

Impact of traffic congestion on road users in Tangerang City

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ABSTRACT

One of the negative impacts of transportation problems is congestion. Traffic congestion in urban areas is gradually becoming an important social and economic problem that needs to be addressed. Tangerang City is one of the supporting cities for the Jakarta metropolitan area as well as an area with a significant increase in population and vehicles, resulting in an increase in the number of people's movements or mobility in order to meet the needs of life. Meanwhile, the length of roads in Tangerang City during 2018-2019 did not increase and it is possible that there will be an imbalance between movement and available road capacity or minimal accessibility. The research approach used is quantitative with primary data sources obtained from closed questionnaire instruments from 180 road user respondents at the TangCity Mall intersection, Tangerang City. Analysis of the data used is a structural equation model with the AMOS 22.00 program to determine the factors that influence the impact of congestion. The results of the analysis show that the factors that most influence the impact of congestion are decreased concentration and loss of energy during traffic jams, which are more common in men who are married at the age of over 35 years, with a diploma level of education, as well as the type of work as a Civil Servant.

Keywords: congestion; accessibility; mobility; structural equation modeling.

INTRODUCTION

Population growth in an area will have an impact on increasing various activities, including transportation. Transportation activities that continue to increase in addition to showing regional developments also indicate the emergence of new problems. Kadarisman et al. (2017) explained, one of the negative impacts due to transportation problems is congestion which causes quite high air pollution and also hampers people's economic activities. Traffic congestion in urban areas is gradually becoming an important social problem and needs to be addressed (Su et al., 2020) because congestion is a very detrimental situation that has social and economic impacts (Hidayat & H, 2017). Kawulur et al., (2020) explained that traffic congestion occurs due to an imbalance between the number of residents, the number of vehicles and the available roads. Some of the consequences of this congestion according to Bergkamp in Aulia (2016) for example, wasted fuel, wasted time, and also environmental damage due to motor vehicle air pollution. The social costs such as travel time to the increase in the number of accidents and stress in the community are also impacts that can be caused by traffic jams (Susanti, 2015). In the end, the ever-increasing congestion causes very high losses in various countries, including Indonesia (Sugiyanto et al., 2011).

Roberts et al. (2019), reports that the projected congestion that occurs in major cities in Indonesia will suffer a loss of at least US\$ 4 billion or an amount of Rp. 56 trillion (assuming the rupiah exchange rate against the US dollar is Rp. 14 thousand) and this figure is equivalent to 0.5% of the Gross Domestic Product (GDP). Furthermore, cities in Indonesia are also among the most trafficked in the East Asia and Pacific region (Roberts et al., 2019). As is known, Tangerang City is one of the supporting cities for the Jakarta metropolitan area and has made this city one of the destinations for urbanization with all its attractions. Based on data from the Central Statistics Agency (BPS), the population in Tangerang City in 2017 was 2,139,3891, in 2018 it was 2,185,304, and in 2019 it was 2,229,901 (BPS Kota Tangerang, 2020). From these data, the population is always increasing every year. With the increase in population, it will result in an increase in the number of people's movements in order to meet the needs of life (Tamara & Sasana, 2017) and also affect the demand for many means of transportation (Cheng et al., 2015).

The number of vehicles used as a means of transportation in Tangerang City continues to increase. BPS Banten Province reported the number of vehicles in Tangerang City in 2018 was 1,435,472 vehicles, and in 2019 there were 1,587,818 vehicles (BPS Provinsi Banten, 2020). Meanwhile, the length of roads in Tangerang City during 2018-2019 did not increase and it is possible that there will be an imbalance between the movement and the available road capacity. For example, what happened at the KS Tubun intersection and the new Bridge road, Anjasmoro (2018) stated that at the maximum flow in the morning and evening the service level of the intersection is F (very bad). The level of service F also occurs at the Shinta signalized intersection (Nuryanto, 2019). One example is on the Teuku Umar road, which has a service level of C in the morning and afternoon and a service level of D in the afternoon (Nuryanto, 2019).

Traffic Congestion

The implementation of transportation activities that continues to increase in addition to showing regional developments also shows the emergence of new problems. Kadarisman et al. (2017) explained, one of the negative impacts due to transportation problems is congestion which causes quite high air pollution and also hampers people's economic activities. The definition of congestion according to the Directorate General of Highways, (1997) is a condition where the traffic flow that passes on the road section being reviewed exceeds the planned capacity of the road which results in the free speed of the road section approaching 0 km/hour, causing queues to occur.

Traffic congestion is an important issue that affects social, economic and environmental aspects (Narotikah et al., 2019) that can affect public health (Nadrian et al., 2019). The perceived consequences of congestion can also be seen clearly from the form of long queues and delays (Tamin, 2008) as well as noise and air pollution (Zhang & Batterman, 2013), thereby reducing air quality and the environment, especially in developing countries (Le & Trinh, 2016). The impact of congestion also causes huge losses for road users, especially in terms of wasting fuel (Susanti, 2015), wasting time and convenience (Tamin, 2008). In a study by Fields et al. (2009) stated that community productivity will be low if they spend more time stuck in traffic jams, and according to Rahane & Saharkar in C Jalagat & M Jalagat, (2016), community productivity is low due to increased stress levels on the road. highway. Therefore, if there is a disturbance in their daily performance, it will have an impact on the quality of life (Narotikah et al., 2019).

Accessibility and Mobility

Transportation infrastructure, in this case roads, is a determining factor for accessibility for the daily routine movement of residents. In facilitating movement, it is necessary to provide regional transportation infrastructure and facilities that can have an impact on increasing community accessibility and mobility and developing an area (Indrashanty & Legowo, 2017). Accessibility is the concept that underlies the relationship between land use and transportation (Indrashanty & Legowo, 2017) In another sense, accessibility means the ease of movement between two places. While mobility is a measure of a person's ability to move which is usually expressed in terms of the ability to pay transportation costs. (Tamin, 2008).

Hypothesis

The hypotheses proposed in this study are (1) H₁ accessibility has an influence on mobility, (2) H₂ accessibility has an influence on road users, and (3) H₃ mobility has an influence on road users.

RESEARCH METHOD

Place and time of research

The location of the research is the Simpang TangCity Mall, Tangerang City and the research time is January 2022.

Data collection method

The method used in the data collection process is the distribution of closed questionnaires which are distributed to 180 respondents who use the road at the Simpang TangCity Mall, Tangerang City. Thus, the data used is primary data. Furthermore, the measurement items used are shown in **Table**

1. The scale used for the measurement items is Likert with 5 levels of alternative answers. Level 1 is used for statements that strongly disagree and level 5 for statements that strongly agree.

Table 1. Constructs and Measurement Items

Construct	Code	Measurement
Accessibility (ACC)	ACC1	There are no side barriers at the intersection
	ACC2	Traffic control devices at the intersection make traffic smooth
Mobility (MOB)	MOB1	Traffic flow/mobility at busy intersections
	MOB2	When passing through the intersection, often experiencing traffic jams
Road Users (RDU)	RDU1	Congestion causes me to lose concentration
	RDU2	Congestion makes my energy drain

Data processing

In order to obtain the information needed in this study, a quantitative approach was used to measure the level of influence of the variables formed by the construct, measured based on **Table 1**, so that a score was obtained which was then processed with statistical data.

Data Analysis

Structural Equation Modeling (SEM) was used as the basis for data analysis using the Analysis of Moment Structure (AMOS) 22.00 program. The SEM stages carried out in this study were Confirmatory Factor Analysis (CFA) for constructs to meet the Good of Fit Index (GOFI) criteria, and continued with hybrid SEM modeling with maximum likelihood estimation techniques.

RESULTS AND DISCUSSION

Characteristics of Respondents

The characteristics that were asked in the research questionnaire on 180 road users at the Simpang TangCity Mall, Tangerang City and also the responses given were shown in **Table 2**. The characteristics of the respondents are used as control variables of the dummy type in SEM modeling.

Table 2. Characteristics of Respondents

Characteristics	Observation	Frequency (n=180)	Percentage (%)
Gender (DGE)	Male	97	46,11
	Female	83	53,89
Age (DAG)	15 – 25 years	59	32,78
	26 – 35 years	56	31,11
	36 – 45 years	59	32,78
	46 – 55 years	6	3,33
Marital Status (DMS)	Not married	67	37,22
	Married	113	62,78
Education Level (DTP)	Senior High School / equivalent	50	27,78
	Diploma	34	18,89
	Perguruan Tinggi	96	53,33
Type of Work (DEM)	Other	22	12,22
	Entrepreneur	28	15,56
	Student	40	22,22
	Private Employee	79	43,89
	Civil Servant	11	6,11
Vehicle Ownership (DVO)	Do not own	48	26,67
	Car	34	18,89
	Motorcycle	66	36,67
	Car and Motorcycle	32	17,78
Monthly Income Level (DTPB)	< Rp. 3,5 million	63	35,00
	Rp. 3,5 million – 5,5 million	37	20,56
	Rp. 5,6 million – 7,5 million	27	15,00

	Rp. 7,6 million – 9,5 million	30	16,67
	> Rp. 9,5 million juta	23	12,27
Types of Mode of Transportation (DMT)	Public transportation	54	30,00
	Private vehicles	126	70,00
Transportation costs (DBT)	Rp. 5.000 – 20.000	82	45,56
	Rp. 21.000 – 40.000	36	20,00
	Rp. 41.000 – 60.000	24	13,33
	Rp. 61.000 – 80.000	21	11,67
	Rp. > 80.000	17	9,44
Travel Time (DWT)	0 – 30 minutes	41	22,78
	31 – 60 minutes	98	54,44
	61 – 90 minutes	39	21,67
	91 – 120 minutes	2	1,11

Confirmatory Factor Analysis (CFA)

The results of the CFA analysis in this study are shown in **Table 3**. In the CFA, an analysis was also carried out to test the validity and reliability of the constructs using the standardized regression weights from the AMOS 22.00 output. Based on the information presented in **Table 3**, all indicators of each variable have a standard load factor value of 0.5 so that all indicators have good validity. Furthermore, the construct reliability of each variable has a value above 0.7, and the variance extracted value for all variables has a value above 0.5 which means that the overall model is good (Haryono, 2016).

Table 3. CFA Analysis Results

Construct	Item	Standard Loading	Reliability	Variance Extracted
Accessibility (ACC)	ACC1	0,790	0,753	0,604
	ACC2	0,764		
Mobility (MOB)	MOB1	0,945	0,963	0,929
	MOB2	0,982		
Road Users (RDU)	RDU1	0,984	0,951	0,906
	RDU2	0,919		

Hybrid Model Structural Equation Modeling (SEM)

This analysis is carried out after the CFA process on the construct. Analysis of data processing was carried out with a conformity test referring to the GOFI criteria (Haryono, 2016) and statistical tests. The results of the SEM modeling of the impact of congestion on road users at the TangCity Mall Simpang Tangerang City are illustrated in **Figure 1**. Furthermore, the results of the conformity test with AMOS 22.00 based on the SEM model **Figure 1** can be seen in **Table 4**.

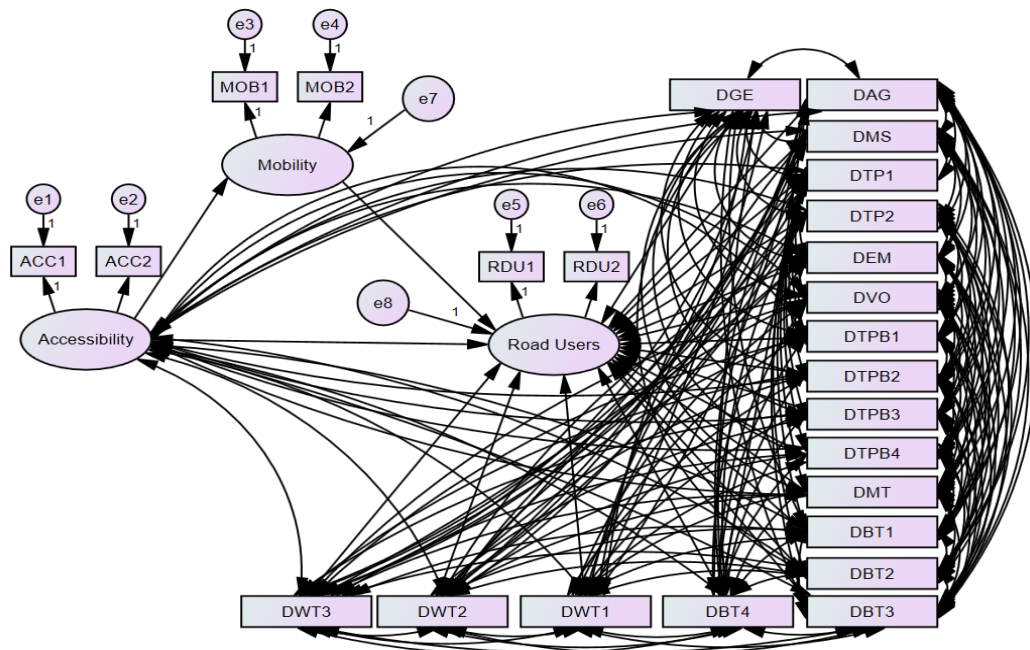


Figure 1. Structural Equation Modeling Test Results Model

Table 4. GOFI Test Result

GOFI	Limitation	Results	Criteria
Chi square statistic (p=5%, df =66)	< 104,138	93,373	Good of fit
Significance probability	≥ 0,05	0,184	Good of fit
CMIN/DF	≤ 2,00	1,139	Good of fit
Goodness of index (GFI)	≥ 0,90	0,963	Good of fit
Adjusted goodness fit index (AGFI)	≥ 0,90	0,852	Marjinal fit
Tucker lewis index (TLI)	≥ 0,95	0,978	Good of fit
Comparative fit index (CFI)	≥ 0,95	0,994	Good of fit
The Root mean square error of approximation (RMSEA)	≤ 0,08	0,028	Good of fit

Hypothesis Test Results

This hypothesis testing was carried out on the 3 proposed hypotheses. The test carried out is to use a t-value with a significance level of 5%. In AMOS 22.00, t-value is the value of Critical Ratio (CR). If the CR value is 1.957 or the probability value (P) 0.05, then H_0 is rejected (the research hypothesis is accepted) (Haryono, 2016). The results of the AMOS 22.00 calculation for the CR value based on the model fit in Figure 1 are presented in Table 5.

Table 5. Hypothesis Test Results

	Path	C.R.	P	Result
H ₁	Accessibility → Mobility	4,565	***	Accepted
H ₂	Accessibility → Road Users	-0,184	0,420	Rejected
H ₃	Mobility → Road Users	15,828	***	Accepted

The value of *** on P indicates 0

Impact of Traffic Congestion on Road Users

The impact of traffic congestion studied in this study includes accessibility and mobility of road users. From the results of the hypothesis test presented in **Table 5**, it can be concluded that mobility has a significant effect on road users, while accessibility does not have a significant effect. Nevertheless, accessibility has a significant influence on mobility. The influence of each of these variables is shown in **Table 6** below.

Table 6. Direct Effects

	ACC	MOB	RDU
Mobility	,413	,000	,000
Road Users	-,011	,835	,000
RDU2	,000	,000	,919
RDU1	,000	,000	,984
MOB2	,000	,982	,000
MOB1	,000	,945	,000
ACC2	,764	,000	,000
ACC1	,790	,000	,000

From **Table 6**, it is known that mobility has a positive effect of 0.835 on road users, while accessibility has a negative effect on road users. However, accessibility still has a positive effect on mobility. Furthermore, in **Table 7** are the CR values and the probability of the respondent's characteristics. Based on the table, of the 10 dummy variables that became control variables including gender, age, marital status, education level, type of work, vehicle ownership, monthly income level, mode of transportation used, transportation costs, and travel time, no dummy was used. significantly affect road users.

Table 7. CR Value and Probability of Respondents Characteristics

	Est.	S.E.	C.R.	P
DGE → Road Users	,018	,060	,298	,766
DAG → Road Users	-,087	,071	-1,227	,220
DMS → Road Users	,045	,081	,558	,577
DTP1 → Road Users	,091	,097	,934	,351
DTP2 → Road Users	,036	,083	,433	,665
DEM → Road Users	-,038	,126	-,301	,763
DVO → Road Users	,047	,103	,455	,649
DPTB1 → Road Users	-,051	,098	-,519	,604
DPTB2 → Road Users	-,221	,122	-1,812	,070
DPTB3 → Road Users	-,210	,125	-1,681	,093
DPTB4 → Road Users	-,123	,128	-,962	,336
DMT → Road Users	,136	,072	1,880	,060

	Est.	S.E.	C.R.	P
DBT1 → Road Users	-,015	,077	-,190	,849
DBT2 → Road Users	,047	,094	,499	,618
DBT3 → Road Users	,066	,108	,609	,542
DBT4 → Road Users	,050	,114	,441	,659
DWT1 → Road Users	,046	,070	,663	,508
DWT2 → Road Users	,066	,098	,672	,502
DWT3 → Road Users	-,406	,269	-1,507	,132

Based on **Table 7**, the CR results for the gender dummy variable (DGE) are positive, which means that the decrease in concentration and energy loss during traffic jams is more common in males than females. Furthermore, the age dummy (DAG) has a negative CR value, which means those aged over 35 years are more likely to experience a decrease in concentration and loss of energy when traffic jams occur. As for the other dummy variables, the groups that often experience decreased concentration and energy loss are diplomas for education level (DTP), in addition to civil servants for type of work (DEM), married respondents for marital status (DMS), respondents who do not have a vehicle for vehicle ownership status (DVO), respondents with a salary of <3.5 million for the monthly income level (DPTB), respondents who use private vehicles for transportation modes (DMT), respondents with expenses of Rp. 61,000 – 80,000 for transportation costs (DBT), as well as respondents with 61 – 90 minutes for the travel time category (DWT).

CONCLUSION

Based on the results of structural equation modeling, it is known that accessibility has a unidirectional effect on mobility. Furthermore, the variables that have a positive or direct influence on the impact felt by road users due to congestion are mobility, gender, marital status, education level for high school/equivalent and Diploma, vehicle ownership, mode of transportation used with transportation costs between Rp. 21,000 up to Rp. 80,000, and travel time up to 60 minutes. The variables that have a negative effect on road users are accessibility, age, type of work with a monthly income level of up to Rp. 9,500,000, transportation costs between Rp. 5,000 up to Rp. 20,000 with travel time between 61 minutes to 90 minutes.

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