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The Effect of Public Transportation Management to the City Planning in Medan

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***Abstract*— The movement of human flows, vehicles, and goods leads to various interactions. Almost all interactions require us to travel. Therefore, the result is the movement of traffic flows. In general, transportation planning makes interaction as easy and efficient as possible. Transportation management is an integral part of city planning. The city plan will cause many traffic problems without considering the transportation patterns. Good urban transportation systems should make public transportation the primary means of mobility; however, people are still reluctant to use public transport in developing countries such as Indonesia. There are still many people who prefer to use private transportation. This study aims to analyze the effect of public transportation management on city planning in Medan. The samples of this research are all the users of public transportations at Medan who are 400 people. The collection methods are coming interviews, distribution of questionnaires, and documentary studies. The data analysis method used in this study is the multiple regression linear analysis. The research results showed that simultaneous transportation encompasses means of transportation, transport infrastructure, service quality, accessibility, public transport routes, and the integration of modes. These significantly affect city planning in Medan, with mode integration being a partially dominant factor of influence. The services of different ways of transport should be integrated with an easy and convenient mode transfer scope.**

***Keywords*— Transportation; public transport; city; planning.**

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I. INTRODUCTION

The major cause of traffic congestion is the high usage of private cars. The increasing number of private vehicles is not balanced with the increase of the roads provided. So, the problem of congestion becomes a common problem in urban areas, especially during rush hours. In some areas, such as Jakarta, efforts have been made to address congestion issues by adopting office hours and school hour's policy. To reduce the accumulation of vehicles at the same hour, the roads must be separated into numerous lanes and be used moderately. It is not only because of peak hours that has become the main problem of urban transportation but the remarkably high number of vehicles. The number of public vehicles is relatively high. Meanwhile, the number of private vehicles increases so much that public transportation provision becomes ineffective and efficient. The key to solving urban transportation problems is managing the transportation system. When public transportation is good, the public will not doubt it and gradually change their transportation mode from private vehicles to public transportation.

As the capital of Indonesia's North Sumatra province, Medan has been developing into a metropolitan city. It is the population and economy that grow and the traffics. The changing of life patterns that have occurred in the life of society because of economic growth will also affect the demand for transportation. The transparency of economic activities encourages people's mobility, including goods and at the same time encourages the demand for transportation. The population of Medan City in 2016 had reached 2,229,408 people, which resulted in the demand for public transportation continued to increase. It is known that the economic growth rate of Medan City in 2016 had increased if compared with the previous year. In 2016 the economic growth of Medan City reached 6.26 percent, while in 2015, it was only 5.74 percent [1].

High population mobility has made the transportation system very important, transporting goods and people. Currently, the mode of transportation has grown rapidly. Based on the data from BPS-Statistics of Sumatera Utara Province until 2017, the number of vehicles in Sumatera Utara Province was 7,094,015 units. From these data, motorcycles dominated as much as 86.88 percent, passenger cars 7.57 percent, freight cars 4.50 percent, and buses 1.06 percent [2]. Motorcycles have become alternatives because it is easy for society to get a motorbike. Motorcycles can be obtained by credit, with a quite low-down payment and long-term installments. With that being said, people from middle to lower social classes can get this transportation mode. The utilization of motorcycles as the transportation mode in an uncontrolled way can cause chaos in the city, seriously threatening the safety and the security of the other road users (pedestrians).

The pattern of urban transportation services has not reached the area of service that the users desire. Due to the lack of good public transportation services, urban populations in Medan increasingly rely on personal vehicles (private cars), especially motorcycles. The availability of public transportation services can only attract those people who have already used public transport (public transport captive riders) and those who do not have other options besides public transport. It has not succeeded in attracting the attention of private vehicle users (choice riders) to switch to public transport. The physical condition and the fleet's reliability that are not good enough and fail to perform as expected have become a limiting factor in attracting more users to use public transportation services.

The only possible way to encourage the community to start using public transportation instead of private vehicles is by improving the minimum service standards. One of the existing legislation is the Regulation of the Transportation Minister of the Republic of Indonesia Number PM. 98 the Year 2013, on Minimum Service Standards for Passengers in Public Motor Vehicles, is expected to be a reference to enhance the performance of urban public transportations [3].

According to the research conducted in Manado City, the best plan for improving the transportation network system is to expand the city's existing network. This is because Manado is expected to be a prospective city due to its geographical potential and natural resources. The resources show that Manado has high opportunities to develop sea and coastal transportation. Nevertheless, Manado should ensure that the current resources are ready to carry out the new transportation services. Numerous steps should be taken, from increasing the discipline of transportation users and pedestrians, maintaining vehicle usage levels, minimizing congestion levels through proper parking arrangements, optimizing the distribution of goods, improving driving license holders' discipline, to maximizing mode integration to access new road networks [4].

The development of Medan city does not match with good transportation facilities (especially public transportations) which cause a traffic jam, and this problem has become one of the many problems that are often faced in Medan. The provision of public transportation services is not optimal and has caused people to use private vehicles. The transportation system in Medan has not met the sustainability criteria yet. It is characterized by the poor quality of the roads, poor quality of the public transportations, increasing number of road accidents, traffic jam on major roads, decreasing the average speed during peak hours, increasing pollution, and very high-cost transportations.

The condition of transportation in the city of Medan is essential for transportation management. Transportation management is an inseparable part of urban planning. Therefore, it is necessary to profoundly investigate the management of urban public transportation, especially in Medan, to support urban planning. This study aims to analyze the effect of public transportation management on city planning in Medan. This study provides an empirical research process by utilizing statistical hypothesis testing using multiple linear regression analysis.

II. Materials and Method

The sample employed in this study is the population of Medan, which is expected to be 2,229,408 people between the ages of 15 to 59 [1] because public transportation is generally used at this age (by productive age). Around 400 people were sampled for this study. This research determines the sample by using a significance level of 5% and implementing the Slovin formula [5] as follows:

$$n = \frac{N}{1+N(e)^2} \quad (1)$$

Where:

n = number of samples
N = total population
e = error rate in sampling

In this study, the accidental sampling technique is used, in which the number of respondents is decided by the number of persons who utilize public transportation in Medan. Also, by observing and completing the questionnaires and studying the documentation.

The data analysis method used in this study is the multiple regression linear analysis. To test the hypothesis, the following model is used:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + e \quad (2)$$

III. Results and Discussion

Based on the results of the analysis by using SPSS, the results obtained are as follows:

TABLE I
Regression Coefficients

Coefficients[a]				
		Unstandardized Coefficients		**Standardized Coefficients**
Model		**B**	**Std. Error**	**Beta**
1	(Constant)	31.085	2.238	
	means of transport	.492	.124	.228
	transport infrastructure	-.376	.112	-.216
	service quality	-.142	.078	-.133
	accessibility	.096	.118	.052
	public transports route	.166	.132	.085
	integration of modes	.735	.136	.329

a. Dependent Variable: City Planning

Based on the table above, the following equation can be made Y = 31.085 + 0.492 X_1 – 0.376 X_2 – 0.142 X_3 + 0.096 X_4 + 0.166 X_5 + 0.735 X_6.

From the equation can be explained that: If everything in the independent variables is considered constant, then the value of city planning is 31.085.The positive value of the regression coefficient X_1 (means of transport) indicates that if the mode of transportation is raised by one unit, the city planning will increase by 0.492 units. The regression coefficient X_2 (transportation infrastructure) is negative (-0.376); if the transportation infrastructure is increased by one unit, the city planning will decrease by 0.376 units. Regression coefficient X_3 (service quality) is negative (-0.142). If service quality is increased by one unit, city planning will decrease equal 0,142 units. The coefficient of X_4 regression (accessibility) is positive (0.096). If accessibility is increased by one unit, then city planning will increase equal to 0,096 units. Regression coefficient X_5 (public transports route) is positive (0.166). If the public transportation route is increased by one unit, city planning will increase equal to 0,166 units. Regression coefficient X_6 (integration of mode) is positive (0.735). If the integration mode is increased by one unit, city planning will increase by 0.735 units.

A. Coefficient Determination Test

The following table shows the result of the coefficient determination test:

TABLE II
COEFFICIENT DETERMINATION TEST

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.442[a]	.195	.183	5.57694

a. Predictors: (Constant), Integration of mode, transport infrastructure, means of transport, accessibility, public transports route, service quality
b. Dependent Variable: City Planning

As shown in Table II, the Adjusted R Square value is 0.183. This suggests that 18.3% of the diversity in city design in Medan can be attributed to modes of transport, transportation infrastructure, service quality, accessibility, public transports routes, and mode integration. Meanwhile, 81.7% is influenced by characteristics other than those covered in this study.

B. Simultaneously Test

The simultaneous test results show the influence of the variables of means of transport, transportation infrastructure, service quality, accessibility, public transports route, and mode integration simultaneously to city planning. It can be seen through the table below:

TABLE III
SIMULTANEOUS TEST RESULTS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2965.498	6	494.250	15.891	.000[b]
	Residual	12223.179	393	31.102		
	Total	15188.678	399			

a. Dependent Variable: City Planning
b. Predictors: (Constant), Integration mode, transport infrastructure, means of transport, accessibility, public transports route, service quality

The table above shows that F_{count} (15.891) is greater than F_{table} (2.237) with a sig. value of 0.000 that is smaller than alpha (0.000 < 0.05). This indicates that the research rejected H_0 and accepted H_a. Thus, means of transport (X_1), transportation infrastructure (X_2), service quality (X_3), accessibility (X_4), public transports route (X_5), and integration of mode (X_6) together significantly influence city planning.

C. Partial Test

From Table IV below, the result of the partial hypothesis testing can be seen.

TABLE IV
PARTIAL TEST RESULTS

Coefficients[a]

Model		t	Sig.
1	(Constant)	13.891	.000
	means of transport	3.973	.000
	transport infrastructure	-3.366	.001
	service quality	-1.820	.069
	accessibility	.813	.417
	public transports route	1.260	.209
	integration of mode	5.409	.000

a. Dependent Variable: City Planning

Based on the table above, the results obtained that the t_{count} for means of transport variables is 3.973 in which the t_{count} is greater than the t_{table} (3.973 > 1.966). Besides that, the sig value. is 0.000 which is smaller than alpha (0.000 < 0.025). Thus, the H_0 is rejected, and the H_a is accepted for the transport variable. Thus, the means of transport partially have a significant effect on city planning in Medan City.

The results of this study are consistent with the prior research. One of the essential objectives of maintainable transportation is to decrease the movement interest, particularly lessening trips made by private vehicles. For an accomplishment, the city should begin moving from planning private vehicle-arranged urban communities to public vehicle well-disposed urban areas [6].

The t_{count} for the transport infrastructure variable is 3.366, which is greater than the t_{table} value (3.366 > 1.966), with the sig value 0.001, which is smaller than alpha (0.001 < 0.025). Hence, the H_0 is rejected, and H_a is accepted for the transport infrastructure variable. Thus, transportation infrastructure partially has a significant effect on city planning in Medan.

It is necessary to foster new techniques and models in controlling transportation infrastructure in current urban areas with expanding viability [7]. They investigate concentrate on improving transportation frameworks and foundations by thinking about the ideal models and ideas of cutting-edge urban arranging. The proficiency of the whole metropolitan vehicle framework relies upon advancing its transportation infrastructure.

The results show that service quality does not significantly impact city planning. As can be seen in the t-test results, the t_{count} of service quality is 1.820, in which the t_{count} is smaller than the t_{table} (1.820 < 1.966) with the sig value of 0.069, which is higher than the alpha (0.069 > 0.025). Hence, H_0 is accepted, and H_a is rejected.

The outcomes [8] showed that the view of individuals of the city of Medan towards public transportation services was delegated low. Quality of service directly affects goals to utilize public vehicles more, and this effect influence aims to

lessen own vehicle use and aims to utilize maintainable methods for transportation, for example, more vehicle sharing [9].

The t_{count} for the accessibility variable is 0.813, which is smaller than the t_{table} (0.813 < 1.966), with the sig value for the accessibility variable, is 0.417, which is greater than alpha (0.417 > 0.025). Thus, the H_0 is accepted, and H_a is rejected for the accessibility variable. Thus, accessibility partially has no significant effect on city planning in Medan City.

This shows the low level of public transport accessibility in Medan, as some parts of the urban areas were not served by public transportation. One indicator of the level of public access to public transportation was the ratio of the length of the road, which was served by the route, with the total length of the road. The higher the ratio, the higher level of accessibility to public transportation.

The t_{count} for the public transports route variable is 1.260, which is smaller than the t_{table} (1.260 < 1.966), with the sig value for public transports route variables 0.209 that, is greater than alpha (0.209 > 0.025). Thus, the H_0 is accepted, and H_a is rejected for the public transport route variable. Hence, the public transport route partially has no significant effect on city planning in Medan City.

The public transportation network's lack of access and disorganization were caused by the community's failure to relocate public transportation from the pickup point to the destination. Several times in shifting the public transportations had resulted in higher costs of using public transportations than the costs of using private transportations (especially motorcycles). The greater the degree of the mode transfer, the greater the cost.

The t_{count} for the integration of mode variable is 5.409, which is greater than the t_{table} (5.409 > 1.966) with the sig value for integration of mode variable 0,000, which is smaller than alpha (0.000 < 0.025). Thus, the H_0 is rejected, and H_a is accepted for mode integration. Thus, the integration of modes partially influences city planning in Medan.

The results show that the variable that has the greatest effect on Medan's urban planning is mode integration. The presence of transportation infrastructure aims to enable the flow of goods and services and the traffic lane that connects individuals to support the regional economy. The availability of transportation infrastructure at Medan City can be seen from the existing road network condition, the types of transportation availabilities, and the circulation of existing traffic-lane.

At Medan, it appears that there is still a very low quality of the highway. Then, the main roads are still full of hollows and quite bumpy for the riders. So much so that it interferes with the comforts and the flexibilities of the riders in driving their vehicles. Mostly, the road conditions are heavily damaged or lightly damaged, resulting in congestion on the main roads and decreasing the average speed during peak hours. The development of the road length is presented in Table V.

Based on Medan Municipality in Figures 2017 [1], at Medan, there is 3,191.50 Km of roads, with 140.70 of the state roads, 33.40 Km of provincial roads, and the remaining 3,017.40 Km are district/city roads. Viewed from the development of the roads from 2015 until 2016, there is no significant long road development. Road facilities in 2016 recorded 2,984.5 Km is in good condition, 18.80 Km is in moderate condition, and 20.10 Km is in damaged condition, while in heavy damage condition is 171.10 Km and the unspecified is 0,00 Km.

TABLE V
LENGTH OF ROAD BY CONDITION AND AUTHORITY 2011-2016 IN MEDAN CITY (KM)

Road Conditions	Person in charge			
	Country	**Province**	**District/City**	**Amount**
1. Good	140.70	33.40	2,810.4	2,984.5
2. Moderate	0.00	0.00	15.80	18.80
3. Damage	0.00	0.00	20.10	20.10
4. Badly damaged	0.00	0.00	171.10	171.10
5.Unspecified	0.00	0.00	0.00	0.00
Medan				
2016	**140.70**	**33.40**	**3,017.40**	**3,191.50**
2015	140.70	33.40	3,017.40	3,191.50
2014	140.70	35.20	3,505.84	3,711.74
2013	170.70	35.20	3,505.84	3,711.74
2012	115.35	40.20	3,279.50	3,435.05
2011	115.35	40.20	3,089.60	3,245.15

In Medan, the public transportations' passengers consist of various types of modes of land transport, such as pedicabs (paddle and motor), taxis, public transportation (MPU), and Damri buses. Transportation in Medan is currently dominated by city transportation, where the management of public transportation is likely to harass passengers with overlapping routes system, resulting in chaos in the city, which is only getting worse as public transportation drivers are likely to pick up and drop off passengers at any locations, regardless of the safety of other road users. The motor tricycles and the paddle pedicabs have also dominated public transportation in Medan, with pedicab drivers performing on a par with city transportation drivers. Other modes of transit are such as taxis and city buses. The city taxi and city bus operate more efficiently than public transportation and tricycles.

City transportation, known as public transportation, has the highest number in Medan. According to data from the Department of Transportation in Medan, there were 235 public transportation routes maintained by 18 companies until 2014, with a fleet totaling 16,066 vehicles. The number of routes realized was 170, with a fleet of 6,698 vehicles, meaning that the number of routes and fleet realized were only 72.3% and 41.7%, respectively.

With an area of 265.10 km², Medan has a diverse topography consisting of lowland hills and beaches. The population until 2014 recorded 2,191,140 people. The population density in Medan is 8,265.33 inhabitants/km². The pattern of the road network structure that takes place forms a grid pattern. It is said that the city's structure has spreading centers of activity. The main space structure with the whole city service scale is located in the city center, including Medan Polonia Sub-district, Medan Maimun Sub-district, Medan Baru Sub-District, Medan Petisah Sub-District, District of West Medan, East Medan Sub-district, and Medan Kota Sub-district. The city center will be the center of activities that serves as an office center, trade and service center, public service center, residential center, and transportation service center.

TABLE VI
LIST OF COMPANY AND NUMBER OF CITY TRANSPORT IN MEDAN IN 2014

No	Company Name	Route Number		Amount	KPs is taken care of in the year				
		Permintted	Realization	Plafon	2010	2011	2012	2013	2014
1	KPUM	93	81	6,061	3,187	2,862	2,415	2,415	2,543
2	PT. Rahayu Medan Ceria/Bus	9	9	1,376	613	667	529	529	523
3	PT. Rahayu Medan Ceria/MPU	8	13	1,355	925	973	949	973	1,016
4	PT. Wampu Mini	8	7	543	283	264	247	248	271
5	CV. Medan Bus	9	7	900	249	250	237	238	390
6	PT. Nasional Medan Taransort	10	7	605	263	164	218	218	113
7	CV. Mekar Jaya	4	3	315	188	176	175	175	157
8	PT. Gajah Mada	8	3	310	196	193	151	156	136
9	PTU. Morina	20	11	1,505	473	522	521	521	521
10	Perum Damri	5	1	60	20	20	20	23	20
11	CV. Desa Maju	7	3	294	146	145	151	137	148
12	CV. Laju Deli Sejahtra	4	1	150	8	8	-	-	-
13	PT. MARS	20	10	1,025	395	409	390	390	390
14	CV. HIKMA	4	2	250	165	94	94	165	165
15	CV. KOBUN	4	2	84	-	-	5	5	-
16	CV. POVRI	5	2	193	23	10	10	10	-
17	Kop. Medan Raya Express	6	2	290	138	138	138	138	120
18	CV. MITRA	11	6	750	275	236	285	285	185
	Amount	235	170	16,066	7,547	7,131	6,535	6,626	6,698

The city's urban shape will greatly affect public transportation [10]. The activities determine the pattern of travel outside of the residence. The pattern of land use distribution in a city has a significant impact on people who travel. In this case, the spatial distribution pattern that is very important is the spatial distribution of the industrial areas, offices, and settlements. The distribution pattern of these three lands uses critical in shaping how people travel, particularly when working or shopping. Differences around residence greatly affect the travel pattern because of certain routes used by public transportation. Therefore, sometimes, it is needed by the people who travel by public transport to make the change of mode more than two times.

The factors that cause traffic density and congestion are the geometry and overall performance of roads and public transport routes, not school and market land [11]. A mix of activity area and spatial variables have a greater impact on zonal travel attractions based on city geographic trends than traditional models that use zonal labor and student variables [12].

The designation of a metropolitan public vehicle limit is crucial for improving the quality of public transportation and reducing traffic [13]. An integrated transportation system is required to support the inter-mode/multi-mode of transport effectively and efficiently. It includes managing inter-mode/multi-mode transportation network settings and an integrated ticketing system.

Multimodal transportation planning is required to go hand in hand with organizations, networks, stations, client data, and admission installment frameworks; all critical effects should be considered, including long haul, backhanded and non-market effects for example, ownership and land-use change [14]. To settle the multi-purpose alternative appealing to private vehicle clients, the operator should attempt to limit boundaries to move in the multi-purpose choice under mobility-as-a-service (MaaS). MaaS can focus on multi-purpose choices, including multi-purpose moves, and client inclinations rely upon the assistance level of the method of transport and their everyday travel conduct [15]. Basic arrangements, for example, rebuilding transport charges, can altogether affect travelers [16].

Modeling the city transport is very important to overcome the existing transportation issue such as traffic congestion. Thus, Palembang City has developed the city transportation model. The program that Palembang has conducted is called as PTV Visum Program in which the modeling is based on the four-step model of transportation. As a result, the developed model has shown excellent reliability in standing for the transportation condition. The program requires Palembang City to build another bridge to connect Ulu and Ilir to minimize traffic congestion. The reason is that it is one of the ways to reduce the traffic load on the existing bridge built in 1965, called as Ampera Bridge [17].

Medan still does not have an integrated public transportation system. It is indicated by the lack of integration of schedules and information about public transportation services between operational modes of public transportation. Thus, resulting in the inability to compute correct trip times and costs. Travel time and travel costs are among the most persuasive elements for anticipating public vehicle interest [18]. The behavior of the pedestrians in the walking area is impacted by the network connection that the town has. Thus, the different zone from each area requires the pedestrians to walk and choose different roads. Junction areas in the old zone tend to be used as the connector to the other streets. Meanwhile, the square and market serve as gathering locations for pedestrians, while significant thoroughfares serve as a guide for pedestrians. On the other side, the main road in the new zone is treated as a connecting path because it is easily accessible and connected to the majority of the streets also because it provides an opportunity to meet a large number of people throughout the walk [19].

The services of various modes of transport should be integrated to ease and expedite mode changeover. The first step in achieving this goal is to shift from a small public transport system to a larger bus ran under contract by the corporation. The social consequences of this mode shift must be carefully considered has become a source of income for

thousands of people in the city. When individuals move from the public vehicle framework to private modes, it is challenging to convert them to the public vehicle framework. Understanding private vehicle possession conduct is significant for understanding potential mode decisions and individual travel conduct, which is fundamental for planning compelling strategies to advance maintainable traveler transport techniques [20]. Consistently assessing the transport travel framework is a significant advance for arranging, activity, and practical administration [21].

The handling of urban transportations problems must be thoroughly be done both in macro and micro ways, i.e.: by opening the economic growth points and the community service agencies (like schools and hospitals) evenly to reduce community mobility and urbanization, create a harmonious city spatial structure, adding road networks and traffic control facilities, providing pedestrians and cycling facilities, and operating mass public transportations.

IV. Conclusion

This study showed that the means of transport, transportation infrastructure, service quality, accessibility, public transports route, and integration of modes simultaneously have a significant effect on the city planning in Medan. The integration of modes is the most dominant variable affecting city planning in Medan. This means the integration of modes is the most decisive variable in the city planning in Medan.

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