Mode Shift Analysis from Private Car to Public Transport in Reducing Car Use and Improving Traffic Performance for Sustainable Transportation

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Abstract: This study analyzes mode choice behavior on Daan Mogot Road, West Jakarta, to address traffic congestion caused by high private car usage. A stated preference survey was conducted with 384 randomly selected respondents to identify factors influencing a shift from private cars to public transport, specifically Transjakarta Bus Corridor 3. Using a binomial logit regression model, the study found that travel time and congestion cost significantly affect mode choice, with 62% of respondents indicating a mode shift. The model demonstrates a good fit with a coefficient of determination of 0.603, indicating the selected variables significantly influence mode choice.

Keywords: Binomial Logit Regression; Congestion Cost; Mode Choice; Travel Time

1. Introduction

In recent years, many large cities have experienced congestion; these areas have become magnets for business development and employment opportunities[1]. Rapid economic growth has led to high travel demand in cities[2,3], and rapid urbanization causes traffic congestion[4]. Traffic congestion is a characteristic of urban areas caused by increased economic activities, increased productivity of population movement, and inadequate facilities. The increase in the number of private vehicles causes a surge in traffic on the highway and leads to congestion, a problem faced by many cities worldwide[5,6]. In addition, urban congestion is caused by the available infrastructure's inability to absorb demand, especially during peak hours[7]. Traffic congestion is caused by insufficient road capacity and results in slower travel, which leads to lost travel time, losses due to vehicle emissions, and increased traffic accidents[8].

Traffic congestion results in wasted fuel consumption, increased vehicle operating costs, travel time, reduced air quality, and traffic safety. Traffic is one of the primary sources of air pollution from exhaust emissions, which can affect urban air quality, the environment, and society. Pollution from vehicle emissions is the leading cause of death of 3.3 million people per year worldwide, and one of the leading causes is vehicle emissions from traffic[9]. According to[10], the transportation sector contributes 25-30 percent of global CO2 emissions, and nearly two-thirds of transportation-related emissions come from road transportation[11]. Several studies have focused on assessing the impact of emissions from traffic congestion, especially in large cities, which causes increased air pollution that can interfere with health[12]. Air pollution from motor vehicles is one of the world's leading causes of death, accounting for 50,000 deaths in the UK[13]. Studies of Currie[14] show that emissions harm health, increase infant mortality, encourage premature births, and reduce birth weight. Studies[15] and[16] show that heavy traffic can also increase the risk of traffic accidents and fatalities. In this case, traffic can affect the environment due to pollution, so German cities have implemented clean air guidelines by banning the entry of highly polluting vehicles to reduce pollution[17] . Therefore, anticipating high mobility in Urban Areas requires integrated and sustainable urban transportation system planning. A sound public transportation system is needed to improve mobility in increasingly dense urban areas[18].

According to data from the TomTom Traffic Index, Jakarta ranked 31st among the most congested cities in the world in 2020. In 2021, its position dropped to 46th out of 404 cities, with a congestion rate of 34%. However, in 2022, Jakarta climbed back to 29th among the world's most

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congested cities[19]. One of the roads in Jakarta that requires performance improvement is Daan Mogot Road. This main road spans 27.5 km, connecting Tangerang to West Jakarta[20]. Research indicates that the performance of this road, particularly at the intersection of Daan Mogot Road and Jalan Panjang, is significantly poor during peak hours—both in the morning and evening. This road's Level of Service (LOS) is classified as category F, with a saturation degree of 1.22, while the average actual vehicle speed is only 12.5 km/h[21].

Congestion on this road has several negative impacts, including increased vehicle operating costs, loss of time value, higher emissions, increased accident risks, road deterioration, declining public health, and heightened psychological stress[22–24]. Therefore, effective solutions are required to address this issue. Major cities such as Singapore, London, and Sweden have implemented congestion cost systems aimed at reducing congestion and emissions. Congestion Cost is a fee imposed on vehicles entering specific areas of a city during peak hours. In addition to implementing a one-way traffic system and an odd-even vehicle restriction policy, one of the primary recommendations is to encourage a modal shift from private vehicles to Transjakarta buses[25] .

Transport mode selection, known as modal split, distributes trips among available transportation modes based on various influencing factors[26]. The discrete choice model mathematically represents real-world conditions[27]. Generally, travelers' mode choice is affected by various factors, including traffic facilities, public transport service quality, and personal attributes[28,29].

In this study, private cars are selected as the primary focus of analysis due to their larger physical dimensions, greater variability in operating speed, and higher spatial demand within the traffic system, despite motorcycles being more dominant in terms of quantity. From the perspective of road space utilization, a single private car is equivalent to multiple motorcycles; thus, mode shift from private cars to buses is expected to have a more significant impact on improving road capacity compared to a similar shift involving motorcycles.

This study advances previous research by integrating real-world survey data with a robust mode choice model and traffic performance evaluation. Unlike earlier studies that broadly recommended congestion pricing and modal shift strategies, this study quantifies the potential impact of congestion cost on modal shift and road performance. The findings underscore that implementing a congestion charge, combined with improvements in TransJakarta services, can be an effective strategy to alleviate congestion on Daan Mogot Road. These insights provide policymakers with concrete evidence to design targeted congestion management policies that promote sustainable urban mobility in Jakarta.

2. Data and Methodology

This study utilizes the Binary Logit Difference Method, which is commonly applied in discrete choice modeling. As outlined by Tamin (2000), the binary logit regression model is employed to analyze mode choice by incorporating quantitative variables such as travel cost and travel time, which are standard parameters in mode shift analyses.

2.1. Study Location

This study was conducted along Transjakarta Corridor 3, which connects Monas to Kalideres, as illustrated in Figure 1. Transjakarta Corridor 3 is a bus service route that connects Pasar Baru to Kalideres. This corridor passes through several bus stops, including Monas, Petojo, RS Sumber Waras, Grogol 1, Jelambar, Indosiar, Taman Kota, Jembatan Gantung, Dipenda Samsat Barat, Jembatan Baru, Rawa Buaya, Sumur Bor, Pesakih, and Kalideres.

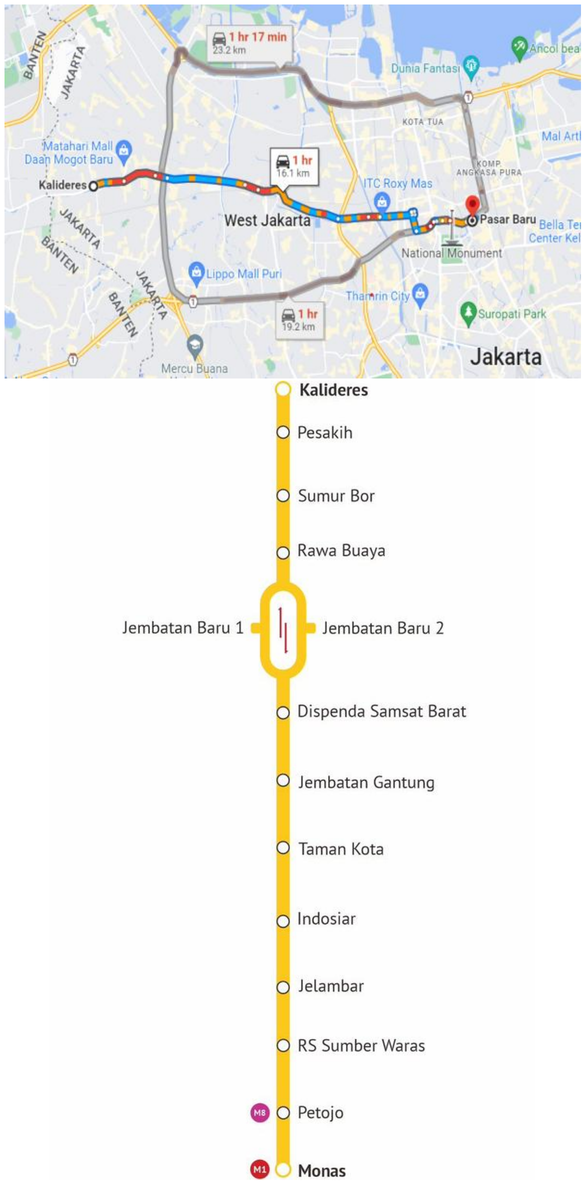

Fig. 1: Study Locations

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2.2. Road Section Performance

The performance of road segments is influenced by several parameters, including vehicle speed, degree of saturation, traffic volume, and road capacity. Following a traffic volume survey conducted along Daan Mogot Road, the collected data were processed to evaluate the operational performance of the roadway segment. This analysis was carried out in accordance with the calculation methods and standards specified in the Indonesian Highway Capacity Guidelines (PKJI) (2014)[30,31]. The primary objective of this analysis is to evaluate the road segment's performance before conducting a mode shift analysis using the binary logit difference method.

The analysis includes calculations of traffic volume, road capacity, degree of saturation, and classification of road service levels, also known as Level of Service (LOS). The calculation of road capacity is conducted using the following equation:

$$C = CO \; x \; FCw \; x \; FCSP \; x \; FCSF \; x \; FCCS \qquad (1)$$

Where:

C = Road Capacity (vehicle/hr)

CO = Base Road Capacity (vehicle/hr)

FCw = Lane width adjustment factor

FCSP = Directional factor

FCSF = Side Friction Factor

FCCS = City Size Factor

Then to calculate the degree of saturation (DS) can be done using the following equation[32]:

$$D = \frac{Q}{C} \qquad (2)$$

C = CO x FCLJ x FCSP x FCSF x FCCS

Where:

Q = Traffic flow (vehicle/hour)

C = Capacity (vehicle/hour)

Subsequently, the road section's Level of Service (LOS) was categorized based on established criteria.

2.3. Public Transportation Performance

In this study, a field survey was conducted to evaluate the operational performance of Transjakarta buses, specifically along Corridor 3 (Monas–Kalideres). The survey examined several key performance indicators, including load factor, travel time, service frequency, and headway. Data collection for load factor and travel time was carried out on Thursday, July 20, 2024, across three time periods: morning, afternoon, and evening. The survey method involved onboard observations, with the surveyors riding Transjakarta Corridor 3 buses as passengers while recording relevant data. The survey was conducted by two observers assigned distinct tasks: Surveyor 1 was responsible for recording passenger counts at the point of departure, during the journey, and at each bus stop; Surveyor 2 measured the distance and travel time between consecutive stops.

2.4. Vehicle Operating Cost

Vehicle operation cost is the cost spent to operate the Vehicle operation cost is the cost spent to operate the vehicle from its origin to the destination. Vehicle operation cost is divided into two components: fixed cost and variable cost[33]. Fixed cost is the cost that remains unchanged despite changes in the travel distance. Meanwhile, variable costs will depend on the travel distance. The cost will vary according to the type of vehicle, type of fuel, maintenance, and other cost[34–36]. LAPI ITB 1997 method is used to calculate the vehicle operation cost. Table 1 shows the cost component and the calculation formula for the LAPI ITB 1997 method.

2.5. Stated Preference

The Stated Preference (SP) technique allows researchers to gather respondents' preferences and behavioral intentions by presenting them with hypothetical scenarios under varying conditions[37]. Socio-demographic data of respondents were collected through an offline interview survey using structured questionnaires. The mode choice attributes included in the survey were identified based on the results of a preliminary attribute identification survey. Attribute data for mode selection were gathered through an offline questionnaire, designed to capture key factors influencing the choice between private cars and Transjakarta buses. The selected attributes primarily reflect quantitative aspects of each mode, such as travel time, travel cost, comfort, and reliability[38]. This survey was conducted offline, but to fill out surveys for respondents, the questionnaires will be distributed online via mobile phone by scanning the barcode on the mobile phone.

The survey was conducted at various locations along Daan Mogot Road, targeting private car users, with a total of 17 distribution points. The interview survey utilized the stated preference (SP) technique, where respondents expressed their preferences based on the given alternatives as stated

Table 1: Formulation for Vehicle Operation Cost Component (LAPI ITB 1997 Method)

Component	LAPI ITB 1997
Fuel consumption	Y = 0,05693S2 - 6,42593S + 269,18567
Oil consumption	Y = 0,00037S2 - 0,0407S + 2,20403
Tire consumption	Y = 0,0008848 S - 0,0045333
Spare parts cost	Y = 0,0000064 S + 0,0005567
Mechanic cost	Y = 0,00362 S + 0,36267
Depreciation cost	Y = 1/(2,50 S + 125)
Capital Interest	Y = 150/(500 S)
Insurance	Y = 38 / (500 S)

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in Table 2. The questions in the survey were designed to gather relevant data for this study while ensuring that the interview process was not too lengthy or disruptive to the respondents' activities. The questionnaire was administered through direct interviews, during which respondents were invited to answer the questions.

A stated preference survey was conducted to understand the impact of congestion pricing implementation on the mode shift between private vehicles and Trans Jakarta. The result from the SP survey is used to obtain a logit biner model. The formulation of individual utility function is developed from the logit biner model. In this study, two independent variables are used: travel time and congestion pricing. Mode shift probabilities will be the dependent variable. A set of scenarios with variations of these two independent variables is included in the SP questionnaire. Table 2 shows the SP scenarios. Logit binary regression is used to define factors that influence the trip maker's choice when implementing congestion pricing. It aims to obtain the probability of mode shifting from private vehicle to public transport, in this case, bus rapid transit (Trans Jakarta), when the congestion pricing is implemented.

2.6. Congestion Pricing Implementation Model

The results obtained from the survey on the performance of the Daan Mogot Road section and the Vehicle Operating Costs (VOC) incurred during both congested and non-congested conditions can serve as a reference in formulating questions for assessing private car users' preferences when selecting a mode of transportation. This study considers two key attributes: travel time (X_1) and congestion cost (X_2). The congestion cost attribute (X_2) is derived from the difference in VOC costs between congested and non-congested conditions, amounting to Rp 18,512.68. Consequently, the congestion cost attribute used in this study is based on the VOC cost differential and the planned congestion cost proposed by the DKI Jakarta Transportation Agency, which ranges from Rp 5,000 to Rp 20,000.

An approach was formulated for the congestion cost scenario to establish a fee range of Rp 10,000 to Rp 20,000, ensuring alignment with the planned congestion cost scheme. The travel time attribute (X_1) was determined by comparing the travel duration of private cars and Transjakarta buses. Based on Jakarta Governor Regulation No. 33 of 2017, which sets the maximum speed of Transjakarta buses at 50 km/h under normal traffic conditions, the longest travel time is estimated to be 56 minutes and the fastest recorded travel time for Transjakarta buses, utilizing an exclusive lane, is 52 minutes. In contrast, private cars have a minimum travel time of 66 minutes and a maximum of 78 minutes. Therefore, the difference between the shortest and longest travel times for Transjakarta buses and private cars serves as a basis for further analysis.

Table 2: SP Scenarios of Congestion Pricing Implementation

Scenario	Travel Time (Minutes)	Congestion Cost (IDR)	Response
1.	15 minutes faster	10000	Using Passenger Car/Using Tj
2.	15 minutes faster	12500	Using Passenger Car/Using Tj
3.	15 minutes faster	15000	Using Passenger Car/Using Tj
4.	20 minutes faster	12500	Using Passenger Car/Using Tj
5.	20 minutes faster	15000	Using Passenger Car/Using Tj
6.	20 minutes faster	17500	Using Passenger Car/Using Tj
7.	25 minutes faster	15000	Using Passenger Car/Using Tj
8.	25 minutes faster	17500	Using Passenger Car/Using Tj
9.	25 minutes faster	20000	Using Passenger Car/Using Tj

According to Tamin (2000), the binary logit regression model is used to model mode choice with commonly used quantitative parameters such as cost and time. Therefore, Equations (3) and (4) are used as follows.

$$Y_i = A + BX_1 + CX_2 \tag{3}$$

$$X_i = Ln[\frac{1-p_1^i}{p_1^i}] \tag{4}$$

So from the equations (3) and (4), we get equations (5) and (6) as follows:

$$B = \frac{(N.\sum X_i Y_i - (\sum X_i \sum Y_i))}{(N.\sum X_i^2 - (\sum X_i)^2} \tag{5}$$

$$A = \bar{Y} - B\bar{X} \tag{6}$$

Hence, it can be assumed that U(Ppv - Ptj) is expressed in terms of two attributes, namely:

$$U\ (Ppv - Ptj) = A + BX_1 + CX_2 \tag{7}$$

Where:

Yi	= non-independent variable
X_1	=variable
X_2	=variable

P^i = Probability of selection
A = regression constant
B and C = regression coefficients
$\bar{Y}$ = average value of Yi
$\bar{X}$ = average value of Xi
U (P_{Pv} - $P_{(TJ)}$)) = Alternative Utility
P_{TJ} = $\frac{expU(Pmp-Ptj)}{1+expU\ (Pmp-Ptj)}$
P_{Pv} = 1 - P_{TJ}

2.7. Data Analysis

The data collected from field data collection (Traffic counting, Load factor of Trans Jakarta), SP survey, and other sources are then analyzed in several stages. From those stages, the cost component and the congestion implementation model will be obtained..

1) Traffic Volume Analysis

Traffic volume data are collected from field observations. In determining the volume of traffic flow, the data used is the highest vehicle volume based on the research survey conducted. The research survey was conducted on Tuesday, Wednesday, and Thursday for 7 hours daily. The survey was conducted on the Monas - Kalideres and Kalideres - Monas road sections. The survey results show that Thursday is the busiest day, with the largest volume of vehicles. The number of vehicles obtained based on the survey was multiplied by the equivalence value according to the Indonesian Road Capacity Guidelines (PKJI 2014) to produce vehicles with light vehicle units (SKR). Based on the Indonesian Road Capacity Guidelines (PKJI 2014), the equivalence value for light vehicles is 1, for heavy vehicles is 1.2, and for motorcycles is 0.25.

2) Road Capacity and Degree of Saturation

According to the Indonesian Road Capacity Guidelines (PKJI) (2014), Road capacity is the maximum flow that can be maintained on a road section at a certain hour/time unit under certain conditions.

3) Vehicle Operating Costs

In this study, the calculation of Vehicle Operating Costs (VOC) is used to consider survey scenarios on Congestion Costs. The calculation of Vehicle Operating Costs (VOC) is only based on the type of light vehicle or, more precisely, MPV, namely the Avanza vehicle. Using Avanza vehicles as one of the BOK calculations was determined through a traffic volume survey conducted on one of the Daan Mogot Road sections, considering the largest number of vehicles crossing the Daan Mogot Road section.

4) Public Transportation Performance

This study conducted a survey to determine the performance of Transjakarta buses, especially corridor three routes (Monas—Kalideres). The survey reviewed the load factor, travel time, frequency, and headway.

5) Implementation of Congestion Pricing and Mode Shift Analysis

The study by January showed that congestion cost comes from the relationship between speed and flow on the road and the relationship between speed and vehicle operation cost[39]. SP survey is conducted to understand the response by road user if congestion pricing was implemented. In the survey, the respondents are asked to respond to series of congestion pricing implementation scenarios (as shown in Table 2). The responses are analyzed using logit binomial model to get the probability of mode shifting from private vehicle to public transport, if congestion pricing is implemented.

6) Evaluation of Traffic Performance After Mode Shift Analysis

After developing the modal shift model from private cars to Transjakarta (TJ), the percentage of private car users who will switch to TJ was obtained. The percentage derived from this study is considered to represent only the light vehicle category (private cars). Consequently, the volume of light vehicles (private cars) passing through Daan Mogot Road is expected to decrease, leading to an improvement in traffic performance on that road segment.

3. Result and Discussion

Based on the survey conducted on Daan Mogot Road, this study obtained results related to the performance of the road section, including road capacity, degree of saturation, level of service, and vehicle speed. Additionally, the study presents findings on Vehicle Operating Costs (VOC), calculated based on the percentage of vehicles crossing Daan Mogot Road, as well as the performance of public transportation, respondent characteristics, and mode selection models. The mode selection analysis includes stated preference methods, sample size determination, mode selection probability, correlation tests, statistical tests, and an assessment of the influence of various attributes on mode choice. Furthermore, the study identifies the most suitable model equations and evaluates the probability of mode selection. Lastly, an evaluation of the road section's performance is conducted following the mode selection analysis.

1) Traffic Volume Analysis

Several parameters, such as vehicle speed and degree of saturation, are used to determine the performance of road sections, including traffic volume and capacity. In this study, the traffic survey was conducted over a single day for a total duration of seven hours, divided into three shifts. The division is arranged as follows: Shift 1: 06:00 am - 08:00 am, Shift 2: 11:00 - 13:00, and Shift 3: 16:00 - 19:00. The survey was conducted on a Tuesday, following a preliminary survey to determine the busiest day among Tuesday, Wednesday, and Thursday. The surveyed vehicles were categorized into three groups: private vehicles, public transportation, and freight vehicles.

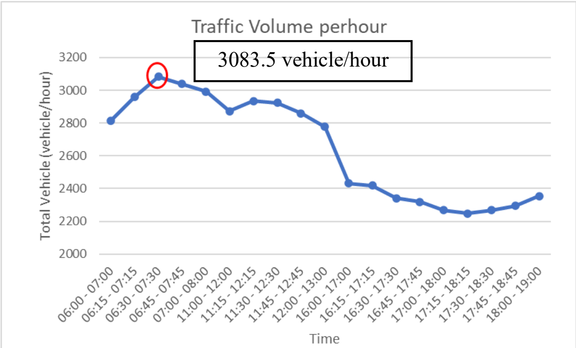

Fig. 2: Hourly Traffic Volume Chart for Monas - Kalideres direction

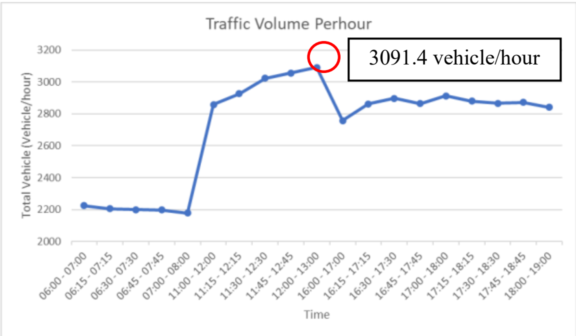

Fig. 3: Hourly Traffic Volume Chart for Kalideres - Monas direction

Based on the traffic volume graph in Figure 2 and Figure 3, it can be seen that the highest traffic volume in the direction of Monas - Kalideres is 3083.5 vehicle/hour and occurs at 06:30 - 07:30. Meanwhile, the traffic volume graph for the Kalideres - Monas direction is 3091.4 vehicle/hour at 12:00 - 13:00.

2) Road Capacity and Degree of Saturation

The capacity of the Daan Mogot road section was calculated using Equation (1). Based on this analysis, the road capacity (C) was determined to be 3,234 vehicles per hour. Several parameters are considered in determining the degree of saturation, which is calculated by dividing the hourly traffic volume by the road section's capacity. The degree of saturation and the corresponding level of service for the road can be observed in Table 3.

The analysis of the level of service on Daan Mogot Road is based on the Indonesian Road Capacity Guidelines (PKJI 2014). In the Monas-to-Kalideres direction, the highest degree of saturation is observed at 0.95 between 06:30 and 07:30, corresponding to the level of service (LOS) E. In the Kalideres-to-Monas direction, the highest degree of saturation is 0.96, occurring between 12:00 and 13:00, also classified as LOS E. A level of service categorized as E indicates that the traffic flow is unstable and may sometimes come to a halt. Furthermore, the traffic volume is approaching road capacity, suggesting that the road is saturated.

Vehicle speed is classified into two categories: free-flow speed and travel speed. This study conducted a survey to

Table 3: Degree of congestion of Daan Mogot Road section

Direction	Time	Total Vehicle/ hour	C	DS	LOS
Study point from Monas to Kalideres direction	06:00 - 07:00	2812,70		0,87	E
	06:30 - 07:30	3083,50		0,95	E
	07:00 - 08:00	2992,50		0,93	E
	11:00 - 12:00	2872,45		0,89	E
	12:00 - 13:00	2777,40		0,86	E
	16:00 - 17:00	2431,15		0,75	D
	17:00 - 18:00	2268,40		0,70	C
	18:00 - 19:00	2353,60	3234	0,73	C
Study point from Kalideres to Monas direction	06:00 - 07:00	2223,60		0,69	C
	07:00 - 08:00	2178,25		0,67	C
	11:00 - 12:00	2858,40		0,88	E
	12:00 - 13:00	3091,40		0,96	E
	16:00 - 17:00	2758,00		0,85	E
	17:00 - 18:00	2912,55		0,90	E
	18:00 - 19:00	2840,90		0,88	E

determine the travel speed, which was found to be 16 km/h. Meanwhile, according to the 2014 Indonesian Road Capacity Guidelines (PKJI), the free-flow speed of vehicles is 56.43 km/h.

3) Vehicle Operating Costs

This study calculated Vehicle Operating Costs (BOK) for the Daan Mogot Road section, which spans 11.2 km. The analysis was based on private car called Avanza vehicles, the most frequently used cars on this route. At a travel speed of 16 km/h, the vehicle operating cost is Rp 1,033.13 per kilometer, whereas at a speed of 56.43 km/h, the cost decreases to Rp 292.93 per kilometer. Consequently, for the entire 11.2 km stretch, the total vehicle operating cost amounts to Rp 49,307.59 at a speed of 16 km/h, while at the free-flow speed of 56.43 km/h, the cost is Rp 30,794.90. This results in a cost difference of Rp 18,512.68 between the two-speed conditions.

4) Public Transportation Performance

This survey was conducted to obtain data on load factors, headway, frequency, and travel time on Transjakarta bus corridor three during and outside peak hours.

a. Load Factor

Based on Table 4, the load factor obtained in the morning,

Table 4: Load Factor of Transjakarta Bus Corridor 3

	Morning	Afternoon	Evening
Time	07.39 - 08.34	11.13 - 12.06	16.03 - 16.59
Parameter	Rush Hour	Non-Rush hour	Rush Hour
Trans Jakarta Capacity	42	39	42
Total Passanger	35	28	34
Load Factor (%)	83,33	72,34	81,8
Scoring Standard	Average	Average	Average

Table 5: Frequency and Headway of Transjarta Bus Corridor 3

Criteria	Value	Score
Headway	4 minutes	Good
Frequency	14 units/hour	Good

afternoon, and evening in sequence is 83.33%, 72.34%, and 81.80%, so the assessment results are in the medium category, where it can be said that the performance of the Transjakarta bus corridor 3 is still fairly feasible and is expected to be able to become one of the preferred modes of transportation.

b. Frequency and Headway

The Table 5 shows the frequency and headway results on Transjakarta bus corridor 3 (Monas—Kalideres), which puts the assessment results in the good category. This means that the performance of Transjakarta bus corridor 3 is still fairly feasible and is expected to be one of the preferred modes of transportation.

5) Mode Choice Model

In this study, 2 attributes were used, namely travel time (X_1) and Congestion Cost (X_2), for the Congestion Cost attribute (X_2) obtained through the difference in the price of VOC at the time of traffic jams and VOC at the time of no traffic jams, which amounted to Rp 18,512.68. So that the Congestion Cost attributes used in this study refer to the results of the VOC difference and based on the Congestion Cost plan that will be applied to several roads in DKI Jakarta of Rp 5,000 - Rp 19,000 planned by the DKI Jakarta Transportation Agency.

Then, an approach is taken to the congestion Cost scenario so that it is worth Rp 10,000 - Rp 20,000. Then, travel time (X_1) is obtained through the difference in travel time for private cars and Transjakarta buses. The fastest travel time on the Transjakarta bus is 52 minutes (exclusive lane), and the longest is 56 minutes (exclusive lane). As for private cars, the fastest travel time is 66 minutes, and the longest is 78 minutes. Therefore, the difference between the fastest and longest time for Transjakarta buses and private cars is 14 minutes and 22 minutes, respectively. So the assumption is that the time of 15 minutes, 20 minutes, and 25 minutes for private cars is faster than it should be with the implementation of congestion cost (X2) on Daan Mogot Road.

Table 6: Regression Analysis Result

Regression Statistics	
Multiple R	0,776
R Square	0,603
Adjusted R Square	0,603
Standard Error	0,821
Observations	3465

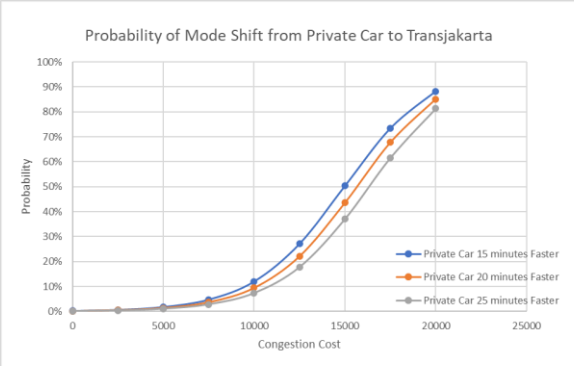

Fig. 4: Probability Graph Model of Mode Shifting from Private Car to Trans Jakarta

A stated preference survey was conducted on 385 respondents at 17 points along Daan Mogot Road. Regression analysis is conducted to obtain the determination of independent and dependent variables. Table 6 shows the parameters that are obtained from the regression analysis.

Based on the regression analysis results, the coefficient of determination (R2) is 0.603 with two independent variables, travel time (X1) and Congestion Cost (X2). The following is the resulting utility function equation:

$$U\ (Ppv - Ptj) = -5.1794 + (-0.05449x1 + 0.000401x2 \qquad (8)$$

Where:

X_1 = Private car travel time is faster

X_2 = Congestion Cost

Based on the Figure 4, it is known that the probability of moving from a private car to Transjakarta is 88%, 85%, and 81% will move with a time difference of 15 minutes, 20 minutes, and 25 minutes, respectively, if the Congestion Cost applied is Rp 20,000. Whereas for a Congestion Cost of Rp 15,000 with a faster travel time of 15 minutes, 20 minutes, 25 minutes, respectively and, the probability of moving private cars to Transjakarta is 50%, 44%, and 37%.

6) Impact of Congestion Cost Implementation on Traffic Performance

Following the mode shift modeling analysis from private cars to Transjakarta buses, a subsequent analysis was conducted to assess changes in road performance based on the projected mode shift percentage. This analysis adopted

Table 7: Road Section Performance Evaluation 81% Probability

Direction	Time	Total Vehicle/ hour	C	DS	LOS
Study points from Monas to Kalideres direction	06:00 - 07:00	2286	3234 vehicle/ hour	0,71	C
	06:30 - 07:30	2418		0,75	D
	07:00 - 08:00	2368		0,73	C
	11:00 - 12:00	2278		0,70	C
	12:00 - 13:00	2253		0,70	C
	16:00 - 17:00	1949		0,60	C
	17:00 - 18:00	1797		0,56	C
	18:00 - 19:00	1888		0,58	C
Study point from Kalideres to Monas direction	06:00 - 07:00	1776		0,55	C
	07:00 - 08:00	1757		0,54	C
	11:00 - 12:00	2294		0,71	C
	12:00 - 13:00	2510		0,78	D
	16:00 - 17:00	2222		0,69	C
	17:00 - 18:00	2321		0,72	C
	18:00 - 19:00	2278		0,70	C

the lowest probability value of 81%, under the assumption that 81% of private car users would be willing to switch to Transjakarta buses under the proposed scenario. In evaluating traffic performance, all vehicle types were converted into passenger car units (PCU) per hour. However, in this mode shift impact analysis, the 81% shift was applied exclusively to the proportion of private cars, without modifying the distribution of other vehicle types such as heavy vehicles and motorcycles.

Analyzing the performance of road sections is carried out using a probability of 81%. A probability of 81% was used as an approach to estimate traffic conditions after a modal shift from private vehicles to Transjakarta buses.After mode selection, the performance evaluation of the Daan Mogot road section can be seen in Table 7.

Based on this Table 7, the level of service of the largest road in Monas - Kalideres and the direction of Kalideres - Monas is class E. After the transfer of private cars to Transjakarta, the level of service of the largest road in both directions is D. So it can be concluded that the analysis of mode selection between private cars and Transjakarta bus corridor three can be one of the recommendations to improve the performance of the Daan Mogot Road section. Therefore, it is important to also improve the service of Trans Jakarta, so that people will be more willing to shift.

4. Conclusion

This study analyzed the factors influencing the choice of transportation mode on Daan Mogot Road, particularly the shift from private vehicles to TransJakarta buses. The findings indicate that the high intensity of private vehicle use has led to severe congestion, resulting in poor road performance with a Level of Service (LOS) rating of E. The study utilized a binary logit regression model to evaluate the impact of travel time and congestion pricing on mode choice. The model revealed that 81% of private car users have shifted to TransJakarta Corridor 3 under certain conditions.

The study also highlighted that congestion pricing implementation could significantly influence mode shift. The cost of vehicle operation was substantially higher during congested conditions, further supporting the need for improved public transportation alternatives. Additionally, an analysis of TransJakarta Corridor 3's performance demonstrated that its load factor, frequency, and headway are at acceptable levels, making it a viable alternative to private car usage.

The results suggest that implementing congestion pricing and improving public transportation services can effectively reduce traffic congestion on Daan Mogot Road. Encouraging a modal shift through strategic policies, including pricing mechanisms and service enhancements, could contribute to more sustainable urban mobility and better road performance in Jakarta.

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