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

Melchior Bria1, Ludfi Djakfar1, Achmad 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 use of transportation modes in commuting to work contributes to congestion in urban areas and is closely related to their work. Therefore, this article describes the relationship between variables related to travel characteristics and work characteristics, and transportation modes used. The travel characteristics variables are the time to go to and from work, stopovers during the trip, and the work characteristics variables are the time to enter and finish work. The identification of the relationship between variables used descriptive analysis based on the cross-tabulation method. The analysis results show that the time to go to work, time to come home from work, stopover when leaving for work has a strong effect on the use of transportation modes. The time to start work and time to finish work has a moderate effect on transportation modes. The majority of transportation modes used in commuting to work are private vehicles. Based on these findings, the management of the urban transportation system needs support from office management to implement policies that can be an effort to optimize the use of public transportation.

**Keywords** : Commuting to Work, Transport 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 resulted in high congestion in urban areas and pollution [1]. Therefore, almost all countries always try to reduce the use of private vehicles while trying to get their citizens to use public transportation [2]. On the one hand, the separation of economic centers and settlements leads to dependence on private vehicles [3, 4]. However, travel in an area must still occur without increasing congestion [5].

One of the types of trips in the city that most contributes to the density of vehicles in urban areas is a round trip with work. For this reason, it is essential to understand the characteristics of commuting to work, one of which is the choice of mode. In many studies, travel characteristics such as time, distance, and travel costs are identified as factors that influence the choice of transportation modes [6]. In general, the study of time includes travel time, waiting time, and time when movements occur. Travel time is greatly influenced by a person's ability to travel [7]. Meanwhile, the distance traveled is influenced by land use conditions and accessibility to public transportation [8, 9]. In several other studies, travel time, distance, and cost significantly affect mode choice [10 - 14]. Furthermore, time, mileage, and cost are susceptible to the use of transportation modes [15], where the more prolonged and farther the use of public transportation tends to decrease [16].

However, specific routine trips, such as commuting to work, are closely related to work characteristics. Studies on work characteristics are generally still the focus of office management, such as working duration, providing incentives, and working time arrangements [6, 17, 18]. It seems that there have not been many studies on the relationship between work characteristics and travel characteristics in describing mode choice behavior. In this article, we examine the mode selection behavior using the approach of the relationship between travel time (time to go to and from work), stopover activities during travel (when leaving and returning from work), and work characteristics, namely the hours of entry and completion of work to the use of transportation modes to travel and mileage. We use cross-tabulation analysis, which is rarely used to describe the behavior analysis of transport mode choice.

1. Method

This study is intended to explain the relationship between variables related to the characteristics of work and work trips and the use of transportation modes (Y1). For the characteristics of work trips, the variables used are a time to go to work leave (X1), time to come home from work (X2), stopover when leaving for work (X3), and stop by when coming home from work (X4). For work characteristics, the variables used are work time, namely time to start work (X5) and time to finish work (X6). The mileage variable (X7) was also analyzed. As a control variable, we use vehicle ownership.

The data for this study were obtained from a survey of workers in the formal sector who commute from home to work and commute every day within Jakarta. The survey used a questionnaire with a total of 250 respondents. The questionnaire contains questions related to research variables, and respondents are asked to choose according to the available answer choices. Furthermore, to see each variable's relationship to transportation modes on work trips, we use the cross-tabulation method. If the variable Xi is independent, and the variable in the column is Yj is the dependent variable, the general hypothesis tested in this study is:

Ho: there is no relationship between variable Xi and variable Yj

H1: there is a relationship between variable Xi and variable Yj

To determine there is no relationship based on the chi-square coefficient, where if < 0.05, then reject H0, and if the chi-square coefficient > 0.05, then accept H0. Furthermore, variables that significantly affect the choice of transportation modes are included in cross-tabulations to see employee trips' characteristics. For correlation we used intervals > 0.4 strong; 0.2 - 0.4 is moderate and < 0.2 is weak.

1. Result

## Analysis of variable relationships

Based on the results of the analysis in Table 1, it can be seen that the Pearson chi-square coefficient for variables X4 and X7 > 0.05, so accept H0, which means that there is no relationship between these variables and the mode of transportation used. Thus the other variables (X1, X2, X3, X5, and X6) have a significant relationship with the use of transportation modes.

**Table 1**. 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 \* Y1 | 250 | 61.7 | 15 | 0.000 | 0.445 |
| X2 \* Y1 | 250 | 59.3 | 15 | 0.000 | 0.438 |
| X3 \* Y1 | 250 | 52.9 | 15 | 0.000 | 0.418 |
| X4 \* Y1 | 250 | 27.9 | 15 | 0.220 | 0.317 |
| X5 \* Y1 | 250 | 41.1 | 15 | 0.000 | 0.376 |
| X6 \* Y1 | 250 | 43.8 | 15 | 0.000 | 0.386 |
| X7 \* Y1 | 250 | 30.6 | 15 | 0.060 | 0.331 |
|  |  |  |  |  |  |

## Travel behavior analysis

First, the travel behavior based on the time to go to work, the mode used, and vehicle ownership. The results of the analysis 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. trips between 5 and 7 hours, 57% of which use Transjakarta buses, use the MRT, online taxis and online motorcycle taxis, respectively 14%. Then for those who have motorbikes, most of their trips are carried out in the range of 7 to 9 in the morning (64%).

However, not everyone who owns a motorbike uses a motor when traveling to work. Those who own a motorbike but use Transjakarta buses and those who travel between 5 - 7 in the morning are 15%, using MRT 9% and online motorcycle taxi 7%. However, for respondents who owned cars and motorbikes and traveled by car, most occurred before 5 am (57%). Then 26% of those who traveled between 5 - 7 in the morning and the rest were above 9 in the morning. Meanwhile, 18% only traveled by motorbike at the time < 5 am, between 5 - 7 hours was 55% and> 9 hours was 27%.

Second, travel behavior is based on time to come home from work, the mode used, and vehicle ownership. In general, most commuting home from work is from the 4 pm to 6 pm hour range. For respondents using Transjakarta public transportation, 27% traveled home before 16, 45% in the range of 4 pm - 6 pm, 12% in the range of 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 who use motorbikes travel between 4 pm and 6 pm, 15% travel back between 6 pm - 8 pm, and 12% travel after 8 pm. However, based on vehicle ownership, most respondents who own cars and motorbikes make their way home before 4 pm as many as 58%; likewise, those who use motorbikes, around 54% travel before 4 pm.

Third, travel behavior is based on stopover activities when leaving for work - the mode used and vehicle ownership. When traveling while leaving for work, most employees do not stop or stop for one specific purpose. The majority of Transjakarta bus users (88%) do not stop over when leaving for work. Likewise, MRT users, 89% of respondents, did not make a stopover. Next, 82% of car users do not stop by when they go to work, and 84% of motorbike users do. For online transportation users, 75% of online taxi users and 70% of online motorcycle taxi users do not stop by. However, for those who have motorbikes, about 16% make one stop on each trip to work.

Fourth, travel behavior is based on time to start work, the mode used, and vehicle ownership. The analysis shows that 42% of Transjakarta bus users come to work at 7 am, 24% at 8 am, and 28% at 9 am. Furthermore, the majority of MRT users come to work at 8 am (63%), while 39% of car users, 29% of motorbike users, and 32% of online transportation users. Employees whose working hours start at 9 am travel using the MRT as much as 21%, cars 9%, motorbikes 4%, and online transportation 4%. These results indicate that private vehicle users generally enter work earlier than users of other modes. Furthermore, 33% of those who have motorbikes but use public transportation leave for work, 35% at 8 am, 29% at 9 am and 3% after 9 am.

Fifth, the commuting to work behavior is based on the time to finish work, the mode 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 work 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 motorbike users do the same, they finish work at 5 pm at most, which is 48%. Meanwhile, on average, online transportation users finish work after 18 hours, which is 35%. Judging from vehicle ownership but using public transportation when commuting to work, most people who have motorbikes generally end their work at 4 pm and before.

1. Discussion

Based on the analysis of the relationship between travel and work characteristics and the mode used, the results show that the time to go to work, time to come home from work, to stop by when going to work has a strong influence on the use of transportation modes. Then the time to start work, time to finish work has a moderate effect on transportation modes. In this context, we can see that 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 from work. This finding is reinforced by cross-tabulation analysis 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 congestion that occurs during the 6 am - 9 am rush hour on roads in Jakarta on every working day.

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 of flexibility in time to work and time to finish work from office management. This finding is in line with Ermans' [17] opinion 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, be it the government, office management, and the community [19].

For this reason, a more comprehensive study is needed to what extent office management can play its role in controlling the use of private vehicles on every working day. This study is limited to explaining the relationship between several factors in the characteristics of travel and work. Thus, an in-depth study is needed not only for working time and providing incentives but also for workloads at the office or overtime at work.

1. Conclusion

Analysis of the relationship between travel time, stopover activities during a trip, and aspects of time to enter and finish work on the modes used show moderate and robust significance. On the one hand, private vehicles (motorbikes and cars) still dominates commuting to work. For this reason, efforts to increase interest in using public transportation must be carried out in an integrated manner by taking into account the characteristics of the work.

**Acknowledgments**

The data for writing this article was obtained from early-stage studies in dissertation writing as one of the requirements for obtaining a doctorate. For that, we would like to thank the Ministry of Research and Technology / National Research and Innovation Agency, Deputy for Strengthening Research and Development, who funded this research.

References

[1] Yang J, Kato H, Ando R and Nishihori Y 2020 Analyzing Household Vehicle Ownership in the Japanese Local City: Case Study in Toyota City *J. Adv. Transp.* **2020**

[2] Ashrafi S R and Neumann H-M 2017 Determinants of Transport Mode Choice in the Austrian Province of Vorarlberg *Real Corp* **6** 121–30

[3] Chu M C, Nguyen L X, Ton T T and Huynh N 2019 Assessment of Motorcycle Ownership, Use, and Potential Changes due to Transportation Policies in Ho Chi Minh City, Vietnam *J. Transp. Eng. Part A Syst.* **145**

[4] Bwire H and Zengo E 2020 Comparison of efficiency between public and private transport modes using excess commuting: An experience in Dar es Salaam *J. Transp. Geogr.* **82** 102616

[5] Almasri E and Alraee S 2013 Factors Affecting Mode Choice of Work Trips in Developing Cities—Gaza as a Case Study *J. Transp. Technol.* **03** 247–59

[6] Ton D, Bekhor S, Cats O, Duives D C, Hoogendoorn-Lanser S and Hoogendoorn S P 2020 The experienced mode choice set and its determinants: Commuting trips in the Netherlands *Transp. Res. Part A Policy Pract.* **132** 744–58

[7] Ishikawa T, Chikaraishi M and Fujiwara A 2019 Does Individual Capability Influence Travel Time Expenditure? Mediation and Moderation Modeling Approaches *Asian Transp. Stud.* **5** 736–49

[8] Aslam S A B, Masoumi H E and Hussain S A 2019 Urban travel characteristics in relation with works-housing balance and accessibility: Results of a survey in Lahore, Pakistan *GeoScape* **13** 31–54

[9] Aditjandra P T 2013 The impact of urban development patterns on travel behaviour: Lessons learned from a British metropolitan region using macro-analysis and micro-analysis in addressing the sustainability agenda *Res. Transp. Bus. Manag.* **7** 69–80

[10] Tushara T, Rajalakshmi P B I K 2013 Mode Choice Modelling For Work Trips in Calicut City *International Journal of Innovative Technology and Exploring Engineering* vol 3 pp 106–13

[11] Athira I C, Muneera C P, Krishnamurthy K and Anjaneyulu M V L R 2016 Estimation of Value of Travel Time for Work Trips *Transp. Res. Procedia* **17** 116–23

[12] Huang R 2017 Simulating individual work trips for transit-facilitated accessibility study *Environ. Plan. B Urban Anal. City Sci.* **46** 84–102

[13] Gaudry M 2018 The utility of journeys, from Dupuit’s constant-time bridge crossing hops to commutes of chosen duration and reliability in the Paris region *Transp. Policy* **70** 53–68

[14] Fioreze T, Thomas T, Huang B and van Berkum E 2019 How employees view smart cycling to work: A regional survey in the Netherlands *Travel Behav. Soc.* **16** 224–34

[15] Irawan M Z, Belgiawan P F, Joewono T B and Simanjuntak N I M 2020 Do motorcycle-based ride-hailing apps threaten bus ridership? A hybrid choice modeling approach with latent variables *Public Transp.* **12** 207–31

[16] Ashalatha R, Manju V S and Zacharia A B 2012 Mode Choice Behavior of Commuters in Thiruvananthapuram City *J. Transp. Eng.* **139** 494–502

[17] Ermans T, Brandeleer C, Hubert M, Lebrun K and Sieux F 2018 Travel between home and work: Current situation and perspectives for action for companies BSI synopsis *Brussels Stud.* **2018**

[18] Batista Ferrer H, Cooper A and Audrey S 2018 Associations of mode of travel to work with physical activity, and individual, interpersonal, organisational, and environmental characteristics *J. Transp. Heal.* **9** 45–55

[19] McTigue C, Rye T and Monios J 2020 Identifying barriers to implementation of local transport policy – Lessons learned from case studies on bus policy implementation in Great Britain *Transp. Policy* **91** 16–25