Research on Behavior on Travel Mode, Going to Metro Station at Ho Chi Minh City

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Abstract: This research presents an analysis of travel mode choice for trips to Ho Chi Minh City metro station. Research methods were inherited through a formula to calculate passenger traffic forecasts to predict passengers, going to the station. Based on the collected data of interviews, traffic surveys, and “Irwin & Von Cube” function, forecast the proportion of travel mode, and use to go to the station and leaving from the station. The results of study are used for the purpose of calculating the size of the metro station parking lots and parking layout plan.

Key words: Behavior on travel mode, parking, metro stations planning.

1. Introduction

Ho Chi Minh City is one of the biggest cities in Vietnam. Congestion of the traffic in this city directly causes bad impact on people’s daily commuting and also local residents’ health and safety. The city government and residents are making efforts to solve traffic problems for example conducting policies giving preferences to developing bus infrastructure system, issuing regulations on limitation of some certain vehicles to urban areas especially improving, constructing traffic infrastructure. In the past few years, many constructions had been built such as: Phu My Bridge project in 2000, East-West Highway project inaugurated in 2009, Nguyen Van Linh Boulevard project inaugurated in 2007, the Thu Thiem Tunnel project inaugurated in 2011 etc.. For public transportation, the city has planned six metro routes and three railway lines. At present, the line 1 from Ben Thanh to Suoi Tien and the line 2 from Ben Thanh to Tham Luong are under construction [1]. This project plays an important role in HCMC (Ho Chi Minh City) public transportation.

In order to attract more residents to use metro as

their daily transportation mode, in addition to designing, planning lines and station, study should be the flow of passengers going to the station, the choice of travel mode to the station of people, the solution and the appropriate policies to create more favor for people using metro. Tao Dan station is one of the special and important stations of metro line 2. This is the station next to Ben Thanh central station and the transfer stations of the metro line 2 and metro line 3 (Fig. 1). Station is located at the Tao Dan Park near the park 23/9 and Ben Thanh Market in District 1. This area is considered to be the heart of Ho Chi Minh City, it is one of the major tourist sites. In addition, District 1 has a big volume of foreign tourists. Here is to be a good destination for everyone in the city on holidays. Station planning purposes is not only better for the passenger but also for the good service and the landscape beauty of the city.

Especially recently, in Ho Chi Minh City more than 90% of individual transport mean is daily transport mode. It is very necessary to plan a parking system in Tao Dan station for using metro before boarding the train. The size parking areas should be based on studying the select modes of travel of people go to station: walk, bike, motorcycle, motorbike, taxi or car etc..

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Fig. 1 Expected location of Tao Dan metro station, here: Line2 and Line 3B are name of metro line in Ho Chi Minh City, R: attract passengers radius assumed with Tao Dan metro station as a center.

2. Research Method

There are several research fields as following:

(1) Research travel demand of people in Ho Chi Minh City based on traffic surveys. Studies use 4-step model to inherit in calculation, forecasting passenger traffic of boarding and alighting at rush hours. Overview of 4-step model: Step 1—The model of generated journey; Step 2—The model of distribution journey; Step 3—The model of selection method of travel; Step 4—Model of route selection [2];

(2) Surveying and interviewing people about the choice of travel mode to the metro station [3];

(3) Using the mathematical model represents the choice vehicles of people to go to the metro station [2];

(4) Analyze, evaluate and propose needed solutions [1, 4].

3. The Results—Mathematical Model Calculations of Transport Options to the Station

The forecast of vehicles used to travel in city between the origin (i) and destination (j) locations,

based on collected documents, interviews, surveys of traffic etc., is made by using some of split methods. In these, the “Irwin & Von Cube” function was based on the principle that the traffic mode of less impedance will have larger volume.

Formulas of functions [3] are:

$$P_{ij}^m = \frac{\frac{1}{C_{ij}^m}}{\sum_m \left(\frac{1}{C_{ij}^m} \right)}$$

$$C_{ij}^m = t_{ij}^m \times VT^m + \frac{d_{ij} \times VC^m + PC^m}{OP^m}$$

where:

P_{ij}^m : Selection probability of vehicle m between areas i and j ,

C_{ij}^m : Overall cost (impedance) of vehicle m between areas i and $m j$,

t_{ij}^m : Time travel by vehicle m between areas i and j ,
 VT^m : time value of the used vehicle m ,
 d_{ij}^m : The distance of used vehicle m between areas i and j ,

VC^m : operating costs of vehicle m ,

PC^m : the parking cost of vehicle m ,

OP^m : The average carrier coefficient of vehicle m .

Vehicle operating costs include the major types, such as: vehicle depreciation cost, tire depreciation, cost of raw materials, oil, fuels such as gasoline, etc.. Through preliminary calculations of costs operating at the present time and future estimates are as shown in Table 1.

Going to the expected metro station, the people's transport types were studied, based on the distance between the house position and station which would be built. According to interviewed households map around the Tao Dan station expected, the authors had contacted to people around the station area with a radius of about 1 km.

Opinion of households is around the station area: 91% of comments is that, need to build a parking lot at Tao Dan station, 5% of comments is that, not necessary, and 4% of comments is that, unknowable. It means that, the most of people wish to have a parking lot at the station for parking of vehicle before boarding the train. This is one of major factors that impact to attraction of people to use metro.

According to the results of the interview to the people, living around the Tao Dan Park, the percentage of travel modes (the share), going to the station is that: 9% for walk, 7% for bicycle, 8% for sit-transported by motorcycle and 76% for shelf-driving motorcycle [4]. It shows that the people' behavior on travel mode in recent time, proportion of pedestrians and cyclists are small. But that is just the opinions of the interviewed people. In fact, the station has not yet been built, so people do not really understand the benefits of using the metro. Therefore, from the experience of other countries, the studies on solution are very necessary, in order to create favorable conditions to encourage people to increase the portion of walking, cycling to the station, instead of using the motorbikes.

Based on the results of household survey, the calculation gave the correlation function between the portion of mode choice and the distance from house position to the station. The portion function for each

mode of travel to the station depends on the distance (impedance), as follows:

$$T. \text{ Walk: } y = -40.5 \times \ln(3.5x + 0.4) + 50.91$$

$$T. \text{ Bike cycle: } y = -4.620 \times (3.5x + 0.4) + 52.74$$

$$T. \text{ Motorcycle: } y = 35.36 \times \ln(3.5x + 0.4) + 3.287$$

$$T. \text{ car: } y = 0.663 (3.5x + 0.4)^2 + 3.904 \times (3.5x + 0.4) - 6.041$$

Here:

y : percent of travel mode, choosing to go to station,

x : the distance to the station (radius to station).

The share model of travel mode, going to Tao Dan station, is shown in Fig. 2.

With the assumption: people around the Tao Dan station area are evenly distributed, not reviewed of vehicle ownership percentage of the population. With based on results, some obtained at Table 2 show result of the proportion of vehicles to the Tao Dan station within a radius of 1 km in Fig. 3.

From the calculation result of vehicle scale going to Tao Dan station, as the basis for calculating the size of the station park, the appropriate architecture is chosen for station and for parking lot of vehicles, including bicycles, motorcycles, cars of the passenger going to station and away from the station in Table 3.

The calculation of construction parking scale at the station needs the structure of the vehicle going to the station, based on the mode choice of people. Combining the calculation result of scale of vehicles, going to Tao Dan station with the passenger forecast in the future, the parking area is formed. Identifying the components of individual transport going to the station, the disposition of parking is selected appropriately.

The construction of the parking lot reserved for metro stations should be combined with fare policies, with priority for metro passengers, such as: reduction

Table 1 Vehicle operating costs.

Year	Unit	Bike cycle	Motorcycle	Car
2002	USD	0.0034	0.0321	0.0877
2011	USD	0.0040	0.0500	0.2200
2020	USD	0.0066	0.0907	0.5716

Fig. 2 The share model of travel mode, going to Tao Dan station, here T: theoretic share value, P: practical share value.

Table 2 The percentage of travel mode, going to Tao Dan station.

Radius (km)	Bicycle (%)	Motorcycle (%)	Car-taxi (%)	Walk (%)	Sum (%)
0.2	46.09	5.72	0.00	48.19	100.00
0.4	44.03	23.42	3.28	29.27	100.00
0.6	40.73	35.22	8.08	15.97	100.00
0.8	37.44	44.08	13.44	5.03	100.00
1	34.14	46.48	19.36	0.01	100.00

Fig. 3 The portion of mode choice, going to Tao Dan metro station within a radius of 1 km.

Table 3 Preliminary calculation results of area for parking at Tao Dan station.

Vehicles	Percent	Number of vehicles	The area unit of one vehicle (m ²)	Area needed (m ²)
Bicycle	26.32%	1,726	1.5	2,588
Motorcycle	56.94%	3,387	3	10,161
Car-taxi	11.49%	371	22	8,170
Sum				20,920

or free on parking for metro passengers, according to the policy of city price support for the public transport.

4. Conclusions

To calculate the size and to form the architecture options for parking area of metro station, to be built in Ho Chi Minh, the specific study is necessary on the people' choice of going to and back from the metro station. Based on this study, the need of parking lots is determined at each station. Thereby, the solutions and policies will be suggested to be able to attract more passengers using metro.

However, this was the initial study result. The cooperation should be sought for deeply studies in further detail, using the reliable method, to build the station to serve people in the best way.

The combination between expected service around

metro station and parking lot is appropriate to facilitate the movement of people, so the metro will be widely used by the people.

References

- [1] Consultant Center for Transport Development, Development Planning of Public Transport in HCMC to 2025, Department of Transport, Ho Chi Minh City University of Transport, Vietnam, 2010.
- [2] T.V. Chinh, Traffic and Economic Survey and Forecasting the Transport Demand, Ho Chi Minh City University of Transport, Vietnam, 2010.
- [3] N.V. Duc, Underground metro station planning, combined with parking at Tao Dan station, Bachelor Thesis, Faculty of Civil Engineering, Ho Chi Minh City University of Transport, Vietnam, 2012.
- [4] Almec Corporation, The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area (HOUTRANS), Japan International Cooperation Agency, Ministry of Transport, Socialist Republic of Vietnam, Ho Chi Minh City People's Committee, 2003.