Chapter IX

Conclusion and Recommendation

This chapter summarizes all analyses and evaluations done in this research, i.e. comparative analysis between study areas and established area, the development of mode choice model, quantifying the station accessibility and station facility and integrating them into the mode choice model, frequency of transit use, and factors affecting propensity to walk to reach station. The main findings from those analyses are discussed, followed by interpretation and policy implications of the results. The chapter concludes with research that can be developed from this study.

9.1 Summary of Findings

The issue of declining transit ridership and how the trend can be stemmed could be examined from many aspects. A wide range of policy initiatives, not just fare reduction or increase in transit supply, should be considered. Traveler behavior approach such as mode shifting from private transportation mode to transit should take into account. Comparative analysis between mass transit system in study areas (i.e. Bangkok and Manila) and the system in advanced city (i.e. Sapporo) revealed that it is important to give proper attention to those who live within station coverage areas but never or very rarely use mass transit for their daily trip.

From the data collection, it was found that those who use transit rarely represent 41% and 43% of all respondents surveyed for Bangkok and Manila, respectively while in Sapporo, is only 26%. It was also found in the study areas that those who used mass transit experienced shorter total travel time than those who used other modes, including private transportation. Moreover, it is revealed that within station coverage area, the proportion of using mass transit is about 45.3% and 44.7% for Bangkok and Manila, respectively while, on the contrary, the use of fixed route transit as a main modes of travel, such as bus and jeepney, is almost at the similar level, i.e. 32% and 41% for Bangkok and Manila, respectively. This situation reflects rivalry instead of complement between mass transit and fixed route transit in the same

corridor. Therefore, mass transit systems in study areas are ineffective since they have a high proportion of infrequent users in their coverage areas.

Data analysis shows that access trip to station covers almost half of the total travel time from home to destination (i.e. school or office) for mass transit users. This finding indicates that focus on access trip improvement in order to make mass transit become more attractive and draw in more passengers is one of the key points to make mass transit work. Among access modes the propensity of walking to access the station is relatively high, i.e. it is about 37% and 36% for Bangkok and Manila, respectively. Results from travel survey analysis reveal a set of important factors that affect the use of mass transit. This finding gives insights in to which accessibility and facility aspect of the station should be considered in order to encourage mode shift to transit. For instance, it was found that access distance, the number of access modes in station area, availability of escalator or elevator at station gates, the number of destinations that can be reached from station within 10 minutes of walking, etc. are important factors that respondents consider the use of mass transit to be advantageous.

Although the final mode choice models estimated for Bangkok and Manila are slightly different, both models revealed similar results related to factors affecting to mode shifting and mode preferences. Their results suggest that time, cost, and distance to the station have significant influence in persuading people to shift their mode to mass transit. The results imply as well virtually in significant role of individual characteristics on mode choice. Like in many transit studies, models results revealed that car availability has negative effect on the tendency to use transit. Also, the demand elasticity of mass transit from the models of study areas appeared similar. Transit demand is inelastic with respect to both time and cost, with the latter relatively more inelastic. Thus, the improvement related to travel time will give greater effect than improvement related to cost.

The development of station accessibility score aims to quantify accessibility and facility parameters of station into a score that can represent the relative overall quality among stations within the study area. By employing the score, the role of accessibility and station facility parameters on mass transit use can be examined. Station accessibility is within the transit operator's domain where it has substantial control over which improvements should be done in order to increase transit attractiveness. Employing station accessibility score can help the transit operators to develop better improvement strategies. For instance, the effectiveness of various

improvement strategies, including installation of escalator, addition mode access mode, reduction in ticket fare, and increase in train speed train in terms of their potential to increase ridership, can be evaluated.

The simulation using the mode choice model with station accessibility score tested the effect of various improvement strategies on the ridership. It is shown that the installation escalator and adding more access modes have significant effect on ridership. Fare reduction also gave positive impact on ridership. It is revealed that the number of passengers that can be gained does not have linear relationship with the level of reduction. The improvement of train speed to reduce in-train travel time can gain more ridership. It is found that improving travel time give greater effect on ridership rather than fare discount. This is consistent with the findings about the demand elasticity of mass transit that discussed earlier.

The variables of time, distance to station, and car availability have a role in the frequency of transit use. The model of frequency of transit use was developed for Bangkok and Manila data in order to evaluate how to persuade people, especially those who lived within mass transit station coverage area, to use mass transit more often. Some results from the models can be summarized as follow. Firstly, the probability of using mass transit more often is likely to be higher as the total travel time by mass transit is less than the total travel time by non-mass transit. Results from Bangkok and Manila showed the similar effect of the time difference between mass transit and non-mass transit mode on frequency of transit use.

Secondly, the frequency of transit use model was developed within station coverage areas where walking is possible. Thus, the models found that those who lived farther from station would be likely to use mass transit less frequently. Finally, models of the study areas showed that the magnitude of the coefficient estimation of car availability is the highest among other all variables in models and has negative sign. It might indicate the dominant role of car availability in making mass transit to be used less often.

Further analysis was carried out to evaluate factors affecting tendency to walk to access station. In addition to walking distance, one important factor is the role of station characteristics. For instance, in the case of Bangkok, travelers within station in high-density residential area or in high-density of street network are more likely to walk than those in station with less density. Station-specific characteristics appear to have substantial influence on access behaviors. Different stations, with different

walking environment, physical characteristics, land use patterns, street network structure, and connectivity to other mode of transportation, seem to exert different levels of influence on the propensity to walk.

Note that the model of walking to station did not reveal the evidence that socioeconomic characteristics of travelers have influence over the propensity to walk to transit station within the coverage area. These results are consistent in both study areas of Bangkok and Manila.

9.2 Research Conclusions and Policy Implications

The results discussed in the previous sections imply that there are several effective strategies to attract potential transit users, the infrequent users within station coverage area. The results also support the policy initiatives that give more attention to improving condition of access trip to reach station as a good approach in making transit system more attractive and gain more passengers.

The concept of accessibility in public transportation can be understood as interaction between components of the system and the people who attempt to use it. The list of important factors affecting the tendency to use mass transit lead to the improvement strategies should be taken. This research has developed two models related to increasing number of transit ridership and one model related to walking accessibility to reach mass transit station. The purpose of the development of the first two models was to understand how to persuade mass transit use to those who live within mass transit catchments area and commute in the pair of origin and destination within mass transit corridor, by shifting their mode of travel to mass transit or by using mass transit more often. Since those models were developed for area where the walking to access is possible, the walking accessibility model was developed in order to evaluate factors affecting on the propensity to walk to reach station. Among other variables, it is revealed that access distance has a key role in all models that were developed in this research.

The application of station accessibility score helps the evaluation of improvement strategies to become more understandable, particularly to involve accessibility and station facility issues such as installation more escalators to reduce effort of access to transit station, building shortcut walkway and adding more gates to reduce number of road crossings, and so on.

Access distance and car availability have roles to induce people to use mass transit. Within acceptance walking distance, increasing the quality of walking environment could be an important strategy to make walking to reach station become an attractive way and to have more mass transit users. For longer access distance, improvement strategy can be carried out by adding more feeder mode to access station.

Evidence in some literatures and as well those found in this research revealed that mass transit system is less attractive for those who have car for making the trip while in developing countries this availability is highly correlated with income. So, providing parking garage within station area could increase mass transit attractiveness for that group. It could be combined with providing exclusive shuttle bus to connect between high-income residential area and station.

Fouracre et al. (2003) argued that many mass transit improvements benefit existing public transportation users more than private car users. It was found in the study areas, and this might be typical in developing countries, the non-private car users or the transit captive users are dominant relatively within mass transit coverage area. In consequence, the improvement strategies to persuade transit captive users to shift to mass transit or to use mass transit more often could give significant effect on ridership rather than spend too much resource to try to shift private car users to mass transit.

The research results revealed insightful issues that can provide guidance of improvement strategies in order to gain more ridership. Attracting the infrequent users to use mass transit more often can gain more ridership significantly. As for socioeconomic issues, market segmentation should also be taken into account to succeed in the ridership increase program.

It is widely agreed that government supports are needed for successful mass transit system. Results from the comparative study show those mass transit systems in Bangkok and Manila are less effective comparing to the benchmark condition, i.e. Sapporo. Both in Bangkok and Manila, bus services, which are owned and operated by different private companies, compete with mass transit lines instead of complement them. All mass transit lines cover dense area in the city where the majority bus routes exist. Moreover, land use developments along the mass transit corridor are not yet consistent with the concept of transit oriented development. These issues are beyond the control of mass transits' authorities. The transit regulators, i.e.

government, should take part and perform coordinated program between mass transit operator and regulators. The result of mode choice model and evaluation of frequency of transit use enhance operators and regulators understanding in the formulation of improvement policies in order to gain more ridership and to persuade less private car use within the city.

9.3 Recommendations and Future Research

Factors affecting transit ridership are various and improving of access to transit is just one that could not stand alone. In this research, characteristics of mass transit, such as fare, headway, capacity and so on are the given conditions. Literature reviewed showed that those aspects play important roles as well. Therefore, improvement of station accessibility and walking environment must be carried out together with improving those factors to obtain greater effect of ridership.

The definition of accessibility is not only about easiness to access or convenience to use but it include how worth while a place to be visited. Thus, in transit accessibility, the good accessibility should cover a number of opportunities that can be reached from destination station. Improvement of station accessibility should be combined with making station more accessible to many destination areas. Adding more gate and built connectivity walkway are examples of strategies to make mass transit become more attractive. Assumption of the research that each individual has free choice to use access mode cannot be true in the real condition and walking captive and car user captive should be considered.

Some future research can be extended from the research results, e.g. using market segmentation approach to increase mass transit ridership. In most cases, segmentation involves selecting certain groups from a population based on the known characteristics [44]. For instance, the 'instant segments' prior to when the research results were found include frequent and infrequent riders, transit dependent and car dependent, high and low income groups, student commuters and work commuters, long and short distance trip, and so on. Future research can be applied to the existing mass transit system to gain more ridership or to the extended lines or to the construction of new lines to have greater ridership.

Other future research can be achieved extending station accessibility measure by employing GIS (Geographic Information System) application to calculate in more

detail and precisely the criteria used in computing score of station accessibility. Due to some limitations in this research, only general observations can be performed to measure some criteria of accessibility. However, if GIS or other *geographically-referenced* tool is used, more accurate measure can be obtained. For instance, since the usage of motorcycle taxi is high in Bangkok, the criterion of availability of other access modes can be expanded to distinguish between for-hired transit modes and fixed route transit. Criterion of effective coverage area, such as land use development and pedestrian environment can be drawn and added into the score of station accessibility.