Travel Demand Forecasting for Planning BRT by Using Stated Preference Approach -Case Study in Vientiane, Laos-

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1. Introduction

The Lao People's Democratic Republic is well on the way to motorization resulting from the rapid economic growth since the 1990s. Especially in Vientiane, the vehicle registration increased vastly in both motorcycles and private cars. This trend is expected to hold in the future. At present, bus is the only public transport in Vientiane which has 4% of the total modal share. To alleviate serious traffic congestion in the future, the introduction of Bus Rapid Transit (BRT) running from central bus station to National university of Laos route is being considered. However, since the intention using the BRT of the resident has not been investigated, the number of users after the introduction of BRT could not be estimated. Thus, in this study, the modal share after the introduction of BRT was estimated by using Stated Preference (SP) approach.

2. Methodology

Since the BRT does not exist yet, the SP survey was applied. On the survey, we assumed that the BRT is in operation, the intention using BRT of the residents along the BRT route and the students of National University of Laos together with current travel behavior were surveyed. Based on the survey results the discrete choice model was built. Finally the modal share was estimated.

3. Questionnaire survey

1) Purpose of questionnaire survey

To understand the people's travel behavior along the BRT route, after the planning BRT is in operation pre-survey of the Stated Preference survey was conducted on 26th to 30th of August, 2012 and the main survey was conducted on 3rd and 5th of January, 2013.

2) Contents of Questionnaire

The questionnaire consists of four main concerns as shown in Table 1. Selectable mode choice is set to be passenger car, motorcycle, BRT and bus. As for the explanatory variables travel cost, travel time, etc. 13 attributions were set. Based on "The Study of Master Plan on Comprehensive Urban Transport in Vientiane" three levels for each attribution were set. By using the $L_{27}(3^{13})$ orthogonal layout of design of experiments 27 patterns of combination were obtained. One set of questionnaire sheet was made by 3 patterns chosen randomly out of 27 patterns.

Table 1 The contents of SP survey

Main concerns	Item of survey
Current travel behavior	Current using travel mode Travel purpose
Intension to use BRT	Use or not use after BRT is in operation
Travel behavior after BRT implemented	Show the different travel time and travel cost for every alternative tranport modes and let the respondent select the most desirable choice
Individual and family attribution	Sex Age Driving licence(car, motorcycle) Number of vehicle ownership(car, motorcycle) Monthly income

3) Survey area

The survey areas in which the questionnaire survey was conducted are shown with the grey shade in Figure 1. These areas were selected from the residence areas and the university campus along planned BRT route.

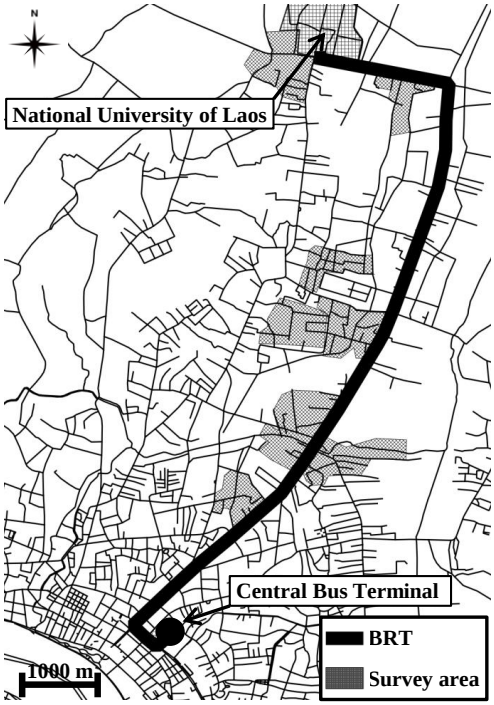

Figure 1 SP survey area

Keywords: BRT, Discrete choice model, Stated preference survey, MNL model, Travel demand
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4) Results

In this questionnaire survey, 270 samples could be obtained from respondents of the survey and 190 samples of them were valid.

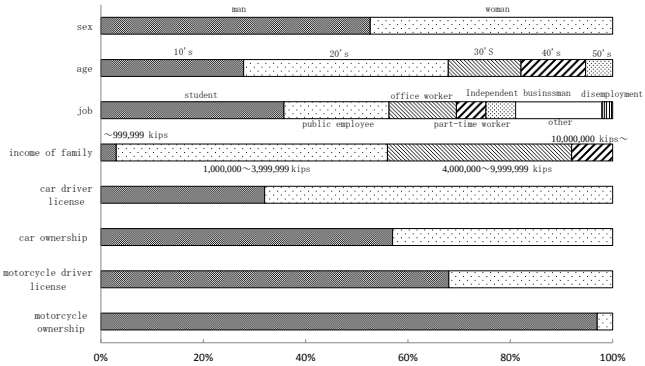

Figure 2 Individual and household characteristics results

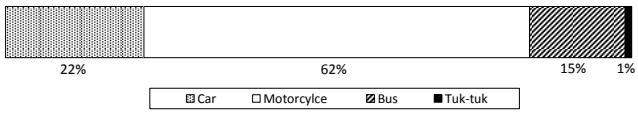

Figure 3 Current modal shares

4. Modeling

The multinomial logit model (MNL model) with the alternatives of car, motorcycle, BRT and bus was formed as a modal choice model. And the MNL model is shown in Equation (1) and (2). The parameters of the utility functions were estimated by using NLOGIT software. The result of the MNL model is shown in Table 2.

$$p_{in} = \frac{exp[V_1]}{exp[V_1] + exp[V_2] + exp[V_3]} \quad (1)$$

$$V_{in} = \beta_1 Z_{1i} + \beta_2 Z_{2i} + ... + \beta_k Z_{ki} \quad (2)$$

where,

P_{in}: Probability that individual n will choose alternative 1

V_{in}: The fixed term of utility relating to alternative i

Z_{ki}: The explanatory variable for the alternative i (For example cost, time)

β_{ki}: The parameter of number k explanatory variables.

Sign condition of each parameter has been logically consistent. Since the t value of all explanatory variables exceed the value 1.96, it resulted in a high explanatory power. The likelihood ratio is 0.17135 slightly low, however the predictive value is 74%, therefore the reliability of the MNL model is relatively high.

In addition, the modal share after the introduction of BRT was estimated as shown in Figure 4. As a result the share of BRT user will be 40%, the share of motorcycle user and passenger car will be decreased from 62% to 37% , 22% to 14% respectively.

Table 2 Result of the MNL model

Transport mode	Variable	Coef.	*t*-stat.
Car	Time	0	-
	Cost	0	-
Motorcycle	Constant	2.64331	8.192
	Time	-0.05685	-2.636
	Cost	-0.00012	-2.061
BRT	Constant	3.88636	7.727
	Time	-0.06464	-4.776
	Fare	-0.00022	-3.629
Bus	Time	-0.03445	-3.550
Common variable (excluded Bus)	Age	-0.56495	-4.789
	Motorcycle driver license	0.82001	2.464
Summary statistics			
N	444		
L(β)	-506.6017		
L(0)	-615.5147		
ρ^2	0.17695		

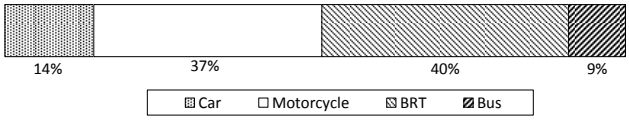

Figure 4 Future modal shares

5. Conclusion

In this study, travel behavior of residents and students along the BRT route was clarified. At the same time the high reliability of the MNL model could be built.

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