Development of Strategies to Improve Attractiveness of Bus Services in Large Cities in Developing Countries

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Abstract: Despite of the fact that public transport plays an important role in enhancing traffic situation in developing countries; however, the share of public transport is very small in comparison with private motorized transport. The increase in attractiveness of public transport is the most effective approach to solve the existing traffic problems. The objectives of this study aim to determine potential factors that affects attractiveness of public transport in term of service quality and social perception, and analyzed the impact of these factors on the attractiveness of public transport.

There are three expected results from this study. Firstly, the influences of the service quality factors and social perception factors on the attractiveness of public transport in developing cities are identified. Secondly, the measures that can contribute to improve the attractiveness of public transport are developed. Lastly, the strategies to improve the attractiveness of public transport are developed for a selected cities.

Keywords: Public transport, service quality, developing countries, attractiveness of public transport.

1 MOTIVATIONS AND GOALS

Large cities in developing countries such as Ho Chi Minh, Hanoi, and Delhi are facing with major challenges due to the urbanization. The urban population is continuous increasing in developing countries, according to WHO the urban population of developing countries is estimated to increase from 2.5 billion in 2009 to almost 5.2 billion in 2050 (Urban population growth, 2014). This leads to increase in travel demand and also demand for transport infrastructure, whereas, the supply of transport infrastructure has often been insufficient capacity to keep up with the growth of mobility. As a result, traffic congestion, traffic accidents and environmental impacts have become serious problems related to this issue. According to the World Bank, 70 percent of road accident occurs in developing countries every year (World Bank, 2002). To be more critical, these issues constrain the economic growth and social development of the cities because of the increasing in costs to solve traffic accidents, environmental problems, loss of time and inclusion, diminish life quality of citizens. Providing new infrastructure to satisfy the transport demand is necessary; however this will be costly, take a long time and cannot bring the sustainable development for urban.

The effective measure to solve traffic problems is to increase the public transport ridership by improving the public transport system. The shifting from using individual vehicles to using public transport saves road space, and the capacity of the road network is used more efficiently. This leads to the reduction in traffic congestion, traffic accident, and emission as well as reduce investment cost for expanding and constructing new infrastructure.

Consequently, there will be decrease in travel time, travel cost and also the mobility in urban areas will be enhanced.

Despite of public transport plays an important role in enhancing the traffic situation in developing countries; however the share of public transport is very small in comparison with private motorized transport. For example, in HCMC, there is only 7.2 percent travel demand of total travel demand of the City (Mai.P, 2010). The main reason for this issue is that the public transport still cannot maintain enough capacity to satisfy the travel demand. The other equally important cause is unattractiveness of public transport with the large part of population due to the variety of reasons such as deteriorating quality of service, unreliable and inconvenient, compared with the individual motorized transport that is very flexible and more convenient (Dhingra.C, 2011). Predominantly, low income or restricted mobility such as elderly people, poor people and students are using public transport. Hence, existing problems of urban transport in developing countries cannot be solved if public transportation is not attractive to citizens who are using private vehicles.

To encourage more people using public transport, this is necessary to identify the factors that influence the attractiveness of public transport. Then the authorities, policy makers and public transport operators can develop the measures to improve the attractiveness of public transport. In developed countries, the public transport is advanced and able to carry large amount of passengers. While, in most developing countries, the public transport is still quite poor and usually bus is the main or even only public transport means in urban areas. Thus, the public transport system in these countries is less competitive compared to private vehicles such as motorcycles or cars. The understanding of potential factors influencing attractiveness of public transport and developing measures to improve its attractiveness in developing countries are motivations of this study.

The overall goal of the study is to find out the effective measures to improve attractiveness of public transport. With the primary aims are to increase the number of public transport users and to develop a sustainable urban transport system in large cities in developing countries. This goal can be divided into the objectives as follows:

• Finding out the role of public transport in urban transport in developing countries and the importance of improving attractiveness of public transport in large cities in developing countries.

• Identifying the effects of potential factors on the attractiveness of public transport in large cities in developing countries

• Identifying the measures that can improve the attractiveness of public transport in large cities in developing countries

• Identifying the existing problems of urban transport in developing countries

• Evaluating the effectiveness of the measures

• Proposing the application process of the measures in an experimental case study in Ho Chi Minh, Viet Nam

2 INFLUENCING FACTORS

The attractiveness of public transport was affected by its service quality and attractiveness of its competitors (private motorized transport). The figure below presents factors which influence service quality of public transport and the attributes individual motorized transport. Based on these understanding, appropriate and comprehensive strategies will be developed in order to increase service quality of public transport and reduce the attractiveness of private transport.
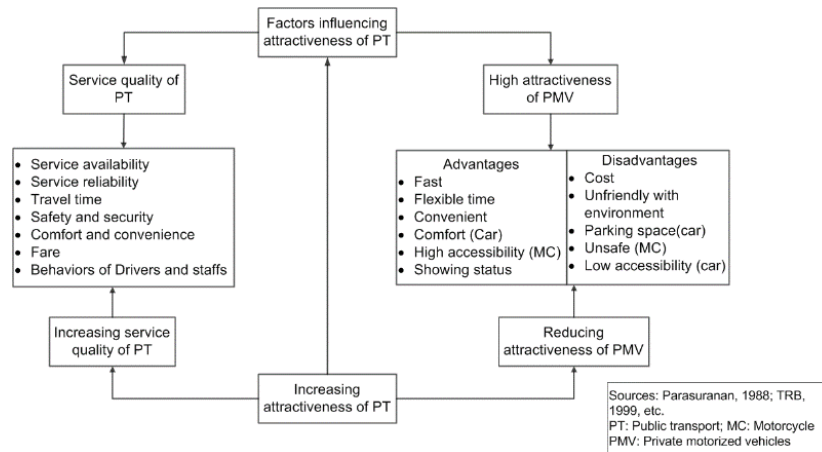
Figure. 1. Factors influencing attractiveness of public transport

2.1 Factors influencing service quality of public transport

The term quality is very widely used in different fields in our society and within each field has different definition. In this research, the service quality is defined as the difference between customer's perception and customer's expectation.

Variety research was conducted to find out the factors that are influencing the service quality of public transport. In transit Capacity and Quality of Service Manual, it was reported that people evaluate the factors that affect quality of public transport differently, depending on their own requirements and situations. The decisions of passengers whether or not using public transport service depend on how well transport service quality is compared to other modes such as cars and motorcycles (TRB, 2003) .Generally passenger loads on-board transit vehicles, the reliability of transit service, door-to-door travel time, safety and security, appearance and comfort of transit facilities are important factors affecting the service quality of public transport.

In 2002, the "Pyramid of Maslow for public transport" was introduced by Peek and Van Hagen displays the priority of the quality factors in public transport (Peek.G & Hagen.M, 2002). The Pyramid consists of different layers that show requirements from public transport passenger aspects. The lower part of the pyramid are basis requirements of customers including safety and reliability, speed, and convenience; these requirements are prerequisites in the decision for choosing a travel mode and need to be provided sufficiently. If not, passengers will be dissatisfied and avoid to use public transport. The upper part of the pyramid are satisfiers, which are additional quality aspects including comfort and experience. The discussion above clearly shows the predominant factors influencing the service quality of public transport. This study focuses on seven predominant factors including service reliability, service availability, travel time, comfort and convenience, safety and security, cost, and behavior of drivers, staffs.

The service availability is one of the most important factor that influences the service quality of public transport. When service is not available, other aspects of service do not matter for a given trip because that trip was not making by this transit, no matter how good the quality of   service is for other places or at other times (TRB, 2003). To become an option for travelers, public transit need to meet five requirements: (1) transit must be provided near trip origin and trip destination (spatial availability), (2) transit must be provided at or near the times required (temporal availability), (3) passengers must be able to access information about when, where and how to use transit (information availability), (4) Capacity of transit must be sufficient (capacity available), and (5) transit service must provide suitable facilities

for both disable people and cyclists in- vehicle and out vehicle such as parking at stops and stations, bicycle connection to stops and stations.

Service reliability of transit system is ability to adhere to schedule or maintain regular headways and a consistent travel time" (Turnquist. M & Blume.S, 1980). Reliability consists of both on-time performance and the evenness of headways between transit vehicles.

Travel time of transit service is one of the most popular aspects that people often consider with other individual modes. Travel time includes of some elements: time to access stops, transfer time, in-vehicle travel time, waiting time at stops and time to access destination. If travel time by public transport is longer than other modes, people who are using public transport may intend to shift using other modes.

Safety and security are the probability of the involvement in an accident such as slips or falls while using transit service is defined as safety and become the victim of a crime is defined as security (TRB, 2003). The safety and security are not only related to the crimes or accidents but it is also related to behavior of other passengers and to the bus operation.

Comfort and convenience are defined as passenger's physical comfort when they access to transport service, when they wait and use transit service. Main components related to comfort and convenient for passenger are benches at stops, shelters, lighting, information signing, vending facilities, seating and standing space on vehicles, and air conditioning on transit vehicle.

Cost of using public transport is characteristics of the monetary cost including some components such as cost of a one-way ride, cost of a transfer, the availability of discounted fares (e.g. for children, students), the availability of volume discounts (e.g. monthly ticket) and the cost of parking at bus stops (Eboli.L & Mazzulla.G, 2012). The number of public transport users will be varied differently depending on the level of ticket price and the price of using other modes. If the price of using public transport is higher than other modes such as motorcycle or car, consequently people will intend to change the travel mode. Public transport is perceived as cheaper compared with car, and cost does not an important factor for shifting to public transport, with the exception of the low-income people, who regard travel cost as a primary factor (Beirão.G & Cabral.A, 2007).

Other factors that may affect the service quality of public transport service such as the courtesy and helpfulness of drivers, ticket agents and personnel appearance, together with the easiness of buying the tickets (Eboli.L & Mazzulla.G, 2012).The public transport system in developing countries is much less advanced in comparison with developed countries, thus passengers often need the assist of drivers and ticket sellers in terms of information or carry luggage on vehicle. Therefore, in developing countries, the behaviors of drivers and ticket sellers might have big influence on the decision of using public transport.

2.2 Attributes of private motorized transport

Increasing in public transport share cannot achieve effectively if there is only focusing on the increase in quality of public transport service but it is also important to understand the attributes of private modes, especially cars and motorcycles, to know why people prefer using individual transports instead of using public transport.

Advantages of private motorized transport: The private vehicle ownership level is different among developing cities and usually it is considered as the reflecting the economic development level. The higher level of income per capita has an inverse relationship with the share of public transport. Recently, the car ownership is increasing in developing cities, and in some countries the ownership of motorized two- wheelers is also soaring. Many studies were identified that car users usually earn higher income; they prefer use cars because of its

comfort, privacy and status consideration. In general, convenience, speed, comfort, and individual freedom are most attractive of car compared to public transport. Otherwise, the car usage provides for users the feeling of sensation, power, superiority and arousal (steg.L, 2005). While, motorcycle users are people from low and middle income, they do not consider much about privacy. In addition, motorcycle use is affordable, far more flexible, convenient, fast, and high ability of accessibility even though it is unsafe and uncomfortable (Perher.J & et, 2004).

In developing cities in Asia, motorcycles are significant cheaper and faster mode of travel compared to public transport. And due to unattractive of public transport services, people tend to use motorcycles even regarding the disadvantages of expose to sun and rain, and significantly higher possibility of accident in comparison with bus transport (GIZ, 2010).

Disadvantages of private motorized transport: Besides the advantages of car using, in the infrastructure condition of road system in developing countries, it is different in some point. For instance, it is difficult for a car to access the entire road system in cities, or in the other words the accessibility of the car is restricted, and in the peak-hour the speed of the car will be slow down due to the chaotic of traffic. Cost is also a big disadvantages of private cars that include fuel cost, taxes, insurance costs and repairs costs. Another disadvantage of cars is parking space, it is difficult to find a parking place and it is also expensive to park in the city. Especially, in large cities in developing countries, there is focusing of offices, markets, shops, schools, and similar places that often generate a lot of travel activities and require high parking demands. And this is difficult to find parking spaces at desired destinations particularly when people go to central of the city (Aderamo.J & Saulau. A, 2013). Recently, people are starting concern about the environment problems, and accidents related to private motorized vehicles. In contrast, the exposure of sun and rain, higher possibility of accidents are regarded as main disadvantages of motorcycles (GIZ, 2010).

2.3 People' Perceptions and Expectations about Public Transport Service Quality

The public transport system is different between developed nations and developing nations due to that the evaluation and expectation of people on service quality factors are different. For example, in Thailand, the travel convenience is perceived as the most important factor affecting the overall customer satisfaction especially for people who use private cars and for routine passengers increase satisfaction when transit fare is reduced. While, the deliberate users who rationally decide using public transport service regard service and information are dominant factors determining the overall satisfaction (Choocharukul.K & Sriroongwikrai.K, 2013). While, in India, the dramatic rising demands for public transport have overwhelmed with existing public transport capacity. Public transport in most cities is perceived as dangerously overcrowded. As a result, the availability of public transport capacity is considered as the most considered factor for people whether or not to use public transit.

Public transport faces severe problems in almost all developing countries, although the situation varies from one country to another and even between cities. The judgment of public transport service varies depending on different passenger categories such as routine passengers, occasional passengers and private-vehicle users. In general, the evaluation of existing public transport users about waiting time, cleanliness and comfort of public transit are more considerable and factors such as driver kindness, bus occupancy and journey time are given less weight. However, non-public transport users evaluating waiting time, journey time and level of vehicle occupancy which are the most considerable and other factors are defined as little influence the transit quality. The reason is people who rarely use public

transport usually have no knowledge about the schedule and therefore they cannot optimize their waiting time, consequently they will have to wait longer, more irritating (Dell's Olio.L & et, 2011) .The perception and expectation about quality service of public transport of people are also affected by public transport system and availability of private modes in different areas in the developing world. And it is necessary to understand what quality attributes of public transport service are important for various kind of customers and what are customer (both current customers and potential customers) expectations of public transport service for service providers when approaching quality improvement and developing strategies that would encourage potential customers change over to using public transport (Redman.L & et, 2013).

The public transport services have the potential to attract car users by improving the quality of service. However, the improvement depends mainly on the perception of each customer group. For instance, in some circumstances, improving accessibility may be enough, but in other circumstances where users are more sensitively concerned to their private motor vehicles, other perceived quality aspects may be needed to be provided. The frequency and reliability of service were perceived as a key influence on public transport demand and satisfaction levels.

3. PUBLIC TRANSPORT IN DEVELOPING COUNTRIES

3.1 General information

In developing cities, the urban transport has much more challenging problems and issues to deal with comparing to cities in developed world. The high number of poor and low income population, rapid increase in urbanization and motorization, high travel demand, poor infrastructure, ineffective government systems characterized by low efficiency, corruption, poor management, lack of public awareness, lack of resources are primary causes of traffic problems in developing cities including the increase in traffic congestion, declining attractiveness of road based public transport, increase in travel costs, accident rates and negative impact on environment are major issues related to traffic and transport in developing cities (Cracknell.A, 2010).

The urban railway transit is not popular in developing cities due to its high construction, operation and maintenance cost. At this time, this system is only operated in some megacities in developing countries such as Delhi, Mumbai, Dhaka and Bangkok. However, the metro system is being constructed and proposed in many other developing cities such as Hanoi, Ho Chi Minh, and Jakarta.

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Figure. 2. Traffic problems and traffic causes in developing countries

The passenger transport in developing countries mainly depends on road-based modes and main public transport service in these cities is conventional bus service. Nevertheless, the quality of public transport service in these cities is remaining at very low level. The bus service in these cities is often insufficient capacity, unreliable service, lack of adequate facilities (vehicles, bus stops), low accessibilities and long travel time. A household survey about public transport in 5 large cities in Africa, namely Johannesburg, Durban, Cape Town, Pretoria, Port Elizabeth found that almost 50% of the households in these cities evaluated that the public transport is too far away and not available to use. Another problems related to public transport in these cities were bad driver behavior, cost of ticket, unsafe, and exposure to crime (Ryneveld.P, et, 2008).

Figure. 3. An example of public transport operation in HCMC, Viet Nam

3.2 Problem and Situation Analysis of Public Transport in Developing Countries, focusing in Ho Chi Minh City

A cause-and-effect diagram is developed in order to identify between problem causes and problem effects (figure 4). This diagram is developed under the traffic condition of large cities in Vietnam. In this diagram, the core problem is identified, namely the low share of public transport. The causes that lead to this problem and the association of theses causes are also identified. The problems would be solved if the share of public transport is increased and defined in order to identify the effects of the problem. Afterwards, specific measures can be identified to deal with the causes in order to solve the problem.

- **Problem causes**

The major causes of the unattractiveness of public transport are poor service quality of public transport and high attractiveness of MC in comparison with public transport.
Due to the characteristics of MC such as small and mobile, MC is able to access the smallest alleys. That is very suitable with the road system in developing cities. Furthermore, the affordable price and inexpensive operational cost of MC which is caused by non-strict control on MC ownership (low taxes, low registration fees) make it easy for the majority citizens.

Long travel time, unreliability, lack of service information, low level of safety and security, uncomfortable and inconvenient are major causes of poor quality of public transport. Generally, there are not any prioritizations for buses; buses are operated in mixed traffic condition and affected by other transport modes lead to the significant increase in travel time and unreliability of the bus service. Additionally, the coordination and cooperation between public transports providers are usually not exist which lead to the competition on the roads between buses. Due to lack of these cooperation and coordination, there is generally no integrated time table of public transport in developing cities, which contributes to the increase in travel time by buses as well as reduce the comfort and convenience for public transport users.

Due to political structures in some cities, the financial, technical, organizational aspects have changed when political aspect changed. This is a result of the lack of continuity of the projects related to public and transport in terms of finance, organization, work programs, etc. The lack of finance, low level of staffing and the lack of professional capacity directly contribute to poor quality of public transport in these cities. The public transport industry is a victim of corruption, the illegal money may demand by vehicle inspectors and

others. That may cause the vehicles unsafe, low quality of vehicles and environmentally unfriendly vehicles. All of three problems can directly or indirectly causes of the low quality of public transport.
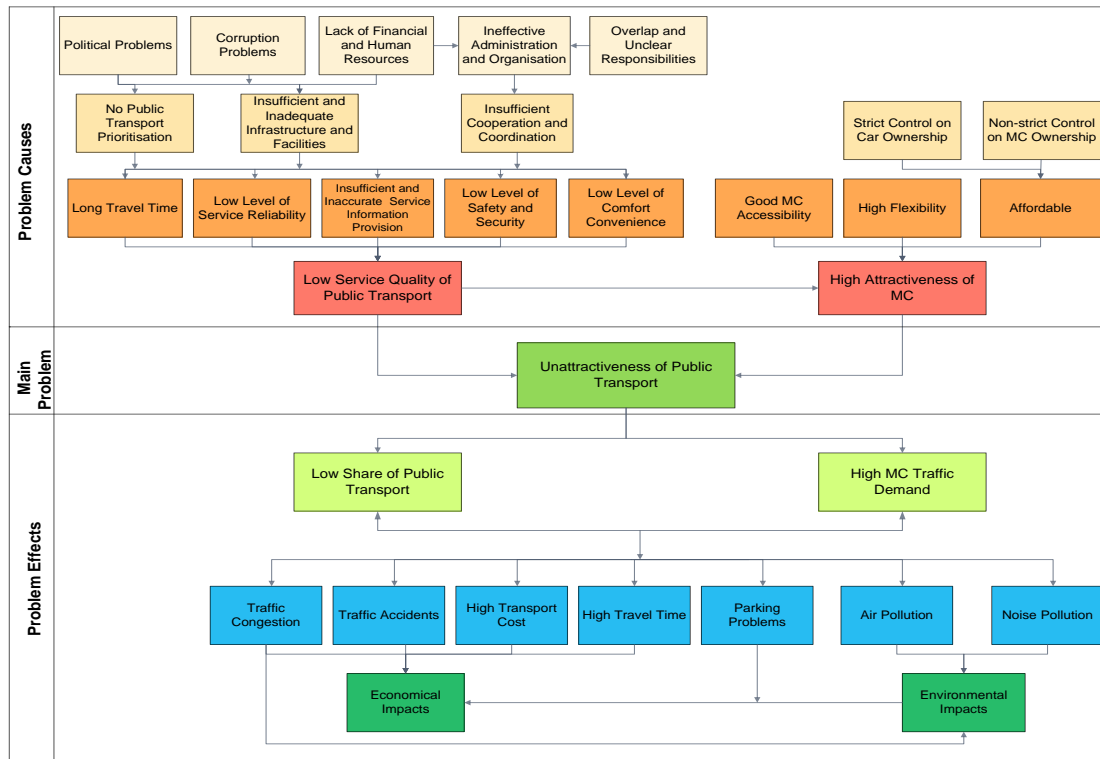
- **Problem effects**

Figure. 4. Cause-and-effect diagram

The primary effect of unattractiveness of public transport is low share of public transport that directly leads to increase MC traffic demand. This situation is responsible for raising the traffic congestion, traffic accidents, and rapid increase in travel cost. The increasing in transport cost includes the increase in fuel cost, purchasing vehicles, parking fees, etc. This also leads to increase in total travel time. That fact leads to an economical loss due to cost for dealing with traffic accidents, traffic congestion, and reduce in the economic productivity and efficiency (long travel time).

The parking related problems such as the lack of parking space and illegal parking, inconvenient and dangerous walking condition for pedestrians is also a result of high MC traffic demand. High share of MC are also caused environmental problems in the city such as air pollution and noise pollution. These consequently affect to the economic development of the city. If the public transport were more attractive in comparison with MC, the number of public transport users may increase and the number of motorists may reduce. The problems affected by current transport situation could reduce.

4 FRAMEWORK OF MEASURE ANALYSIS

4.1 Objective System

The objectives of improvement the attractiveness of public transport in HCMC is directly developed by transferring from the effect-and- cause diagram in previous part into

objective diagram. The objectives should be achieved by increasing in attractiveness of public transport described in this diagram. In addition, the objectives have to be reached in order to increase the attractiveness of public transport also presented. By fulfilling the objectives of the improvement of the attractiveness of public transport, the aims of transport system can be reinforced. The figure 5 shows the objective system based on the development of the cause-and-effect diagram.
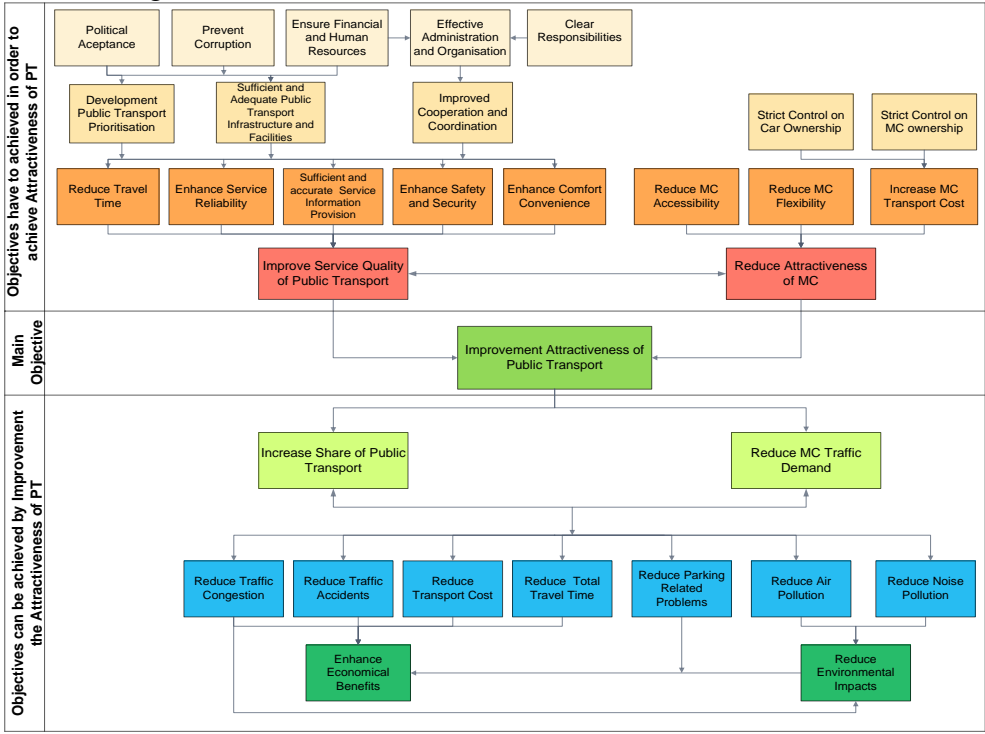

Figure. 5. Objective system

- **Objectives can be achieved by improving the attractiveness of public transport**

The objectives, which can be achieved by enhancing the attractiveness of public transport, are to increase the number of public transport users and subsequently leading to the reduction in the number of motorists. As a result, the major problems related to MC traffic are significantly reduced namely traffic congestion, traffic accidents, parking problems, and environmental problems.

If the service quality of public transport is improved and attractiveness of MC is reduced, there will be more people shifting from using MC to using public transport. There will be less MC on the roads and at intersections that can be resulted in congestion reduction. The road users can travel faster and travel time will be shorter. That contributes to the increase in the economic productivity and efficiency of the city. Furthermore, the total transport cost will be reduced. The transport costs saved are internal costs (cost for buying vehicles, fuel, parking fees, vehicle maintenance costs and road maintenance cost, cost of travel time, taxes, etc.) and external costs (cost for dealing with environmental pollution, economic production losses, cost related to accidents, etc). Traffic congestion reduction is also contributed to the reduction in negative impacts of traffic on environment due to less waiting time of vehicles. In addition, if there are less use of MC, the number of accidents would be reduced. To what extent improvement the attractiveness of public transport can contribute to the reduction in parking related problems.

Another issue that could be achieved by improvement the attractiveness of public

transport is the reduction of environmental impacts such as noise and air pollution. The less use of private modes leads to less fuel consumption. That also contributes to reduce the external transport cost and help to enhance the economic benefits.

- **Objectives which have to be achieved, in order to attain the improvement of the attractiveness of public transport**

The improvement of the attractiveness can be achieved by enhancing the service quality of public transport and reduce the desirability of MC.

Reduction in travel time enhances service reliability, improves public transport information provision, reinforces safety and security, and boosts the comfort and convenience of the public transport service that all are required in order to raise the service quality of public transport. And all these requirements are main objectives of the mentioned measures in this research. However, achieving these objectives require the provision of prioritization for bus operation, sufficient and adequate provision of infrastructure and facilities for public transport as well as ensure the effective coordination and cooperation among related organizations. These improvements can be obtained by ensuring the political acceptance, avoiding corruption, guaranteeing financial and human resources, making sure of the effectiveness of administration and organization.

On the other hand, it is important to reduce desirability of MC, which is aiming to make it less attractive comparing to public transport. In order to reach this aim, there is necessity to implement a strict control on MC ownership and car ownership by increasing vehicle purchasing costs, registration fees, etc. which will all directly affects the MC transport cost. Additionally, the accessibility and flexibility of MC should be reduced. All of these issues can contribute to directly and indirectly reduce the attractiveness of MC. Moreover, the strict control on car ownership has to be ensured, if not the increase in the number of car leads to serious problems related to traffic and transport in the City.

4.2 Assessment Method

In order to assess the measures to increase the service quality of public transport and reduce the private motor use, a multi-criterion assessment model is used. This method is applied to find out the measures that appropriate and applicable for the unique conditions of transport system of targeted areas (Hung.K, 2006). According to the objective system both the effectiveness and feasibility of each measure are assessed. However, the assessment criteria have been modified in order to suitable for candidate measures.

Figure. 6. Assessment of measures (Huong.L, 2014)

The assessment effectiveness of measures

The effectiveness is measured by estimating the impacts of measures on the defined objectives. The effectiveness of each measure can be assessed in term of four objectives following

- Objective 1: Increasing the service quality of public transport
- Objective 2: Reducing the private motorized vehicle use
- Objective 3: Increasing the traffic safety
- Objective 4: Improving the economic benefits (e.g. reduce the transport cost, increase

the revenue)

- Objective 5: Reducing the negative impacts on environment (e.g. reduce air pollution, noise pollution, fuel consumption).

The levels of impacts of each measure on the objectives are qualitatively scaled (high, medium, low and non-effect) and corresponding points (from 0 to 3 points) are given for further evaluation. The more assessment points a measure achieve, the more effectiveness of this measure is.

The assessment of the applicability of the measures

The applicability of each measure is indirectly measured by estimating the difficulty of the barriers that the city would have to overcome in order to implement the measure. The applicability of each measure is assessed in term of cost, institutional participation, and public acceptance.

- The cost of measure includes two main components the investment cost and operation cost and maintenance cost. The cost of measure defined the affordability of the city in implement of the measure. The low cost requirement, the measure is implemented faster.
- The institutional participation is defined as the required support and participation of the institutions, which are not the initiator or implementer of the measure. The required institutions can be transport related institutions (transport operators, transport authorities and traffic enforcers) and political decision marking institutions (political institutions, elected institutions). The less institutions involved in a measures, the high applicable of measure is.
- The public acceptance indicates the estimated commitment of both one the users who directly use the public transport service under the impacts of the measure and other non-public transport users who affected by the implementation of the measure.

The more points a barrier achieve, the less difficulty for its implementation, and the more applicable measure is.

5 DEVELOPMENT OF STRATEGIES FOR VIETNAMESE CITIES

5.1 Potential measures

In order to improve attractiveness of public transport (PT), this is necessary to improve the service quality of public transport as well as reduce the attractiveness of private motorized vehicles (PMVs) (e.g. car, motorcycle) that is the main competitor of public transport. On the one hand, the increasing in service quality of public transport aims to attract more people to use public transport instead of using individual transport. On the other hand, the reducing in attractiveness of private transport aims to make more people shift to use public transport. A group of supportive measures also mentioned to support two main groups of measures in order to achieve success of these measures.
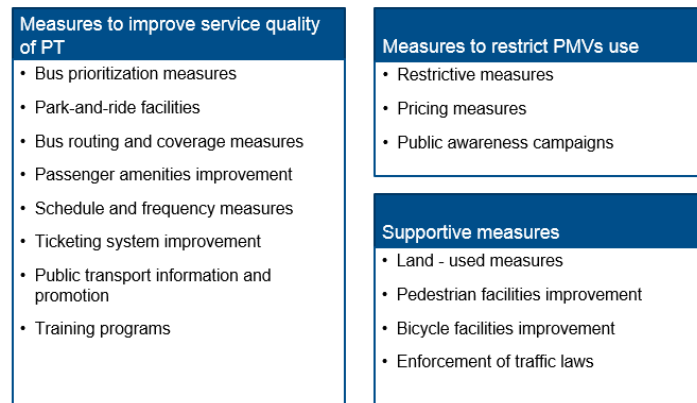
Measures to improve service quality of PT	Measures to restrict PMVs use
• Bus prioritization measures	• Restrictive measures
• Park-and-ride facilities	• Pricing measures
• Bus routing and coverage measures	• Public awareness campaigns
• Passenger amenities improvement	
• Schedule and frequency measures	**Supportive measures**
• Ticketing system improvement	• Land - used measures
• Public transport information and promotion	• Pedestrian facilities improvement
• Training programs	• Bicycle facilities improvement
	• Enforcement of traffic laws

Figure. 7. Measures to improve attractiveness of public transport (Huong.L, 2014)

5.1.1 Measures to improve public transport service quality

The measures for improving service quality of public transport focus on improvement the performance of seven influencing factors that detail described in previous parts including availability of service, service reliability, travel time, comfort and convenience, fare, safety and security and behavior of drivers and staffs. The seven "category actions" each of these containing more specific and detailed measures to improve the service quality of public transport will be identified.

Bus priority measures: Bus prioritization is key way to improve the quality of bus service. This measure has widely applied in developed countries. In developing countries, bus prioritization measures have applied in recent years and have not been widely accepted due to the finance barrier and difficulty to deal with high volumes of private motor vehicles. The bus prioritization measures aim at minimizing the disturbance from other transport modes on the operation of buses. As a result, the travel time by buses is reduced, the reliability of bus service is increase and the quality of bus service is increase in general. The bus prioritization measures are basically categorized into three main groups consisting of (1) measures at traffic signals, (2) measures for travel ways, and (3) measures for bus stops. The priority for buses at traffic signals could help to reduce delay and time-loss at intersections and contribute to increase the reliability of bus service (Fornauf.L, 2009).

The prioritization measures for public transport at traffic signals can be passive prioritization or active prioritization. The passive priority operates regardless the traffic at intersections, the design of traffic signal programs based on knowledge of transit route and ridership patterns. When the transit operations are predictable passive priority can be effective for public transport (Smith.R, & et, 2005). Active measures react directly to the current traffic volume at the intersection, then the special technical equipment at intersections and traffic signals for the buses are needed (Fornauf.L, 2009). The active prioritization measure will only be activated when a bus is present, due to that active priority can disturb other traffic at traffic signals (Wahlstedt.J, 2014).

The prioritization measure for bus on travel ways will significantly reduce travel time by bus, then the reliability of the bus service will be improve, and other factors such as comfort and safety will improve as well. There are a number of measures that have been introduced to prioritize for bus travel ways such as bus ways, exclusive bus lanes, time-restricted bus lanes, and bus lanes shared with other modes. Most of them have been studied and implemented under specific conditions of cities in developed countries. However, the bus priority in developing cities has not been widely accepted due to the low quality of bus service, lack of strong regulation enforcement, and difficulties of dealing with high

volumes of private motor vehicles.

Figure. 8. Bus lanes shared with other specific transport modes (Transport for London)

Park-and-ride Facilities: Park and ride facilities are common in developed cities. This give the an availability of alternatives to driving alone, by providing travellers an opportunity to transfer from low-to high- occupancy vehicles (TRB, 2004). Park-and-ride has huge benefits; it has the potential of reducing total vehicular travel, conserving energy, reducing pollution emissions, and increasing the use of public transport (Chirstiansen, et, 1975). Park-and-ride can be located on the edge of a downtown area or other major activity centres. This could reduce the traffic demand entering the city centres.

Bus Routing and Coverage Measures: The bus routing refers as single route and as a system of routes working together. Bus coverage is a measure of the proportion of an area, corridor or population served by bus service. The appropriate changes in bus routing system and bus coverage can increase the accessibility and availability of public transport service for public transport users, and provide alternatives to motorized vehicle use, especially in congested areas that can minimize the motorized travel. The main measures related to bus routing and coverage are service expansion, service restructuring, circulator/distributor routes, and feeder routes.

Passenger Amenities Improvement: Passenger amenities, both at bus stops and on vehicles play an important role in increase transit ridership. The amenity can provide better transit experience for its customers because it makes public transport more comfortable, safer and may contribute to reduce travel time by public transport. Additionally, amenities may also influence new riders' perception of public transport (TRB, 1999).

Schedule and Frequency Measures: Scheduling and frequency modifications are among the most popular service changes that transit operators make to improve service effectiveness. An appropriate operational schedule and frequency of service can increase the utilization efficiency of vehicle and crew as well as contribute to minimize overall passenger journey time and enhance convenience (TRB, 2004). Furthermore, schedule changes may improve reliability of the service, reduce waiting times of passenger and avoid or reduce passenger anxiety that can increase the attractiveness of public transport service. The modifications of scheduling and frequency can be categorized into six types including change of frequency, change of service hours, frequency changes with fare changes, combined service frequency, regularized schedules, and reliability changes (TRB, 2004).

Ticketing System Improvement: To attract and retain current transit riders, the cost of public transit use must be competitive with the costs of using an automobile. The adjustment of fare levels, fare structures, and fare collection can make the public transit less expensive and more convenient for passengers in comparison with private transport

Public Transport Information and Promotion: The primary goal of transit information and promotion improvement is to increase public transport ridership that will

contribute to retain existing customers and attract new passengers. An effective information provision and promotion effort may improve the image of public transport and raise the awareness of car users and motorcyclists. The transit information and promotion improvement are categorized into mass information provision, mass market promotion, targeted information provision, targeted promotion, on-going passenger information provision, and real – time transit information provision (TRB, 2004).
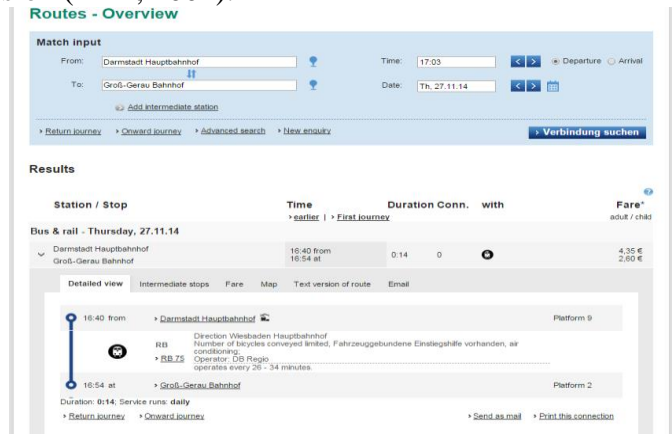

Figure. 9. Public transport information provision on public transport website in Germany (RMV, 2016)

5.1.2 Measures to restrict the usage of private motorized vehicle

The best way to restrict private modes usage is to make it become slow, uncertain and expensive modes for travel (Coombe.D, et, 1996). In this part, the measures that can contribute to reduce the attractiveness of travel by private vehicles are described. These measures aim at increasing the travel time, travel cost by using private modes, and reduce its comfort, convenience and accessibility. Additionally, the public awareness campaigns also presented that aim at raise the awareness of people about the motorized private vehicle use.

Restrictive Measures: Restrictive measures include physical restriction on use, parking control, and vehicle ownership restriction.

Physical restriction on use is one of the effective measures to reduce car use in urban areas. The measures include extensive pedestrian areas, environmental zones, traffic calming, and road space reallocation to buses (bus priority). These measures can promote the public transport usage, reduce individual vehicle use and improve the urban environment but these measures also can lead to increase in the total travel time in the network, reducing efficiency, increase queues length and then adding to environmental impact. These measures would be required careful testing before being recommended for application in practice.

Parking controls usually are reducing parking spaces, restricting parking duration and limiting operating time of parking spaces. These measures can contribute to reduce traffic congestion, environmental impact and accidents. However, the performance of these measures will depend very much on how parking is controlled. Reducing parking spaces may lead to increase the time spend for searching parking spaces, which may have adverse impacts on congestion (Coombe.D, et, 1996). In developing cities, the corruption relating to collection of charges and fines, and tracing offenders is a big difficulty for achieving the effectiveness of a parking control measures (Cracknell.A, 2010). The controls are generally inexpensive to implement, but require strong enforcement if they are to be effective.

The vehicle ownership restrictions lead to a forced shift to alternative modes of transport and consequently to an increased modal share of public transport and non-motorized. Singapore has successfully used "vehicle quota" to limit the total number of vehicles

registered in the city. In Singapore, the quota for each vehicle category is determined by the Land Transport Authority (LTA). In order to own a car, people have to go through a bidding process, and if successful, a certificate of entitlement is achieved. Additionally, the increase in vehicle prices, registration fees, and vehicle license fees can be used to restrict the vehicle ownership.

The pricing measures involved the entity of all instruments, through which the users pays for his potential or realized special travel in passenger or freight traffic (Boltze.M, 2012) . The primary pricing instruments can emerge as purchase prices, vehicle taxes, fuel taxes, parking fees and congestion charges. All these instruments can achieve effectiveness but it needs strong political commitment. The pricing measures aim to influence travel mode choice by changing the cost of private vehicle travel.

Public Awareness Campaigns: Public awareness campaigns aim at making the residents, particular personal vehicle users, more aware of the effects of their travel behaviours on the environment and in terms of sustainability, and to inform them to the alternatives available including use of other modes and changes in destination and frequency of travel (Coombe.D, et, 1996). The activities to deliver the campaign messages can be campaign websites, printed flyers, meeting and focused presentations, exhibitions, radio talk shows, events such as car free days, ride-to-work days.

5.1.3 Supportive Measures

However, the mentioned measures in previous parts cannot solve all the described problems by themselves. These measures should do together with other traffic related measures, for example:
- Traffic rerouting: permanent, temporary or periodic rerouting for other vehicles in the highly loaded traffic volume routes in which buses are operated.
- Infrastructure measures: e.g. open a new road, a new parking place or provide new public transport modes such as light rail transit or metro transit
- Land- used measures: e.g. locating different types of activities close together in order to reduce the amount of travel trips or change the transport modes
- Strengthening legal, institutional and financial for public transport
- Enforcement of traffic laws
- Pedestrian facilities improvement
- Bicycle facilities improvement

These measures are recommended for specific conditions of each targeted areas. The application of supportive measures can help to improve the effectiveness of basis measures.
The successes of measures are different in different applied areas. Measures which are successful in one city may not successful in another. The success of measures highly depend on characteristic of applied city such as city size, traffic situation of city, level of development of city. In addition, no single measure on its own is likely to solve public transport problems in developing cities. For this reason, a package of measures is likely to be more effective than selecting any one measure on its own. A package of measures is likely to deal with more problems; one measure can offset the disadvantages of other measures or can reinforce the impact of each other.

5.2 Development of strategies for Vietnamese Cities

Based on current situation of traffic and public transport in large cities in Vietnam with focusing on Ha Noi and Ho Chi Minh City, two main strategies for these cities are

defined, one is short-term strategy, and one is long-term strategy. The short-term strategy will focus to develop the "public transport system as a competition system". The long-term strategy focuses to develop the "public transport system as priority system". Beside this, a universal recommendation is also discussed.
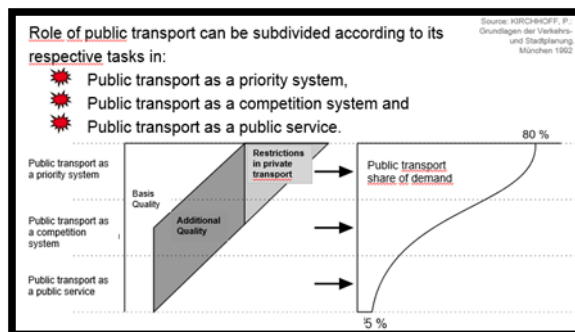

Figure. 10. Role sharing - public transport/private transport (Boltze.M, 2012)

5.2.1 Description of the strategies

Short-term Strategy: The short-term strategy focuses on the existing condition of public transport system and develops a strategy for improving this situation, to make public transport become a competition system. This strategy is recommended for current transport situation and the transport situation in next few years, before the first metro line is operated at earliest in 2018 because there will be no significant changes with the current traffic situation.

The short-term strategy aims to achieve the objectives of the study by raising the ability of competition of public transport system in order to make public transport to become more competitive than private transport. This strategy focuses on three aspects, firstly there will be focused on enhancing the service quality of public transport with the aim to improve travel experience by public transport for people. That subsequently contributes to change the image of public transport in citizens' mind. Secondly, the measures to reduce the advantages of motorized private vehicles are developed, which make individual transport to become less attractive transport mode compared with public transport.

Finally, the raising awareness of people about their travel behaviours is included in the short-term strategy.

Long-term strategy: The long-term strategy focuses on develop the public transport system to become as a priority system in the transport system. The strategy is developed on the supposition that an efficient mass rapid transit system will have been established in next five to ten years. In this situation, there is an assumption that the motorcycle traffic demand has slightly increased and still have highest share in total transport demand. The car travel demand also increase, however if the short-term strategy could implement effectively, the car traffic in next five to ten years is still at low share in total transport demand. And the share of public transport system is slightly increased due to the increase in its service quality and the restriction on private vehicle use.

Figure. 11. Description of the strategies (Huong.L, 2014)

Due to the mass rapid transit system is available at this time; it is socially acceptable to apply more restrictive measures for private transport since there is an alternative transport mode ensuring the mobility for all social classes. And there is also higher social acceptable to enhance the higher priority for operation of buses. The cooperation of bus system and mass rapid transport system can serve the major travel demand of the city.

5.2.2 Description of measures

For the short-term strategy, in order to make public transport to become a competition transport system in HCMC, the number of measures that assessed in previous part is selected based on their effectiveness-values and applicability-values. In more detail, the measures with high applicability-value selected (e.g. measures should have an applicability-value higher than two points). And these measures should have effectiveness-values as high as possible.

For the long-term strategy, measures which have low applicability-values can be implemented. However, measures which have an effectiveness-value lower than five are excluded. Due to the highly increase in traffic demand in the city, in order to increase the attractiveness of public transport, the higher priority should be provided for public transport service.

The following table shows the list of selected measures for implementing in short-term and long-term strategies. In this table, different measures are recommended for different applied areas including measures for whole bus system, trunk routes, and measures to restrict motorized private vehicle usage.

Table 1. Application measures for Vietnamese Cities

Application areas	Measures	Short-terms strategy	Long-terms strategy
Measures for bus system	Restructuring bus network (e.g. establishing a hierarchical bus network)	●	○
	Providing park and ride facilities	●	●
	Providing necessary facilities at bus stops (clear marking, providing shelter, etc.)	●	○
	Establishing an appropriate fare structure	●	○
	Improving ticketing system and payment facilities	●	○

Category	Measure		
	Improving passenger amenities	•	•
	Providing public transport information	•	•
	Implementing public transport promotion (discount, free to ride)	•	•
	Changing operating time	•	○
	Implementing frequency changes with fare changes	•	○
	Regularizing schedules	•	○
	Integrating schedules and ticketing system	○	•
	Providing real-time information	○	•
	Training programs for drivers, staff, ticket sellers	•	○
Measures for trunk routes	Bus lanes shared with other transport vehicles	•	•
	Fully-separated bus lanes	•	•
	Time-restricted bus lanes	•	•
	Physical restriction measures (pedestrian and cycling zones)	•	•
	Partly dynamic bus lanes	○	•
	Active priority at signalized intersections	○	•
Measures for private motorized vehicles	Parking control	•	•
	Vehicle ownership restriction	•	•
	Vehicle taxes/fuel taxes	•	•
	Parking charge	•	•
	Public awareness campaigns	•	○
	Congestion charge	○	•

- • Highly recommendation for implementation
- ○ Less focusing on implementation

5.2.3 Measures for short-term strategy

Measures for whole bus system: In this part, a group of measures that should be applied for whole bus system in the cities is described consist of:

1) Restructuring bus network, which helps to improve the accessibility of public transport service. Bus network should be an integrated network with clear hierarchy between bus routes, which includes trunk-bus routes, feeder bus routes, and circular bus routes.
2) Providing park and ride facilities at large stations where long bus services and public bus services are operating together. The parking fee should be fee for people who use city-bus service in order to encourage people using public transport.
3) Providing necessary facilities at bus stops (clear marking, providing shelter, etc.), which can enhance the safety for passengers. Additionally, the activities such as parking, standing, and business should be completely prohibited at all of bus stops in order to ensure the boarding and alighting activities of passengers as well as reduce the disturbance for buses (when buses access the bus stops).
4) Establishing an appropriate fare structure, which could help to increase the patronage

of existing bus users and may attract new bus users. The fare structure should be determined based on travel distance, travel time, offered services, user categories, etc.

5) Improving ticketing system and payment facilities may contribute to enhance the convenience for public transport users as well as increase the reliability of ticketing system. The ticket machines should be provided at main stations. Passengers can buy single ticket directly from ticket sellers on buses, or from ticket machines.

6) Improving passenger amenities, the amenities of bus service at bus stops and on buses is necessary. Instead of changing vehicles or re-constructing bus stops, first or all the current vehicles and infrastructure (e.g. bus stops) of bus system should be improved. That can be achieved by enhancing the equipment/facilities at both bus stops and on buses (e.g. enhancing the lighting system at bus stops, providing shelters at bus stops, providing the air-conditioners on buses, etc). These improvements also contribute to increase the security for passengers at bus stops.

7) The public transport information should be provided widely by using printed papers, radios, and television especially by using the public transport website. The public transport website should be designed easily for passengers to understand. The information of ticket prices, bus routes, bus maps, operating time of buses, and bus headways should be provided at all bus stops, bus stations, on buses and in the internet.

8) Public transport promotion campaign is effective way to attract new bus users. This measure encourages people to try to use public transport, which consequently may contribute to change the perception of people about the public transport service.

9) In order to satisfy the travel demand of citizens, the changing of operation time and frequency of buses should be implemented. The operating time of bus service should be prolonged in the evening. This not only helps to satisfy travel demand of citizens but also reduces the number of accidents that related to drunken people (common lifestyle of citizen in cities is drinking in the evening after finish a working day).

10) Implementing frequency changes with price changes, by reducing the headways of buses or providing express service in the peak-hours, the current public transport system can satisfy the travel demand of passengers.

11) Providing regularized scheduled that helps passengers to have better plan for their travels.

12) The providing training courses for bus drivers and ticket sellers are necessary in order to improve the skills and behaviors of bus drivers and ticket seller. The training courses should be focused on training them to be polite and supporting with passengers.

Measures for trunk routes: Based on current road conditions in trunk-routes, different prioritization measures can be applied including:

13) Bus lanes shared with other transport vehicles (should be implemented on the roads which have more than two lanes for each direction)

14) Time-restricted bus lanes (should be implemented on the roads which have more than two lanes for each direction)

15) Physical restriction measures, the pedestrian and cycling zones can be established in some streets in the city centre. In these streets, the travel by private vehicles should be prohibited and only bicycles and buses are allowed to operate. However, there are should allow car access or motorcycle access in specific time of day in order to serve the business purpose. The parking spaces in the edge of these streets should be

provided. And the parking fees should be free for residents whole live in pedestrian and cycling streets. If the pedestrian and cycling streets are successful, more streets can be transformed to pedestrian and cycling zones, to achieve walking quarter.

16) Fully – separated bus lanes should be only implemented in cities centers where the number of motorized vehicles are usually very high.

The information about these priorities should be provided for road users in advanced; guidance information and signals for prioritization have to provide clearly; and the re-routing for individual transports should be taken into account.

Measures to restrict motorized private vehicles usage: Together with measures to improve service quality of public transport service, the measures that reduce the attractiveness of public transport should be provided, the measures should be:

17) Parking control measures should be identified based on the time of parking (peak hours/off-peak hours), duration of parking instead of control parking per turn.

18) The parking price should be increase both for motorcycles and cars.

19) Restricted in vehicle ownership, the "vehicle quota" should be applied in order slow down the increase in the number of motorcycles and cars. The strict controlling of ownership the driving license should also implemented.

20) Vehicles taxes for car ownership should be kept at high level and vehicle taxes for motorcycles should be increased. Because when the income level increase, the people tend to own new motorcycles or buy new cars, without strict control on vehicle ownership the number of cars and motorcycles could increase significantly in next few years.

21) Public awareness campaigns are effective measures to raise the awareness of people about their travel behaviours. Children should be involved in these campaigns because they might have influence on travel behaviours of their parents. The car fee day can be transformed to motorcycle free day, or cycling day.

Recommendation of universal applicability: The strategy is most effective in Vietnamese cities. However, the traffic characteristics and public transport system in thesis cities are relatively similar with other cities with high number of motorcycles in the traffic flows. Thus, this short-term strategy can be recommended for these cities. However, it should be noted that the successes of measures are different in different applied areas. Measures which are successful in one city may not successful in another. The success of measures highly depend on characteristic of applied city such as city size, traffic situation of city, level of development of city.

5.2.4 Long-term Strategy (Public Transport as Priority System)

Measures for bus system: Combine with measures which have implemented in short-term strategy, in the long term strategy there are some main measures should be highly focused to implement including:

1) The park-and-ride facilities should be provided at all metro stations, which ensure the intermodal change between buses, motorcycles, cars and mass rapid transit service and the parking fee should be free for public transit riders.

2) Implementing integrated schedules and ticketing system between public transport

services, which can improve significantly the convenience for passengers.

3) Providing the real-time transit information that helps passengers to have better plan for their travelling, and the convenience, comfort could highly enhanced.
4) Continuously improving passenger amenities. For example, the changing buses from high-floor buses to low-floor buses and re-constructing bus stops could greatly improve the passenger amenities. However these changing should be synchronous with each other.
5) Continuously providing public transport promotion.

All of these changing and improvement help to increase the service quality of public transport significantly. This help to achieve the higher acceptance from public in the giving more priority for public transport system.

Measures for trunk-bus routes:

6) Continuously providing fully separated bus lanes in the trunk routes and in cities centers.
7) Implementing partly dynamic bus lanes.
8) Bus lanes shared with other transport vehicles.
9) Providing active priority signal programs at intersections to provide higher prioritization for bus system. The travel time of buses could be reduced significantly in these cases. However, these measures should be applied on the trunk-bus routes in order to ensure the economic aspect.

Measures for private motorized vehicles: The continuous increase in income level will lead to increase in the number private vehicles, especially in the number of cars. Thus, the measures that restrict the increase in the number of private vehicles should be implemented continuously form short-term strategy to the long-term strategy. However, in the long-term strategy, the prohibited motorcycle ownership should be taken into considered to implement. Additionally, the congestion charging should be applied for cars to slow down the increase the car ownership in the city.

Recommendation for universal applicability: The strategy is most effective in large cities in Vietnam, since bus system and mass rapid transit system can be excellent alternative transport modes for individual transport. This strategy is recommended for some Asia cities which will establish the mass transit system in the near future. However, the successes of measures are different in different applied areas. Measures which are successful in one city may not successful in another. The success of measures highly depend on characteristic of applied city such as city size, traffic situation of city, level of development of city. Thus, there is should be considered carefully before applying these measures for another cities.

6 CONCLUSION

The increase in the attractiveness of public transport is one of the most effective approaches that can solve the problems related to traffic and transport. This consequently leads to an increase in the number of public transport users, which is a fundamental requirement to achieve a sustainable development in developing countries. However, the development of the attractiveness of public transport must not be developed separately from other planning process, but rather be integrated in an overall municipality planning. The development should be focused both on the increase in service quality of public transport and

the restriction on private motorized vehicle use. In addition, the supportive measures should be implemented together with the basis measures in order to achieve higher success.

A short-term strategy and a long-term strategy have been developed for Vietnamese cities. The short-term strategy is developed for the situation that no mass rapid transit exists in these cities. Thus, this strategy focuses on develop the public transport becomes as "competition system", which have higher attractive in comparison with individual motorized transport. The measures that contribute to increase the service quality of public transport service are selected. Additionally, the measures that contribute to reduce the attractiveness of private motorized vehicles are also selected, which aim to restrict the use of these private vehicles. Different groups of measures are recommended for different application areas in the city.

Taking an efficient mass rapid transit system for granted, the long-term strategy focuses to develop "public transport as priority system". In this situation, the bus system and the mass rapid transit system will responsible to transport a major travel demand in the city. In the long-term strategy, measures that give higher priority for public transport should be implemented such as fully-separated bus lanes, active priority for bus operation; and measures that have higher restriction on private vehicle use should be also implemented, which can be prohibited motorcycle ownership or implement congestion charging for cars.

The strategies are most suitable for Vietnamese cities, however this is highly recommended for other Asian cities, which have similar traffic characteristics with HCMC and Ha Noi (motorcycle dependent city). Ho Chi Minh and Hanoi have good opportunities to achieve a sustainable development. If transport authorities and other political institutions cooperate efficiently and effectively in compliance with strategic goals, the motorcycle dependent cities can develop to sustainable cities, which are transit-oriented cities, avoiding a car dependent development.

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