ACCEPTANCE OF NEW TRANSPORT MODES FOR STUDENTS: A STATED PREFERENCE APPROACH

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Abstract: *Bandung traffic condition is worsened by the sparse public transport network. The Government is planning to provide other modes of transport such as LRT as an alternative to current existing modes such as minibus, car, motorcycle and online car and motorcycle. Other than those mentioned modes, we propose a new convenient transportation mode in form of safe shuttle for students' daily commutee. Since the proposed modes from both the government and the research team do not exist yet, a stated preference method is used as tools to measure the preference of the respondents. The survey is divided into three parts where the first part is an SP survey with 12 scenarios, and several attributes including travel time, travel cost, waiting time, transfer amount, access and egress, frequency, convenience, security and parking cost. The second part is inquiring about attitudes while the last part is asking respondents characteristics. Several modelling methods are also proposed to analyze the data such as Multinomial Logit, Random Regret Minimization, Mixed Logit, and Hybrid Choice Model.*

Keywords: *New transport modes; choice model; SP survey; attitudes; Indonesia*

Introduction

Bandung metropolitan area with the number of population of 2.5 million is currently the 3rd most populated city in Indonesia (Bandung, B. P. S., 2017). With population density around 15 thousand per km^2, the traffic condition in the city will be inevitably affected. As noted by Dharmowijoyo et al. (2018) the city has weak public transport networks and services that encourage travellers to use motorcycles to reduce their travel costs and time. Tarigan et al. (2016) stated that paratransit and private vehicles were the primary modes of public transport (PT) due to the lack of mass transport modes. Bandung City Government is currently planning to provide light rail transit (LRT) as an alternative mode to solve traffic congestion problem (Ramdani, 2018). With the addition of LRT, there are more alternative modes for Bandung citizens other than the minibus and private vehicles.

Belgiawan et al. (2016) conducted a study on 500 undergraduates in Bandung, and they found that factors such as attitude towards cars significantly influence car ownership decision. Belgiawan et al. (2017; 2014) also found that other than attitudes, norms factors especially peer and parents have significant influence over students' intention to own a car. Therefore, the existence of convenient, safe and well endorsed public transport might influence students to shift from private vehicle to PT.

On the other hand, the increase of online transportation (such as Gojek, and Grab) is influential in changing travel behaviour. Several studies indicated that the high demand for this mode potentially reduced private vehicle ownership and usage (Metcalfe & Warburg, 2012; Silver & Fischer-Baum, 2015). Online transportation can also threaten the existence of conventional public transport and taxis (Rayle, Dai, Chan, Cervero, & Shaheen, 2016). Traffic congestion in urban areas in Indonesia has also worsened in recent years due to increased ownership and use of private vehicles (Joewono, Tarigan, & Susilo, 2016). It has been suggested that rising of online transportation in metropolitan cities such as Jakarta, Bandung, and Yogyakarta may contribute to this phenomenon. In addition to conventional transportation, there are also other alternatives such as online transport.

Based on this background, we can assume that new mobility service might be needed to reduce traffic congestion. This new mode that is convenient and safe is expected can be used for students for daily commutee. However, with the introduction of the new mode, it is still unclear whether students will choose the new mode compared to the existing ones. Thus, the objective of this research is to prepare a stated preference survey in order to find out the significant attributes and factors that influence students to choose a mode for daily commutee.

The structure of this paper is as follows: After the introduction, we discuss literature on stated preference (SP) methods followed by discussions on attributes and variables for SP survey. Finally, we conclude the paper and discuss the limitation of the study.

1   Data Collection

1.1   Research Approach

When facing several choices, it is logical to assume that people tend to choose alternatives that maximise their utility with the smallest possible sacrifices per economic principles. This concept is widely known as random utility maximisation (RUM). In transportation research, one of the most widely used models in the academic world is the multinomial logit formulation (MNL) (Ben-Akiva & Lerman, 1985; McFadden, 1973).

With the above assumptions, we will use the method of choice modelling analysis especially MNL (Ben-Akiva & Lerman, 1985; McFadden, 1973) or also mixed logit method (Hensher & Greene, 2003).

There is also an increasing interest in applying an alternative modelling approach called random regret minimization (RRM) (Chorus, 2010; Chorus, Arentze, & Timmermans, 2008). Using an RRM, an individual, while choosing between alternatives, is assumed to minimize anticipated regret rather than maximize its utility. RRM is a context-based modelling approach because the decision to choose an alternative depends on the relative performance of the selected alternative attribute against other alternative attributes. This modelling technique has been applied to the route selection model (Chorus, 2012; Chorus, Rose, & Hensher, 2013), parking spots, shopping locations (Chorus, Arentze, & Timmermans, 2008), car fuel selection (Chorus, Koetse, & Hoen, 2013; Hensher, Greene, & Chorus, 2013), willingness to pay for new transportation services, and leisure and travel time (Hess, Beck, & Chorus, 2014).

1.2   Survey Design and Data Collection

The survey is designed to understand respondents' mode preferences if there is a new mode of transportation implemented in the city of Bandung. The target of the respondents is students. Respondents receive an explanation that there will be a new convenient mode of transportation introduced to provide a sense of security and comfort for students who will commute from home to campus. In this research, we named this alternative mode shuttle bus. There are seven alternative modes in this study that five of them are already seeen on the streets of Bandung: minibus, car,

motorcycle, online car, and online motorcycle. We add two more alternative modes that currently are not presented in the city, i.e. LRT and shuttle.

Respondents are informed that shuttle refers to public transport serving campus-house routes with facilities such as air conditioning, wi-fi, and safety equipment. Minibus refers to PT provided by the government where at least 15 passengers can ride it. Online car and motorcycle refer to all public transport modes based on online applications (, Grab, and Gojek).

Questionnaires are divided into three sections; The first part is an SP survey, using the stated preference method (Abou-Zeid, Ben-Akiva, Bierlaire, Choudhury, & Hess, 2010) which asks about 12 sets of selected labelled experiments with several attributes. These attributes include travel time, travel cost, waiting time, transfer amount, access and egress, frequency, convenience, security and parking cost. The list can be seen in Table 1. Travel cost refers to the cost of tickets for public transport and fuel costs for cars/motorcycles. With this division, the value of travel time savings (VTTS) (Mackie, Jara-Dıaz, & Fowkes, 2001) between mode options can be compared.

Table 1 Alternatives, attributes and their values for SP experiments

Attribute	LRT	Minibus	Car	Motorcycle	Online Car	Online Motorcycle	Shuttle
Travel time (min)	30, 45, 60, 75	30, 45, 60, 75	30, 45, 60, 75	20, 30, 40, 60	30, 45, 60, 75	20, 30, 40, 60	20, 30, 40, 60
Travel cost (IDR)	5, 10, 15	4, 8, 12, 16	12, 16, 18, 20, 25	4, 8, 12, 16	12, 20, 30, 40	12, 16, 20, 25	12, 16, 20, 25
Waiting time (min)	10, 15, 20, 25	10, 15, 20, 25			10, 15, 20, 25	10, 15, 20, 25	10, 15, 20, 25
Number of Transfers	0, 1, 2, 3	0, 1, 2, 3					
Parking cost (IDR)			5, 10	2, 4, 6			
Access and Egress time (min)	5, 10, 15	5, 10, 15					
Frequency (no per hour)	12, 6, 3	12, 6, 3					12, 6, 3
Congestion time (min)		10, 15, 20, 25	15, 30, 45, 60	10, 15, 20, 25	15, 30, 45, 60	15, 30, 45, 60	15, 30, 45, 60
Convenient (0,1,2)	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2
Security (0,1,2)	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2	0, 1, 2

The second part of the questionnaire is asking about attitudinal variables. These attitudinal variables can be seen in Table 2. Variables for attitudes are taken with several adjustments from Abou-Zeid et al. (Abou-Zeid, Ben-Akiva, Bierlaire, Choudhury, & Hess, 2010) and Al-Ayyash (Al-Ayyash, Abou-Zeid, & Kaysi, 2016). The third part of the questionnaire asks respondents about their socio-demographic characteristics such as age, sex, and income. The experimental design was developed by NGENE with a D-efficient design (Bliemer, Rose, & Hensher, 2009). The size of choice depends on the number of attributes. Each experiment contains different variable values. Data is collected using online survey tools (i.e. SurveyMonkey, Google form, etc.). Survey links are distributed across several social media groups (Facebook, Instagram, Twitter, and WhatsApp) and the network of our colleagues. The targeted number of respondents is 500 respondents according to the criteria mentioned by Israel (Israel, 1992). In addition to online surveys, we also plan field surveys.

Table 2 Attitudinal Variables

No	Variables	Scale (7 points Likert Scale)
1	It is comfortable to go by public transportation to campus.	Strongly Disagree – Strongly Agree
2	It feels safe to go by public transportation.	Strongly Disagree – Strongly Agree
3	Going by public transportation is worth its price compared to going by car.	Strongly Disagree – Strongly Agree
4	It is comfortable to go by car to work.	Strongly Disagree – Strongly Agree
5	It feels safe to go by car.	Strongly Disagree – Strongly Agree
6	The one in the household that needs the car most of the work trip is the one that uses the car.	Strongly Disagree – Strongly Agree
7	In our family, we are equals when deciding who is going to use the car.	Strongly Disagree – Strongly Agree
8	Measures to improve public transportation should be undertaken.	Strongly Disagree – Strongly Agree
9	I consciously limit my car use to reduce emissions.	Strongly Disagree – Strongly Agree
10	I like sharing rides with others.	Strongly Disagree – Strongly Agree
11	I prefer to share rides only with people of the same gender.	Strongly Disagree – Strongly Agree
12	I am willing to try ride sharing because it allows me to meet new people.	Strongly Disagree – Strongly Agree
13	I will pay more to get more technologically advanced products.	Strongly Disagree – Strongly Agree
14	It feels convenient to use online car and motorcycle	Strongly Disagree – Strongly Agree
15	Online car and motorcycle is easily accessible	Strongly Disagree – Strongly Agree

2   Modelling Approach

Several modelling approaches can be used for analyzing the data, including advance choice modelling such as MNL (Ben-Akiva & Lerman, 1985; McFadden, 1973), Mixed Logit (Hensher & Greene, 2003), and RRM (Chorus, 2010; Chorus, Arentze, & Timmermans, 2008). Another

modelling approach that can be used where we integrate latent variables and observe variables. This modelling approach is called hybrid choice model (HCM) (Ben-Akiva, et al., 2002; Walker & Ben-Akiva, 2002). The framework of the HCM with several adjustments for this research can be seen in Figure 1. Observe variables such as attributes of alternatives, characteristics of respondents (age, gender, and income) are represented as a rectangle. Latent constructs such as attitude and utility are represented as an ellipse. Solid arrows represent a causal relationship between variables, while dashed arrows represent measurement and finally dotted arrows represent error terms. In the model, attributes of alternatives are hypothesized to influence utility and the characteristics of respondents. Attitude will interact with characteristics of respondents which is assumed to influence choice decision.
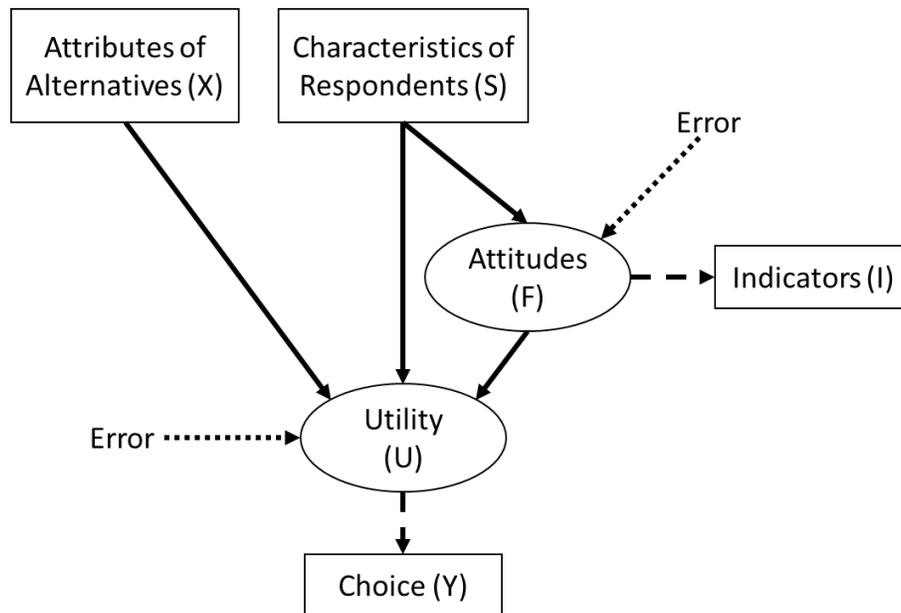

Figure 1. Modelling Framework

3   Conclusions

Since new transportation modes such as LRT and shuttle are not available yet, the best method to understand the preference of respondents in choosing the best alternative is through stated preference survey. We determine several alternative modes that currently present such as minibus, car, motorcycle and online public transport as other alternative modes. We select several attributes that have potential to influence respondents' decision in choosing the preferred modes. We also

add respondents' characteristics such as age, income, and gender. Finally, attitudinal variables are also included in the questionnaire since it is widely known that attitude influence intention and behaviour. For modelling approach, we propose hybrid choice model since it can measure the influence of latent and observe variables towards a choice decision. The limitation of the study is that we focused our study only on students in Bandung who commute to campus every day. Therefore, there is a possibility of selection bias.

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