Understanding travel behavior to increase interest in using public transportation on commuting to work

M Bria1, L Djakfar1, A Wicaksono1

1University of Brawijaya, Faculty of Engineering, Department of Civil Engineering, MT. Haryono Street 167, Malang 65145, East Java, Indonesia

Correspondence: melchibria@gmail.com

**Abstract**. The significant use of public transportation mode by workers in commuting to work contributes to easing congestion in urban areas. Therefore, this research aims to analyze workers' mode choice behavior in commuting to work using the relationship approach consisting of travel and work characteristics. The travel characteristics variables comprise the time to and from work, and stopovers during the trip, while the work characteristics variable is time to enter and finish a job. Respondents in this study are employees that work in the formal sector, with the descriptive analysis based on the cross-tabulation method used to identify the relationship between variables. The results showed that the time to go to work, return home, and stopover when leaving has a strong effect on transportation modes. Meanwhile, the time to start and finish work has a moderate effect, with the majority making use of private vehicles. Therefore, based on these findings, the management of the urban transportation system needs support from office management to implement policies that can optimize the use of public transportation modes.

**Keywords**: Commuting to Work, Travel Behavior, Transportation Mode, Travel Characteristic, Work Characteristic

1. Introduction

The increasing use of private vehicles and the disproportionate provision of facilities and infrastructure with suboptimal public transportation activities and services has led to high traffic congestion and pollution in urban areas [1]. Therefore, various countries worldwide are seeking ways to reduce the use of private vehicles and encourage citizens to use public transportation [2]. However, the separation of economic centers and settlements into rural and urban areas has encouraged private vehicles' dependence [3, 4]. Therefore, various policies, such as public transportation, need to be implemented to ease congestion [5].

One of the types of trips that significantly contribute to vehicles' density in urban areas is the round trip with work. Therefore, due to reason, it is essential to understand the characteristics of commuting to work, such as the means of transportation utilized. According to several studies, travel characteristics such as time, distance, and costs are identified as factors that influence the choice of transportation modes [6]. Generally, the study time consists of travel, waiting, and movement time. [7] stated a person's ability to travel is greatly influenced by that travel time, while the distance is influenced by land use conditions and accessibility to public transportation [8, 9]. Furthermore, in several other studies, it was stated that travel time, distance, and cost significantly affect mode choice [10 - 14]. Meanwhile, time, mileage, and cost are susceptible to the use of transportation modes [15], whereby the more prolonged and farther the distance, the greater the decrease in the use of public transportation [16].

However, specific routine trips, such as commuting to work, are closely related to work characteristics, which are generally still the focus of office management, providing incentives, duration, and working time arrangements [6, 17, 18]. There are currently limited studies on the relationship between job and travel characteristics in describing mode choice behavior and using cross-tabulation analysis methods. Therefore, this research aims to analyze the mode choice behavior in commuting to work using the relationship approach between travel characteristics and work with the transportation modes. The variables studied in the travel characteristics are travel, stopover, and distance time, while work characteristics include hours of entry and completion of work.

1. Method

This study was carried out in the city of Jakarta to determine the behavior of people commuting to work during working days. Travel behavior is the relationship between work trips and work characteristics using transportation modes. In the characteristics of work trips, the variables used are time to go to work (X1), time to come home from work (X2), to stop by when going to work (X3), and to stop by when coming home from work (X4). For work characteristics, the variables used are the time to start work (X5) and time to finish work (X6). To complement this study, the travel distance variable (X7) was also analyzed, with the vehicle ownership used as the control variable. The modes of transportation (Y) which are the object of study are Transjakarta bus rapid transit (BRT), Jakarta mass rapid transit (MRT) Jakarta, cars, motorbikes, online taxis, and online motorcycle taxis.

Data were obtained from a survey of 250 workers in the formal sector that travels to and from the city of Jakarta in a bid to go work using a questionnaire, which consists of questions related to the research variables. Table 1 shows the research variables and measurement models used to produce data to be used for analysis.

**Table 1:** Research variables and their measurements

|  |  |  |
| --- | --- | --- |
| No | Variables | Measurement |
| 1 | Time to go to work | (1) < 05.00; (2) 05.00 – 07.00; (3) > 07.00 – 09.00; (4) > 09.00 |
| 2 | Time to come home from work | (1) < 16.00; (2) 16 – 18.00; (3) >18 – 20.00  (4) > 20.00 |
| 3 | To stop by when going to work | (1). Never; (2) 1 stopover; (3) 2 stops; (4) > 2 stops |
| 4 | To stop by when coming home from work | (1) Never; (2) 1 stopover; (3) 2 stops; (4) > 2 stops |
| 5 | Time to start work | (1) 07.00 – 08.00; (2) > 08.00 – 09.00; (3) > 09.00 – 10.00; (4) > 10.00 |
| 6 | Time to finish work | (1). < 16.00; (2) 16.00 – 17.00; (3) > 17.00 – 18.00; (4) > 18.00 |
| 7 | Travel distance | (1) < 5 Km; (2) 5 – 10 Km; (3) > 10 – 15 Km; (4) >15 – 20 Km; (5) > 20 Km |
| 8 | Transportation mode | (1) Transjakarta BRT; (2) Jakarta MRT; (3) Car; (4) Motorcycle; (5) Online taxis; (6) Online motorbike taxis |

The collected data were analyzed with a cross-tabulation used to determine the relationship between one variable and another in two stages. The first is to determine the correlation between the variables in the row and the column in the table. In this method, a variable is defined with respect to a column and a row. The mode of use (Y) is placed in the column in the table, and the other variables (X1 - X7) are placed in the row, respectively. Therefore, when the variable in the row is Xi, and the column is Yj, the general hypothesis tested in this study is as follows:

* H0: there is no relationship between Xi and Yj
* H1: there is a relationship between Xi and Yj

When the chi-square coefficient is less than 0.05, H0 is rejected, which means a relationship between Xi and Yj. Conversely, when the chi-square coefficient is above 0.05, H0 is accepted, which means there is no relationship between Xi and Yj. To understand the correlation between variables, strong intervals above 0.4 and 0.2 - 0.4 are moderate, while those below 0.2 are weak.

The second is the analysis of travel behavior using the cross-tabulation method. The variables used are those with a significant influence on the use of transportation modes in commuting to work, while the control variable used to determine travel behavior is vehicle ownership. Therefore, each variable with a significant effect is compared with the mode of transportation used and vehicle ownership.

1. Result and Discussion

## Analysis of variable relationships

The relationship between variables X and Y is expressed in Pearson chi-square values. Table 2 shows the relationship between variables, which is determined based on the coefficient of asymptotic significance (2-sided) and a certain contingency coefficient. In general, the entire sample is valid with degrees of freedom (df) of 15.

Based on the results of the analysis in Table 2, it can be seen that the Pearson chi-square coefficient for variables X4 and X7 are above 0.05. Therefore H0 was accepted, which means that there is no relationship between these variables and the mode of transportation used. However, the other variables (X1, X2, X3, X5, and X6) have a significant relationship with the use of transportation modes.

**Table 2**: The value of the chi-square coefficient and the contingency coefficient

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable  Xi \* Yi | N valid | Pearson Chi-Square | | | Contingency  Coefficient |
| Value | Df | Asymptotic significance (2-sided) |
| X1 \* Y | 250 | 61.7 | 15 | 0.000 | 0.445 |
| X2 \* Y | 250 | 59.3 | 15 | 0.000 | 0.438 |
| X3 \* Y | 250 | 52.9 | 15 | 0.000 | 0.418 |
| X4 \* Y | 250 | 27.9 | 15 | 0.220 | 0.317 |
| X5 \* Y | 250 | 41.1 | 15 | 0.000 | 0.376 |
| X6 \* Y | 250 | 43.8 | 15 | 0.000 | 0.386 |
| X7 \* Y | 250 | 30.6 | 15 | 0.060 | 0.331 |
|  |  |  |  |  |  |

## Travel behavior analysis

Firstly, travel behavior is based on the time to go to work, the mode used, and vehicle ownership. The analysis results show that the majority of trips from home to work based on the type of transportation mode used are made at intervals between 5 am and 7 am. Furthermore, 57% of trips between 5 and 7 hours use Transjakarta buses, MRT, online taxis, and motorcycle, respectively. For those with motorbikes, most of their trips are carried out from 7 to 9 in the morning (64%).

However, not everyone that owns a motorbike uses it when traveling to work. Those that own it motorbike but use Transjakarta buses and those that travel between 5 - 7 in the morning are 15%, while those that use MRT and online motorcycle taxi are 9% and 7%. However, respondents that traveled by car despite owning cars and motorbikes carried out the activity before 5 am (57%). Approximately 26% traveled between 5 - 7 in the morning, and the rest were above 9 am. Meanwhile, 18% only traveled by motorbike at the time below 5 am, between 5 - 7 hours was 55% and above 9 hours was 27%.

Secondly, travel behavior is based on time to come home from work, the mode used, and vehicle ownership. In general, most people commuting time from work from 4 pm to 6 pm. For respondents using Transjakarta public transportation, 27% traveled home before 6 pm, 45% between 4 pm - 6 pm, 12% between 6 pm - 8 pm, and 16% after 8 pm. Likewise, for MRT users, cars, motorbikes, and online vehicles, most return trips are made in the range of 4 pm - 6 pm. Approximately 66% of respondents that use motorbikes travel between 4 pm and 6 pm, 15% travel back between 6 pm - 8 pm, and 12% after 8 pm. However, based on vehicle ownership, 58% of the respondents that own cars and motorbikes make their way home before 4 pm, while 54% of those that use motorbikestravel before 4 pm.

Thirdly, travel behavior is based on stopover activities when leaving for work, the mode used, and vehicle ownership. When traveling while leaving for work, 88% of Transjakarta bus users did not stop over when leaving for work. Likewise, 89%, 82%, and 84% of MRT, car, and motorbike users. For online transportation users, 75% and 70% of online taxi and motorcycle users did not stop. However, for those that have motorbikes, approximately 16% make one stop on each trip to work.

Fourthly, travel behavior is based on time to start work, the mode used, and vehicle ownership. The analysis showed that 42% of Transjakarta bus users come to work at 7 am, 24% at 8 am, and 28% at 9 am. Furthermore, 63%, 39%, 29%, and 32% of MRT, car, motorbike, and online transportation users come to work at 8 am. Approximately 21%, 9%, 4%, and 4% of employees used MRT, cars, motorbikes, and online transportation, respectively. These results show that private vehicle users generally enter work earlier than others. Furthermore, 33% of those that have motorbikes but use public transportation leave for work, 35% at 8 am, 29% at 9 am, and 3% after 9 am.

Fifthly, the commuting to work behavior is based on the time to finish, the model used, and vehicle ownership. The analysis results show that Transjakarta bus users at most finish work before 4 pm by 39% and at 5 pm 31%, while MRT users generally finish at 5 pm, which is 68%. For private car users, as many as 43% finish work at 5 o'clock and before 4 pm, while 48% of motorbike users finish at 5 pm. Meanwhile, on average, online transportation users finish work after 18 hours, which is 35%. Judging from vehicle ownership, however, using public transportation when commuting to work, most people that have motorbikes generally end their work at 4 pm.

Based on the relationship analysis between travel and work characteristics as well as the mode used, the results showed that the time to go to work, return home from work, and stop by when going to work has a strong influence on the use of transportation modes. Meanwhile, the time to start and finish work has a moderate effect on transportation modes. This context shows that the work trips that shape travel behavior are also influenced by the characteristics of a person's work, which are related to the hours of entry and return. This finding is reinforced by the cross-tabulation analysis, which stated that the average trip made between the time range from 6 am to 9 am is related to the time of entry to the office in the morning. The analysis also shows the high use of private vehicles, especially for employees whose time to work is 7 in the morning. The results can be used to explain the congestion that occurs from 6 am - 9 am during rush hours on Jakarta roads every working day.

Therefore, in connection with this result, the office management role can be included as one of the regulators that can change employee behavior in using public transportation, for example, by issuing a policy on the flexibility of time to work and finish from office. This finding is in line with Ermans' [17] research, which stated that in controlling the behavior of using personal vehicles on commuting to work trips in the city, it is necessary to involve the office's management where the employee works. Therefore it is essential to combine integrated transportation policies in collaboration and interaction with all parties, such as government, office management, and the community [19].

For this reason, a more comprehensive study is needed to determine the extent to which office management can play a role in controlling the use of private vehicles during working days. This study is limited to explaining the relationship between several factors in the characteristics of travel and work. Therefore, an in-depth study is needed not only for working time and providing incentives, rather for workloads or overtime.

1. Conclusion

In conclusion, the relationship between travel time, stopover activities during a trip, and aspects of time to enter and finish work on the modes used moderate and robust significance. Conversely, private vehicles, such as motorbikes and cars, still dominate the transportation mode of commuting to work. Therefore, for this reason, efforts to increase interest in using public transportation need to be carried out in an integrated manner by taking into account the work characteristics.

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