Section4 Study on a Methodology for Optimal Bus Rapid Transit System Design in Vientiane Capital, Lao PDR

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1. Introduction

Vientiane is a small city with approximately 588,000 residents (estimated in 2007). However, traffic congestion has already become one of serious problems. This is due to the increasing of private vehicle usage such as passenger cars and two-wheel vehicles for 25% per year. Accident on the roads is also increasing, which most of the cases involved with 2-wheel vehicle and passenger cars. The above-mentioned problems can possibly be solved if the bus service is improved providing efficiency and effectiveness. In this study, Bus Rapid Transit (BRT) is introduced in order to serve as an alternative mode on the existing road infrastructure between Urban districts and Centre Business District with its special characteristic of high quality bus-based transit system that provide fast, comfortable and cost effectiveness within urban mobility[1]. This research therefore attempts to study an optimal design of BRT system. Two main routes were selected (figure 1): Route A, where there are large communities and high demand of travel including from CBD to Thong Pong Station and Route B was to the National University for the total length of 24 km.

2. Methodology

Since the main purpose of this research is to determine an optimal BRT system. Therefore, the objective functions set forth takes into account three perspectives: the passengers, the transit agency and the community. A good BRT route is defined as an attractive one from all the three perspectives. Six objective functions were set: the first two straightforward objectives are to maximize time cost saving for current transit riders and minimize cost for new transit riders. These are strictly the perspective of passengers. The third objective is to minimize the unnecessary investment cost and related long-term operating and maintenance cost. This is strictly the perspective of transit agency or the investor. The last three objective functions: reduce accident cost, improve more employment opportunity and encourage more development along the routes. These objectives represent the perspectives of the government, community and the BRT passengers.

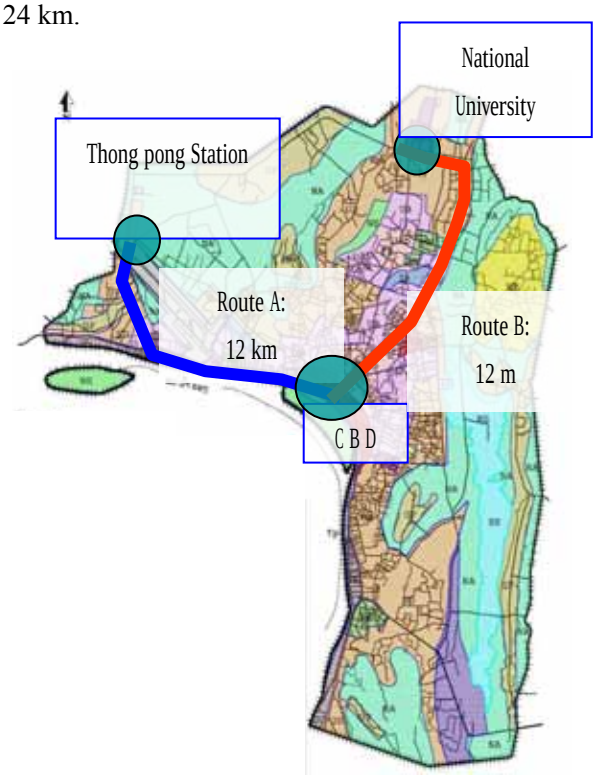

Figure 1 Map of Study Area

The flow of this study is conducted in 4 main steps: determine combinations of BRT elements based on the setting of combination, access cost for each combination, conduct sensitivity analysis of the combinations with respect to travel demand, cost and cost-effectiveness, and finally select optimal system for BRT.

Key Words: Traffic Congestion, Bus Rapid Transit, Optimal System Design

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In order to make passenger forecasting, questionnaire was then developed; the person trip survey and related preference survey were carried out in the study area. The target groups were made to large scale of employees, students and so on. 759 samples of 800 distributed were collected with the total males and females of 448 and 311 respectively. Prior conducting optimization, Finding Probability of Automobile users taking transit was obtained in the form below (Table 1).

$$P_{in} = \frac{1}{1 + \sum_{j} e^{\Delta U_{ij}^{n}}} (\forall j \neq i)$$

3. Survey and the Result

Some analysis based on stated preference has been made and the results showed that 42% of the total 3 trip purposes will choose to ride BRT for the reason of monetary saving, then frequent service, avoid traffic, avoid accident which share percentage of 17%, 16% and 14% respectively (figure 2). The main reasons for not using BRT: if BRT station is far from home, owning of private automobile as this importantly referred to social status and if service is not frequent which contribute to the share of 35%, 26% and 20% respectively.

$$\text{Private Car}: \quad U_{cn} = \beta_1 X_{cn1} + \beta_2 X_{cn2} + \beta_4 X_{cn3} + \beta_5 X_{cn4} + \lambda_c$$

$$\text{Motorcycle}: \quad U_{mn} = \beta_1 X_{mn1} + \beta_2 X_{mn2} + \beta_4 X_{mn4} + \beta_5 X_{mn5} + \lambda_m$$

$$\text{BRT}: \quad U_{bn} = \beta_3 X_{bn3} + \beta_4 X_{bn4} + \beta_5 X_{bn5} + \lambda_b$$

Table 1 Utility Function of Individual Travel Mode

Parameter	Parameter	Parameter	Parameter
Gender (1=male, 0=female)	β_1	Travel cost (Kip)	β_5
Age	β_2	Dummy of private car	λ_c
Access time to BRT station (m)	β_3	Dummy of motorcycle	λ_m
In-vehicle travel time (minute)	β_4	Dummy of BRT	λ_b
Variables	**Variables**	**Variables**	**Variables**
Gender (1=male, 0=female)	$X_{cn1}; X_{mn1}$	In-vehicle travel time	$X_{cn4}; X_{mn4}; X_{bn4}$
Age	$X_{cn2}; X_{mn2}$	Travel cost (Kip)	$X_{cn5}; X_{mn5}; X_{bn5}$
Access time to BRT station (m)	X_{bn3}		

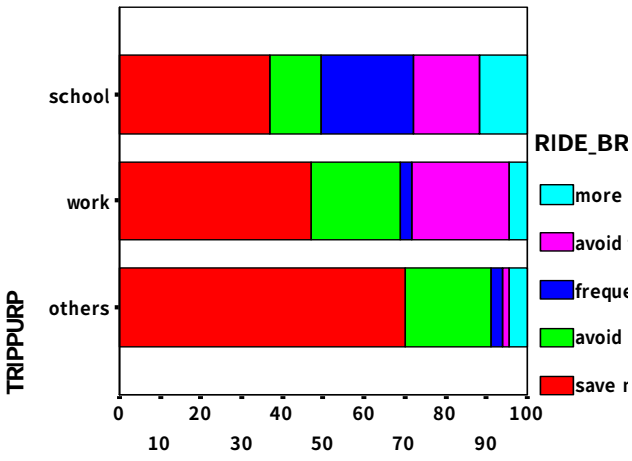

Figure 2 Reasons for Riding BRT

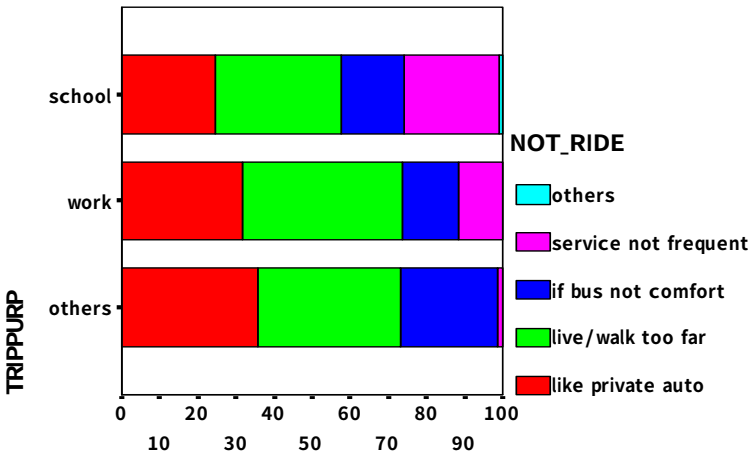

Figure 3 Reasons for not Riding BRT

4. Conclusion

From the result of survey, there is a trend that the implementation of BRT system is feasible as there are high correspondent percentages of demand. For further study, Passenger forecasting using Traditional 4-Step Model and followed by an optimal system design will be made based on the use of sensitivity analysis method. For the expected result of this study, the BRT system with low cost of construction will bring lots of social and economic benefits for all stakeholders especially transit riders and development along the routes and act as sustainable public transportation.

Reference: 1. Wright, L. Bus Rapid Transit Planning Guide, pp 11, June 2007.