

Strategy to Reduce the Use of Private Cars and Motorbikes to Campus to Support the Green Campus Program

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Abstract— The United Nation states that vehicle fuel gas emissions from the transportation sector are a significant contributor to global warming. One of the preventative steps that universities can take is to limit the use of vehicles to and within the campus environment. Andalas University as one of the largest campuses in West Sumatra is very interested in taking an active role in reducing vehicle fuel gas emissions. The first aim of this research is to observe the ratio of vehicles entering campus to the campus population, and calculate the percentage reduction in private vehicle use, in order to increase the UI green metric level. Second, identifying potential private vehicle users who will switch to using Trans Padang public transportation. Traffic volume data collection is carried out using video recordings. A questionnaire interview survey was also carried out to analyze the campus population's preference for switching to public transportation. The survey results show that the volume of vehicles entering campus is more than twelve thousand vehicles. To achieve an increase in the value of one level of the UI green metric requires a reduction in private vehicles of 63.4%. The results of the chi-square test for the variables of employment, private vehicle ownership, and monthly income influence the variable frequency of private vehicle use. Users of motorbikes, private cars, online taxis and paratransit wish to shift mode using Trans Padang, and conventional motorcycle taxi users really wish to shift mode using Trans Padang.

Keywords: *Green Metric, Chi-square test, Index value.*

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1. Introduction

The United Nations states that greenhouse gas emissions from transportation contribute significantly to global warming. In Jakarta, recent research shows that air pollution causes more than 10,000 deaths, 5,000 hospital admissions, and 7,000 children experience various health problems yearly, with losses reaching trillions of rupiah [1]. Various efforts are needed to overcome the problems arising from transportation sector emissions. Regarding the issue of air pollution, which is getting worse in Jakarta, the government is trying to deal with air pollution through public transportation [2]. The government is trying to improve the quality of public transportation as a solution to dealing with air pollution through the electrification of Transjakarta public transportation [3]. One option for implementing the concept of environmentally friendly transportation in the campus area is a transportation policy to limit the number of private motorized vehicles on campus, and instead encourage the use of public transportation which will have a healthier environmental impact [4].

Research shows that road expansion will trigger the emergence of new trips by motorized vehicles (induced demand). However, in the long term, new roads will also experience congestion due to the increased use of motorized vehicles due to temporary "driving comfort". The same thing also

happens with the provision of parking spaces. Additional parking spaces in an area will result in more private vehicle use, as abundant parking spaces increase the convenience of accessing the area by car or motorbike. Without efforts to control the use of private motorized vehicles, there will still be the issue of insufficient parking space due to increasing dependence on cars and motorbikes [1].

Starting December 20, 2022, the Trans Padang bus corridor VI with the Padang City Center - Unand Campus route will officially be launched. This form of cooperation between the city government and Andalas University is expected to support the city of Padang as a healthy, comfortable, smart, and green city, just like Andalas University has a green campus. The presence of the Trans Padang bus supports the need for mass transportation because there are many Andalas University students. If it is not supported by the existence of this fast transit bus, the problem of congestion and unavailability of parking facilities will disrupt campus activities. The survey results on the volume of vehicles entering the Andalas Limau Manih University campus compared to the population of the campus community still need improvement according to UI Green Metric standards. This research tries to simulate a reduction in the number of vehicles entering campus, assuming that users will move using mass public transportation, namely Trans Padang buses and commuter campus buses.

This research tries to simulate a reduction in the number of vehicles entering campus, assuming that users will move using mass public transportation, namely Trans Padang buses and commuter campus buses. A willingness to use public transportation survey was conducted to find out what percentage of private vehicle users want to switch to using public transportation (Trans Padang buses and campus shuttle buses).

2. Method

2.1 Data Collection Methods

In this research, there are two (2) data collection methods. First, collecting data on the volume of vehicles entering the Andalas University campus in Limau Manih Padang. Data was obtained through a video recording survey of vehicles entering campus starting at 07.00 a.m. until 05.00. p.m. The survey was carried out over three (3) working days. The video recording results are read through a media player, and by using a counter application, vehicle volume data is classified based on motorcycle (MC), light vehicles light vehicle consisting of private cars and paratransit (“angkot” in bahasa), and buses. Carrying out a video recording survey of the volume of vehicles entering campus, as shown in Figure 1.

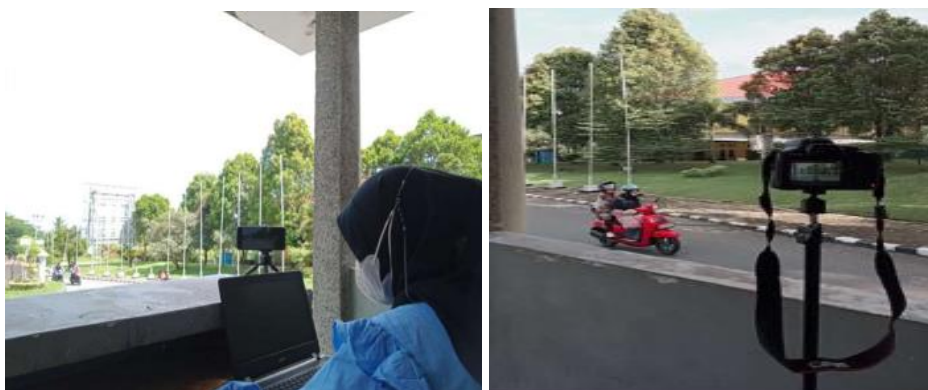


Figure 1. The Traffic Volume Survey

The second data collection method is through a questionnaire to determine the potential for campus communities to switch to using public transportation. The distribution of questionnaires was carried out offline and online. The questionnaire is designed in 2 parts. The first part is to determine the personal characteristics of respondents, namely gender, occupation, vehicle ownership, income per

month, modes of transportation frequently used to and from campus, and frequency of use. In the second part, the preference for moving by bus was asked if given the option of comparing cost, comfort, safety, accessibility, and efficiency with frequently used vehicles. In research regarding willingness to use a public bicycle system in Nanjing City, it was found that socioeconomic factors (gender, employment, and car ownership) have more impact on user willingness than travel restrictions [5]. The factors influencing the commuters' willingness to use KRL, MRT, and BRT modes in Jakarta are security, safety, amenities, affordability, equity, and regularity [6].

Respondents select preferences using a Likert scale. The measurements in this study used a 1-4 Likert scale, namely:

Scale 1 = Really do not want to switch to using Trans Padang buses

Scale 2 = Do not want to switch to using public Trans Padang buses

Scale 3 = Want to switch to using Trans Padang buses

Scale 4 = Really want to switch to using Trans Padang buses

Questionnaire interview survey of the campus population (students, employees, and lecturers) by sampling. Determination of the number of samples using a simple random sampling technique. Based on the Slovin formula [7], with a population of 35,212 and an error of 5%, the minimum sample size is 394 respondents. In this study, 520 respondents filled out the questionnaire completely. Distribution of questionnaires directly at Economic and Business Faculty (FEB), Medical Faculty (FK), Faculty of Engineering (FT), Faculty of Agriculture (FP), Faculty of Mathematics and Natural Sciences (FMIPA), and Faculty of Animal Husbandry (Faterna) parking locations, where Trans Padang buses pass. The online survey used a Google form with the same questions and was shared via the researcher's social media.

2.2 Data Processing Methods

The data processing method to increase the parameter value of the ratio of the number of vehicles compared to the population of the campus community is by simple trial and error. There are 3 variables (number of motorbikes, light vehicles and buses) that influence the total number of vehicles. The variable number of motorbikes and light vehicles was reduced to lessen the number of vehicles entering campus, while the number of buses entering was increased. However, this research only limits the discussion to the percentage of people who want to move using Trans Padang bus transportation. Another study discusses how many buses should operate if there is a reduction in the number of vehicles.

Respondents' personal characteristics data were processed using descriptive statistics. Then, a cross-tabulation was carried out to look for factors that influence the frequency of use of public transport. The chi-square test was carried out using the SPSS 22 software [8]. The conclusion regarding the willingness to switch to using Trans Padang buses is the result of the value generated by using the Index% formula [9].

$$\text{Index \%} = \text{Total Score} / Y * 100 \quad (1)$$

$$\text{Score Interval} = 100 / \text{total Likert score} \quad (2)$$

$$Y = \text{highest Likert score} * \text{number of respondents} \quad (3)$$

Criteria for interpretation of scores based on intervals:

Value 0% - 24.99% = Really do not want to switch to using Trans Padang Bus

Value 25% - 49.99% = Do not want to switch to using Trans Padang Bus

Value 50% - 74.99% = Want to switch to using Trans Padang Bus

Value 75% - 100% = Really want to switch to using Trans Padang Bus

3. Result and Discussion

The results of the average traffic volume for three (3) days of data collection are shown in Table 1. Under existing conditions, the average number of vehicles per day entering the Limau Manih University campus is 12,000, consisting of 80% motorbikes, 19.35% light vehicles, and 0.65% buses. The population of Andalas University is 35,316 people, so the ratio of the number of vehicles and the population is 0.34. The strategy to increase the parameter value of the ratio of the number of vehicles and the total population is to reduce the total number of vehicles entering the campus by 63.4% or a ratio value of 0.124. The reduction in motorbikes and light vehicles entering campus was 63.4%, while the addition of buses entering was 0.25%.

Table 1. Number of Vehicles Entering Campus

Type of vehicle	Existing Condition	The expected Condition
Motorcycle (veh)	9,600	3,470
Light Vehicle (veh)	2,322	840
Heavy Vehicle; buses (veh)	78	80
Total (veh)	12,000	4,390
Ratio vehicle population	0.34	0.124

The results of the recapitulation of questionnaire data from 520 respondents showed that 54% of respondents were male, 66% of them were students, only 26% did not have private vehicles and 45.6% had an income of Rp. 1,000,000-5,000,000 per month (table 2).

From the question of which vehicle is most often used to go to campus, using public transportation is greater (46%) than using private vehicles (44%) where 16% are paratransit users and 11% are Trans Padang transit bus users, the rest use conventional motorcycles (MC) taxi, online MC taxi, online car taxi (Figure 2).

The reasons for using vehicles in the previous question are using Trans Padang buses for reasons of cost and comfort, using paratransit and online MC taxis for reasons of accessibility, using online car taxis for efficiency considerations (Figure 3).

Paratransit was the public transportation most frequently used in the last two (2) weeks when the survey was carried out, where 49% used it more than six (6) times per week (Figure 4).

Table 2. Characteristic Responden

Variable	Characteristic Responden	Percentage
Gender	Male	56
	Female	44
Occupation	Student	66
	Staff	8
	Lecturer	11
	Other	15
The motorized vehicle Ownership	Motorcycle	48
	Car	11
	Motorcycle and Car	16
	Not owning	26
Income per month (Rp)	<1,000,000	31.9
	1,000,000-5,000,000	45.6
	5,000,000-10,000,000	18.8
	>10,000,000	3.7

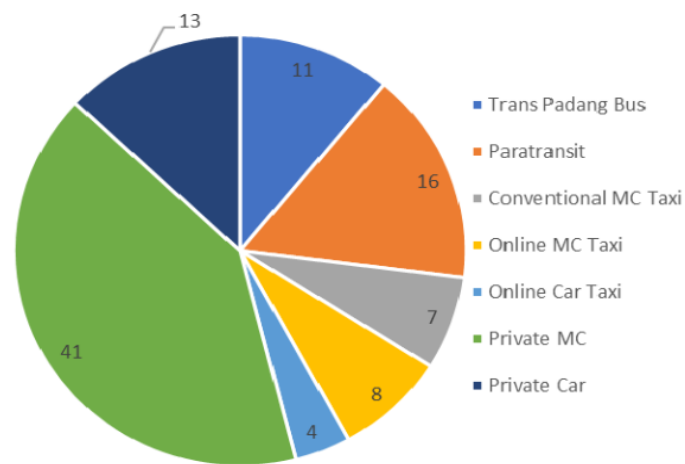


Figure 2. Frequently used vehicles

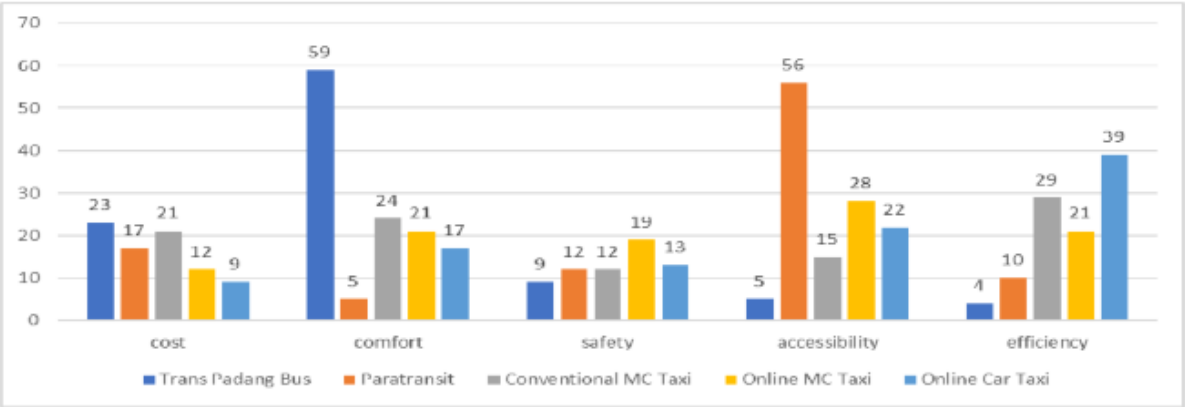


Figure 3. Reasons for using the vehicle

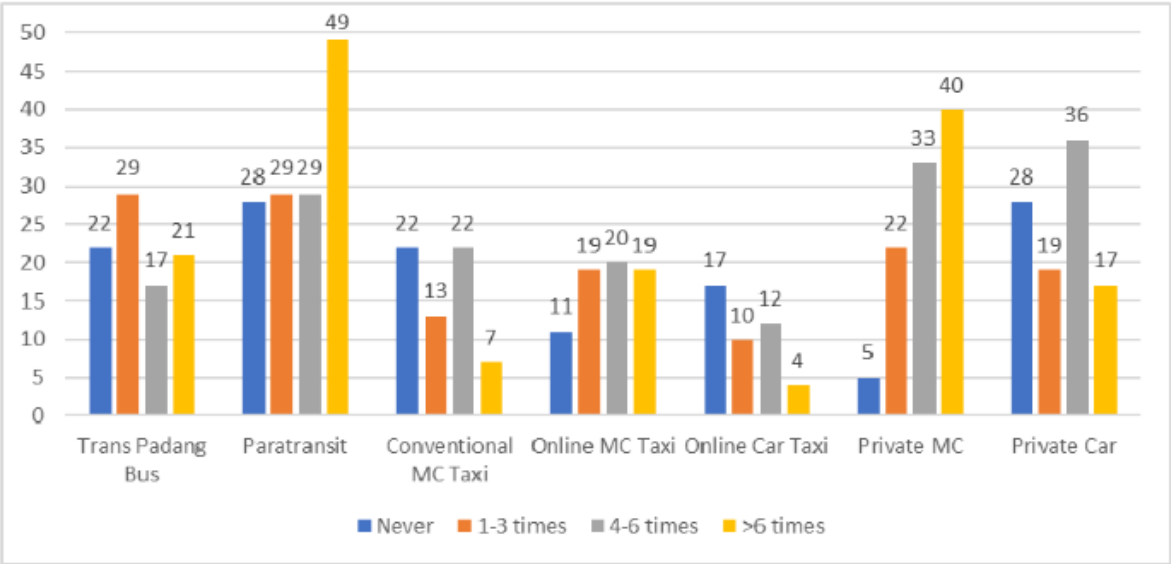


Figure 4. Frequency of vehicle use in the last 2 weeks

The results of the cross-tabulation chi-square test of the variables occupation, private vehicle ownership, and income per month with the variables frequently used vehicle, frequency of vehicle use in the last 2 weeks with a confidence level of 95% ($\alpha=0.05$) are summarized in table 3. The null hypothesis assumption (H_0) in the hypothesis test is that there is no relationship between the occupation, private vehicle ownership, income per month and the variable frequently used vehicle, frequency of vehicle use in the last 2 weeks at $\alpha=5\%$. If the P-value < 0.05 , then the decision is to reject H_0 . It was concluded that there was relationship between variables [10].

The statistical test results for all variables obtained P-value (Asymp. Sig.) = 0.00 < 0.05 (table 3). Conclusion Null Hypotheses (H_0) are rejected, meaning that the variable occupation, private vehicle ownership, and income per month affect the variable frequently used vehicle frequency of vehicle use in the last 2 weeks.

Table 3. Chi-square test

Variable			P-Value	Conclusion
Occupation	frequently used vehicles		0.00	Reject H_0
	Frequency of vehicle use in the last 2 weeks		0.00	Reject H_0
Private vehicle ownership	frequently used vehicles		0.00	Reject H_0
	Frequency of vehicle use in the last 2 weeks		0.00	Reject H_0
Income per month	frequently used vehicles		0.00	Reject H_0
	Frequency of vehicle use in the last 2 weeks		0.00	Reject H_0

The willingness of the non-bus user campus community to switch to using Trans Padang buses was 62.5% (table 4). The data processing results using the index method show that conventional motorcycle taxi users really want to switch to using Trans Padang Buses, while other non-bus users want to switch to using Trans Padang Buses (table 5).

Table 4. Willingness to switch to the Trans Padang buses

Frequently used vehicle	Really do not want to switch	Do not want to switch	Want to switch	Really want to switch	Total
Private MC	27	90	68	29	214
Private car	9	30	16	12	67
Online MC/car taxi	0	14	52	0	66
Conventional MC taxi	0	0	34	0	34
Paratransit	0	4	79	0	83
Total	36	138	249	41	464

Table 5. Index Value

Frequently used vehicle	Index value (%)	Interpretation
Private MC	61.6	Want to switch to using Trans Padang Buses
Private car	61.6	Want to switch to using Trans Padang Buses
Online MC/car taxi	69.7	Want to switch to using Trans Padang Buses
Conventional MC taxi	75.0	Really want to switch to using Trans Padang Buses
Paratransit	73.8	Want to switch to using Trans Padang Buses

The strategy to reduce the number of non-bus vehicles entering campus by 63.4% has the potential to be achieved because the campus community's willingness to switch to using Trans Padang buses is an average of 62.5%. To achieve this, a strategy that integrates Trans Padang buses and campus shuttle buses is needed to overcome weaknesses in accessibility and efficiency. It is necessary to increase the Trans Padang corridor 6 bus fleet operating to increase mobility using Trans Padang buses.

4. Conclusion

Under existing conditions, the average number of vehicles per day entering the Limau Manih University campus is 12,000, consisting of 80% motorbikes, 19.35% light vehicles, and 0.65% buses. The population of Andalas University is 35,316 people, so the ratio of the number of vehicles and the population is 0.34. The strategy to increase the parameter value of the ratio of the number of vehicles and the total population is to reduce motorbikes and light vehicles entering campus was 63.4%, while the addition of buses entering was 0.25%. The chi-square test results for the variables occupation, private vehicle ownership, and income per month affect the variable frequently used vehicle frequency of vehicle use in the last two weeks. The reasons for using Trans Padang buses are cost and comfort. The willingness of the non-bus user campus community to switch to using Trans Padang buses was 62.5%. The strategy that integrates Trans Padang buses and campus shuttle buses is needed to overcome weaknesses in accessibility and efficiency. It is necessary to increase the Trans Padang corridor 6 bus fleet operating to increase mobility using Trans Padang buses.

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