PLANNING AND EVALUATION FOR THE PUBLIC MINIBUS SYSTEM IN CHIANG MAI MUNICIPALITY

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1. Introduction

In Chiang Mai municipality, the existing public transportation depends mainly on minibus system. Minibus is a modified small truck by adding two benches and a roof. It can carry approximately 12 passengers. Currently, there are almost 3,000 minibuses operating without fixed route and fixed bus stop. It can serve either as taxi or bus service. The service selection is come from minibus drivers and transit users agreement. Minibus fare is determined by the driver based on the type of service. However, minibus drivers can sometimes refuse to give the service. To gain more profit, minibus usually provides the service in high demand area. This makes transit users in low demand area suffer from low frequent service.

In the other words, transit users often face with poor, unreliable and costly service. Minibuses also cause delay to both minibus users and road users. Moreover, accessibility and equity for some passengers cannot be achieved. Consequently, the public transportation has declined and leads to the increasing number of private vehicles and, eventually, traffic congestion problems.

Therefore, the main purpose of this study is to introduce the fixed route for public transportation system in Chiang Mai municipality. In addition, the proposed public transportation system will be analyzed its effects by comparing the traffic conditions with existing system.

2. Public transit planning in Chiang Mai municipality

Since existing minibus system in Chiang Mai municipality has been served for more than 30 years, transit users are familiar with its service. Therefore, this study retains the role of minibus as the main public transportation system. However, minibus will be operated in fixed route system. In addition, air-conditioned minibus as well as taxi (minibus operated as taxi) will be introduced to make public transportation system more attractive. As a result, there are three types of minibus service in Chiang Mai municipality, namely, non air-conditioned minibus, air-conditioned minibus and taxi. It should be noted that fixed route minibus system in this study is not recommended to operate with fixed bus stop. This is due to Chiang Mai people are familiar with existing minibus which operating with door-to-door service. On the other hand, introduction of fixed bus stop may extremely reduce attractiveness of the proposed minibus system. Therefore, it is recommended that fixed bus stop service should be introduced after minibus users accustom to fixed route minibus.

2.1 Minibus transfer terminals relocation.

Recently, suburban minibus is served for minibus users in suburban area to journey between suburban and Chiang Mai municipality, while urban minibus is used within the municipality. Consequently, minibus transfer terminal is needed for such passengers. To date, minibus transfer terminals are located within the city center. This makes some conflicts between urban minibus and suburban minibus due to overlapping of service area. Moreover, it creates more road congestion within the city center.

Therefore, this study proposes to move minibus transfer terminals out of the city center. Locations of terminals are designed based on geographical road network, which result in five minibus transfer terminals around ring road as shown in Figure 1.

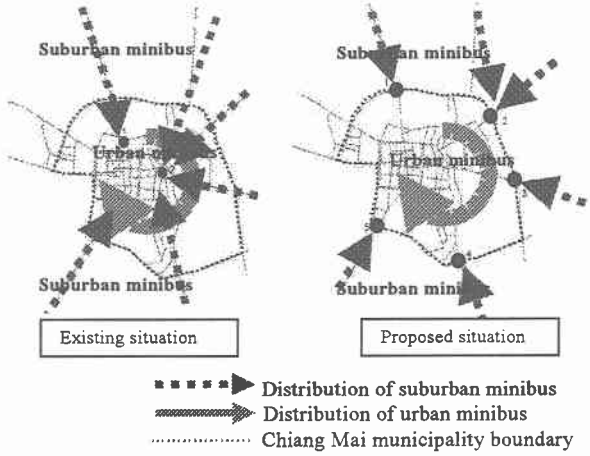

Figure 1. Minibus transfer terminals relocation

2.2 Route design for fixed route service

To introduce fixed route transit service, minibus routings are designed using GIS application. The design process begins with determination of places where minibus should pass nearby, which results in 21 places. Then, each selected place is linked together by shortest distance consideration. The next step is to eliminate subset routes which 104 routes are remains. After that, duplicate routes are merged. Finally, 21 bus routes for proposed transportation system are obtained.

3. Transportation model

This study employs four steps technique to develop transportation models. The overall process used for modelling in this study can be shown in Figure 2.

3.1 Trip generation

Based on a previous study, ETA (1996), the study area is divided into 69 zones, 62 internal zones and 7 external zones. Trip production and trip attraction models are determined by using multi-regression technique.

The models are built for four trip purposes, namely, home based work, home base study, home based others and non-home based. As a result, total of 1.24 million person trips per day is obtained by using the equations with socio-economic data in year 2000.

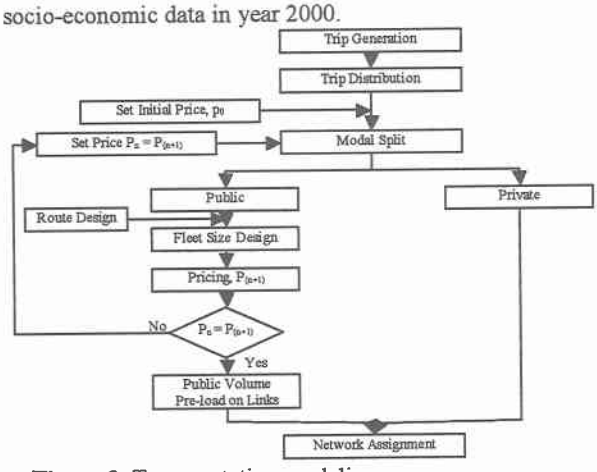

Figure 2. Transportation modeling process.

3.2 Trip distribution

To determine origin and destination tables (O-D table), O-D tables in year 1994 are used. Considering same O-D pattern for year 1994 and year 2000, O-D tables in year 2000 are obtained by using uniform growth factor method. The O-D tables are categorized by the period of time into peak and off-peak hour, which based on current daily traffic volume variation data.

3.3 Modal split model

Disaggregate modal split models are employed to estimate transportation market share. A modal split model is constructed by using state preference data (SP). The data is obtained using questionnaire survey. As a result, total of 1,465 questionnaire sets are distributed to people around Chiang Mai municipality.

To construct a modal split model, travel time and travel cost are only used in the utility functions. Maximum likelihood method is used to estimate the coefficient in the utility function. Ten model structures are set up to determine suitable form of utility function. In addition, the models are tested whether it is multinomial logit model or nested logit model. The results show that only the multinomial logit model is qualified. To check the accuracy of the proposed models, both internal and external validation processes are also performed. As a result, the estimated share of transportation market in Chiang Mai municipality is finally obtained.

From figure 3, it can be seen that the public transportation share is increased, when the proposed minibus system is introduced (nearly 40% of total transportation market share). This due to minibus accessibility, fare reduction and introduction of new services (air-conditioned minibus and taxi) are improved.

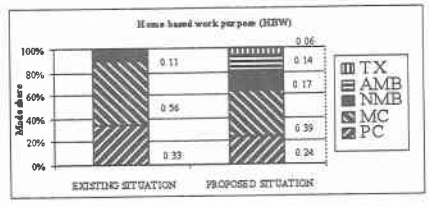

Figure 3. Transportation market share of HBW purpose.

3.4 Design of proposed minibus system

Minibus demands, result from a modal split model, are used to calculate the number of required minibus and its overall operating cost. Then, minibus fares can be calculated based on total minibus operation cost. As a result, total of 2,975 minibuses are required for all minibus operations. This implied that proposed minibus system could be implemented by using all existing minibuses. In addition, minibus fare of 5 Baht and 7 Baht are set up for non-air conditioned and air conditioned minibus service.

3.5 Network assignment

By using capacity restraint algorithm, traffic data on each link can be obtained. The results are crosschecked by comparing traffic volumes at screen lines between estimated and actual data. As a result, vehicle-distance, vehicle-hour and travel speed are used as indicators for evaluation of proposed minibus system.

Proposed minibus system can reduce vehicle-distance and vehicle-hour occurred Chiang Mai municipality by 23 % and 33 %, respectively. In term of travel speed, it is increased up to 30 % (in CBD area). It can be concluded that not only transit users will get benefits from proposed minibus system, but road users and society as a whole will also receive these advantages.

4. Conclusions

In this study, minibuses served as fixed route system are proposed. In addition, air-conditioned minibuses and taxi are introduced. Moreover, five transfer terminals are proposed around Chiang Mai municipality. Minibus routing system (21 routes) is also designed using GIS application. This would make public transportation system more accessible and more reliable.

Based on proposed minibus system, the results from transportation model show that minibus users would satisfy with lower fare (from 13 to 5 Baht per trip for non air-conditioned minibus). Therefore, minibus share is increased from below 20% in existing situation to be almost 50%. In addition, road users would be able to increase travel speed, which is one of the benefits from less congestion. The other advantages are energy and time saving. For the above-mentioned reasons, this proposed minibus system, therefore, might be a beneficial implementation for Chiang Mai municipality.

References

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2. ORTUZAR, J. D. and WILLUMSEN, L.G., "Modelling Transport".,John Wiley&Sons, Inc., 1996.