word *transportare*, where *trans* means opposite or next to *portare*, which means carrying or carrying, in English transportation means transportation to move from

one place to another. Transportation means transporting or carrying something to the other side or from one place to another. In other words, transportation is an activity to transport or move or carry an item / service from one place to another. It can be stressed that transportation is a service used as a tool to obtain economic benefits in various fields of business activities and social relations (Kamaluddin, 2003).

## **2.2 Congestion**

Congestion is an indication that vehicles passing on the road are approaching or exceeding road infrastructure capacity. This condition causes the speed of traffic to slow down so that the overall ability of the crossing is reduced. This means that the congestion that occurs in the city because the traffic volume has exceeded the capacity of the design of the road section so that the vehicle speed is lower than the speed of the design of the relevant road network (Warpani, 2017).

If the flow of traffic approaches the road capacity, congestion starts. Congestion increases when the flow of road users increases beyond the capacity of the road so that there is a buildup of vehicles at several points (parts) in large numbers so that vehicles cannot move freely and even stop. Total congestion occurs when a vehicle must stop or not move at all (Tamin, 2000).

## **2.3 Traffic Congestion**

Traffic Congestion can be interpreted as the road user exceeds the capacity of the road, causing a buildup of vehicles in large numbers. With the excess capacity of road users makes the vehicle speed slows down and even stops. Congestion causes increased costs for travel and goods movements, wasted time, accidents, and psychological tension (Black, 1995).

Meanwhile, according to Morlok in (Parlaungan, 2005), the causes of traffic congestion are not only factors of individual road user behavior, but are due to several reasons namely:

- a) The flow of vehicles passing through the road has exceeded the road capacity.
- b) There is road improvement.
- c) Part of a certain road landslide.
- d) Flooding occurs so as to slow down the speed of the vehicle.
- e) Behavior of road users who do not obey traffic.
- f) There was a traffic accident resulting in a smooth disruption.
- g) Technical errors from traffic signs.

## **2.4 The Social Economic Role of Transportation**

The economy is essentially connected to the production, distribution and consumption of humans. This is also the same as the role of transportation for the economy. The economic roles in transportation include (Morlok in Pangaribuan);

- a) Transportation enlarges the reach of the resources needed by an area, so that an area can make it possible, getting cheaper resources, which previously did not exist into existence with access to transportation.
- b) The use of resources is more efficient because there is good specialization and division of labor.
- c) The existence of transportation makes the distribution of goods needed properly distributed and to its destination.

## **2.5 Economic Environmental Impact Assessment**

Assessment of environmental impacts on damage or loss involves an assessment of the analysis of costs and benefits to natural resources. This not only depends on the market value of goods produced from resources but also other costs incurred by these resources (Fauzi, 2004).

The impact of an activity can be direct or indirect. Intended direct impact is the impact caused by the main objective of the activity or policy directly, both in the form of costs and benefits. The impact can be in the form of damage to natural resources or environmental degradation which reduces the pace of economic development. With the occurrence of environmental damage will reduce the level of productivity of natural resources resulting in various social problems and economic development which will then be felt by the community at a far higher cost (Fauzi, 2004).

# **III. Research Methods**

## **3.1 Research Location and Time**

The city of Medan became a research location chosen consciously considering several reasons, namely, (1) Medan became one of the major cities in Indonesia which had problems with congestion levels that were quite severe as other metropolitan cities, (2) Medan City had a fairly dense population which can represent the real face of Indonesian cities, (3) Researchers residing in the city of Medan are expected to support research activities to take place until completion.

The time of the study was carried out in 4 months, with estimates from May to June primary data collection through questionnaires, and in July to August data processing as well as preparation to completion.

### **3.2 Types and Sources of Research Data**

This research uses primary and secondary data. Primary data were obtained by giving questionnaires to road users of the study sites that have been determined. The secondary data obtained through reliable data publication sources such as the Medan City Government, the Central Statistics Agency (Provincial and Municipal), official reports of the relevant state institutions, and the mass media that can be justified. The secondary data used in the form of transportation statistics in the city of Medan, population and settlement statistics, vehicle growth, official statistical reports related to topics such as the Medan City budget budget report in the form of transportation sector budget allocations and suggestions as well as pre-suggestions as a comparison of primary data in analyzing the role of the government in improving the quality of transportation in the city of Medan.

### **3.3 Research Population**

Population is a generalization area consisting of objects / subjects that have certain qualities and characteristics determined by researchers to be studied and then drawn conclusions (Sugiyono, 2014). The population of this study is the public transportation service users, both private and public transportation, taking into account the distribution of residential areas such as.

The location of the research sample is the road users who pass the intersection area of Jalan Jamin Ginting Simpang USU Campus (Medan Baru) as many as 30 respondents, Jalan SM Raja as many as 30 respondents, Jalan Brigjen Katamso as many as 30 respondents, Jalan Prof. HM. Yamin as many as 30 respondents, the intersection of Jalan Gatot Subroto as many as 30 respondents, Jalan Setia Budi as many as 30 respondents, and Jalan Putri Hijau (Medan Kota) as many as 35 respondents so that the total respondents were 215 people.

### **3.4 Data Processing and Analysis Methods**

The data and information obtained will be analyzed quantitatively and descriptively. Descriptive method is used to see the social impact of traffic congestion through questionnaires, while the quantitative method uses the middle value formula. The data analysis tool uses the Pacific International Consultant (PCI) to calculate the expenditure of vehicle fuel spent during the trip. The use of PCI analysis tools takes into account the study of this research on waste of fuel due to congestion by considering aspects of time duration, number of vehicle engine siliner, including fuel.

## **IV. Research Results and Discussion**

### **4.1 Volume and Origin of Motorized Vehicles**

The volume of motorized vehicles in the city of Medan tends to increase every time along with the growth of vehicles which has increased every year. The number of vehicles in the community based on data from the police as many as 2,412,551 units consisting of 534,799 units of private car vehicles 205,401 units of freight vehicles and trucks totaling 50,115 units, motorcycles totaling 1,623,236 units

From the types of vehicles above, it can be concluded that motorcycles dominate vehicles that are widely used by the public in their activities. Then followed by private cars and then public transportation. In addition to existing vehicles originating from Medan, not a few of them also actually come from areas around Medan who come to Medan to work or just for recreation/vacation. This was proven that as many as + 40 respondents had to travel a considerable distance of 10 km or more each day, and some of them came to Medan to work in various private companies and as drivers of public and online transportation. Many opportunities and opportunities to work in urban areas make them willing to travel tens of kilometers and even spend hours on a trip to get to their destination. This condition certainly contributes to the volume of vehicles that are beyond estimates which adds to the burden of limited traffic. Of course it is very interesting to be further investigated for the impact and contribution of the volume of vehicles coming from outside and entering Medan every day.

Based on data obtained through a questionnaire survey, the percentage of movement of citizens in traveling from the area of origin is quite diverse. The distance between 0 - 5 km<sup>2</sup> is 64 respondents or 30%, while the distance between 6-10 km<sup>2</sup> with the most number is 86 or 40%. Furthermore, the distance is 10-20 km<sup>2</sup> with 57 respondents or 26%, the last mileage +20 Km<sup>2</sup> is 8 people or 4%. From these results it can be estimated by several other possibilities, that 70% of residents who work/move in the city of Medan live or come from suburbs or even outside the city of Medan. They have to take quite a long journey that is a journey that reaches 6-20 Km in one trip so that the traffic space needs longer. This shows the poor planning of the Medan City spatial plan in preparing population migration by providing housing and access to housing that is more affordable and efficient in terms of travel and distance.

#### **4.2 Traffic Infrastructure**

The quality of transportation infrastructure in the city of Medan can not be said to be good, from the range of public roads, public transportation and from the physical quality. This is worsened by the absence of adequate terminals or stations and available in sufficient numbers. This condition is a complaint for some traffic drivers, both transportation drivers and even drivers who force public/city transportation to increase passengers arbitrarily.

The unavailability of other public facilities in serving the public in the form of adequate and comfortable public transportation, forcing people to use private transportation both cars and motorbikes in their activities. Most respondents who worked were met in the field claiming to be willing to switch from private transportation to public transportation if public transportation was available that was always available, convenient, and affordable.

To improve the public transportation service system, the government continues to improve both through the procurement and improvement of facilities and infrastructure in various places with budgeting through the Regional Budget. Central and local governments continue to collaborate to increase the need for more viable mass transportation by providing inter-regional bus fleets. The bus transportation serves from the area of Kota Binjai - Meda - Deli Serdang, commonly called Damri Mebidang. This transportation is expected to be able to break down into an alternative for people to want to move from private vehicles to public transportation. However, the observation of the transportation operational researchers has not really been able to change the way the habits of the people who are already comfortable using private vehicles. Most respondents acknowledged that the transportation was not yet effective as an alternative because of limited travel routes and the small availability of the fleet, and the bus also experienced the same traffic jams so that it was often too late to enter offices or schools.

The length of roads in Medan City has increased from year to year, both in terms of the addition of roads and road improvements through widening of the roads. However, these efforts have not been able to significantly reduce congestion. The total number of roads based on the Medan City Statistics Agency in 2015 amounted to 3,191.5 km<sup>2</sup> consisting of details of the length of roads based on the authority of the Medan City Government for 3,017.4 km<sup>2</sup>, the Provincial Government authority for 33.4 km<sup>2</sup>, and the Central Government authority for 140, 7 km<sup>2</sup>. Increasing the Government's budget in an effort to improve public services through traffic advice is also always increasing every year. In 2018 the Medan City Government budgeted Rp.1.7 trillion for infrastructure expenditure activities, the PUPR Dinas budget provided for building roads and drainage is only Rp.546.5 billion while the remaining budget is for the Sanitation and Landscape Service. The budget increased from 2015 in which the Medan City Government provided infrastructure spending of 1.19 trillion rupiah to the PUPR Office and the Sanitation and Parks Office which was passed through the Medan City Regulation No.8 in 2015 on the 2016 Budget.

#### **4.3 Calculation of Fuel Losses Due to Congestion**

The consumption of fuel oil (BBM) for each vehicle due to being hit by traffic must have increased. The increase in consumption depends on the duration of road users experiencing congestion, meaning that the longer the vehicle is experiencing congestion in both stopping and slow running situations will increase fuel consumption. But the increase in fuel consumption is not only caused by the duration of the vehicle affected by traffic jams, fuel consumption is also affected by the amount of engine cylinder capacity or cc of the vehicle. The greater the number of cc of the vehicle engine, the greater the fuel consumption as well, and vice versa the smaller the vehicle, the more efficient fuel consumption.

The efficiency of fuel consumption is also influenced by geographical conditions, meaning that fuel consumption is more efficient in areas of flat and straight road traffic compared to climbing areas using the same vehicle. Efficient fuel consumption is also influenced by topographical form and road conditions. The shape of the road in urban areas is very different from non-urban areas. Public roads in urban areas that tend to be crowded with vehicles, and full of traffic signs, have many intersections that force vehicles to not reach the optimal or normal speed limit require more wasteful fuel consumption compared to when the vehicle is running at normal and stable speed such as in urban areas that have minimal obstacles that slow down vehicles so that fuel consumption is more efficient. In addition, the increase in fuel consumption is also caused by vehicle loads and road conditions, meaning that the higher the vehicle load will increase fuel consumption, as well as the damaged road conditions, not only slowing down the vehicle's rate but increasing vehicle consumption.

Based on the calculation of the operational costs of the vehicle (BOK) the amount of fuel expenditures for a Motorcycle vehicle when it is at a speed of 10 km/hour that is equal to Rp.1,083/km/hour, whereas with a high speed rate of 120 km/hour generates fuel expenditure of Rp.1740 km/hour. While fuel consumption expenditure of Rp.565 km/hour in speeds reaching 50 km/hour. Based on the results of the research questionnaire the average speed of the vehicle reached 21 km/hour with fuel consumption reaching Rp.855/km/hour.

While the cost of fuel consumption of the lowest type of vehicle is in the speed of 50 km/hour with the amount of consumption Rp.565/km/hour, while the highest consumption with a speed of 120 km/hour with consumption of Rp.1740. Meanwhile the average speed of a vehicle based on research is 13 km / hour with fuel consumption of Rp.1,014/km/hour.

The analysis used to determine the amount of fuel consumption is by using the international accounting consultant (PCI) calculation model. The indicator used by this equation model is the effect of speed and travel time on the fuel consumption used by vehicles with the hypothesis that if there is a congestion of fuel consumption will increase.

The calculation results above can be analyzed that the wasteful consumption of fuel due to congestion experienced by road users of one-way motorcycle vehicles is 0.159 liters/vehicle. If the price of the type of pertalite fuel is estimated when normal is Rp.7,800/liter or the loss of wasteful consumption of fuel reaches 1,240.2 rupiah/vehicle one way, or 2,480.4 rupiah per day commuting.

The average number of motorcycle vehicles that pass through the protocol road at 7 exits leading to Medan during rush hour ie 16.00 - 19.00 is 39 units per minute. The number of vehicles affected by traffic jam at one exit is 7,020 units, if multiplied by 7 entrances, the total number of vehicles trapped in traffic every day is around 49,140 units of motorcycles. So the loss of road users due to waste of fuel in the city of Medan every day that is the number of vehicles times the cost of loss that is,  $49,140 \times \text{Rp. } 2,480.4 = \text{Rp. } 121,886,856$  every day. The value of the loss is quite large if it is accumulated in a year, in 2019 the total workdays are reduced by 243 days off. So from the total loss of waste of gasoline motorcycle types in a year is Rp.29,618,506,008 per year or as much as 29.6 billion rupiah.

The amount of gasoline waste due to congestion of 0.195 liters/1000 km/vehicle, or Rp.1,521 per vehicle in one trip, or Rp.3,042 daily (round trip) assuming the normal price of pertalite is Rp.7,800. -

The average number of vehicle types of cars that pass through the protocol road at 7 exits leading to Medan during rush hour ie 16.00 - 19.00 is 24 units per minute. The number of vehicles affected by traffic jam at one exit is 4,320 units, if multiplied by 7 entrances, the total number of vehicles trapped in traffic every day is around 30,240 cars. So the loss of road users due to waste of fuel in the city of Medan every day that is the number of vehicles times the cost of loss that is,  $30,240 \times \text{Rp. } 3,042 = \text{Rp. } 91,990,080$  every day. The value of the loss is quite large if it is accumulated in a year, in 2019 the total workdays are reduced by 243 days off. So from the total loss of waste of gasoline motorcycle types in a year is Rp.22,353,588,440 per year, or as much as 22.3 billion rupiah per year.

So the total waste of gasoline waste suffered by road users due to congestion in Medan every year is around  $\text{Rp. } 29,618,506,008 + 22,353,588,440, - = 51,972,095,448$  rupiah or as much as Rp.51.9 billion.

#### 4.4 Calculation of Losses of Time Wasted Due to Congestion

The next loss that is no less important is experienced by road users, namely time loss. This type of loss is so easily felt that it can even be estimated sufficiently by calculating the duration of the trip when it is reduced by normal time, so that it can be calculated how much total additional time is needed to reach a certain destination. Even vehicle users find it easier to remember the length of the trip they need each day, including the duration of the traffic jam on the road. This happens because the community almost always even experiences traffic jams at certain hours, so that it can estimate the total time needed when stuck in traffic to the destination.

**Table 2. Results of Calculation of Wasted Time Use**

Information	Motorcycle (171)	Cars (44)
Average Travel Duration Every Day in One Trip	76,1 Minutes	85,0 Minutes
Average Duration When Normal	30,6 Minutes	36,5 Minutes
Time Losses Due to Congestion	35,6 Minutes	48,5 Minutes

**Source: Primary Data Processed**

Based on the results of a survey of quoisiers, the average duration of road users' trips for motorbike riders takes 76.1 minutes or an increase of 116% in one trip. The time is increased from the travel time should be 30.6 minutes. For road users who use private cars and public transportation requires a duration of travel of 85.0 minutes. The duration is much increased during normal traffic which is 36.5 minutes or an increase of 132% of normal time.

If the value of the time is accumulated in a week (5 working days) and every day of travel (going home and going), the motorcyclist spends an additional time of 356 minutes or (5 hours 9 minutes) and driving the car requires an additional 455 minutes or (7 at 58 minutes)

Another impact of loss of time for road users can be lost revenue and potential revenue. Some people who work in the private sector will experience salary deductions if they are late for entering the office. Some who work in the trade sector and other economies have the potential to lose income due to congestion, such as food and service entrepreneurs. Based on the calculation of the loss of motor vehicles the type of car has a loss as well as a potential loss of income for lost time of Rp. 48.5 minutes every day. If the value is multiplied by the UMK Medan amount of Rp.2,969,824, then the amount of lost income or the potential loss of income due to traffic jams by cars is Rp.12,502.8 every day.

Income losses or the potential loss of income from time losses also occur in motor vehicles. Every motorbike ride requires additional time or loss of time for 35.6 minutes on each day's trip. That amount if multiplied by the amount of UMK Medan, then the amount of loss that must be borne by each ride is Rp.9,177.32 every day.

## **V. Conclusion and Suggestion**

### **5.1 Conclusion**

From the explanation above it can be concluded:

First, the wasteful consumption of motorcycle vehicles due to traffic every day is 0.159 liters/vehicle or 1,240.2 rupiah/vehicle. While the value of fuel waste in a vehicle is 0.195 liters/1000 km/vehicle, or Rp.1,521 per vehicle. The total loss of road users due to waste of car fuel in a year due to traffic jams in the city of Medan each year is  $29,618,506,008 + 22,353,588,440 = 51,972,095,448$  rupiah or Rp.51.9 billion.

Second, the time loss also occurs on motorbike vehicles is 35.6 minutes every day, while the time loss on motor vehicles is 48.5 minutes every day.

### **5.2 Suggestion**

First, the magnitude of the potential for perceived loss, both central and regional governments give special attention to improving the regional transportation system. The additional large costs that must be borne by the community is very large if it is accumulated, not only economic losses but also will reduce community productivity. It takes a real step to unravel the congestion that has caused significant losses both in terms of spending fuel oil (BBM) and the loss of time wasted in traffic every day. Improvements to clear congestion in the short term can be done with the presence of traffic officers from the relevant Dinas, but for the long term a construction of an adequate, convenient, and affordable transportation system is integrated and integrated throughout all modes of transportation so that citizens switch from private transportation to public transportation.

Secondly, this study only included 2 variables to analyze the loss impact of traffic congestion namely the loss of fuel waste and time loss. Therefore additional studies are needed to analyze the loss of different variables such as environmental damage through air pollution resulting in a decrease in health, the impact of social losses such as increased emotions, fatigue on the road that causes deterioration of health.

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