DOCTOR'S THESIS

A study on travel intention for the integration of mass rapid transit with motorcycle in developing-country cities: A case of Ho Chi Minh City

途上国都市におけるモーターサイクルと公共交通とを組み合わせた移動に対する行動意図に関する研究－ホーチミンシティでの調査をもとに

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ABSTRACT

Motorcycle use is increasing steadily in developing countries. Many megacities have implemented policies and strategies as an attempt of mitigating urban transport problems, such as private vehicle growth, traffic congestion, and environmental pollution. Since it is unmanageable to develop transport infrastructure to meet increasing mobility demand, new transit alternatives such as mass rapid transit (MRT) and bus rapid transit (BRT) have been invested in solving urban transport problems in many metropolitan areas. The phenomenon of motorcycle growth and the need of MRT systems have presented many challenges for researchers and policy makers in cities within developing countries. While the implementation of MRT systems is regarded as an approach meeting high travel demand and improving public transport service, MRT developments may be undermined by the use of motorcycles. Since low-middle income people find motorcycle an affordable mode of transport in comparison to automobiles, the growth of motorcycle ownership and usage has accelerated the motorization process within cities in developing countries. However, some cities lack the economic resources required to implement MRT systems soon while the rate of motorcycle ownership is increasing. The issue is the likelihood that motorcycles will become the most prominent mode of urban transport, before MRT can be developed and public transport systems are able to provide an efficient service. Therefore, motorcycle management should be conducted before MRT development, in order to limit future obstacles for the integration of MRT and motorcycles. In this context, it is important to understand people's travel intentions regarding new transit alternatives, for implementing appropriate measures in motorcycle use. The main purpose of this study is to investigate the factors that influence peoples' travel intentions, in order to manage motorcycle use, with respect to MRT systems in cities within developing countries. It aims to suggest rational measures for motorcycle mobility, to enhance existing public transport, and to contribute to future integration of MRT with motorcycle in motorcycle-based context.

The study focuses on cities within developing countries, with characteristics such as high growth or modal share of motorcycle use; lacking or beginning construction of MRT systems; existing public transport services which are undeveloped or have poor performance; low and middle levels of income; fast urbanization and rapid motorization. Ho Chi Minh City (HCMC) in Vietnam has been selected as a representative city within a developing country for this research. The study was designed with the psychological approach to achieve three objectives : i) To analyse potential changes of travel behaviour in motorcycle-based contexts; ii) To explore motorcycle use intentions considering MRT performance; iii) To identify factors influencing the future choices of MRT use.

Three field questionnaire surveys were conducted to gather the required data in order to achieve the objectives of this study. The basis of the questionnaire structure includes: Socio-economic demographics, travel behaviours and attributes, attitudes and preferences, and MRT uses. Stated preference technique was applied for questions relating to MRT. Statistical techniques (t-test, analysis of variance, and discriminant analysis), Structural Equation Modelling, and the Binary logit model were used for the data analysis.

Since there is no MRT system in HCMC at this time, people do not have the option of using it as an alternative mode of transport. Many factors of previous studies such as travel patterns and built environments are only able to exist in the context of existing operating MRT systems. Therefore, factors relating to current travel behaviours should be considered to investigate their influences on behavioural intentions and future MRT choices. While bus use has little share in urban transport, attitudes toward travel modes might be important factors of mode choices and travel intentions. Moreover, motorcycle taxis represent a minor role in connecting bus services. How people perceive access to buses may affect their decisions to use buses in the future. It is found that different commuter groups will have different travel intentions based on diverse of attitudes, preferences, and motorcycle use frequency. People who are bus oriented intend to have bus use and to reduce motorcycle use. People with specific preferences in bus access and motorcycle taxi experiences have the intentions of mass rapid transit use. Long trip are preferred for future mass rapid transit use. It indicates that travel behaviours of motorcycle dependent cities have potential to be changed under new transit developments.

Similar to cities in developed countries, people living in residential developments have higher intentions of using their car, than other modes of transport. Motorcycle continues to be the main mode in new urban areas, but less motorcycle use is also considered. Increased use of buses is less intended in comparison with private vehicle use intention. In new urban areas, residential developments might encourage car accessibility by efficient infrastructure; however there is low accessibility for public transport systems. Unless conventional buses are improved, new residential developments impose challenges for public transport services. Therefore, urban development must be controlled in accordance with public transport development. The introduction of MRT systems can be enhanced by policy implications in parking management. While the use of private vehicles should be controlled in city centres, motorcycle should be used as MRT access in peripheral areas. Long journeys, parking constraints, and congestion make Park-and-Ride the most preferable choice for motorcycle users.

Although intention is an important predictor of mode choice behaviour, differences between intentions and actual choices may occur. Trip chaining complexity and traffic condition are found to be main factors affecting future MRT choices. Although Pro-Environment, Measure Acceptance, and Bus Safety Belief have relationships with MRT intentions, these factors are not predictors of MRT choices. On the contrary, Pro-Motorcycle and Pro-Automobile use has negative impacts on MRT choices while they are not associated with MRT intentions. Preference of driving motorcycles to access bus services affects both MRT intentions and choices. Different determinants of the intentions and choices of MRT use indicate that different policies should be implemented in urban transport planning, depending on the process of MRT implementation.

Following research, some policies for Ho Chi Minh City include: regulations of motorcycle taxi service, bus reforms in new urban developments, transit fare encouragement, parking controls in city centre and suburban stations, Park-and-Ride schemes for bus use and suburban area, campaign programs for safety and environment, and land use and transport planning integration. Although HCMC was selected as a case study, the research findings are also useful for other cities within developing countries

where motorcycle use is increasing in urban transport. Since motorcycle taxis are regarded as private services competing with taxis and conventional buses in Ho Chi Minh City, the effect of motorcycle taxi experience on future MRT choices may be slightly changed in other cities within developing countries. Survey populations should include more low income groups and car users to gain a variety of attitudes and preferences. Influences of para-transit and other public transport modes should be explored more when analysing and modelling MRT intentions and choices. Security problems are probably determinants of motorcycle use in some contexts within developing countries. Therefore, additional attitudes and preferences may be required to identify the impact of security problems on travel intentions. Travel distance may not have many influences on MRT choice in small and medium-sized cities. Survey instruments of this study can be revised and utilised to grasp people's attitudes, preferences, and intentions regarding other transit alternatives such as bus rapid transit and monorail.

As a phenomenon of motorisation, motorcycles become an important mode of transport within many cities in developing countries. The popularity of motorcycle use provides opportunities for private mobility and creates challenges for transport planning. Since MRT systems were introduced in megacities of developing countries, it is important to identify the new role of motorcycles to meet the goal of sustainable development. This study has explored factors influencing travel intention in a motorcycle-based city, in order to contribute to the integration of MRT and motorcycle use. Although this thesis focuses on travel intention, the influences of intention on mode choice behaviour were also explored. It is forecasted that motorcycles will soon be used as private modes of transport, and the implementation of MRT systems will begin late in African cities. Therefore, the findings of this thesis may be considered for motorcycle mobility management in those cities. Further studies should focus more on travel intentions regarding the difference in time, influences of trip chaining complexity on travel intentions, and travel intentions of low and high income people to provide comprehensive views. It aims to encourage motorcycle to become a part, rather than a dominant mode in the diversity of urban transport.

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LIST OF ABBREVIATIONS AND SYMBOLS

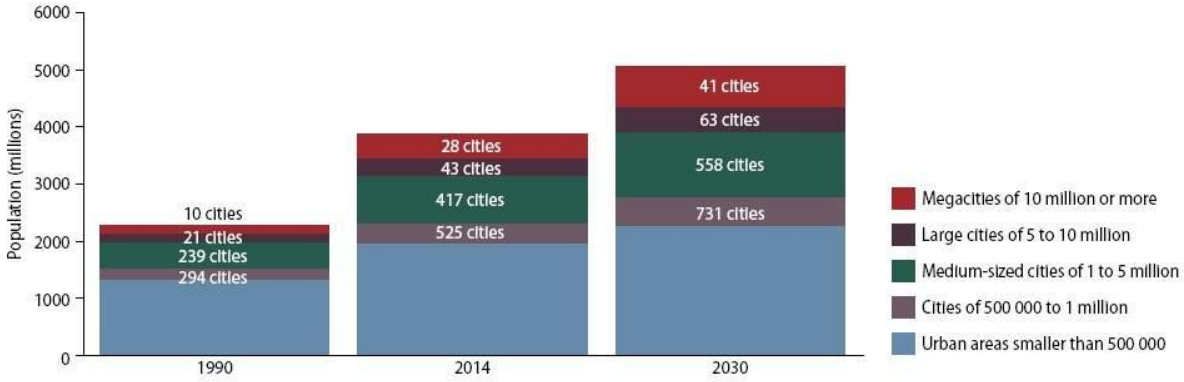
MRT	Mass Rapid Transit
BRT	Bus Rapid Transit
NMM	Non-Motorized Modes
HCMC	Ho Chi Minh City
DOT	Department of Transportation
JICA	Japan International Co-operation Agency
GDP	Gross Domestic Product
VND	Vietnamese Dong
CBD	Central Business District
TPM	Planning Transport Model
SP	Stated Preference
RP	Revealed Preference
TPB	Theory of Planned Behaviour
SN	Subjective Norm
PBC	Perceived Behavioural Control
NAM	Norm activation model
PN	Personal Norm
AC	Awareness of Consequence
AR	Ascription of responsibility
TA	Travel Attitudes
TI	Travel Intention
PT	Public Transport
SPSS	Statistical Package for the Social Sciences
ANOVA	Analysis of Variance
SD	Standard Deviation
AMOS	Analysis of Moment Structures
SEM	Structural Equation Modelling
Chi-sq/ DF	Ratio of Chi-square to Degree of Freedom
GFI	Goodness of Fit Index
AGFI	Adjusted Goodness of Fit Index
CFI	Comparative Fit Index
RMR	Root Mean square Residual
RMSEA	Root Mean Square Error of Approximation
R^2	Percentage (%) of variance explained
VKT	Vehicle Kilometres Travelled
α	Cronbach's Alpha

CHAPTER 1

1. INTRODUCTION

1. 1 BACKGROUND

Urbanisation is occurring rapidly in the world. According to United Nation (2014), of the world's population, 3.9 billion people, over half are living in urban areas. Half of the world's urban population are residing in towns and cities of less than 500,000 inhabitants (see Figure 1.1). The number of megacities with more than 10 million habitants is predicted to grow from 28 in 2014 to 41 in 2030. Smaller and medium-sized cities are projected to contribute to the main growth of megacities. In Asia and Africa, medium-sized cities and cities with less than 1 million residents grow most rapidly among urban agglomerations. Urban population is forecast to grow to 6.4 billion people by 2050. The urbanizing growth of Africa and Asia is higher than that of other regions. Most of the urbanisation process is proceeding in developing countries (Gwilliam, 2013).

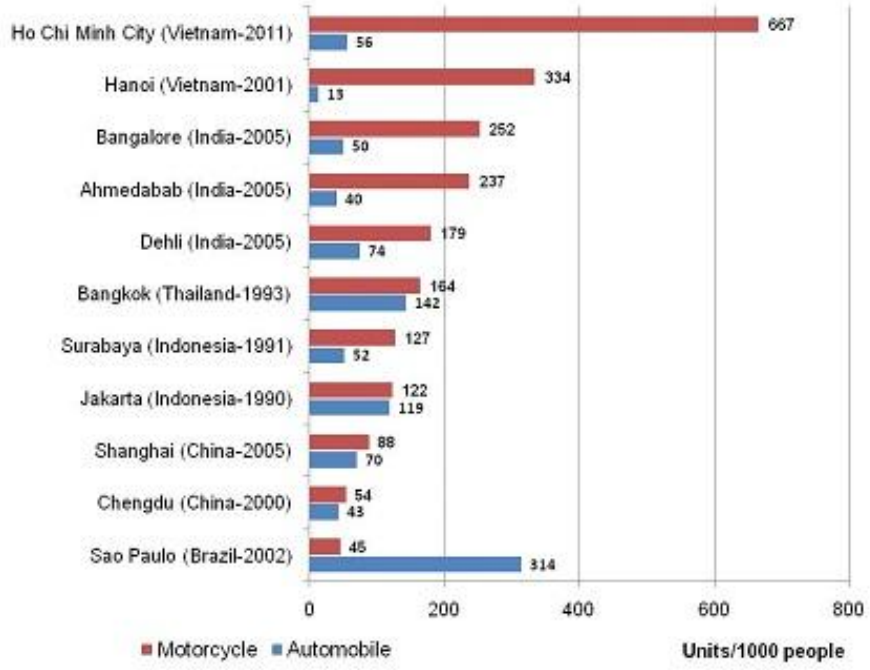


(Source : United Nation, 2014)

Figure 1.1 : Global urban population growth by city sizes

Beside rapid urbanisation, motorisation has been accelerating in many metropolitans. While the rate of car ownership achieves saturation point in developed countries, the growth of car ownership is higher than the rise of GDP in most Asian megacities (Senbil et al., 2007). Although automobiles are regularly referred to as the main indicator of motorisation, another aspect of the motorisation process is characterised by the high level of motorcycle ownership and use (see Figure 1.2). Motorcycle use is growing steadily in many low and medium economies. Motorcycles account for half of vehicle fleets in Asian countries, and become a dominant mode of transport in Laos, Cambodia, and Vietnam (Gwilliam, 2003; Chin, 2011). There is a high growth of motorcycle ownership in South Asian countries such as India, Pakistan, and Bangladesh. Although conventional buses and para-transit services retain a significant proportion in the emerging economies such as Thailand, Indonesia, and the Philippines, motorcycle rates are still increasing. In Latin American countries, the level of vehicle ownership is still low in comparison with North American and European countries. However, the growth of light duty vehicles and motorcycles contribute to the high rate of vehicle ownership, particularly in Brazil, Mexico, and Colombia (Hidalgo & Huizenga,

2013). In Kuala Lumpur (Malaysia) and Bangkok (Thailand), the rate of private motorised vehicles including motorcycles are the same as those of European developed countries (World Bank, 2001). In Southeast Asian region, the motorcycle growth in medium sized cities is extremely higher than that of large cities, although the rate of motorcycle ownership is still low (Kidokoro & Kubota, 2007). Therefore, there are more challenges for secondary cities lacking sufficient resources to mitigate urban transport problems, similar to those of megacities such as Bangkok, Kuala Lumpur, Manila, and Jakarta.



(Source : Compiled by author from many data sources)

Figure 1.2 : Motorcycle and automobile ownership in cities within developing countries

Since motorcycle use becomes an important aspect of urban transport, particularly in Asia, the concept of "*motorcycle cities*" has been introduced to indicate the cities following motorcycle-oriented transport (Barter, 1999). Ho Chi Minh City (Vietnam) where the modal share of motorcycles accounts for over 90% of urban transport is an example of a motorcycle city (JICA, 2004). The high modal share of motorcycles results in more served congestion and influences on bus performance (Van & Fuji, 2009). In South East Asia, some medium-sized cities have a high growth of motorcycle ownership, although there is a low rate of motorcycle ownership in comparison to megacities (Kidokoro and Kubota, 2007). In addition, Phnom Penh (Cambodia), Vientiane (Laos), and Ho Chi Minh City (Vietnam) have higher rates of motorcycle ownership and usage than others, such as Bangkok (Thailand) and Jakarta (Indonesia). In many sub-Saharan African cities such as Lagos (Nigeria), Douala (Cameroon), Cotonou (Benin), and Mombass (Kenya), motorcycles have been used for commerical purposes or public transport (Sietchiping et al., 2012). Within many developing countries motorcycles are gradually being recognised as an important mode in urban transport.

Chaotic urban development and poor transport systems contribute to rapid motorisation in developing countries (Susilo et al., 2007). Emerging motorisation coupled with increasing urbanisation causes serious concerns about the heavy economic, environmental, and social

costs of urban transport systems. Rapid motorisation and road network limitations lead to serious congestion problems, noise, air pollution, and traffic accidents (Shimizu et al., 2003). Moreover, economic growth leads to increased income, which in turn leads to accelerating personal mobility and private vehicle ownership. Consequently, travel demand overloads public transport service and transport infrastructure supply. It is typically characterised by the decline in public transport ridership and the rise in private vehicle use. It raises the question how the disadvantages of motorisation are resolved while personal mobility is still maintained (Sperling & Claussen, 2004).

Cities within developing countries have implemented policies and strategies to tackle urban transport problems, such as private vehicle growth, traffic congestion, and emission (Dissanayake et al., 2002). Since it is unmanageable to develop transport infrastructure to meet increasing mobility demand, public transport and MRT have been invested in to solve urban transport problems. Many megacities such as Bangkok, Beijing, Shanghai, Delhi, Teheran, Cairo, Sao Paulo, and Mexico City have implemented MRT systems to mitigate traffic congestion in the last decades (Koizumi et al., 2013). Other cities such as Jakarta, Hanoi, and Mumbai are in the process of project implementation.

Although MRT contributes to reduce the impacts of motorisation such as congestion and pollution, it raises debate about economic and operational efficiency (Gwilliam, 2003). Financial limitations are common obstacles for MRT implementation. Many Asian cities meeting requirements in population density and urban-scale for mass transit performance, fall short in terms of economic resources, only reaching low or medium levels (Townsend & Zacharias, 2010). In Bangkok (Thailand) and Manila (Philippines), some MRT lines have ridership lower than demand forcasted (Okada et al., 2003). High fares, limited MRT networks, access difficulties, and poor connections with other modes are main reasons for low ridership. In Latin American countries, bus systems compete with MRT rather than becoming feeder modes (Cervero, 1991). The growth of private vehicles results in more difficulties for public transport services.

The phenomenon of motorcycle growth and the need of MRT systems have presented many challenges for researchers and policy makers in developing countries. While the implementation of MRT systems is regarded as an approach meeting high travel demand and improving public transport services, MRT developments may be undermined by motorcycle use in the future. The growth of motorcycle ownership and usage has accelerated the motorisation process in low and middle economies because motorcycles are affordable modes of transport in comparision to automobiles. This results in a higher challenge to shift travellers from private vehicles to public transport and non-motorized transport (Fourace, 2003).

Beside the role of personal mode, motorcycles have been utilised as public transport in African countries or para-transit in Asian cities (Tsao, 2010; Prabnasak & Taylor, 2009; Un-Habitat, 2010; Abuhamoud et al., 2011; Guillen et al., 2013). Moreover, motorcycle is recommended to be a feeder mode of MRT systems or to be used as an access mode to BRT corridors (Vu, 2013a; Satiennam et al., 2013). It was suggested that urban rail network should keep an important role as the "*back bone*" in urban transport system of Asian megacities (Morichi, 2005). In the future, motorcycles may become an important mode and MRT system will be developed to meet high travel demandin many cities in developing countries. While motorcycle use is negatively evaluated in terms of traffic safety, other mobility advantages such as congestion reduction, accessibility improvement, and flexible

travel are rarely recognised. Therefore, the integration of motorcycle and MRT should be carefully considered, ensuring personal mobility and positive roles of motorcycles, to enhance MRT performance. Since achieving this prospect is challenging, it is necessary to have appropriate policies for motorcycle use management before MRT development. Many cities within developing countries lack economic resources to implement MRT systems soon while the rate of motorcycle ownership and use is increasing rapidly. It is likely that motorcycles will become a dominant mode before MRT infrastructure is implemented in urban transport. In the condition of lacking new transit alternatives, it is crucial to understand people's travel intentions to establish the foundation for future integration of motorcycle and MRT.

1. 2 STATEMENT OF PROBLEMS

It is believed that motorcycle only kept a transition role between private car and public transport in early economic development (Pongthanaisawan& Sorapipatana, 2010). However, motorcycle use still exists in parallel to car use in developed economies such as the case of Taiwan. Using private vehicles over long periods of time will lead to vehicle dependence (Dupuy, 1999). Motorcycle dependence may result in more difficulties in shifting travellers from motorcycle to public transport. Therefore, it is necessary to explore the potential of changing travel behaviours in motorcycle-dependent cities. The intention of using public transport may be explained by underlying factors, such as attitudes and preferences rather than by socio-economic demographics and existing travel attributes.

Studies on travel behaviour have been conducted to explore the feasibility of shifting travellers from private vehicles to MRT. Classified by Zhao et al. (2002) and Brons et al. (2009), these researchers focus on 4 main groups: 1) Transit service; 2) Access characteristic; 2) Feeder service; 3) Land use; 4) Users' characteristics. However, automobiles are the main objective of these studies. Park-and-Ride schemes have been mentioned as solutions for shifting commuters from private vehicles to MRT. Tsao (2011) found that motorcycle users could be more convinced to use MRT than automobile users in Taiwan. Since it is convenient to ride motorcycles a short distance, motorcycle use can become a feeder mode for MRT in Asia (Vu, 2011). In addition, Park-and-Ride facilities around subway stations can accommodate more motorcycles than cars of the same area. However, it is unclear which factors might persuade motorcyclists accept both MRT and motorcycle use. Influences of motorcycle and MRT combination use on conventional public transport have not been explored yet.

Sustainable mobility has been increasingly integrated in transport policies and strategies in recent decades. Automobile and public transport were the main focus in studies of sustainable mobility, but there are few similar researches for motorcycle use (Rose, 2009). Motorcycle users may have different thinking in comparision with car users. For example, motorcycle riders have lower awareness on environmental pollution than automobile drivers (Chang & Lai, 2013). While habits of private vehicle have negative influences on travellers' intention to use MRT, the habit of car use is stronger than that of motorcycle use (Chen &Chao, 2011). Motorcycle users may become potential passengers for alternative transit. In developing countries, however, most motorcycle riders belong to low and middle income groups, who may become car users with increasing income instead of using MRT or continue to use motorcycle. Therefore, the intentions and the choices of motorcycle users may be critical and should be explored.

Stated Preference (SP) has been applied to forecast travel demand of new transit alternatives in the cities of developing countries (Fujiwara et al., 2003; Long et al., 2011; Bando et al., 2015). This method is often used to grasp people's thoughts, interests, and preferences for situations that have not happened yet (Van Zyl et al., 2001). However, SP data is also limited if respondents lack knowledge about new transit alternatives and are unfamiliar with complex question forms (Sivakumar et al., 2007). People who can not imagine MRT characteristics and performances can misunderstand the questions or provide unreliable answers. Therefore, hypothetical questions must be appropriate for travellers to understand. As a result, MRT demand can be forecast precisely, and appropriate policies can be proposed for motorcycle management in a sustainable manner.

In general, the study aims to answer the following questions:

-How attitudes and preferences influence travel intentions in motorcycle dependent cities?

-How future motorcycle use will be affected by following MRT development?

-How MRT choices will be considered in different circumstances?

-What kinds of questions are appropriate to grasp people's attitudes, preferences, intentions, and choices without experiences on MRT in a motorcycle-based context?

1. 3 GOAL AND OBJECTIVES

The main purpose of this study is to investigate factors influencing travel intentions in order to manage motorcycle use with respect to MRT in developing-country cities. It aims to suggest rational measures for motorcycle mobility, to enhance existing public transport, and to contribute to the future integration of MRT with motorcycles in motorcycle dependent cities. To achieve the goal of this study, there are three specific objectives to be established, which are as follows:

- To analyse potential changes of travel behaviour in motorcycle-based contexts.
- To explore motorcycle use intentions considering mass rapid transit performance.
- To identify factors influencing the future choices of mass rapid transit use.

1. 4 SCOPES AND LIMITATIONS

The study focused on cities in developing countries, with the following characteristics:

-Low and middle levels of income

-High growth in population, urbanisation, and motorisation

-Increasing growth or high modal share of motorcycle

-Public transport service undeveloped or under poor performance

-Lacking an MRT system or at the beginning stages of constructing an MRT system

This research selects Ho Chi Minh City (HCMC) as a typical case of a developing city for research implementation. HCMC is a major commercial centre and the most dynamic city in Vietnam. During the rapid urbanisation, the urban transport situation of HCMC has worsened, especially in the highly urbanised and emerging urban areas. The significant change in traffic conditions during the last decade was characterised by a rapid increase in the number of motorcycles and passenger cars, a reduction in that of bicycles and a declining trend of bus services. Private vehicles still account for the major share of daily transportation. Motorcycles became the primary mode while bus services hold a limited role and MRT have not yet been established. The rise of motorcycle use and the growth of car ownership occur

in many developing cities. However, the unusual characteristic of HCMC is the high rate of motorcycle ownership..

1. 5 DEFINITION OF TERMINOLOGIES

Motorcycle is defined as a road-based vehicle with two or three wheels (Nishitateno & Burke, 2014). Mopeds and motorised scooters are grouped as different kinds of motorcycle.

Mass rapid transit (MRT) indicates rail-based public transport that provides the highest capacity and fastest speed in comparision with other transit modes such as bus rapid transit, monorail, and tramway (Fouracre et al., 1990; Gardner & Kuhn, 1992; Fox, 2000). MRT can be understood as rail-based public transport if new transit alternatives have been implemented in a city within a developingcountry. However, bus rapid transit can be understood as MRT in case no rapid transit system is available in urban transport and existing bus service exists in poor perfomance.

Travel intention is defined as a willingness to select a specific mode in future travel (Tangphaisankun et al., 2011). Based on the Theory of Planned Behaviour, travel intention is understood as a behavioural intention in particular (Ajzen, 1991). The strength of travel intention indicates how much people attempt to perform travel behaviour.

1. 6 STRUCTURE OF THESIS

This study includes seven chapters and appendixes. While backgrounds, objectives, scopes and limitations of the study, and an outline of the theisis are descibed in Chapter 1, the remaining chapters are summarised as follows:

Chapter 2 presents motivations and literature reviews. General information about motorcycle growth, MRT system implementation, Park-and-Ride practice, and urban transport planning in the developing countries are provided. Problems of motorcycle use and existing policies for motorcycle mobility management are also analysed.

Chapter 3 explains research methodology. The selection criteria of the case study city, characteristics of the study area, data collection methods, and analysis methodologies are also presented. Information about Ho Chi Minh City is described to provide local characteristics.

Chapter 4 investigates the potential for changes in travel behaviour with respect to MRT in motorcycle-based contexts. The relationships among motorcycle use, attitudes, preferences, and intentions are also confirmed.

Chapter 5 explores future motorcycle use considering MRT performance in motorcycle dependent cities. Urban transport contexts, attitudes toward traffic concerns, transit preferences, behavioural intentions, and feasible combinations of motorcycle and MRT are examined.

Chapter 6 diagnoses the determinants for the choices of MRT use. Stated Preference technique is applied to achive acutal choices of MRT. The effects of policy measures are considered, to examine how mode choice behaviour will be changed.

Chapter 7 synthesises the results, proposes policy implications, recommends the possibility of further studies.

CHAPTER 2

2. LITERATURE REVIEWS

2. 1 MOTORCYCLE PHENOMENON

Many studies focusing on motorcycle use are classified in categories such as main user, trip features (purpose, distance, duration, street type), area for popular use or suggested, public transport use, functions/ potential role, and policy measures/ strategies (see Table 2.1). In particular, there are many thoughts provoked, presenting an overview of motorcycle growth as below.

2.1.1 Causes for motorcycle growth

Motorcycle is the popular mode of urban transport in many cities within developing countries (Nagai et al., 2003; Nishitateno & Burke, 2014; IRF, 2012). Motorcycles can be found across Asia and are spreading to Latin America (Sperling & Claussen, 2004). After the decline of state-owned public transport, motorcycles recently emerged as another form of public transport, meeting growing demand in sub-Sahara cities (Kumar, 2011). The rise of cheap motorcycles is accelerating the motorisation process, encouraging a leap from buses and bicycles to motorised private vehicles. In Brazil, the number of motorcycles increased 14 times from 1990 to 2008 and increased by 100% from 2005 to 2009 (Estupiñan et al., 2012). Similarly, the number of motorcycles increased three times in Sao Paulo in the duration between 1985 and 1997 (Vasconcellos, 2005).

(a) Khon Kaen (Thailand)

(b) Vientiane (Laos)

(c) Phnom Penh (Cambodia)

(d) Jaipur (India)

Photo 2.1 : Motorcycle traffic in developing-country cities

Increasing numbers of privately owned and used vehicles are common features of rapid motorisation in Asian countries (see Photo 2.1). It leads to significant changes in urban transport and travel behaviour in the near future (Morichi, 2007). Asian countries have a motorcycle ownership rate higher than 100 vehicles /1,000 people in comparison with other regions in the world (Hsu et al., 2007; Senbil et al., 2007). The annual rate of motorcycle growth is around 11% in Bali (Indonesia) and 14% in Hanoi (Vietnam) (Wedagama & Dissayake, 2010; Vu & Shimizu, 2005). Motorcycles account for a high proportion of motorised trips in mega cities such as Hanoi (81%) or HCMC (90%) (JICA, 2004). The increasing motorcycle use has resulted in the definition of 'two-wheeler' cities (Koizumi et al., 2013). High rates of motorcycle ownership are concentrated in Southeast Asia (Prabnasak &Taylor, 2009; Cervero, 2013). It is explained that economic growth in rapid travel demand has increased in recent decades (Prabnasak et al., 2013). Motorcycles have become the main mode of low income people due to their low cost purchase, operation and convenient parking (Asri & Hidayat, 2005; Tsao 2010; Wen et al., 2012). In mid-sized cities, the growth of motorcycle ownership and use is increasing (Prabnasak et al., 2013; Satiennam et al., 2013).

This growth can be explained by a variety of reasons. It is found that economic development level, income increase, deterioration of public transport, traffic conditions, and land use affects motorcycle ownership and use in developing countries. Regular motorcycle use has become a part of lifestyle in East Asia (Prabnasak & Taylor, 2008).

Economic development levels have strong relationships with the growth of motorcycle ownership and use (Nagai. et al., 2003; Hsu & Lin, 2007; Pongthanaisawan & Sorapipatana, 2010). In developed countries, the motorcycle ownership ratio is much lower than the car ownership ratio. For example, in Japan, the rate of motorcycle ownership and use decreased by 20% in recent decades. In developing countries such as Thailand, Indonesia, India, the rate of motorcycle ownership is growing rapidly. Taiwan-a developed economy is a special case, maintaining a high proportion of motorcycles in urban transport. Malaysia whose income is between Taiwan and Vietnam has a declining rate of motorcycle ownership.

Although motorcycle ownership tends to increase in low economies, it also depends on economic growth. In other words, where the income is increased per capita there will be an impact on private vehicle ownership demand. Due to low purchase cost, motorcycles become the private mode of transport for the low-income population (Vu & Shimizu , 2005; Liu, 2006; Tsai & Lin, 2007; Leong et al., 2007). In low and medium economies such as China, Vietnam, and India, the rate of motorcycle ownership and use is particularly rapid since economic growth accelerates this process. Some Asian countries have motorcycle factories established so that low income people can afford motorcycle prices (Senbil et al., 2007). Continuous increase in fuel costs resulted in motorcycle registration growth in Manila (Philippines) since it was more economic for motorcycle use (Uy et.al, 2007). Low incomes would soon have personal vehicles when their income is improved. Increasing income affects motorcycle ownership sooner than car ownership. In some Asian countries, motorcycle ownership rate becomes high before there is significant increase in income (Senbil et al., 2007).

As a result of rapid motorisation, public transport services have become unbalanced and fail to meet travel demands in cities within developing countries (Zhang & Fujiwara, 2004; Lucas, 2011). The lack of public transport services results in motorcycle use in rural or city expansion areas (Nagai et al., 2003). Due to limited resources, many local governments are

facing difficulties in public transport development (Khisty, 1993). The deterioration of public transportation contributes to private vehicle increase. In some cases public transport services are underdeveloped, and private vehicles are selected to meet travel demand for increased activities (Feng & Sun, 2013; Chen & Lai, 2011). For example, the state of being slow, unreliable, dangerous, and overloading of buses and trains results in passengers' shifting to cars, motorcycles, and scooters in India (Pucher et al., 2005). Motorcycles provide door-to-door trips and trips by motorcycle are more reasonable, flexible, convenient, fast, and reliable than public transport trips (Pucher et al., 2004). In Indonesia, public transport fare is sometimes higher than the expenses incurred by motorcycle use (Lucas, 2011). In HCMC (Vietnam), most commuting trips are made by motorcycles since the bus services only meet 7% of travel demand (Department of Transportation, 2014). While it takes time to develop MRT systems, people continue to depend on motorcycles in commuting trips.

Motorcycle use not only exists in rural areas and suburbs but also in urban areas. Motorcycle use is characterised as a high mobility vehicle, and can be used to overcome traffic congestion in city centres in developing countries (Department of Transportation, 2004; Sano et al., 2005, Acharya & Morichi, 2007; Leong & Mohd Sadullaha , 2007; Chang & Wu, 2008). Traffic conditions contribute to increased motorcycle ownership in cities within both developing and developed countries. In Paris (France), traffic congestion also results in increased motorcycle use to save time travelling (Kopp, 2011). This phenomenon also occurred in London (United Kingdom) where motorcyclists are exempt from congestion charge in comparison with car users (Duffy, 2004).

Land use and transport infrastructure are considerately associated with widespread use of motorcycles. High densities and narrow streets cause difficulties for driving cars in city centres of Asian countries (Senbil et al., 2007). It is easier to find parking spaces for motorcycles since the parking area required is smaller than that of a car (Vu, 2015). An example of a city that is lacking a road system is Bangkok (Thailand), where main streets are saturated in peak hours and motorcycle users can move easily in local narrow streets (Cervero, 2013; Acharya & Morichi, 2007 ; Feng & Sun, 2013).

2.1.2 Functions and roles of motorcycle

Motorcycles are not only used for personal purposes but also for common uses such as public transport and trade in Asian developing countries and sub-Saharan African countries (Guillen & Ishida, 2004; Prabnasak & Taylor, 2009; UN-HABITAT, 2010b; Mateo-Babiano et al., 2011; Abuhamoud et al., 2011; Guillen et al., 2013). A motorcycle taxi is referred to as a "*xe om*" in Vietnam, "*ojek*" in Indonesia, "*habal-habal*" in the Philippines, "*zemidjan*" in Benin, "*Kabu Kabu*" in Niger, "*bendskin*" in Cameroon, "*Okada*" or "*alalok*" in Nigeria, "*boda boda*" in Kenya and Uganda, and "*oleyia*" in Togo (Rahman, 2007; Sietchiping et al., 2012; Vu & Iderlina, 2013). In Southeast Asian cities such as HCMC, Hanoi, Jakarta, Bandung, Bangkok, and Davao, motorcycle taxis are found everywhere including street intersections, bus stops, railway stations, shopping centres, and main entrances of residential areas (Cervero, 2000; Hanaoka, 2007). In Lagos (Nigeria), Douala (Cameroon), Cotonou (Benin) and Mombassa (Kenya), motorcycle taxis becamea popular mode of public transport. In medium-sized cities in Peru and Colombia, there are some cases where motorcycles are used as public transport (Estupiñan et al., 2012).

The introduction of motorcycle taxis was initiated by the private sector, in order to create part-time jobs for extra income and adapt to the needs of passengers (Iles, 2005; Guillen et al., 2013). Due to low capital and operating costs, motorcycle taxis appear to complement conventional buses. In Kenya, the development of the boda-boda service was the result of non-market control in fuel prices (Sietchiping et al., 2012). Rising fuel costs make "*boda-boda*" provide more economic benefits, and motorcycle taxis are considered relatively affordable selections. Consequently, motorcycle taxis can compete with traditional taxis.

Motorcycle taxis have some advantages in comparison with traditional four-wheeled vehicles (Sietchiping et al., 2012). For example, motorcycles can provide door-to-door trips, access to urban areas lacking roads for cars, and save travel time (Acharya & Morichi, 2007; Vu, 2011; Chen & Lai, 2011). In Bangkok (Thailand), motorcycle taxis provide faster trips on the main roads during peak hours (Cervero, 2013).

2.1.3 Motorcycle use problems

Motorcycle use can become a problem for urban transport planning in developing countries, particularly in Asia (Guillen & Ishida, 2004; Gwilliam, 2003). Although motorcycle use provides some benefits such as low cost travel, low fuel consumption, manoeuvrability, and door-to-door travel, problems such as traffic risk, noisy pollution, and emissions are also mentioned (Prabnasak & Taylor, 2009; Prabnasak et al., 2013). The high rate of motorcycle ownership and use does not guarantee the goal of sustainable mobility if motorcycle users shift to car use (Gwilliam, 2003).

Although motorcycles can be useful for travelling during peak-hours, road space is also limited due to the lack of infrastructure development. Therefore, high traffic by motorcycle will result in inevitable traffic congestion (Pucher et al., 2004; Tran et al., 2012; Wen et al., 2012; Asri et al., 2013). HCMC (Vietnam), where modal share of motorcycle is over 90 %, suffers frequent congestions (Department of Transportation, 2014).

Riding motorcycles is very convenient and inexpensive (Satiennam et al., 2011). Moreover, motorcycles provide more speed and flexibility than a bus service affected by congestion. Therefore, it is very difficult to encourage a modal shift from motorcycles to alternatives. As a result, motorcycle use undermines the development of public transport services and restricts the use of other sustainable modes such as walking and bicycle (Gwilliam, 2003; Prabnasak &Taylor, 2008; Prabnasak &Holyoak et al., 2013).

Traffic accidents are common risks of motorcycle use in travel and trade (Prabnasak & Taylor, 2009; Tran et al., 2012; Wen et al., 2012; Prabnasak et al., 2013). Traffic accident rates are higher in Asian developing countries due to high motorcycle dependence (Satiennam et al., 2011). Increasing motorcycle ownership and use led to a loss of traffic safety and increase of traffic accidents (Asri & Hidayat, 2005; Pucher et al., 2005; Uy et.al, 2007; Rose, 2009; Asri et al., 2013). Motorcycle traffic flow, mixed with various flows makes traffic flow become more complicated and lead to transport systems to become more dangerous (Hsu et al., 2007). Accidents caused by motorcycle riding are increasing not only in number but also in severity (Sano et al., 2005). Motorcycle is shown as an unsafe mode of urban transport.

The environment is being polluted by the increase of private vehicle use (Pucher et al., 2004; Asri & Hidayat, 2005; Pucher et al., 2005; Wen et al., 2012). Motorcycle use leads to air pollution, noise pollution, environmental impact, and living quality degradation (Sano et al., 2005; Satiennam et al., 2011; Tran et al., 2012). Although new technology can reduce

pollution, motorcycles are still considered an unsustainable mode (Gwilliam, 2003). Due to high motorcycle dependence, many Asian developing countries are facing challenges of environmental pollution caused by motorcycles (Satiennam et al., 2011; Gwilliam, 2013).

2.1.4 Measures for motorcycle use

Many researches focus on safety awareness, environment protection, and traffic management as main themes of motorcycle use controls. In general, vehicle engine management, traffic restriction scheme, and restriction on private vehicle usage are recommended for reducing urban transport problems (Chin, 2011). Emission standard, vehicle standard, traffic safety regulation, vehicle registration quota, parking control, economic measure (taxes, fees, and prices) are suggested for motorcycle ownership and use controls (Feng &Sun, 2013).

For pull approaches, public transport improvement and development have been discussed. Nagai et al. (2003) represent the case that good public transport can manage the growth of motorcycle ownership. Additionally, the introduction of high quality public transport is likely to promote behaviour changes in motorcycle use (Prabnasak et al., 2013).

For push approaches, Vu and Shimizu (2005) found that high registration and annual ownership taxes decreased the annual rate of motorcycle ownership growth from 16% to 7% in Ha Noi (Vietnam). Satiennam et al. (2011) recommended increasing parking fees as a solution for motorcycle use reduction in Khon Kaen University. Wen et al. (2012) applied models of motorcycle ownership and usage to examine the influences of policy measures in registered motorcycles and total kilometres travelled. Increasing license tax/fuel fees and insurance costs affect the total number of motorcycles; however, total kilometres travelled will be reduced by raising gas prices and parking fees. Chen and Lai (2011) suggested policy implementation to reduce driving habits. For example, motorcycle parking on sidewalks should be prohibited and motorcycle use areas need to be restricted. It is believed that these measures can break motorcyclists' habitual actions. Furthermore, the authors noticed price mechanism might not be appropriate in a motorcycle-based context, since it results in complication in practice and becomes unrealistic for minor changes in motorcycle use cost. In Manila (Philippines), amendments to the helmet law is suggested, for standard helmet use in motorcycle purchases (Uy & F. Regidor, 2011). Regulations for motorcycle taxi operation are suggested for improving safety and service management (Vu & B. Mateo-Babiano, 2013). Safety requirements should be considered when using motorcycles for delivery (Sano et al., 2005).

For soft approaches, safety education is recommended to raise awareness in using motorcycle taxis (Vu & B. Mateo-Babiano, 2013). School programs might contribute to pupils' attitudes toward environmental friendly travel mode, in order to reduce private vehicle usage and fuel price (Chang & Lai, 2013).

In practice, transport policy becomes increasingly related to sustainable mobility, congestion problems, traffic safety, air quality, climate change, energy, security, and liveable urban. Private vehicle growth is a challenge affecting sustainable mobility and requires a fundamental change in transport policy settings (Toleman & Rose, 2008). While automobile and public transport services get the attention of sustainable mobility development, motorcycle use has not been focused on (Rose, 2009). Raising awareness about potential use

of motorcycles aims to promote transport policies in tackling congestion, enhancing accessibility, and reducing emissions (Department for Transport, 2005).

There are different approaches in implementing motorcycle control measures. While London authorities decided there should not be any charge for motorcycles in urban areas to encourage motorcycle use, Paris recently introduced a subsidy program for electronic motorcycle purchase (Duffy, 2004; Kopp, 2011). It can be explained that motorcycles maintain a small proportion of urban transport within cities in developed countries. However, many cities within developing countries face challenges in managing the increase in motorcycle demand. In Kunming and Shanghai (China), city authorities' limited motorcycle use in high-traffic areas of city centres (Cherry, 2007). In Yangon (Myanmar), motorcycles and other non-motorised modes such as trishaws and bicycles are banned in city centres (Fujiwara, 2003). In Vietnam, some policies such as limiting new motorcycle registration, or increasing import duties were implemented to restrict motorcycle ownership in the periods between 2003 and 2005 (Shimizu et al., 2003). However, the limitation of motorcycle ownership resulted in controversial issues in motorcycle-based contexts. These policies are regarded as ineffective if public transportation is not improved to become an alternative mode.

Even though public transport system is invested, shifting from two-wheel vehicles to public transport is not an easy task. Conventional buses are judged as crowded, insecure, dependent, and uncomfortable (Pucher et al., 2004). Railway system itself cannot solve traffic congestion and meet travel demand (Hanaoka, 2007). In the case of Bangkok (Thailand), the number of registered private vehicles still increased when BTS and MRT lines began operating.

The improvement of public transport can bring a certain level of success at the beginning. However, opportunities for bus services will be severely limited if private vehicle use is still high and is unlikely to decrease (Emberger et al., 2008). Furthermore, short-term achievements will soon be lost if travel demand growth is not restricted (May et al., 2003). Therefore, it is necessary to conduct both management solutions in motorcycle use and public transport development.

Some solutions have been implemented to change motorcycle functions, including the combination of motorcycle and public transport, the standardisation of motorcycle taxi services, and the formulation of motorcycle as public transport. In Taipei (Taiwan), Park-and-Ride policies contribute to parking spaces near MRT stations to facilitate motorcyclists and bicyclists who involve MRT use (Tsao, 2010). In Thailand, motorcycle taxi services are managed to encourage people to reduce private vehicle use or to use motorcycle taxis for public transportation access (Satiennam et al., 2013). Some African authorities are trying to regulate motorcycles in public transport system. For example, the government of Kenya reduced import tax for motorcycles used for public transport and as private taxis (Sietchiping et al., 2012).

Table 2.1: Summary of motorcycle use analysis

Author (Year)	Case study cities(Countries/Areas)	Main Users	Trip features (Purpose, distance, duration, street type)	Area for popular use or suggested	Public transport use	Functions/ Potential role	Policy measures/ Strategies
Nagai et al. (2003)	Bangkok and other cities (Thailand)			x			x
Guillen & Ishida (2004)	Davao (The Phililppines)		x	x	x	x	
Sano et al. (2005)	Bangkok (Thailand)	x	x	x		x	x
Vu & Shimizu (2005)	Hanoi (Vietnam)						x
Acharya & Morichi (2007)	Bangkok (Thaland), Jakarta (Indonesia), Taipei (Taiwan)		x	x			x
Lai and Lu(2007)	Taiwan						x
Deng, Xu and Wang (2009)	Guangzhou (China)						x
Dissanayake and Morikawa (2010)	Bangkok (Thailand)		x				
Tsao (2010)	Taiwan	x			x		x
Chen & Lai (2011)	Taipei and Kaohsiung (Taiwan)		x	x			x
Chin (2011).	South Eastern Asia and the Pacific			x			x
Satiennam et al. (2011)	Khon Kaen (Thailand)	x	x				x
Vu (2011)	Japan, Korea, Taiwan, Malaysia, Thailand, Indonesia, Vietnam		x	x		x	
Uy & F. Regidor (2011)	Manila (The Phililppines)		x				x
Wen et al. (2012)	Taiwan			x			x
Chang. & Lai. (2013)	Taiwan						x
Feng & Sun. (2013)	Asia megacities		x	x	x	x	x
Jones et al. (2013)	Hanoi (Vietnam)						x
Guillen et al (2013)	Davao (The Phililppines)	x	x		x		
Prabnasak et al. (2013)	Khon Kaen (Thailand)			x			x
Satiennam et al. (2013)	Khon Kaen (Thailand)	x	x	x	x		x
Vu and B. Mateo-Babiano (2013)	Ho Chi Minh City (Vietnam)	x	x	x	x	x	x

2. 2 MASS RAPID TRASIT IN DEVELOPING-COUNTRY CITIES

2.2.1 Implementation and performance

There are many definitions relating to mass transit system (MRT) (see Table 2.2). The differences are not only based on transit capacity but on transportation type and geography. Previously, MRT was grouped in higher categories such as rail mass transit, mass transit, urban mass transit, and urban rail (Fouracre et al. , 1990; Tangphaisankun, 2009; Gwilliam, 2013; Koizumi et al. ; 2013, Bray & Sayeg , 2013). Gardner and Kuhn (1992) use the term 'Mass transit' to indicate busway, light rapid transit, and metro. However, the term 'Mass rapid transit' was used not only for tramway, light rapid transit, metro, and suburban rail but also for buses with reserved lanes (Fox, 2000; Fourace & Dunkerley, 2003). Guerra (2014) uses the term 'High-capacity transit' to group bus rapid transit, metro, and commuter rail.

Table 2.2 : Definition of mass transit

Author	Definition	Description
Guerra (2014)	High-capacity transit	Bus Rapid Transit(BRT) Metro Commuter rail
Gwilliam (2013)	Mass transit	Bus Rapid Transit Mass rapid transit
Bray and Sayeg (2013)	Urban rail	Light rail transit (LRT) Monorail Mass rapid transit (MRT)
Koizumi et al. (2013)	Urban mass transit	Bus Rapid Transit Metro (subway, LRT, monorail)
Tangphaisankun (2009)	Mass Transit	Bus Rapid Transit Light rail transit Mass rapid transit Subway
Fourace and Dunkerley (2003)	Mass rapid transit	Bus using dedicated rights of way Tramway Light Rapid Transit Metro Suburban rail
Fox (2000)	Mass rapid transit	Busway Light Rapid Transit Metro Suburban rail
Gardner and Kuhn (1992)	Mass transit	Busway Light rail transit Metro
Fouracre et al. (1990)	Rail mass transit	Light Rapid Transit Mass rapid transit

Unlike developed countries, many developing countries lack MRT systems to meet the travel demand increased by motorisation (Susilo et al., 2007). Before the 1990s, MRT systems had been implemented in many cities in countries and regions such as Korea, Singapore, and Hong Kong (Fouracre et al., 1990). In the last two decades, developing-country governments have invested in mass transit in some cities within Asia, Latin American and Africa. Many MRT systems were constructed or planned in Asia than in other regions (Koizumi et al., 2013).

Urban rail projects were conducted in Asian cities aiming to tackle congestion and pollution (Acharya & Morichi, 2007). Suburban railway systems managed by national railway companies have poor performance and contribute little on urban transport. In Manila (Philippines), transportation systems including mass rapid LRT network 1, LRT2, and MRT 3 operated respectively in 1984, 2004 and 1999 (Tiglao & Padu, 2007). In Jakarta (Indonesia), the BRT system has operated since 2004 while MRT lines were not yet completed. In Bangkok (Thailand), the study of MRT was proposed in the 1970s in order to meet mobility demand and city access (Townsend & Zacharias, 2010). However, the MRT system including BTS, MRT, and SARL only began operation in 1999 (Bray &Sayeg, 2013).

In Latin America, BRT systems were built and used more commonly than MRT (Koizumi et al., 2013). The metro system in Buenos Aires (Argentina) was built and operated in 1923. From late 1960 to 2000, metro system construction began in Mexico, Brazil, Venezuela, and Peru. From 2000 until the present date, only MRT systems were operated in Lima (Chile) while BRT systems were widely implemented in many other cities.

In Africa, MRT systems have not been implemented yet. This could be explained by socio-economic characteristics of African cities. Many African countries are grouped in low economic levels so that the capability of MRT investment is impossible. In 1987 Cairo (Egypt) was the only African city where the MRT system was operated (Cerverio, 1991)

2.2.2 Impacts and problems

Financial limitations are one of the difficulties faced in implementing MRT in developing countries. In Asia, some routes such as LRT3 (Manila) and BTS (Bangkok) were invested by private sector in Built-Operation-Transfer form (Bray & Sayeg, 2013). MRT3 route, running along the EDSA corridor, is the first case of Build-Lease-Transfer (BLT) form in the Philippines. In Jakarta (Indonesia), MRT system implementation was mentioned first in the 1980s when traffic congestion became severe (Susilo et al., 2007). In 1996, Indonesian government planned to implement the first phase of subway system in Jakarta, but the 1997-1998 economic crisis affected project implementation. In 1999, the subway project was redesigned for reducing investment costs. Jakarta monorail was built in 2004 but stopped in 2008 due to legal issues and funding shortages. Budget difficulties, political issues, and institutional reforms made MRT and monorail implementation difficult. Some studies have questioned which MRT systems have appropriate costs and meet the limited resources of cities in developing countries (Fouracre et al., 2003; Gwilliam, 2002). MRT expansion to densely populated suburbs still faces challenges of ridership such as the case of line B in Mexico City (Guerra, 2014).

Low ridership poses another issue that affects MRT operation. In Bangkok, ridership was lower than forecast after BTS and MRT system were opened in 1999 and 2003 respectively (Chalermpong & Wibowo, 2007). Low-income people cannot afford to use the

rapid transit system in Bangkok (Townsend & Zacharias, 2010). The MRT3 operation started in 1999 in order to tackle traffic congestion (Okada et al., 2003). However, ridership did not achieve the volume expected. Although MRT3 provides reliable transport and efficient transport capacity, disadvantages of MRT 3 use includes high ticket prices and limited connectivity with other modes of transport. After fare reduction in the year 2000, ridership increased significantly. However, there is still a gap between demand forecast and current patronages.

Modal shift is another problem of MRT performance. According to Fouracre and Dunkerley (2003), the majority of MRT passengers used to be bus users. Investment to expand Metro B (Mexico City) has significantly increased MRT use although new MRT users mostly shift from public transport (Guerra, 2014). MRT systems do not significantly affect modal shift from private vehicle to MRT. If MRT cannot attract many passengers, especially from automobile users, the environmental benefits of MRT use is low (Doll & Balaban, 2013). If metro investment serves a purpose for mainly suburban trips, without housing development or commercial centres nearby MRT peripheral zones, MRT cannot compete with other modes of transport for regional trips (Guerra, 2014).

Land use change around stations always accompanies MRT system development. Although Transit-Oriented-Development (TOD) has been applied for MRT corridors in Bangkok (Thailand), land use around many stations does not consist with TOD concept (Sanit, 2012). It is explained that high income people who are the main residents around MRT stations have little MRT access by walking form.

Asia's developing countries have distinctive features including high economic growth, rapid urbanisation, megacity development, high population density, income disparities, limited transport infrastructure, and lack of financial resources. The challenge is to distinguish how to meet increasing travel demands, but maintain balanced modes of transport (Acharya & Morichi, 2013). Due to the lack of rail transport systems, cities within the areas of developing Asian countries are often influenced by the impact of motorisation and urbanisation (Okada et al., 2003). Without railway systems, this effect not only causes traffic congestion but also environmental pollution. Acharya and Morichi (2007) suggested that only MRT networks significantly contributed to public transport service improvements, and affect car use. A delay in MRT construction will result in difficulties in improving public transport operations.

2.2.3 Factor influencing rail-based public transport

In general, factors contributing to the propensity to use transit can be categorised into four streams: transit service; transit accessibility, land use/urban design, and transit users' characteristics (Zhao et al., 2002). Similarly, Brons et al. (2009) identified train service, train accessibility, and characteristics of local people and neighbourhood as important factors accounting the probability of using trains. As summarised by Loo et al. (2010), variables affecting rail transit ridership are included in the following main categories: land uses, station characteristics, socio-economic demographics, and inter-modal competition. Kuby et al. (2008) classified determinants of boarding light-rail station into five categories: (1) traffic generation; (2) intermodal connection; (3) city scale; (4) network structure; and (5) socio-economic. In particular, some relevant literatures focus on predictors of rail-based public transport use.

The effects of transit service on rail transit choices have received extensive discussion. Travel time is negatively associated with the propensity of using rail transit (Abdel-Aty, 2001). As a part of travel cost, high fare is considered the leading cause of passengers' dissatisfaction on light rail transit in Manila (Okada et al., 2003). Using Stated preference and Reveal preference data, Fujiwara et al. (2003) found that travel time, travel cost, waiting time, access time, and egress time are negatively related to new transit systems in Yangon City (Myanmar). The cost and time incurred by workers' commuting affected their rail transit behaviours (Sanit, 2013). Moreover, Wibowo and Chalermpong (2010) noticed that a reduction of travel time had more influence on mass transit choices than a decrease of travel cost. However, a higher distance when commuting increased the likelihood of transit use (Abdel-Aty, 2001). Shorter travel time by train makes an officer to less likely to commute by automobile (Cevero, 2006).

For transit accessibility, Park-and-Ride facilities increase rail ridership by providing travel options for local people living beyond walking distance from stations (Ducan & Christensen, 2013). People find train stations more accessible by Park-and-Ride provision. Moreover, proximity to train stations is also the main predictor of mass transit use. The more people live near transit stations, the higher the number of transit ridership is (Wibowo &Chalermpong, 2010). A shorter distance to stations increased the probability of rail transit being chosen (Jayme & Chalermpong, 2013). Cervero (2007) found that living within half a mile of a train station increased the likelihood of commuting by rail. Access and egress distances to train stations are relatively related to the probability of using rail (Cervero, 1994a; Beimborn et al., 2003). Lindsey et al. (2010) found that commuters whose workplaces are close to train station are more likely to use transit.

The advantages of land use density and diversity have been a point of focus, particularly in Transit-Oriented-Development areas. Increasing development densities within walking distance of train stations contributes more transit riding and walking than other land use predictors (Cervero, 2005). Mixed use development around transit stations contributes to the exploitation of transit capacity in rail transit catchment areas (Arrington & Ceveron, 2008). Consequently, employment access via rail transit promotes more commuting trips by train (Cervero, 1994c). Urban design, particularly for pedestrian paths, enhances walkable environment for transit access. However, streetscape improvements and neighbourhood design have little effect on transit choices among individual living in station areas (Litman, 2008).

Socio-economic characteristics are considered as important variables in order to explain the likelihood of choosing mass transit. Income is a determinant for rail transit behaviour (Sanit, 2012). Middle income negatively influences the likelihood of being a transit user, while low income people are positively associated with rail transit (Abdel-Aty, 2001; Sanit, 2013). It is also supported by Fouracre et al. (2003) that high income people limit to shift from personal modes to MRT. People who have car ownership are less likely to use mass transit systems (Wibowo &Chalermpong, 2010). Females, single individuals, office workers, and people who have more than three members in their family prefer automobile than rail transit (Sanit, 2012). In addition, the presence of children and a middle income negatively influenced the likelihood of being a transit user (Sanit, 2013). People with a low level of education and young people who are aged between 20-39 prefer transit to other modes (Abdel-Aty, 2001).

The roles of attitudes and preferences have been examined as important determinants of mode choice behaviour. Sanit et al. (2014) found that people who have positive attitudes toward commuting by train are likely to be rail passengers. As pointed out, people with a preference for travelling by rail transit are likely to live in a residential location with easy access to a station (Pickup & Town, 1983; Van Wee et al., 2002). In general, Bagley and Mokhtarian (2002) investigated the relationships among attitudes, lifestyles, residential locations, and travel behaviours. It was found that attitudinal and lifestyle variables had the more of an influence on travel behaviour than residential location characteristics. The relationships between built environment variables and travel behaviours are mainly explained by residential self-selection - the effects of attitudes on the choice of residential location.

2. 3 PARK-AND-RIDE

2.3.1 History

Park-and-Ride (P&R) schemes used as a transport planning tool for traffic demand management (TDM) aims to encourage commuters to use public transport, and limit driving private vehicle to city centres. P&R facilities are usually adjacent transport hubs where public transport services are connected to downtown areas. Based on geography and location, remote P&R, peripheral P&R, and local P&R are categorized as three major P&R systems (Mingardo, 2013).

Park-and-Ride schemes have been implemented in many cities and regions of developed countries (Dijk & Montalvo, 2011; Duncan and Cook, 2014; Mingardo et al., 2015). Bus-based P&R schemes have been incorporated in the United Kingdom since the 1960s (Meek et al., 2010). In the Netherlands, rail-based P&R systems were first introduced in 1979 (Mingardo et al., 2015). In Asian regions, P&R schemes are becoming more popular with MRT development in recent years (Barter, 2012).

The advantages of P&R schemes have been discussed in many studies. P&R schemes can be regarded as a way to limit private vehicle use. Employees who live outside walking-distance to transit nodes can drive their car to railway stations or bus stops, and use public transport for their entire trips. It is especially important for outer suburbs or urban areas where population density is low and public transport service is limited (Hamer, 2010). P&R schemes not only improve public transport patronage but also decrease commuters' automobile use to central locations, since a part of car journey is replaced by public transport. P&R services are considered appropriate solutions for commuters who do not want to drive long-distance trips to their workplace. While local buses have the limitation of a timetabled schedule, P&R services provide more choice for travellers to access rail stations (Parkhurst, 2000). In American cities, P&R facilities combined with rail networks allow car users who live in low-density suburbs flexible trips to the centre. (Kuby, 2004). The combination of P&R facilities and elevated rail systems attracted many travellers to change their chosen travel modes in Bangkok (Thailand) (Perera, 2006).

2.3.2 Problems

Previous studies focused on whether P&R schemes can achieve the goals of sustainable development. The P&R scheme in theory encourages a combination of car and public transport. Consequently, public transport patronage will be increased and private vehicles will be reduced in city centres. Positive effects may include a decrease of parking pressures in

central areas, limitations of traffic congestion on main corridors, and a reduction of pollution in urban cores.

European local governments are considering the impact of P&R (Dijk et al., 2013). Some divergent effects and different solutions have been discussed. First, some travellers who used to be public transport users or used non-motorized modes to access transit nodes become car users using P&R facilities (Mingardo, 2008; Wiseman et al., 2012). Some travellers who use P&R services have never driven a car (Parkhurst, 1995). Secondly, the total vehicle kilometres travelled (VKT) increases rather than decreases in theory. While recent studies found that P&R schemes contribute to VKT reduction in USA, a similar study showed that P&R schemes result in VKT increase in UK and the Netherlands (Duncan &Cook, 2014; Parkhurst, 1995; Parkhurst , 2000; Mingardo, 2013). As Meek et al. (2011) presents, bus-based P&R increase travellers' VKT. Thirdly, congestion and pollution could be increased in peripheral areas or in urban fringes (Clayton et al., 2014). If car access trip is longer than train journeys, P&R facilities provide little contribution on congestion reduction (Dickins, 1991; Parkhurst, 2000). Fourth, bus-based P&R schemes result in ineffective effects on modal split change, and lead to increased automobile usage in some situations (Mingardo, 2013). Finally, P&R facilities potentially influence on the targets of Transit Oriented Developments. Large-scale parking may result in low walking, noise attraction, traffic effects, and landscape impact near public transport nodes (Duncan&Christensen, 2013). While P&R schemes are regarded as an effective solution for encouraging mass rapid transit in low-density areas of suburbs, it can cause negative effects in transit nodes surrounded by medium-density and mixed land use (Meek, 2008; Kim et al., 2007).

In general, Park-and-Ride schemes hold an important role as a part of transport policies and strategies for traffic demand management. Besides the positive benefits, P&R facilities still have many controversial issues. Transport planning should be integrated into land use in order to achieve the success of P&R schemes (Batty et al., 2015). However, P&R schemes only become effective if they are implemented in package policies (Dijk & Montalvo, 2011).

2.3.3 Factors influencing Park-and-Ride choices

According to Olaru et al. (2014) the time-of-day, access modes, paid parking spaces, and bike lockers are the main predictors for P&R preference at train stations in comparison with distance. When a rail station is located in high-density land use, many people living in walking-distance choose walk access to station instead of using P&R facilities (Kim et al., 2007). Hole (2004) believed that P&R schemes would succeed in limiting car availability if charge policies were introduced for parking-on-site at work places.

MRT systems have being implemented in recent years in China, Thailand, Malaysia, and Singapore. Many Asian cities such as Beijing, Guangzhou, Bangkok, Kuala Lumpur, Hong Kong, Singapore, and Taipei applied P&R schemes for promoting MRT and limiting private vehicle (Barter, 2012). Rapid growth of car ownership resulted in a high increase of P&R in stations of the Kelana Jaya line (Khalid & Kadar Hamsa, 2013). In Putrajaya (Malaysia), Syed Adnan and Kadar Hamsa (2015) discovered that main factors encouraging P&R demand included parking costs, travel time, traffic congestion, and belief in public transport services. In Nanjing (China), high income riders with driving experience rarely consider P&R as a travel option (He et al., 2012). However, congestion levels and parking fees will increase P&R choices. Qin et al. (2012) concluded that traffic conditions were high

influencers of P&R choice over travel attitude. In Singapore, Seik (1997) found that travel cost was an important determinant affecting P&R choices.

2.3.4 Park-and-Ride for motorcycle use

In some Asian countries, motorcycle use is the most popular choice because of convenient and economic benefits. As a consequence conventional buses rarely attract private vehicle users, especially motorcyclists. Therefore, it is a challenge to shift peoples travel choice from motorcycle use to a combination of motorcycle and public transport. The introduction of MRT systems provides a different approach for motorcycle use. For example, the city government of Taipei (Taiwan) enhanced parking standards for motorcycle and bicycle at MRT station for P&R encouragement (Tsao, 2010). Establishing P&R utilities for motorcycles along the BRT were conducted in Jakarta (Indonesia) and Bangkok (Thailand) to reduce environmental pollution by motorcycle, and to encourage motorcycle users to shift from motorcycle to high quality public transport systems (Nugroho et al., 2010; Satiennam et al., 2013).

2. 4 ATTITUDES AND BEHAVIOURAL THEORIES

Attitudes are defined as expressions evaluating something in a positive or negative view (Oppenheim, 2005). Social psychologists classify attitudes into three groups: perceptions, feelings, and conations (Golob, 2001). Perceptions (cognitions) are beliefs evaluating the attributes of an object. Feelings are emotional judgements about favour or disfavour. Conations encompass one's drive, willingness, and behavioural intent. Most attitude-behaviour studies focus on perceptions and feelings.

Attitudinal theory has been applied in travel behaviour research since the 1960's. It complements the use of traditional random utility theory for planning travel demand (Okamura et al., 2013). Random Utility Models (RUMs) have been traditionally used for travel choice modelling and transport demand estimation. The predictors of RUMs include not only individual characteristics, attributes of alternatives but also travel patterns. The introduction of attitudinal theory has been able to provide a higher explanation for analysing mode choices and travel intentions (Okamura et al., 2013). It was found that attitudes contribute a better explanation for travel behaviour analysis beside socio-economic characteristics and travel attributes. The influences of attitudes on behavioural change have been conceptualised by some theoretical studies. The Norm activation model (NAM) and Theory of Planned Behaviour (TPB) provides conceptual frameworks for many empirical studies on attitude-behaviour relations (Schwartz, 1977; Ajzen, 1991).

Schwartz (1977) proposed the Norm activation model (NAM) to explain pro-social behaviours (see Figure 2.1). According to this theory, personal norms (PN), awareness of consequences (AC), and ascription of responsibility (AR) are three psychological dimensions for predicting individual behaviours. The process of norm activation begins with the awareness of problems and the feeling of being responsible to perform a particular action. The personal norm process assumes that a predictor of behaviour is influenced by both awareness of consequence and ascribed responsibility. As the outcome of moral obligation, a personal norm determines the behaviour of support or disfavour towards an adverse consequence (Schwartz & Howard, 1981; Cordano et al., 2011; De Groot&Steg, 2009).

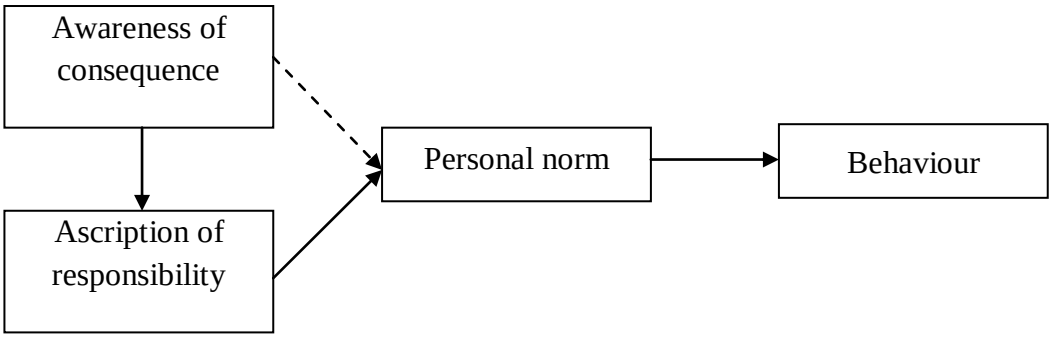


Figure 2.1 : Norm Activation Theory (Schawatz, 1977)

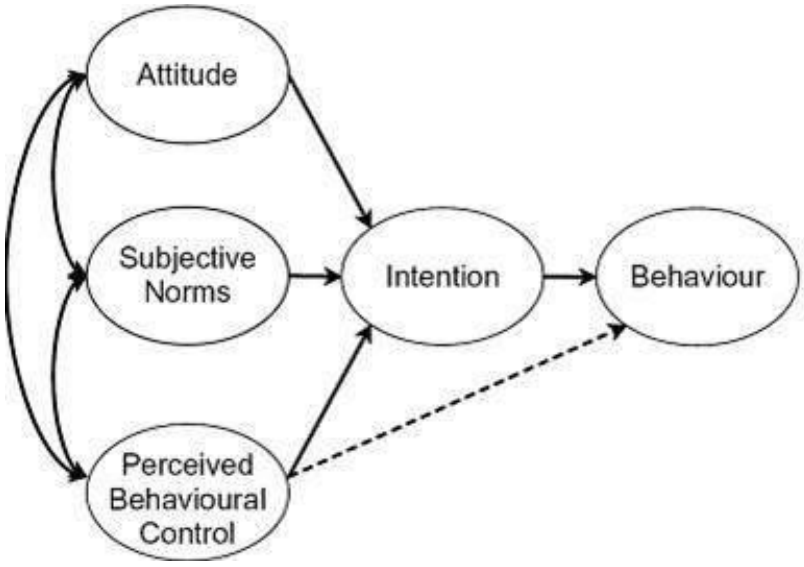


Figure 2.2 : Theory of Planned Behaviour (Ajzen, 1991)

According to the Theory of Planned Behaviour (TPB), a behavioural intention is based on attitudes toward the behaviour, subjective norm, and perceived behavioural control (Ajzen, 1991). A behavioural intention is defined as an important precursor of future behaviour. The strength of intention indicates how greatly people will attempt to conduct the behaviour (see Figure 2.2). Therefore, understanding behavioural intention results in valuable prediction about a given behaviour. The application of TPB has been conducted in previous studies on travel behaviour. In developing countries, there are some studies focused on behavioural intentions (Fujii & Van, 2009; Javid, 2012; Okamura et al. 2013; Tangphaisankun et al. 2011). However, such a study of travel intention with respect to MRT has been rarely conducted in a motorcycle-based context.

2. 5 TRAVEL INTENTION

The relationships between psychological factors and travel intentions have been explored widely in the transportation field (see Table 2.3).The basic construction of Theory of Planned Behaviour has been utilised in a range of studies (Bamberg et al., 2003a; Bamberg et al., 2003b; Hsiao and Yang, 2010; Kerr et al., 2010; Chen & Chao, 2011; Chen & Lai, 2011; Eriksson & Forward, 2011; Chang & Lai, 2013; Hoang Tung et al., 2015). Furthermore,

others have focused on the association between attitudinal aspects of travel modes and intentions (Choocharukul, K. et al., 2006; Tangphaisankun et al., 2009; Javid et al., 2016). Some authors combined TPB and NAM for improving explanatory power of their travel behaviour models (Choocharukul et al., 2007; Van & Fuji, 2007; Chang & Lai, 2013). Similarly, the relationships between perceived transit services and intentions were discussed (Van & Fuji, 2009; Fu & Juan, 2016; Javid et al., 2013). Socio-economic characteristics and demographics that were included in the original model also had significant influences on travel intentions (Van & Fuji, 2009; Chowdhury & Ceder, 2013; Nordlund& Westin, 2013; Bando et al., 2015). Personalities, preferences, personal norm, belief, interest, and other psychological determinants such as auto oriented, transit oriented, service oriented, and car oriented were found to be predictors of intentions (Abrahamse et al., 2009; Tangphaisankun et al., 2011; Nordlund & Westin, 2013; Okamura et al., 2013; Bando et al., 2015).

Habitual factors were considered to examine the tendency of behaviour change. Bamberg et al. (2003a) explored the influences of free public transport passes on bus use intention in Giessen (Germany). It was uncovered that habit has no contribution on intentions or future transit behaviour. Chen and Lai (2011) pointed out that habit of motorcycle use has an insignificant relationship with intention; however habit is the main predictor of actual motorcycle use in Taipei (Taiwan)- a motorcycle-related context. If good public transport is provided, motorcyclists have a much higher intention and habit of using transit than that of driving a car. Another study by Chen and Chao (2011) indicated that habit of private vehicle use negatively affects the intention of shifting from private vehicle to public transport use. Since motorcycle users' habitual use of private vehicle has lower influences on switching intention, than that of car users, motorcyclists are likely to be potential passengers of MRT systems.

Some attitudinal aspects of car and public transport (symbolic/affective, instrumental, and social orderliness) have significant influences on the acceptance of car use reduction in Tokyo (Japan), while these variables have no impacts in Bangkok (Thailand) (Choocharukul et al. , 2006). However, the moral obligation against driving to work was found to be negatively related to the intentions to reduce car use (Choocharukul et al., 2007; Abrahamse et al., 2009). Moreover, people who have a low consideration on personality traits intend to reduce private vehicle use (Javid et al., 2013).

There are few studies relating to the intentions of using rail-based public transport (Hsiao & Yang, 2010; Nordlund & Westin, 2013; Bando et al., 2015). Attitudes concerning mass transit accessibility and perceptions on para-transit services have association with mass transit intention (Tangphaisankun et al., 2009). Personality and preferences have influences on mass transit intention (Tangphaisankun et al., 2011). Presently, public transport users who are highly car-oriented or hold high concern over eco-friendly levels are most likely to use mass transits.

Şimşekoğlu et al. (2015) developed a model explaining the roles of attitudes and perceived quality of service when using public transport. It is reported that priorities of safety and security, priorities of convenience, and travel mode attitudes have positive influences on the intention of public transport use. However, individuals who have strong habit of car use or high evaluation on trip flexibility intend to have less usage of public transportation.

Table 2.3 : Literature reviews on travel intentions

Author (Year)	Country (City)	Intentions	Variables with significant relationships with intentions
Bamberg et al. (2003a)	Germany (Giessen)	Public transport use	Past car use , Attitudes, SN, PBC
Bamberg et al. (2003b)	Germany (Giessen)	Car and bus use	Past travel choice (Habit) , Attitudes, SN, PBC
Choocharukul et al. (2006)	Thailand (Bangkok)	Car use reduction	Attitudinal aspects of car and public transport
Choocharukul et al. (2007)	Thailand (Bangkok)	Private car use for commuting trip	Attitudes, SN, MO
Van and Fuji (2007)	Vietnam (Ho Chi Minh City)	Car, bus, taxi, bike taxi use	Attitudinal aspects of travel modes, PBC, SN, MO
Abrahamse et al. (2009)	Canada (Victoria)	Car use reduction for commuting	Attitudes, PBC, PN
Tangphaisankun et al. (2009)	Thailand (Bangkok)	Mass transit use	Mass transit accessibility, Paratransit services
Van and Fuji (2009)	Vietnam (Ho Chi Minh City)	Bus use	Age, Gender, Moral concern, Quality perception
Hsiao and Yang (2010)	Taiwan	High Speed Rail use	Attitudes, SN, PBC
Kerr et al. (2010)	Australia (Brisbane)	Car use	Attitudes, SN, PBC
Chen and Chao (2011)	Taiwan (Taipei)	Shifting to PT	Attitudes, PBC, SN, Habit
Chen and Lai (2011)	Taiwan (Taipei)	Motorcycle use	Attitudes, PBC, SN, Habit
Eriksson and Forward (2011)	Sweden	Car, Bus, bicycle use	Attitudes, SN, PBC, Descriptive norm
Lai and Chen (2011)	Taiwan (Taipei)	Transit use	Service quality, Perceived value, Satisfaction, Involvement
Tangphaisankun et al. (2011)	Thailand (Bangkok)	Mass transit use	Personality, Preference
Javid et al. (2012)	Pakistan (Lahore)	Para-transit use	Auto oriented, Transit oriented, Perception on service quality
Chang and Lai (2013)	Taiwan	Reduction of private vehicle use	Attitudes, PN, Multi mobility, Awareness of consequence
Chowdhury and Ceder (2013)	New Zealand (Auckland)	Bus use with transfer	Gender, Frequent bus user, Bus use as transfer, Transfer walking and waiting time, Self-Efficiency
Javid et al. (2013)	Pakistan (Lahore)	Private vehicle reduction	Travel attitudes, Personal traits, PBC
Nordlund and Westin (2013)	Sweden	New railway	Values, Beliefs, Age
Okamura et al. (2013)	Philippines (Manila)	Jeepney use	Service oriented, Car oriented
Bando et al. (2015)	Indonesia (Malang)	Motorcycle, Angkot, Light rail transit	Gender, Household income, Personal expenditure, Interest in new transit
Hoang Tung et al. (2015)	Japan (Saitama)	Bus use	Attitudes, PN, PBC, Descriptive norm
Şimşekoğlu et al. (2015)	Norwegian	Public transport use	Attitudes, Priority of flexibility, Priority of convenience, Priority of safety and security, Car use habit
Javid et al. (2016)	Pakistan (Lahore)	Public transport use under stated condition	Attitudinal aspects of car and public transport
Fu and Juan (2016)	China (Shaoxing City)	Public transit	Cost, Intangible service, PBC, Satisfaction, Habit

Chowdhury and Ceder (2013) applied TPB to identify psychological factors, which were set to predict public-transport users' intentions to travel on routes involving transfers. It was found that users' perceived controllability had less influence on their intentions than self-efficacy. It indicates that how users perceive confidence, holds an important role when accepting routes that involve a transfer.

Van and Fuji (2007) identified psychological constructions including Symbolic affective, Instrumental and Social Orderliness, Subjective Norm, Perceived Behavioural Control, and Moral Obligation. Each have influences on peoples behavioural intentions of using car, bus, daisu bus, taxi, pick-drop passenger car, and motorbike taxis in Ho Chi Minh City.

Choocharukul et al. (2007) applied the Theory of Planned Behaviour and Norm Activation Theory, to propose a model that enables the prediction of behavioural intention when choosing private car use for future commuting trips. Attitude, subjective norm, perceived behavioural control, and moral obligation are psychological variables that were recognised as having significant relationships with the travel intention of undergraduate students after graduation.

Okamura et al. (2013) explored users' perceptions toward jeepney services and behavioural intentions in Manila (the Philippines). Distinctive lifestyles classified by whether individuals were car oriented or service oriented resulted in different characteristics in both perceptions toward jeepney services and behavioural intentions.

Van and Fuji (2009) found that moral concerns, quality perception and age were determinants of bus use intention. Understanding the role of bus services positively contributes to the intention of bus use. In addition, the higher the perception of the buses quality of service, the more people intend to use buses. Younger people and females are less likely than other demographics to have bus use intention.

Lai and Chen (2011) established a conceptual relationship model between behavioural intentions of transit users and related determinants including service quality, perceived value, and satisfaction. It is reported that involvement had more influence on public transport use intention than the other factors.

2. 6 PLANNING PERSPECTIVES IN DEVELOPING COUNTRIES

2.6.1 Transport planning model

Since the 1960s, transport planning has followed a classic deductive approach for solving urban transport problems (Banister, 2002). It is typically described as a process which includes data collections and forecasting models. The initiation of the classic approach in transport planning began in the USA in 1953 (Poboon, 1997). The 1950s and 1960s were also the motorisation periods in the United States and other western countries. As the central part of transport planning process, the Transport Planning Model (TPM) includes four linked sub models (trip generation, trip distribution, mode choice, network assignment) evaluating alternatives in the basic process. This TPM encouraged a substantial road building scheme to meet the high demand for private travel. The basic process includes problem definition, diagnosis, projection, constraint identification, option suggestion, plan formulation, testing of alternatives and evaluation (Thomson, cited in Banister 2002). Social-economic characteristics (population and employment) and land use patterns are important inputs for forecasting travel demand in future years. Based on the output of this model, transport

alternatives will be suggested. Although the new process in urban transport planning has been developed over many years, its basic structure is still adopted in many transport studies. Across the world, this kind of traffic engineering approach became dominant for transport and urban planning (Knoflacher, 2009).

In the 1970s, American planners faced the emerging concern by the tremendous increase of motorised transport (Banister, 2002). Consequently, there was a shortage of transport infrastructure in meeting the future demand. In addition, European cities also faced the problem of car-oriented transport (Knoflacher, 2007). The classic approach in transport planning has resulted in many adverse effects such as public transport decline, urban sprawl, high levels of energy consumption, and environmental deterioration. It is a fact that transport planning has been seeking other approaches for solving increasing negative impacts of motorised transport in recent decades (Heijden, 2004).

The idea of sustainable development has emerged as there have been growing concerns of climate change since the 1970s. Its common definition was first cited in the Brundtland Report as a guide for future action (WCED, 1987). As a result, there was a need to find alternative paradigm based on sustainable development (Banister, 2007). Sustainability has been emphasised in different transport planning practices in both developed and developing countries. In the 1980's and 1990's, there was also an attempt to integrate transport into land use, social and economic policies as well as public participation, especially in European countries. However, "*a major paradigm shift in transport planning*" has not been raised yet (Banister, 2002).

In developing countries, Poboon (1997) it was found that the TPM had been adopted without modification to meet local context. Dimitriou (1992) pointed out deficiencies of TPM application outside western nations. For example, the role of informal public transport and non-motorised transport are not mentioned in detail, while they are essential part in many developing cities. The TPM focuses much more on transport infrastructure development, while developing countries have little resource in finance. Another illustration of TPM transfer failure is the unsuccessful attempt to apply TPM in South East Asia's urban transportation planning by Japanese consultants in the 1970s (Rimmer, 1986). This is because the urban development pattern of mega cities such as Manila, Bangkok, and Jakarta are different from that of Japanese cities.

In brief, the TPM is still applied extensively, especially in the favour of practitioner due to its strengths (logical process, guide for making decisions, framework for testing) and the lack of other alternatives for TPM replacement (Banister, 2002). While transport planning in western regions has been moving to focus on sustainability, the classic model of transport planning is still applied in developing countries. There has been a gap between the assumption of the conventional approach and the local conditions of developing cities due to the different characteristics in historical developments, concepts, practices and resources (Poboon, 1997).

2.6.2 Perspectives from policy implementation

Traditional approaches such as 'predict and provide ' and 'demand management' used to be options for transport planning (Bertolini, 2008). Cities in developing countries followed such approaches for extensive road building and highway development. During the 1950's and 1960's, examples of car-oriented transport and urban planning can be found in the cases of Jakarta (Indonesia), Bangkok (Thailand), and Manila (Philippines) (Abeyasekere, 1989;

Poboon, 1997; Rimmer, 1986). In this period, standards and planning methodologies based on being car-oriented were used in the setting of urban or transport planning studies within Asian cities (Dimitriou, 1992).

Since the 1970s, motorisation has accelerated in many megacities within developing countries (Dimitriou, 1992). The growth of private vehicles continues its inevitable process. It is found that the rate of passenger cars is higher in cities within developing countries in comparison to cities in developed countries with the same level of income (Morichi, 2005). Moreover, motorcycles become dominant modes in many low-income cities (Kenworthy, 2011). While motorcycle growth began in South East Asia in the 1980s, the phenomenon of motorcycle use has continued in other regions of Asia, Latin America, and Africa since the 1990s (Dimitriou, 1992; Nagai et al., 2003; Sperling & Claussen, 2004; Kumar, 2011). However, limiting private vehicle use seems to be ineffective in the context of increasing urban mobility and lacking transport infrastructure. While conventional bus and para-transit are still the choices of low-income people, existing public transport conditions become inefficient for meeting the increasing travel demand (Susilo, 2007).

Transport planning is increasingly involving sustainable development (Hayashi et al., 2004). Planning must be orientated by environmental objectives (Banister, 2002). In developing countries, the challenges of urban transport planning are not only emission reduction but also enhancement of transport infrastructure (Banister, 2013). As can be seen in Southeast Asian countries, infrastructure development as the indicator of economic growth becomes the priority of transport planning, rather than environmental concern and social equity (Emberger et al., 2008). Automobile-orientated transport planning results in environmental emissions and delayed improvement of public transport systems (Pendakur, 2011). Basic road networks should be the priority before soft instruments are applied for motorisation management (Acharya & Morichi, 2007). Developing countries are facing difficulties in keeping the balance between achieving sustainable development and meeting mobility needs.

In recent decades, alternative transit developments have become new targets of urban planning in cities within developing countries. Mass transit systems have been introduced as an attempt to tackle urban transport problems. Due to the fact that it takes time, and there is high capital for the implementation of mass rapid transit, less expensive alternatives such as bus rapid transit, monorail, and light rail have been considered in planning and practice (Gwilliam, 2003; Morichi & Acharya, 2007). BRT is discussed as an option for public transportation improvement and it ensures transit accessibility for low-income people (Gwilliam, 2003; Mitric, 2013). The success of integrating BRT into transport land use plan can be found in Curtiba, Brazil (Schafer, 2011). This is a successful example of high quality bus systems preventing a middle-income city with high growth of car ownership, to become a car-oriented city. However, using BRT is still beyond affordability of the poor in Africa (Vermeiren, 2015). Therefore, the poor should be the central point of urban transport planning (Sietchiping et al., 2012; Cervero, 2013; Herwagi, 2015). The implementation of new transit alternatives should be considered in term of feasibility (Morichi & Acharya, 2007).

In summary, it has been realised that developing countries with limited economic resources should plan urban transport in the future, to address the diversity of travel demand. Mass transit systems, conventional bus, para-transit, non-motorised transport modes and private vehicles hold distinctive roles and different potential in developing countries. In the

case of motorcycle dependent cities, motorcycles should be maintained as a part of the integrated urban transport system in a sustainable manner rather than being excluded.

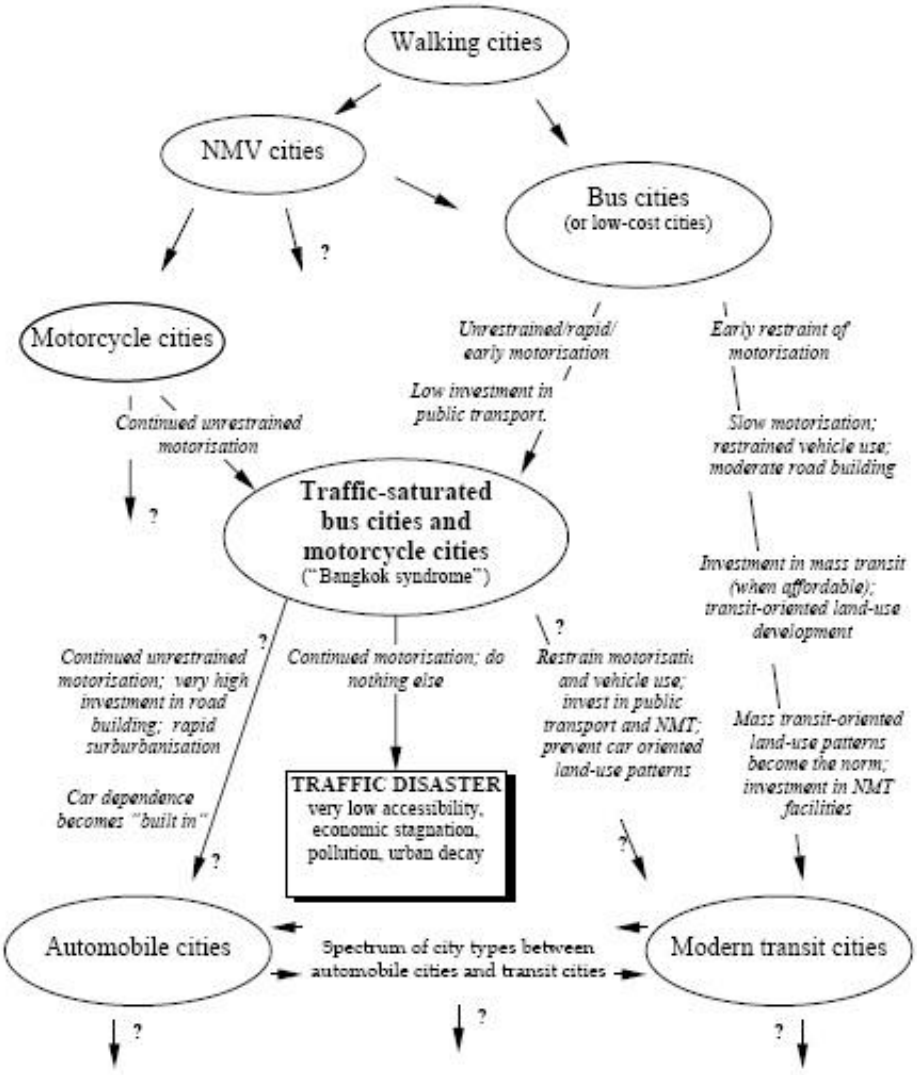
2.6.3 Perspective from academic view

The vision of cities within developing countries has been discussed in many studies. Hook and Replogle (1996) introduced four city types based on a variety of motorisation levels: (i) non-motorised transport city; (ii) mixed-traffic city; iii) public transport city; iv) private vehicle city. According to these criteria, Asian cities with high population density cannot become cities of private vehicle dominance. However, non-motorised transport cities are decreasing due to motorisation growth. Similarly, Barter (2004) provided a relationship model among cities of developing countries, which was based on the development of urban structures and urban transport (see Figure 2.3). Examples of bus cities are those within Asian cities, that are growing, and in the post-war era up to the year 1970, in which urban transport was characterised by bus-based public transport, walking, and non-motorised transport modes. Singapore and Seoul are examples of cities that are transforming from bus cities to rail-oriented transit cities since the 1960s. Until 1990, characteristics of bus cities still remained in Surabaya, Jakarta, and Manila while car-oriented land use began in Bangkok and Kuala Lumpur. Ha Noi and Ho Chi Minh City (Vietnam) are examples of motorcycle cities. For long-term strategies of Asian cities, Morichi (2005) suggests a model which has a multi-modal transportation system with rail-based public transport domination. In this case, MRT becomes the backbone of urban transport system in a poly-centric urban structure (Morichi & Acharya, 2007).

In terms of new transit alternatives, MRT implementation is considered as a long-term solution for solving traffic congestion of cities within developing countries, especially in Asia (Hayashi et al., 1998; Acharya, 2005). MRT implementation times depend on population and economic growth (Koizumi et al., 2013). Therefore, an appropriate time for MRT development was considered for meeting economic resources and travel demand (Morichi & Acharya, 2007). It contributes significantly to urban transport planning, particularly targeting short-term and long-term objectives. Late implementation of MRT systems can lead to many challenges in traffic management in the future, when private vehicle dependence becomes popular. Although Transit-Oriented-Development (TOD) has been implemented for solving difficulties in MRT performance, practical outcomes have been found to be different from TOD concept, in the case of Bangkok, Thailand (Sanit, 2012). The integration of MRT development and metropolitan planning in particular and the integration of transport and land use in general have also been discussed in many studies (Gwilliam, 2003; Cervero, 2013; Gwilliam, 2013).

In comparison to developed countries; developing countries have para-transit systems with diverse types and forms. Para-transit systems provide services that cannot be met by conventional buses. Para-transit can be mentioned in other terms, such as informal transport mode, indigenous mode, and LAMAT (Cervero & Golubb, 2007; Mateo-Babiano, 2011; Spraying, 2015; Phun, 2016). Besides their advantages, para-transit systems have limitations in service quality and performance. Therefore, it is suggested that para-transit should be regulated in an integrated urban transport system (Cervero & Golubb, 2007; Oshima et al., 2007; Sietchiping et al., 2012; Hidalgo & Huizenga, 2013). Integrating para-transit as the

feeder mode into mass transit were also discussed (Satiennam et al., 2006; Tangphaisankun et al., 2010; Vu, 2013b).



(Source: Barter, 1999)

Figure 2.3: Models of urban transport and land use in cities within developing countries

The increases of motorcycle ownership and use become distinctive characteristics of many cities within developing countries. Lai and Lu (2007) suggest that motorcycle use should not become popular, because it is difficult to apply traffic management policies to private vehicles. However, motorcycle use may hold a vital role in managing motorisation by postponing the growth of car ownership (Pongthanaisawan & Sorapipatana, 2007; Vu, 2011). Integrating motorcycles into mass transit systems such as MRT and BRT have been mentioned in term of practices and functional forms (Tsao, 2010; Vu, 2013a; Satienam et al., 2013).

2.6.4 Perspective for motorcycle dependent cities

It has been found that motorcycle use is rarely considered in planning, infrastructure development, and emission measures (WBCSD, 2001). The provision of transport infrastructure is still an automobile-based process in developing countries (Pendakur, 2011). Besides the role of personal mode, motorcycle is also utilised in para-transit, taxi, and delivery service. Since rapid transit systems will be implemented to meet high travel demand within Asian cities in the middle and long term, motorcycle is suggested to be used in short trips or to become an access mode of public transport service (Vu, 2013a). However, it is argued that this scenario only occurs if rapid transit systems have been implemented and public transport has become an efficient network. Until public transport is improved, motorcycles continue to be used for meeting personal mobility. However, motorcycle cities or motorcycle dependent cities such as Ha Noi and Ho Chi Minh City (Vietnam) were judged as examples of unsustainable approaches in urban transport (Gwilliam, 2013).

It was found that motorcycle ownership rises rapidly at the early stages of economic development, characterised by low income levels (Pongthanaisawan & Sorapipatana, 2010). When economic development reaches a certain level, motorcycle ownership ratios raise slowly until it reaches saturation point (Nagai et al., 2003). If the transition period of motorcycle growth continues over time, motorcycle use will become popular in urban transport. Even though economic development reaches high levels in which travellers can afford to own a car, motorcycles still exist as an important mode in developed countries and regions such as Malaysia and Taiwan (Masujima & Iwata, 2001; Vu & Shimizu, 2005; Wen et al., 2012). In Taiwan, policy makers expect that a capita income trend will change the ratio of motorcycles and passenger cars, and that motorcycle use is just a transient phenomenon (Lai & Lu, 2007). However, motorcycle and car ownership still increase, despite a higher level of income in recent years (Hsu et al., 2007). This demonstrates that motorcycle use is still parallel to car use, even though the quality of public transport services has been improved. Motorcycle dependence exists as a result of a long-standing habit of motorcycle use, which might undermine public transport development. Although Taiwan is a successful example of a way to manage motorcycle use, there are many challenges for developing countries with lower economic resources to follow Taiwan's case. Therefore, the priority of motorcycle planning should be based on economic growth, infrastructure system, and public transport development.

Existing studies provides an overview about planning perspectives in cities within developing countries. The literature covered in planning perspectives leads from ideas of vision, planning goal, motorcycle, mass rapid transit, integration, and equity through to approaches in master plans, project implementations, and transit performance (see Figure 2.4). In the context of motorcycle dependent cities, traffic diversity, transit accessibility, environment protection, social equity, and people's intention may be new challenges for transport planning. While the potential roles of motorcycles have been mentioned, as above, it is necessary to explore the mechanism of integrating motorcycles into mass rapid transit for moving to a sustainable future.

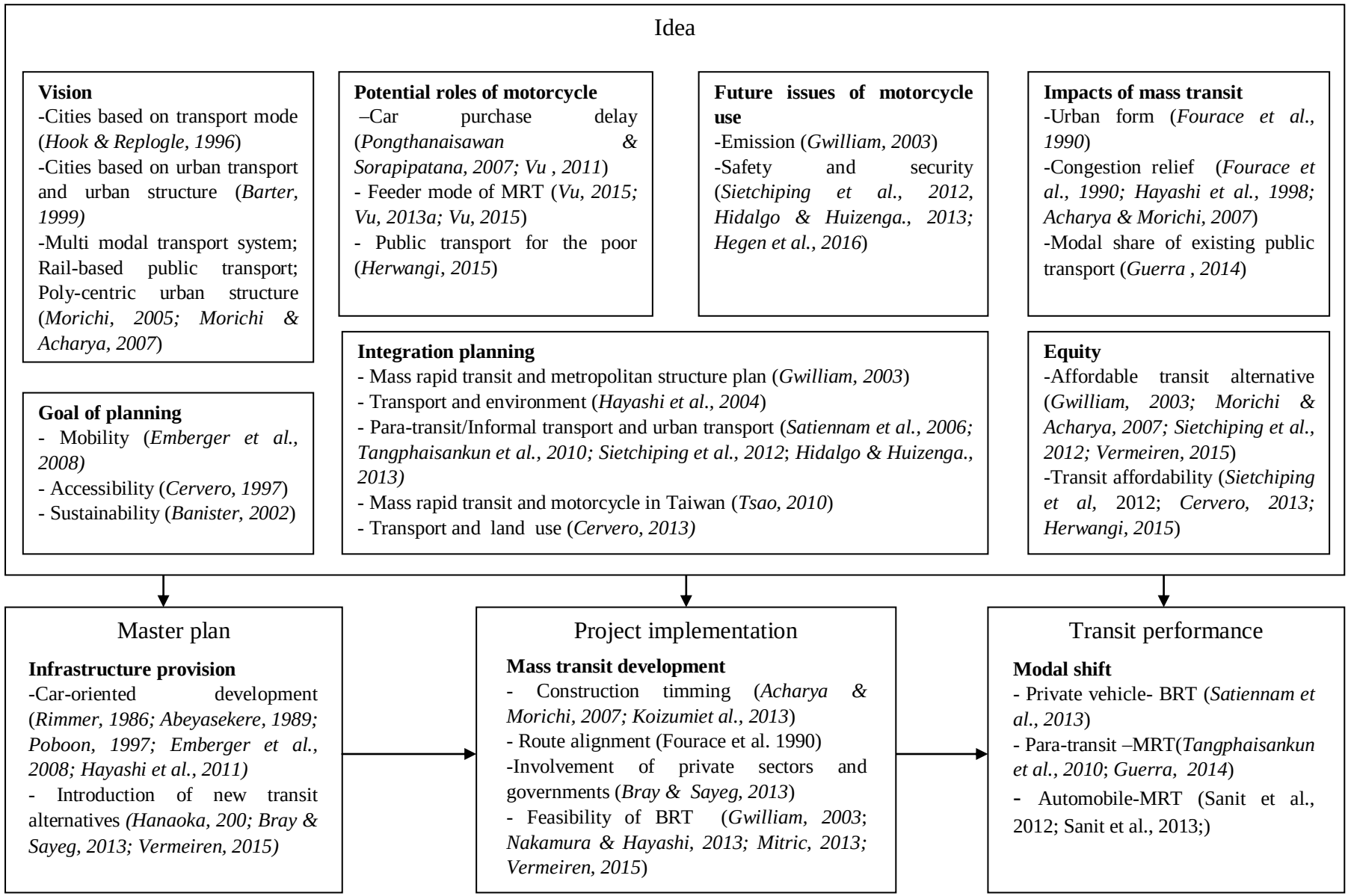


Figure 2.4: Relationships among planning perspectives in cities within developing countries

CHAPTER 3

3. RESEARCH METHODOLOGY

3. 1 RESEARCH FRAMEWORK

A methodological framework was developed to achieve the main goal of research in analysing the travel intentions in motorcycle-dependent regions of developing countries. Figure 3.1 describes the research processes of this study. The research structure is explained as follows:

1. A literature review is undertaken to explore motorcycle phenomenons, mass rapid transit developments, Park-and-Ride schemes, attitudes and behavioural theories, travel intentions, and planning perspectives. Based on literature review, the research purposes, objectives, and scopes will be developed.

2. The selection criteria of case study city must be suggested. Ho Chi Minh City, Vietnam has been selected to be representative of developing-country cities meeting the criteria and the scope of this study.

3. Based on research objectives, questionnaires will be designed and surveys will be conducted in selected study areas: i) City centre in phase I; ii) Suburban area in phase II; iii) MRT corridor in phase II. The first and second phases of data collection involve analysing travel intention. Some questionnaire items of previous surveys can be revised and continually used for next ones. The third phase of data collection relates to modelling travel behaviour.

4. The potential of travel behaviour changes are investigated by finding relationships among motorcycle use, attitudes, preferences, and travel intentions. The results and analyses identify commuter groups, preferences, and trip types with potential of encouraging public transport use (For more details, see Chapter 4).

5. Motorcycle use intentions are continually explored by considering mass rapid transit performance. Important factors of future motorcycle use and preferences for the combination of motorcycle and mass rapid transit will be explored (For more details, see Chapter 5).

6. The future choices of mass rapid transit use are modelled in association with social-economic characteristics, locations, travel attributes, traffic conditions, attitudes, and preferences. Stated preference techniques can be applied to grasp commuters' future MRT choices. The influences of traffic conditions and policy measures are considered by including stated preference data. Structural Equation Modelling and Binary Logit Model are utilised to determine the influences of predictors on travel intentions and mode choice behaviours. Factors influencing the intentions of motorcycle and mass rapid transit use in previous steps can be imported in travel behaviour models. (For more details, see Chapter 6).

8. Finally, key findings are summarised for policy development and recommendation. Implications for Ho Chi Minh City are suggested. In addition, attentions are given for implications in other cities within developing countries.

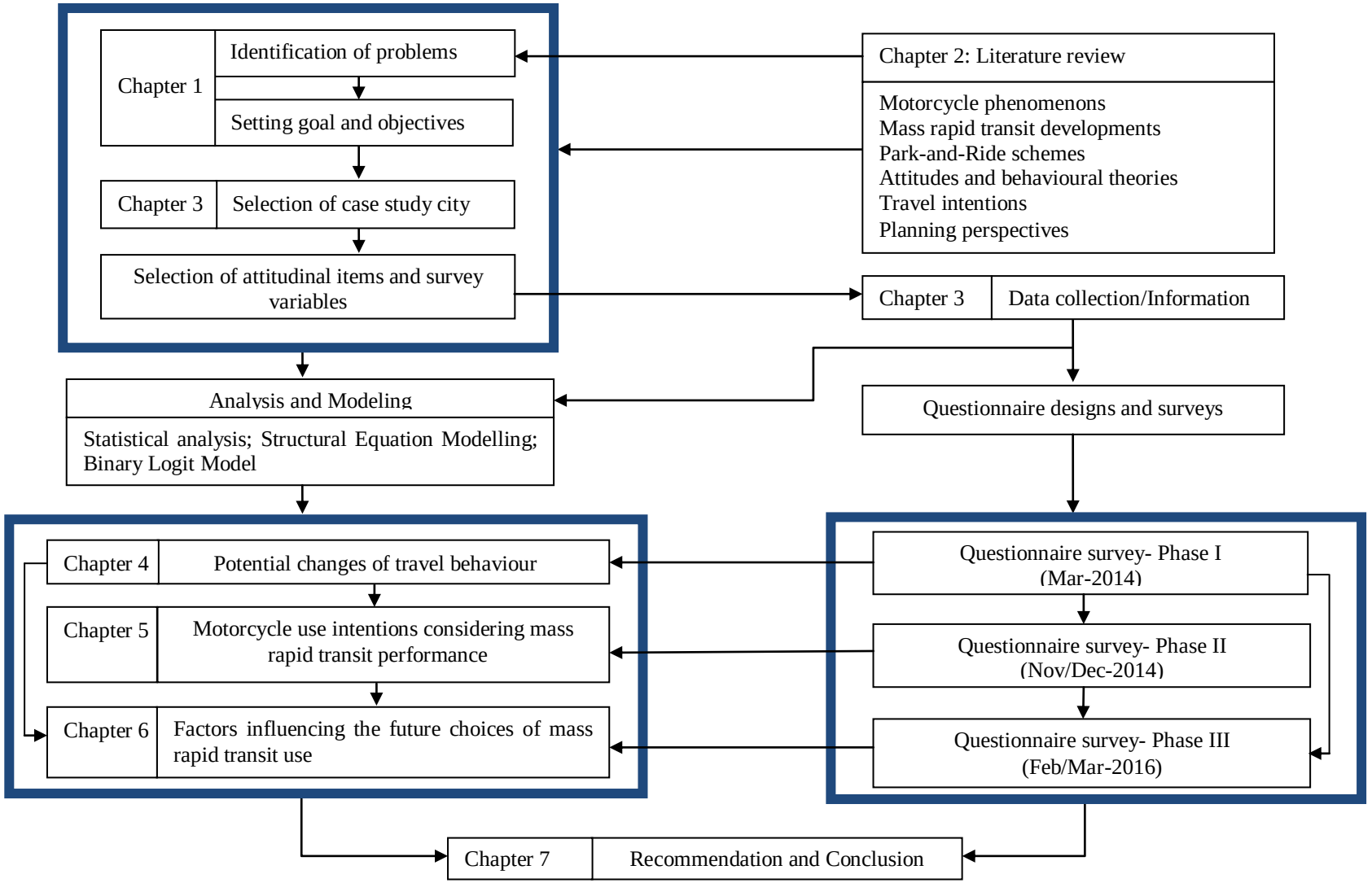


Figure 3.1 : Research framework

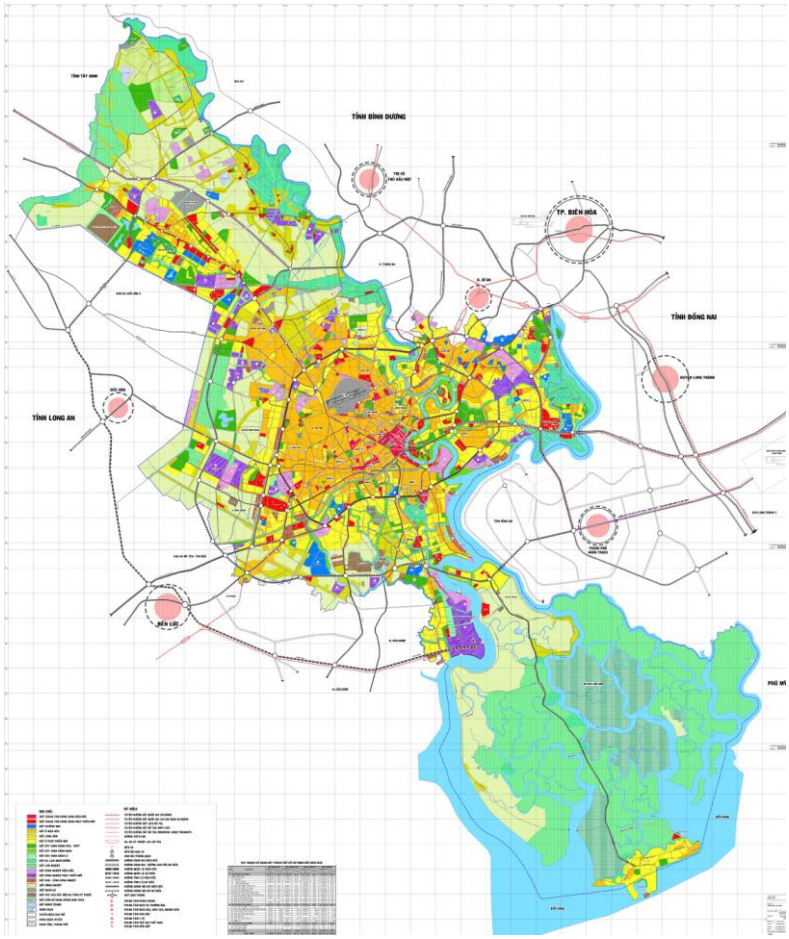
3. 2 CHARACTERISTICS OF STUDY AREA

3.2.1 Socio-economic characteristic

Located in the southern part of Viet Nam, Ho Chi Minh City (HCMC) has an area of 2,095 km^2 and includes 19 urban districts and 5 rural districts. In 2011, the total population of HCMC was 7.1 million and is expected to grow to 13.8 million by 2025 (Ministry of Transportation, 2013). HCMC and seven surrounding provinces constitute the greater Ho Chi Minh City metropolitan that has an area of 30,404 km^2.

3.2.2 Urban development

When the economy of Vietnam transferred to market oriented in 1986, urban development in HCMC progressed rapidly. The increase in urban population associated with economic growth and motorisation has led to an expansion of urban areas. HCMC was categorized into old inner city areas, new urban areas, and rural areas which account 7%, 17%, and 76% of city areas respectively (See Figure 3.2) (Ministry of Construction, 2013).



(Source : Ministry of Construction, 2013)

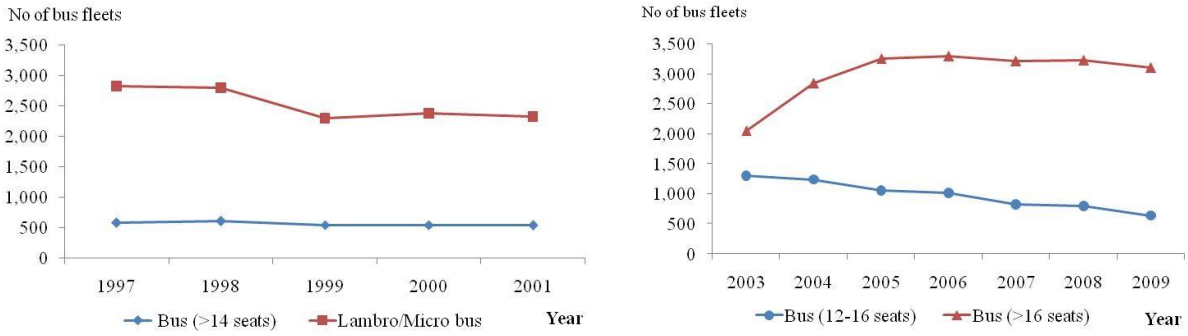
Figure 3.2 : Ho Chi Minh City Urban Planning Master Plan

In recent decades, most urban developments have been largely in the peripheries of the existing built-up areas and toward the northeast, northwest, and north of the city along the existing primary roads (JICA, 2004). The rate of urbanisation is higher in new urban areas

than in others. Being adjacent to the city centre, districts of new urban areas have high urban growth attributing to residential projects and industrial facilities. The MRT 1 corridor is located mainly in the northeast area (districts 2, 9, and Thu Duc). It is forecasted that traffic along Ha Noi Highway that is also MRT 1 corridor would reach a very high level of transport demand and severe congestion without the MRT (JICA, 2004).

3.2.3 Urban transport problems

The re-integration of Vietnam into the world economy and the concomitant shift to market economy affected HCMC much earlier than other parts of the country. The significant change in traffic conditions during the last two decades was characterised by a rapid increase in the number of private vehicles, a reduction in that of bicycles, and a declining trend of bus services (JICA, 2004). In last three years of the 1990s, there was a moderate decrease of bus fleets (see Figure 3.3a).



(a) (b)

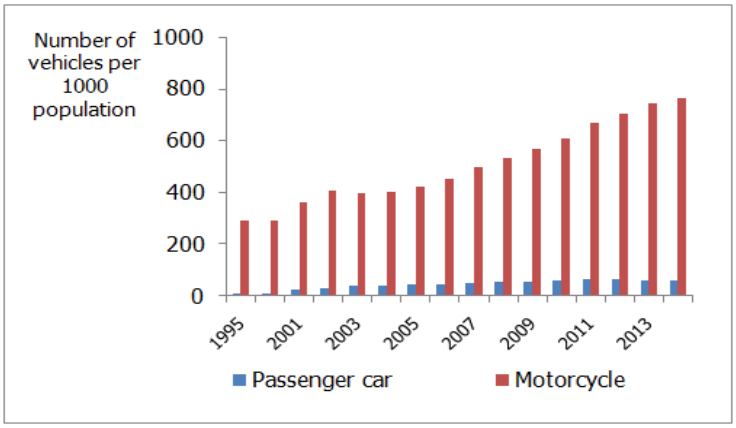
(Source : Department of Transportation, 2014)

Figure 3.3 : Growth of bus fleets

Photo 3.1 : Motorcycle traffic in Ho Chi Minh City

In 2002, the number of registered private vehicles included 60 thousand cars and 2 million motorcycles. From 2002 to 2011, the number of private vehicles increased rapidly

with individual incomes growth. In this period, GDP per capita increased 3.7 times (JICA, 2004). In addition, automobile and motorcycle manufacture contributes to low market prices for private vehicles. As a result, travel demand rose significantly in last decades. In 1996, modal share by motorcycle was estimated as 64%; however, this figure was 75% in 2004 (JICA, 2004). Motorcycle becomes popular in daily traffic (see Photo 3.1). By May 2014, the number of registered private vehicles in HCMC is 6.5 million including 0.5 million cars and 6 million motorcycles (Department of Transportation, 2014) (See Figure 3.4).



(Source : Department of Transportation, 2014)

Figure 3.4 : Private vehicle growth in Ho Chi Minh City

Transport service currently includes road–based modes such as bus, taxi, and motorcycle taxi. From 2002 to 2009, the number of taxis has increased rapidly from 3,597 units to 10,700 units (Department of Transportation, 2013). Although motorcycle taxis have not been regulated, it provides convenient trips with reasonable price in comparison with taxis. Motorcycle taxis appeared in the period bus service became deteriorated and motorcycle growth increased. Cyclo used to be a cheap and popular mode, but it was banned from certain streets and areas in city centre. Water transport is limited to local users' needs along rivers. Railway system that mainly operates for inter provincial transportation is not used as urban transport while mass rapid transit systems are being implemented.

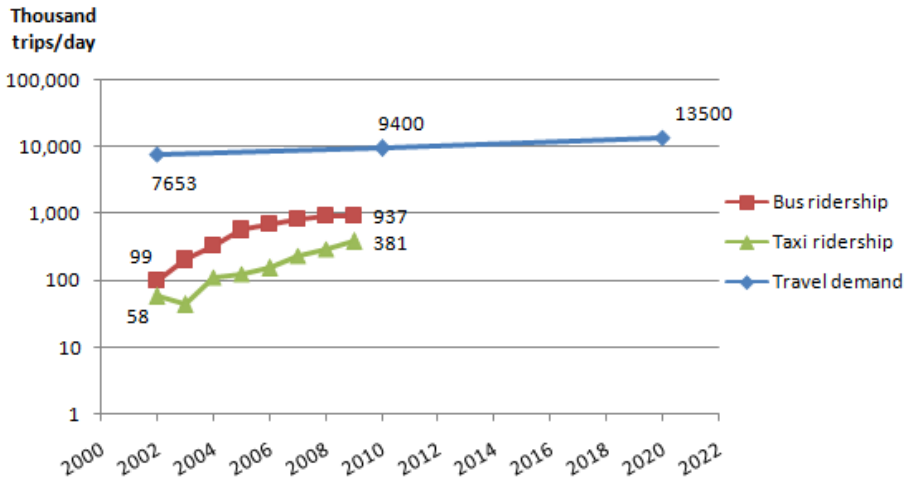
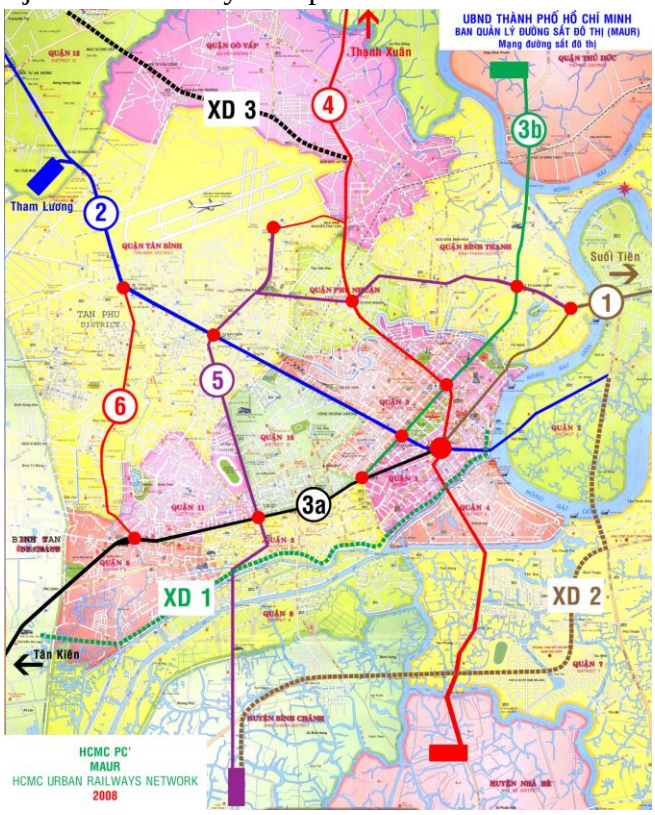


Figure 3.5: Public transport ridership and travel demand forecast

Since 2002, HCMC's government has focused on public transportation development (see Figure 3.3b). Bus transport has been supported through subsidized price policies, investment loans on facilities, and capital and infrastructure. By 2014, there were 137 bus routes including 107 subsidized ones. However, bus and taxi account for only 7.2 % of travel need while this figure is 5.4% for bus transport (Department of Transportation, 2014). As can be seen in Figure 3.5, travel demand had been predicted as over 9.4 million trips per day; but bus ridership was only around 937,000 trips per day in 2009 (JICA, 2004; Department of Transportation, 2013).

3.2.4 Public transport planning

According to the Public Transportation Master Plan toward 2025, bus systems will include 67 inner city routes; inter province routes, and 6 bus rapid transit routes. According to the Transport Master Plan toward 2020, there will be seven metro lines, two monorails, and one tramway with 167 km in length (see Figure 3.6) (Ministry of Transportation, 2013). Since public transport system has only conventional bus, it fails to compete with private vehicles which account for a major share in daily transportation.



(Source: Ministry of Transportation, 2013)

Figure 3.6 : Mass rapid transit plan

Currently, the first two MRT routes, namely MRT 1 and MRT 2, have been launched in HCMC. Their construction will be finished in 2019 and 2020 respectively. While MRT 2 route lies on an eleven-kilometre-corridor, the total length of MRT 1 is approximately 20 kilometres. Since the last station of MRT 1 is located near the boundary of HCMC and Binh Duong province, MRT 1 supplies travel demand not only for HCMC's urban transport but also for inter-provincial need.

3. 3 STATED PREFERENCE METHOD

Stated preference (SP) method is a technique for collecting behaviour data based on condition that does not exist in the present but may occur in the future (Van Zyl et al., 2001; Rastogi, 2004). In transport planning studies, Stated preference method is usually applied for grasping alternative travel choices or attitudes toward new policies for travel demand management.

SP method has some advantages on assumption capacity and economic condition (Van Zyl et al., 2001). First, travellers may provide answers about the situation that has not appeared yet. SP survey supports demand prediction of alternative public transport, especially in the area where alternatives have never been introduced yet. Second, SP attributes such as travel time and travel cost can be assumed in hypothetical questions. Since revealed preference (RP) data has limited ranges of attributes' level, small variations of RP data are not enough to predict behaviour changes (Nor et al., 2006). However, SP method can estimate behavioural responses by providing more variability of data attributes' values. Third, multiple responses can be collected in a SP question while each respondent has only one answer for each RP question.

While a SP survey provides many benefits in exploring unpredictable behaviour in new conditions, it also has some weaknesses in sampling procedures, bias answers, questionnaire design problems, and interviewing performance (Van Zyl et al., 2001). If some respondents may not understand hypothetical questions and have unbiased choices, many attributes or options will increase the complexity of SP questions (Noir et al., 2006). This will make the respondents feel afraid and have unreasonable choices causing unreliable data. Therefore, it is necessary to consider trade-off between SP design complexity and data quality (Schkade & Payne, 1994). Furthermore, Reis et al. (2004) summarised four typical problems of unreliable SP data : (i) Data inconsistency; (ii) Lexicographic behaviours; (iii) random behaviours; and (iv) Minimal distribution of chosen alternatives. Similarly, Hess et al. (2010) identify non-trading choices, lexicographic behaviours, and inconsistent responses are three main issues in stated choice data. Moreover, data quality can be affected if respondents lack knowledge about subjects mentioned in SP questions. For example, developing-country travellers lacking experience and information about transit alternative system can have wrong choices about future MRT use (Sivakumar et al., 2007).

Improving efficiency and quality of SP survey data has been focussed in a variety of transport studies. In general, proposed solutions are usually categorized into two groups: (i) Question content; (ii) Interview method. Simplifying questionnaire design and improving respondents' understanding about SP question are common features of these solutions.

SP survey designs always have challenging tasks to ensure that respondents can perceive hypothetical questions. Van Zyl et al. (2001) suggested that SP questionnaire should have no more than 4 variables and scenarios are smaller 10. Moreover, the value of fixed time and costs should be based on real life. Rastogi (2004) recommended that attributes and levels should be as low as possible, such as 2 or 3 respectively. Sivakumar et al. (2007) suggested that SP questions should be attached by descriptions and photos that make respondents be able to imagine hypothetical scenarios and to have accurate answers. Scenarios should be presented in pairs so that respondents can provide reliable answers without confusing choice

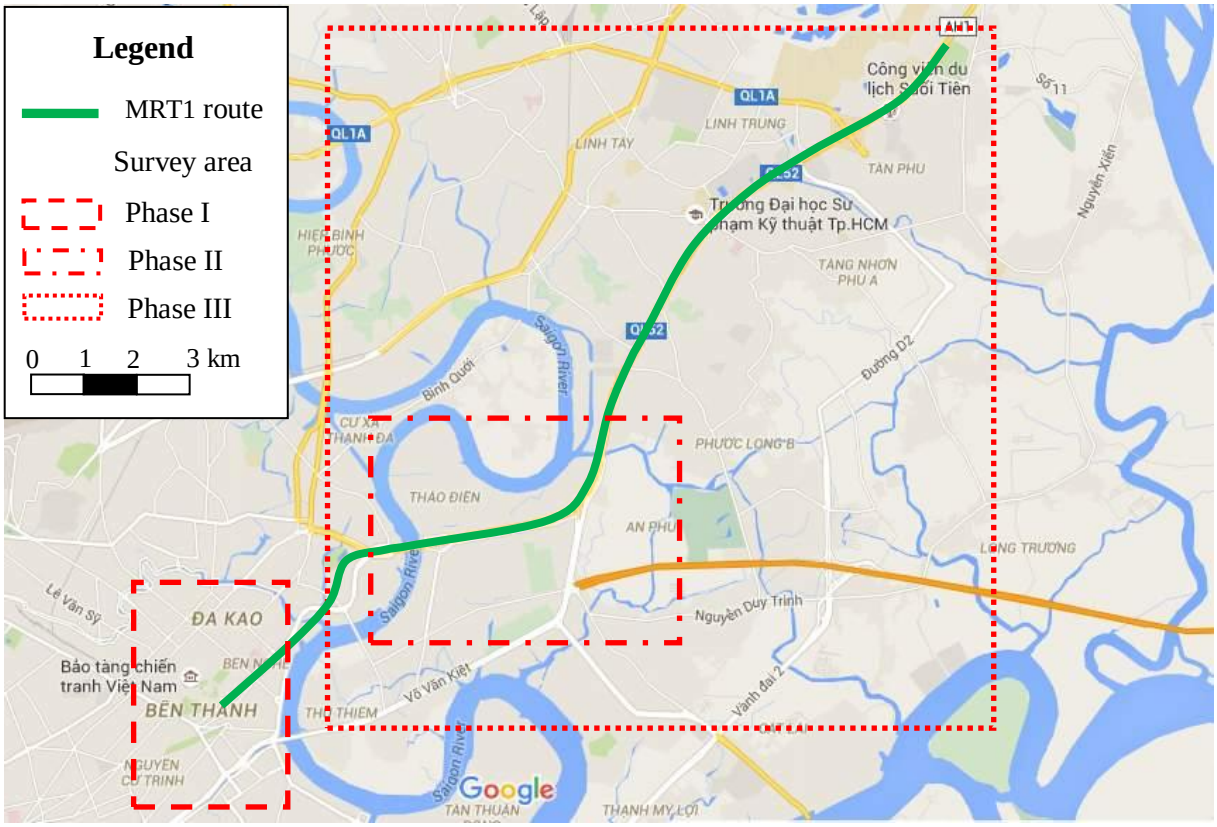
complexity. Tabular format is recommended if interview time is limited (Rastogi, 2004). Hypothetical scenarios must be closed to actual situation such as experienced travel route and related characteristics (Hensher, 2010).

Methods of interview performance might enhance the reliability of SP data. Van Zyl et al. (2001) concluded that interviewers should not mention options with favourable cost to the respondents since they may pay attention to cost variables. Interviewers can have deep prior discussion with respondents for being aware of possible errors (Fifer et al., 2014).

Although SP method has been applied in developed countries, the transferability of SP model needs many improvements in developing countries (Loo, 2012). Developing-country cities are characterized by differences in motorization and urbanization. While automobile is the main topic of many transport studies in developed countries, motorization of developing countries is characterized by large divergences in urban transport. Furthermore, motorcycle emerges as a phenomenon in some Asian megacities. Therefore, SP survey design should focus local conditions to ensure efficient transferability of SP models.

3. 4 DATA COLLECTION

Three field questionnaire surveys were conducted to get required data in order to achieve objectives of this study (see Figure 3). Department of Civil Engineering, University of Transportation involved in organising survey teams.



(Adapted from Google Map)

Figure 3.7: Survey areas

First, the potential changes of travel behaviour were investigated in phase-I survey. Mutual relationships among motorcycle use, travel attitudes, bus access preferences, and travel intentions were considered. Based on attitudinal evaluation, commuters were classified into four groups. MRT choices were regarded as intentions since Stated preference questions were similar for all respondents. Second, Phase-II survey aimed to explore the relationship between motorcycle use intentions and corresponding factors in the context of new urban development. Urban transport was evaluated in both city centre and local neighbourhood. Important preferences for Park-and-Ride were identified for formulating key variables in next survey. Furthermore, people's attitudes relating traffic concerns and transit preferences were collected. Finally, in phase-III survey, individual's preferences, attitudes toward travel modes and policy measures, and intentions were collected for analysis and modelling. Attitudes and preferences formulating important factors in previous results were imported in last survey questionnaire.

Table 3.1: Data set of travel survey

Id	Targeted respondent	Method	Year	Location	Scale	Samples
1	Office-based commuters	Interview and self-completion	2014 Mar	City centre	General data at city level	198
2	Suburban residents	Interview	2014 Nov-Dec	Residence surrounding future stations in peripheral zone	Detailed data in new urban area	215
3	Station-area residents	Interview and self-completion	2016 Feb-Mar	Residence surrounding all MRT stations	Detailed data along MRT corridor	219

Table 3.1 describes three data sets achieved in three field surveys. Interview and self-completion are main methods of field surveys. While interviewees of the phase-I survey are not limited in residence location, the others focus on target population in specific stations and along MRT corridor.

3.4.1 Questionnaire design

Questionnaire structures basically include four categories: Socio-economic demographics, travel behaviours and attributes, Attitudes, preferences, and intentions, and Mass rapid transit (see Table 3.2). In every survey, depending on research requirements, these categories were named differently from the others. Details of questionnaire designs are presented in chapter 4, chapter 5, and chapter 6.

Figure 3.8 presents the relationships among questionnaire designs. At the beginning, survey (Phase I and phase II) questions relating to mass rapid transit focused on the intention of using MRT in term of travel distances (long trip and short trip), access/egress modes, Park-and-Ride preferences (situation, time, and cost). In this period, qualitative data was collected to grasp a general view of mass rapid transit use. In phase III-survey, some attributes of Stated preferences questions (travel time, travel cost) were calculated in details and provided for respondents in order to attain actual choice behaviour.

Table 3.2 : Questionnaire content

Category	Survey		
	Phase I	Phase II	Phase III
Socio-economic demographics	General information	Individual and household information	Individual information
Travel behaviours and attributes	Travel and trip patterns	Travel patterns	Travel attributes
Attitudes, preferences, intentions	Trip preferences Attitudes toward travel modes Bus access preferences Intentions	Perceived urban transport Transit preferences Attitudes toward traffic awareness Intentions	Travel preference Attitudes towards travel modes and policy measures Intentions
Mass rapid transit	Stated scenario	Park-and-Ride	MRT choices

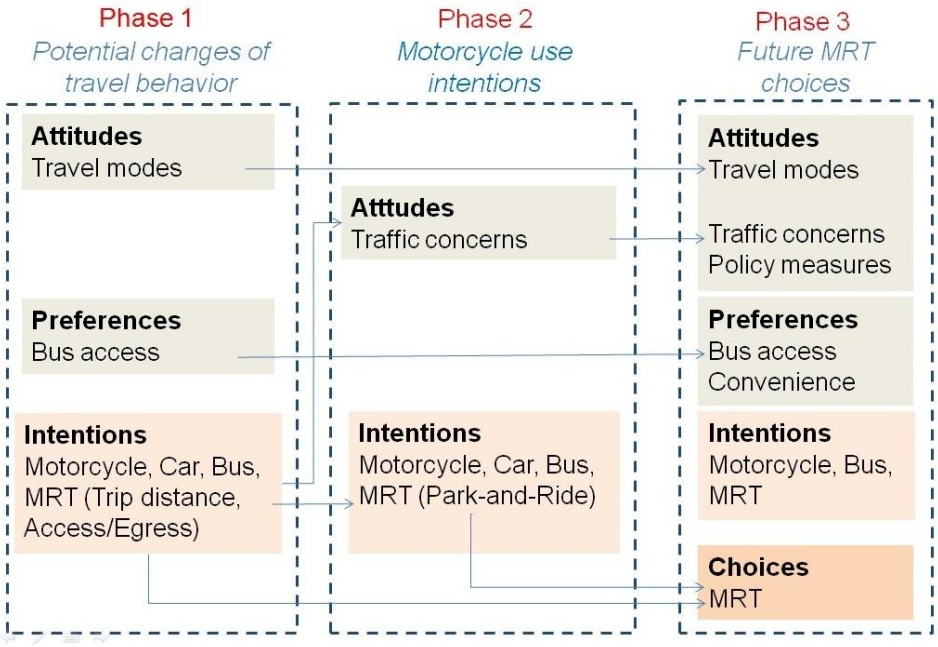


Figure 3.8 : Relationships among questionnaire designs

State preference technique has been applied in some studies on rail-based system in developing countries. Travel time and cost are commonly chosen as basic SP variables (see Table 3.3). Moreover, other variables for SP choice experiment can be frequency and discount rate (Bando et al., 2015), annual accidents rate (Rizzi & Ortuzar , 2003), or crowding level (Basu & Hunt, 2012).

Table 3.3 : Stated preference studies relating to new transit alternatives

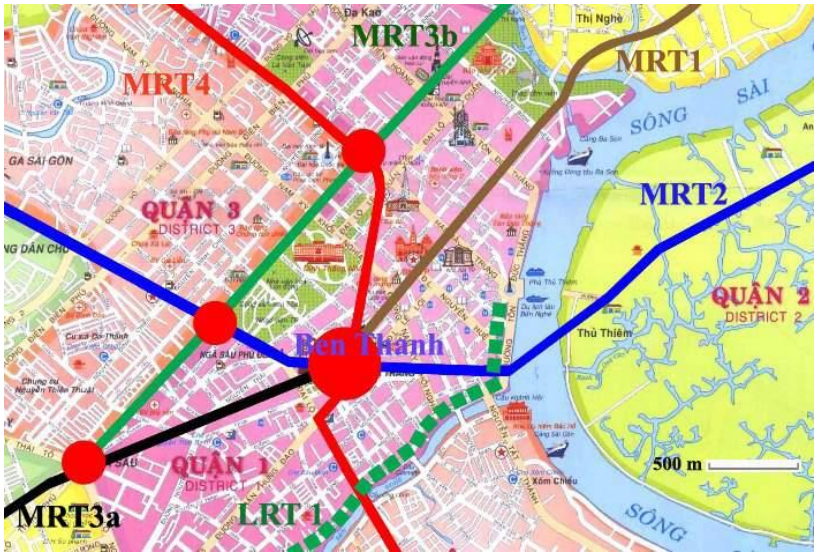
Study	Interview method	Target population	Alternative	SP attributes	Attributes based on existing situation
Jimene & Villoria (1997)	Personal interview, self-completion	Car users	Mass Rail Transit	Travel time, Travel cost	
Hayashi et al. (1998)	Interview	Vehicular users	Car, bus, rail	Travel time, travel cost	
Fujirawa et al. (2003)	Interview	Suburban residents	Car, bus, railway, new transit system	Travel time, travel cost, waiting time, and punctuality (public transit)	Access time, egress time (public transit)
Sivakumar et al. (2006)	Drop-off and pick-up	Household residents and officers	BRT, Bus	Travel time, travel time variance, fare, comfort	
Basu & Hunt (2012)	Face-to-face interview	People at train stations	Suburban train	Ride time, headway, train fare, crowding level	
Satiennam et al. (2013)	Interview	Private vehicle users	BRT, motorcycle, car	Waiting time, Fare	Access time, In-vehicle time, egress time
Bando et al. (2015)	Interview	Students	Motorcycle, Angkot, LRT	Travel time, Delay time, Total cost, Walking access time (Angkot, LRT), Frequency (Angkot, LRT), Discount rate (LRT)	

3.4.2 Sampling and survey

a. Phase-I survey

The survey was launched during March 2014 (Photo 3.2a). It was piloted with a group of 20 undergraduate students of Ho Chi Minh City University of Transport. The survey focuses on travel intentions in a motorcycle-based context. Since motorcycle is the main mode of commuting trips, commuters are chosen as survey population. The target respondents are commuters who have regular trips to the CBD (District 1 and District 3) of HCMC. These districts belong to the inner core area attracting most commuting trips from inner fringe and emerging peripheral areas of HCMC (JICA, 2004). There are not only large businesses and commercial centres but also administrative places. The survey area is limited around the Ben Thanh Bus Terminal (District 1) and aligned future MRT routes (see Figure 3.9).

Surveyors contacted commuters at office buildings, schools, and public facilities in the survey area. The respondents self-completed questions and then returned the questionnaires to surveyors. Other interviews were also undertaken at bus terminal and parking lots around the bus terminal. Since it is difficult to have cooperation from bus passengers in the morning, those interviews were conducted in the evening. The respondents completed the questionnaire with the assistance of surveyors. After removing incomplete responses from the initial questionnaires (N=220), 198 usable samples were obtained for further analysis.



(Adapted from Ministry of Transportation, 2013)

Figure 3.9 : MRT master plan map in city centre area of HCMC

b. Phase-II survey

The survey was carried out in November and December, 2014 (Photo 3.2b). As illustrated in Figure 3.10, survey sites are mainly located in specific wards of district 2 (Thao Dien, Binh An, and An Phu). Used to be suburban area of HCMC, district 2 was urbanized rapidly in last two decades. Most of residential projects have not been finished yet while some developments are still under construction. Road density of Thao Dien and Binh An is as high as that of city centre. However, this figure is significant low in An Phu. It is the fact that vacant land is still available in this ward and many residential developments are being in process (see Table 3.4).

Table 3.4 : City, centre and site information

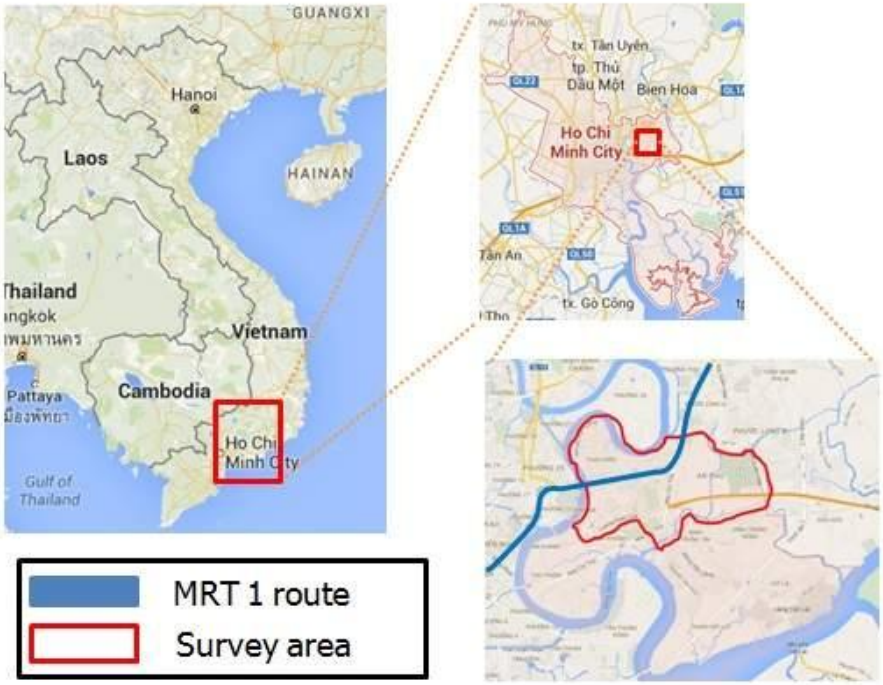
(Source: HCMC Department of Transportation, 2014)

	Ho Chi Minh City	City centre (District 1)	District 2			
			All	Thao Dien	Binh An	An Phu
Area (km^2)	2692.57	7.73	49.75	3.73	1.87	10.21
-Residential area (%)				57	49	26
Population (persons)	7,162,864	180,225	147,490	16,256	19,105	17,928
Density						
-persons/km^2	2,660	23,315	2,965	4,354	10,219	1,756
-roads/km^2	1.5	16.6	7.3	15.3	18.7	4.3
-road length km/km^2	1.4	9.7	3.6	5.5	6.4	1.5

Due to the lack of secondary road system, most of bus routes are only aligned to such main roads. There are 3 stations of MRT line No 1, namely Thao Dien, An Phu, and Rach

Chiec, in the survey site. All stations are designed as elevated constructions on Ha Noi Highway. This corridor connects HCMC and north-east provinces in the Ho Chi Minh City Metropolitan Region.

There was a training session for surveyors on 19th November, 2014. During the training, surveyors did exercises by interviewing each-others, using the questionnaires, to be familiar with the questionnaires. The pilot survey was implemented for students of University of Transportation on 21st November, 2014. Since questionnaire content includes attitudinal items, pilot survey aims to know how people can understand questionnaire questions, especially statements of attitudes. Based on respondents' comments and results of the pilot survey, questionnaire contents were discussed in depth and revised in order to provide simple expressions and clear contents for respondents.



(Adapted from Google Map)

Figure 3.10 : Location of phase-II survey sites

Contacts with local authorities had been implemented since September, 2014. Later, survey teams were introduced to representatives of resident units. The leader of resident unit informed local people about the survey and then accompanied surveyors during interview process. The surveys were conducted mainly at residential households where household representatives accept interviews. Participants must be commuters who are living in survey site. The priority time is evening for weekdays or day time for weekend. Extra questionnaire sheets were also collected at public places such as local councils, supermarket, schools, and universities where there are many local residents visiting every day. All questionnaire sheets were finished by face to face interviews. After removing incomplete responses from the initial questionnaires (N=230), 215 usable samples were obtained for further analysis.

c. Phase-III survey

The survey was conducted in February and March 2016 (Photo 3.2c&d). Following the process of second survey, contacts with local authorities had been prepared in one week before survey was carried out. There are 13 stations located in 5 districts and along MRT 1 corridor. However, interviews were only conducted in residences around 11 stations in 4 districts. Since trip destinations were assumed around Ben Thanh station in Stated preference questions, respondents living near first two stations, Ben Thanh and Ba Son, were excluded from survey population.

Face to face interview is the main method used in the survey. Most of interviews were carried out in the evening in weekdays or in daytime in weekends. The selection of samples was based on the introduction of households' representatives. Residence leaders accompanied interviewers to every household until this process was finished.

(a)

(b)

(c)

(d)

Photo 3.2 : Survey team, preparation, and interview process

In every meeting, interviewers began with the explanation for questionnaire content. Participants were provided with careful instruction on survey questions, especially attitudinal items and Stated preference scenarios. Every respondent has SP questions different from that of the others since travel time and cost are based on their residence address. First, interviewers identified where respondent's houses are located so that distances to MRT stations and city centre were estimated. Second, total travel time and cost were summarised after other expenses and durations such as fuel cost, parking fee, MRT fare, MRT access duration, and duration from nearest station to city centre were calculated. Finally, interviewers asked respondents' choices in every hypothetical case. There are two scenarios relating to MRT use with non-egress trips and with egress trips. In every scenario, eight cases were extracted by

orthogonal design in SPSS software. However, only four cases were randomly introduced to every respondent in order to limit answer's bias.

The number of questionnaire sheets was 230; however, only 219 samples were collected. Since some respondents suggested returning questionnaire after self-completion, interviewers carefully explained respondents how to answer Stated preference questions. However, some given questionnaires lack information about MRT choices. Finally, only 187 samples have enough data for Stated preference questions.

3. 5 ANALYTICAL METHOD

3.5.1 Statistical analysis

A t-test is a statistical comparison of two data groups. The t-test procedure is conducted under the null hypothesis in which the mean of two groups are equal. If the null hypothesis is rejected, it indicates that the means of data sets are significantly different from each other.

Analysis of variance (ANOVA) is a set of statistical methods that compares the degree of differences among three or more means. It is the extension of t-test for multiple groups. The null hypothesis is assumed that the means of dependent groups are equal. If the hull hypothesis is rejected, it indicates that at least one mean of data groups is significantly different from the others.

Regression analysis is a statistical procedure that predicts the relationship between one dependent variable and one or more independent variables. However, it does not examine the causal relationship among the variables. A function of the independent variables includes different coefficients indicating the strength between every independent variable and the dependent variable.

Discriminant analysis is a statistical method that distinguishes two or more groups by measured characteristics. The dependent variable is categorical one while independent variables are continuous or dichotomous. Discriminant analysis is useful in identifying which variables are the best predictors of group classification.

3.5.2 Structural Equation Modelling

Structural Equation Modelling (SEM) is a general approach to multivariate data analysis. It has been used in sociology, psychology, business, and biological science since the 1970s. Researchers began to apply SEM in travel behaviour in the 1980s. Following a confirmatory approach rather than exploratory, SEM is often used to test causal models for multiple variables (Bentler, 1988). Based on hypotheses, models will be built and tested through several statistical methods including confirmatory factor analysis, path analysis, factor analysis, time series analysis, analysis of covariance, and multi regression.

A general SEM model includes two components. First, a measurement model that is constructed by confirmation factor analysis (CFA) defines the relationship between latent variables and observed variables. Second, a structural model estimates relations among latent variables by multiple regressions (Bollen, 1989; Blunch, 2008). The strength of the relationships among variables is estimated by covariance analysis method. Ordinary least square, generalized least squares, and Maximum likelihood are commonly used to assess the fit of parameter estimation. Observed variables that are not good indicators of the latent

variables will be excluded. An example of SEM is shown in Figure 3.11. Latent variables are shown as circles or ellipse. Measured variables are drawn as squares or rectangles.

A SEM procedure includes the following steps: Model Specification, Model Identification, Estimation of free parameters, Assessing Fit of the Model, and Model Modification. The goodness-of-fit of models can be measured by some parameters such as chi-square/ degree of freedom ($\chi 2$/DF), Goodness of fit index (GFI), Adjusted goodness of fit index (AGFI), Root Mean Square Error of Approximation (RMSEA, and Root mean square residual (RMR) (Golub, 2003). Sample size ranging from 100 to 200 cases is recommended to provide reliable statistical analyses (Hoyle, 1995).

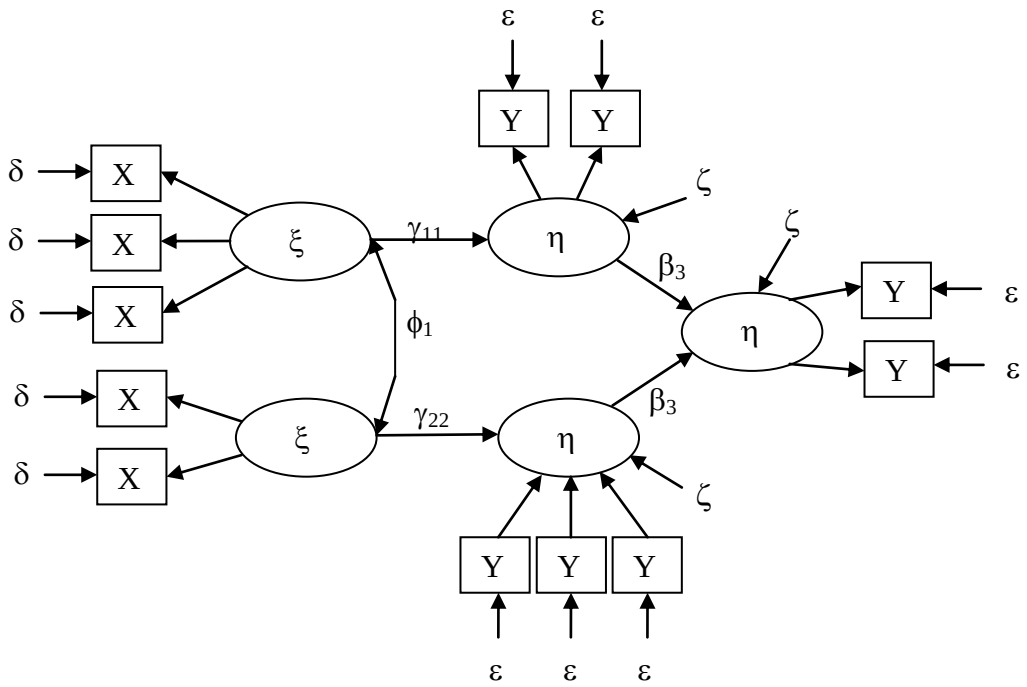


Figure 3.11: SEM model example

3.5.3 Binary logit model

As a special case of discrete choice models, the binary logit model is used to estimate the probability of an event occurring in relation with one or more predictors. In binary logit model for travel behaviour, choice set contains exactly two alternatives. The probability of an alternative i being selected by person n is given by the following.

$$P_n(i) = \frac{e^{V_{in}}}{e^{V_{in}} + e^{V_{jn}}} \qquad (3.1)$$

V_{in} and V_{jn} are observable components of the utilities of alternative i and j and can be described in linear functions as the follows.

$$V_{in} = \sum_k \beta_k x_{ink} \qquad (3.2)$$

$$V_{jn} = \sum_k \beta_k x_{jnk} \qquad (3.3)$$

$\beta = [\beta_1, \beta_2, ..., \beta_k]$ is denoted as the vector of k unknown parameters and x_{ink} and x_{jnk} are observed variables.

The probability of choosing alternative j is also the probability for not selecting alternative i and it is calculated as

$$P_n(j) = 1 - P_n(i) = 1 - \frac{e^{V_{in}}}{e^{V_{in}} + e^{V_{jn}}} \qquad (3.4)$$

The likelihood of a behaviour occurring relative to the likelihood of a behaviour not occurring can be rewrite as

$$Ln\left[\frac{P_n(i)}{P_n(j)}\right] = Ln\left[\frac{P_n(i)}{1 - P_n(i)}\right] = Ln\left[e^{(V_{in} - V_{jn})}\right] \qquad (3.5)$$

If the differences in the utilities are not considered, (3.5) can be rewrite as

$$Ln\left[\frac{P(Y=1)}{1-P(Y=1)}\right] = \beta_o + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + ... + \beta_k X_k \quad (3.6)$$

Where Y is a binary response variable and X = (X_1, X_2, ..., X_k) be a set of explanatory variables which can be discrete, continuous, or a combination.

CHAPTER 4

4. POTENTIAL CHANGES OF TRAVEL BEHAVIOURS

4. 1 INTRODUCTION

Motorisation is occurring rapidly at a global level. In developing countries, this process is encouraged by high economic growth and fast urbanization. The increasing growth of private vehicles seems to continue as an inevitable process. Many megacities are experiencing not only the high growth of car ownership and usage but also a similar trend for motorcycles. It is predicted that car use will gradually substitute motorcycle use to account for major share of private modes, as income reaches a specific level. It is assumed that higher rates of motorcycle growth only happen in the early economic development (Nagai et al., 2003; Pongthanaisawan & Sorapipatana, 2010). However, a case in Taiwan, a developed region with parallel development in cars and motorcycles, has indicated that motorcycle as well as passenger car use will play a vital role in developing countries as economic growth continues. Since motorisation has accelerated at a lower income level, motorcycle dependent cities have more obstacles in implementing 'pull' and 'push' strategies to control private vehicle use.

In the recent decades, new transit alternatives such as Bus Rapid Transit (BRT) and Mass Rapid Transit (MRT) have been introduced as effective approaches for mitigating urban transport issues in many Asian megacities. It aimed to reduce private vehicle use and improve service quality of public transport. The advantages of MRT systems have been illustrated with successful examples in Hong Kong, Kuala Lumpur, and Singapore. The introduction of MRT has been examined as a contextual factor influencing mode choice behaviour of motorcyclists in Taiwan - a motorcycle development region (Chen & Lai, 2011). MRT is considered as an efficient option to meet high travel demand in megacities of developing countries (Morichi, 2005). It provides a major contribution to urban transport improvement (Acharya & Morichi, 2007). Although high economic growth has resulted in a rapid increase of private vehicles in megacities such as Bangkok, Manila, and Jakarta, conventional bus and para-transit services still hold a significant proportion in urban transport of these cities (Hanaoka, 2007). This situation is different from that of motorcycle-dependent cities where motorcycle use has become a long-standing habit and modal share of public transport contributes little to travel demand. Asian cities with the high share of two-wheel vehicles have urban traffic distinct from the global trend (Koizumi, 2013). It means that there are more challenges for MRT use in the area where motorcycles emerge as a dominant mode. While researches in shifting travellers from passenger car to MRT have been explored, there are fewer studies for motorcycle use. A study of people's travel behaviours with respect to MRT is recommended for managing private vehicle growth without limiting urban mobility in a motorcycle-based context.

There is a growing body of literature built around the factors that make people likely to use transit. In term of MRT, it was identified that access to rail stations holds a vital role in improving MRT ridership. Station features, walking environment characteristics, travel patterns (time, cost, and distance), and feeder modes should be considered in connecting traveller to rail station (Chalermpong &Wibowo, 2007; Wibowo & Chalermpong, 2010). In addition, Tangphaisankun et al. (2010) highlights commuters' satisfaction on para-transit services (safety, comfort, and convenience) as positive influences on mass transit connectivity

and transit use intention. Car ownership is found to be a negative factor for MRT use (Wibowo & Chalermpong, 2010). The level of rational mobility in car use affects people's auto dependency which influences MRT use intention (Hayashi et al. 1998). Commuters who are eco-friendly and public transport passengers who are car-oriented prefer to use mass transit (Tangphaisankun et al. 2011).

In terms of bus and para-transit services, auto oriented and transit oriented factors considerately influence commuters' preference to use public transport (Javid, 2012). Different lifestyles such as being car oriented and service oriented affect the intention of using jeepney services (Okamura et al. 2013). In motorcycle dependent regions without MRT, it is noted that geographical features contribute to the popularity of bus service and motorcycle use (Nagai et al. 2003). For example, there is less usage of public transport in rural areas in comparison to urban areas, due to the important role of motorcycles for local economic conditions. Moreover, education level, household income, household size, travel distance, working status, accompanying person, and trip complexity are important variables for using buses (Tran et al. 2012). Psychological determinants such as moral concern and perception on bus quality have significant influences on bus use intention (Fujii &Van, 2009).

Since MRT systems have not been developed in HCMC yet, people lack experience in using this alternative. Many factors of previous studies such as travel patterns and built environments only exist in the context of operating MRT systems. Therefore, factors relating to current travel behaviours should be considered to investigate their influences on behavioural intentions and future MRT uses. Since motorcycle use becomes the dominant mode of transport while bus use has little share in urban transport, attitudes toward travel modes might be important factors of mode choice and travel intention. Additionally, motorcycle taxis play a minor role in connecting bus service. How people perceive bus access might affect future bus use.

The main objective of this chapter is to analyse potential changes of travel behaviours with respect to MRT in motorcycle-based contexts. Based on background and research, the hypothesis of this study is that a group of commuters have travel intentions of public transport use. The three following objectives include:

i) To evaluate travel modes in terms of symbolic aspects and usages through attitudes and preferences of commuters

ii) To explore behavioural intentions of existing modes and future mass rapid transit uses

iii) To analyse behavioural intentions of existing travel modes and future mass rapid transit uses by different attitudes and preferences

4. 2 DATA MEASURES

A questionnaire survey with stated preferences was developed to understand commuters' behavioural intentions and future MRT uses (see Appendix 1). The survey questionnaire consists of the following four parts: (A) General information; (B) Travel and trip patterns; (C) Attitudes and opinions; and (D) Stated scenarios. The first part includes items such as gender, age, residence location, workplace/school location, occupation, household composition, household vehicle, and household income. The second part consists of current travel behaviours and trip patterns such as mode use frequency, commuting mode, travel duration, parking information, travel expense, business trip, and commuting trips. The

third part comprises trip preferences, attitudinal items regarding travel modes, bus access preferences, and behavioural intentions. The fourth part aims to understand commuters' intentions to use future MRT.

Table 4.1 shows that two-thirds of respondents (69%) were aged between 23 and 40. About 32% of the respondents were government officials and office staff. More than half of commuters (53%) were living in households with two to four members. The proportion of sample household with motorcycle ownership was 95%. The average of the monthly household income was within the 15-20 million VND bracket. Moreover, 37% of households had monthly incomes higher than 20 million VND. This simply explains the fact that households with car ownership keep a significant proportion of respondents' households.

Table 4.1 : Socio-economic characteristics and travel patterns (n=198)

Category	Description
Gender	Male (52%), Female (48%)
Age group	18-22 (13%), 23-40 (69%), >40 (19%)
Occupation	Manager (13%), Professional (16%), Office worker (27%), Official (15%), Labour/Worker (11%), Sale person (6%), Student (12%)
Household members	Single (15%), 2-4 persons (53%), 4-6 persons (23%), >6 persons (9%)
Monthly household income*	< 10mil. VND (30%), 10-20 mil.VND (32%), >20 mil. VND (37%) *
Vehicle ownership	Motorcycle (95%), Passenger car (23%)
Commuting mode	Motorcycle (74%); Car (9%); Bus (17%)
Motorcycle use frequency	>5 days/week (65 %); 3-5 days/week (11%); <=2 days/week (16%); Sometime (6%); None (1%)
MC taxi use frequency	>5 days/week (1%); 3-5 days/week (3%); <=2 days/week (1%); Sometime (46%); None (49%)
Car use frequency	>5 days/week (8%); 3-5 days/week (7%); <=2 days/week (6%); Sometime (44%); None (35%)
Bus use frequency	>5 days/week (7%); 3-5 days/week (13%); <=2 days/week (10%); Sometime (35%); None (35%)
Commuting trip length (one way)	< 5 km (37%); 5-10 km (34%); 10-15 km (17%); >15 km (12%)
Parking expense	No cost (24%); < 5,000 VND (33%); 5,000-10,000 VND (34%); Others (9%)

* 10,000 VND ≈ 0. 5 USD (2015)

Similar to the characteristic of HCMC' population, nearly 74% of respondents use motorcycles as the main travel mode for daily commuting. The percentage of commuters selecting buses and cars are 17% and 9% respectively. Two-thirds of respondents (65%) use motorcycles more than five days a week, while this rate is only 8% for car usage or 7% for bus usage. About 70% of the respondents sometimes use bus service or never get on bus. The percentage of respondents using buses 3-5 days per week is 13%. Half of commuters (49%) never use motorcycle taxis. One third of commuters have a commuting length lower than five kilometres. One fourth of commuters have free parking, while almost 33% of respondents paid less than 5,000 VND per day for parking. It is consistent that HCMC is a motorcycle dependent city since parking is not a problem for motorcycle use.

For attitudes and opinions, respondents were asked whether they agreed or disagreed with a series of statements on an ordinal scale. Subjective judgments were given on a four-point Likert scale, ranging from "1= Strongly disagree" to "4=Strongly agree". Since respondents might be unfamiliar with the psychological approach of the questionnaire survey, the simplicity of choices (no neutral options) aims to limit blank answers and unreliable data

from respondents. Statements on trip preferences (13 items) measure respondents' agreement about what people consider in daily trips. Attitudes toward travel modes (11 items) captures commuters' agreements on usage of motorcycle, car, and bus. A part of car use items are adapted from relevant prior studies (Javid, 2012; Okada et al. 2003; Tangphaisankun et al. 2010; Okamura et al. 2013). Statements on bus access preferences (5 items) show how much commuters accept different modes to access bus service. Statements related to behavioural intentions (5 items) measure agreement regarding to motorcycle, passenger car and bus use such as: "*For long trip, I might consider transportation modes different from motorcycle*", "*I might use car more than motorcycle in case both are available in my household*" and " *I intend to use bus more if it is possible*".

Table 4.2: Time and cost illustration for 10-km trip

	MRT	Motorcycle	Motorcycle taxi	Car	Taxi	Bus
Time (minutes)	18	20	20	25	25	30
Cost (VND) *	>7,000	13,000	40,000	35,000	330,000	8,000

* 10,000 VND ≈ 0. 5 USD (2015)

For stated scenarios, commuters were asked to answer questions regarding whether they wanted to use MRT. Information was provided for commuters to have sufficient imagination about Mass Rapid Transit. The introduction of MRT system focuses on its high capacity and frequent schedule, such as 2 -3 minutes for the distance of 1.5-2 km between two stations nearby. The ongoing MRT projects (MRT 1 and MRT 2) were also introduced. Commuters were also informed that bus routes, other public transport (motorcycle taxi, taxi), and parking facilities might be available around MRT stations. Travel cost and duration of 10-kilometer distance by different transportation modes were provided for preferences (see Table 4.2). Commuters were supposed to go to office/school or return back to their house, in which MRT routes were available between their origin and destination. Finally, commuters were asked the question "*Would you like to use future MRT in case...*?" for different access/egress modes and distances (long trip/short trip). For example, respondents were asked whether they want to use MRT for 15-minute walking access. If respondents selected Yes, other questions were raised for future MRT use with motorised-vehicle access. Final choices were based on the respondents' answers. In this study, the length of five kilometres was chosen for distinction between long trips and short trips, since it is popular for daily commuting trips (JICA, 2013).

4. 3 RESULTS

4.3.1 Attitudes, preferences, and behavioural intentions

In general, most of respondents state high acceptance of statements (Table 4.3). For trip preferences, travel time in control (*Item C10*), convenience (*Item C12*), and safety (*Item C8*) are most considered in daily trips. Travel cost (*Item C3*) are evaluated as a less important preference.

Figure 4.1 shows the results of attitudes toward travel modes. For motorcycles, 84% of respondents agree that riding a motorcycle likes basic daily need (*Item C14*) while 43% of commuters think of alternative modes, different from motorcycle for going somewhere (*Item C16*). Only 25 % of commuters refuse to use motorcycles in short trips i.e. 15-minute walk

(*Item C17*). Almost 67% of respondents think it is normal to drive a motorcycle for one hour continuously (*Item C18*). For passenger cars, 67% of commuters have always dreamed of owning a passenger car (*Item C19*). However, only 43% of respondents will keep their intentions to purchase a car, despite parking difficulties (*Item C21*). This indicates that car parking constraints might postpone commuters' car purchase. For bus transport, a significant proportion of respondents (36%) lack information about bus schedules and bus routes surrounding their households (*Item C23*). More than half of commuters (56%) used to select buses even though they could use a private vehicle (*Item C24*). This means that commuters might prefer bus services to motorcycles in some circumstances.

Table 4.3 : Mean scores of trip preference statements

Item	Statement	Mean
C10	I like travel time in control.	3.76
C12	Convenient trip is my first priority to select the transport mode to go somewhere.	3.74
C8	Safety is more important than cost in my daily transportation.	3.73
C11	Punctual trip is the priority in daily transportation.	3.59
C7	Continuous traffic is my priority in daily travel.	3.57
C6	I hate traveling in bad condition (e.g. rush hours, rainy weather)	3.65
C1	I always feel concerned as gasoline price increases.	3.53
C9	Saving time is more important than cost in my daily transportation.	3.47
C13	Convenience is more important than cost in my daily transportation.	3.43
C2	I know relatively my weekly transport cost.	3.41
C5	I feel stressful when I travel on crowed streets.	3.28
C3	I often consider travel cost for inner city trip.	3.08
C4	I like to be a passenger than a driver even though I have a chance to drive.	2.94

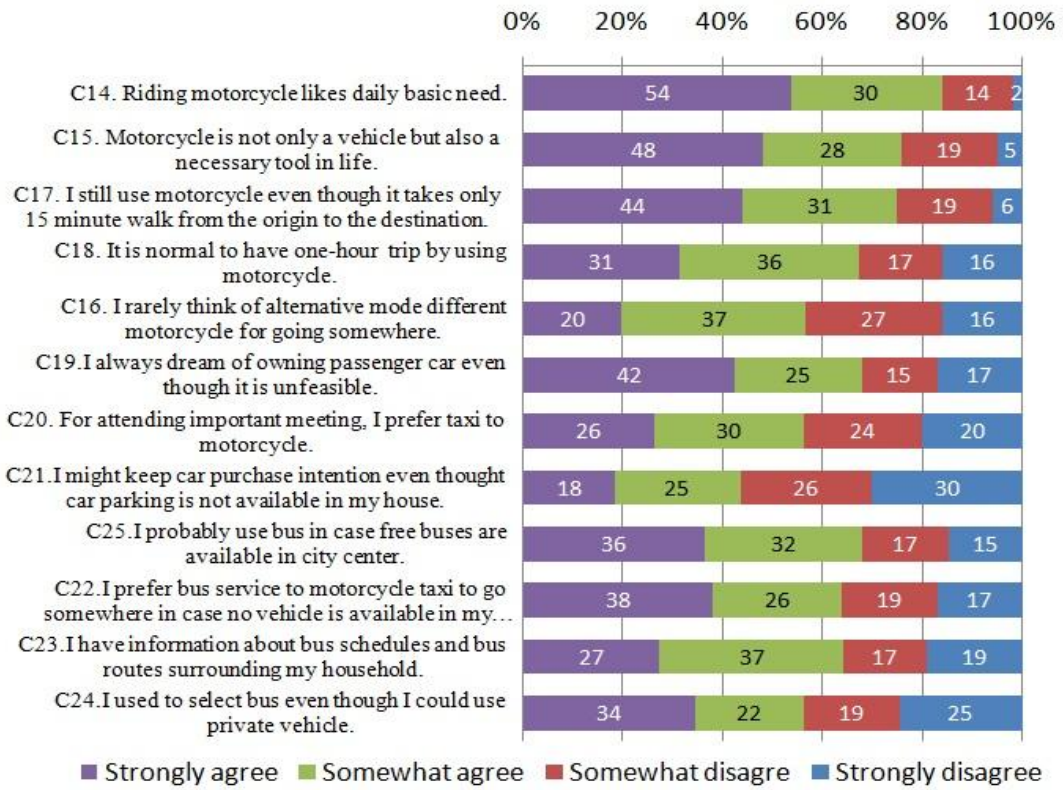


Figure 4.1 : Participants' response to travel mode attitudes

It can be observed from Figure 4.2 that respondents tend to accept walking, bus transfer, and motorcycle use as passengers to access bus services. Almost 89% of commuters accept a 5-10 minute walk to access bus stops, whereas the percentage of respondents using two bus routes to get to their destination, or being motorcycle passengers to bus stop account 73% and 71 % respectively (*Item C26, C30&C28*). Only 49% and 42% of commuters agree to use motorcycle or motorcycle taxis as bus access modes (*Item C27&C29*). This indicates that commuters do not want to use motorcycle taxis to access bus services. It is the fact that the service costs of motorcycle taxis are usually higher than bus fares. Therefore, motorcycle taxis might not become a feeder mode for bus transport, although it is sometimes used for bus access.

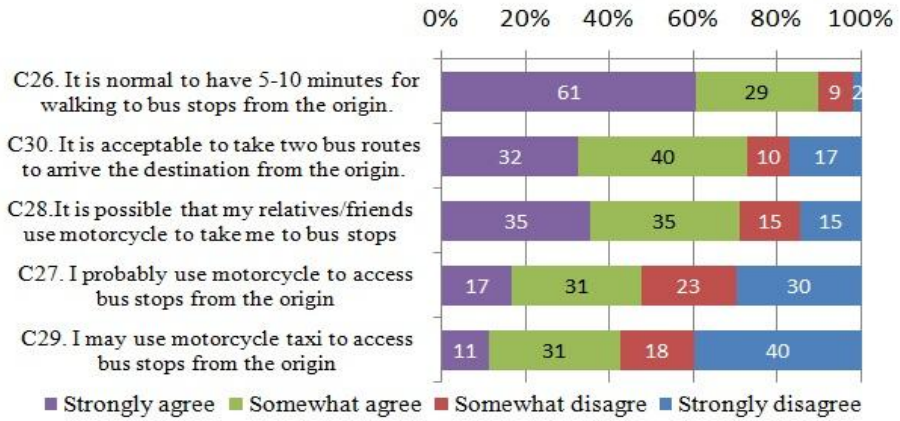


Figure 4.2 : Responses to bus access preferences

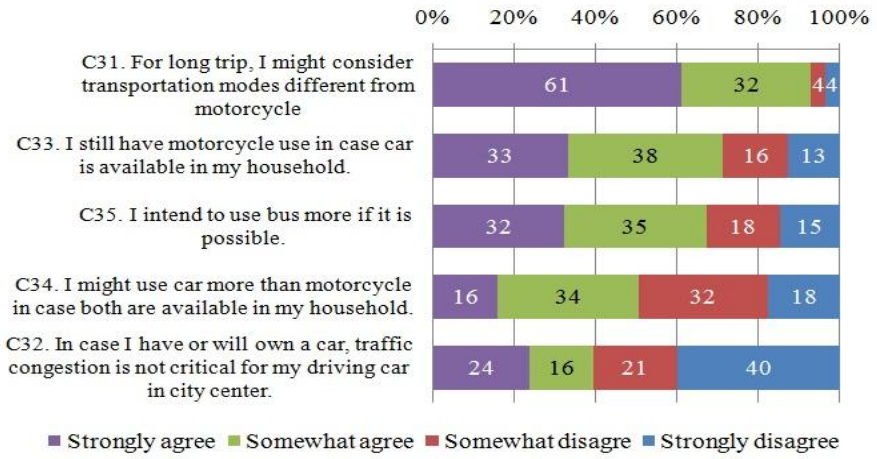


Figure 4.3 : Commuters' behavioural intentions

As illustrated by Figure 4.3, a high percentage of respondents (93%) think they might consider other transport modes, instead of motorcycles for long trips (*Item C31*). Around 61 % of the samples think traffic congestion has little effect on their driving car habit in the city centre if they have or will own cars (*Item C32*). More than 71% of respondents agree to keep their motorcycle use in case car is purchased in their household (*Item C33*). However, nearly half of commuters (46%) intend to use a car more than a motorcycle (*Item C34*). Two-thirds of respondents (67%) might use buses in the future if it is possible (*Item C35*). This means that one-third of commuters will not use the bus even though bus services can be accessed,

indicating that there are still a significant proportion of commuters that would prefer to use private vehicles, even if public transport is improved.

4.3.2 Future mass rapid transit uses

According to Figure 4.4, around 25% of commuters would not consider future MRT use for long trips, but this rate increases to around 42% for short trips. This substantial change indicates that commuters are not likely to choose MRT use for short distance. It can be seen from Figure 4.5, walking, motorcycle, and buses are popular modes for MRT access and egress. Motorcycle taxis and taxis are also used for egress trips.

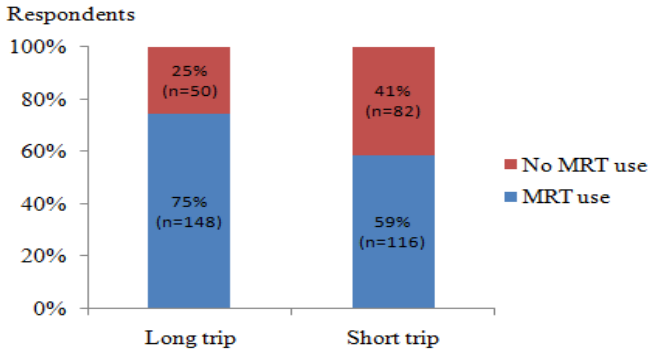
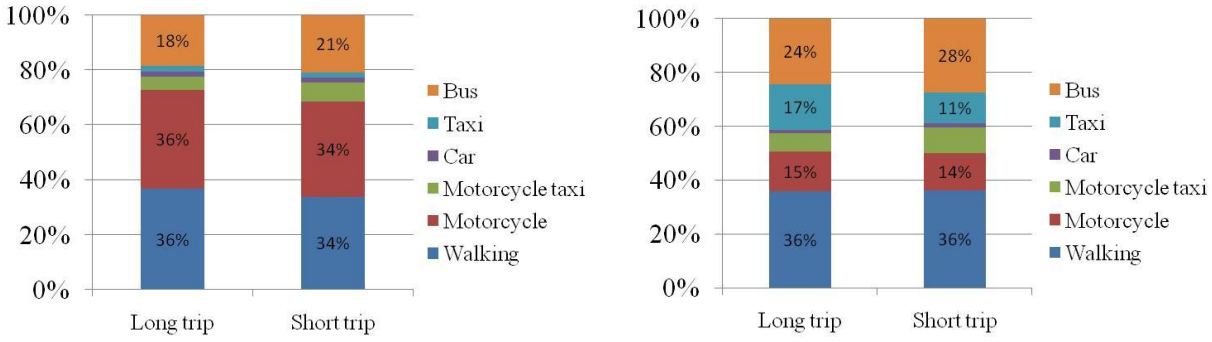


Figure 4.4 : Future MRT uses by trip types



(a) Access modes (b) Egress modes

Figure 4.5 : Access modes and egress modes for future MRT uses

4. 4 ANALYSIS AND COMPARISON

A Principal Component Analysis (PCA) with varimax rotation technique was employed to identify underlying dimensions which summarise attitudes toward travel modes. Consequently, the main factors were extracted from attitudinal items related to motorcycle, car, and bus use. Furthermore, the method suggested by DiStefano et al. (2009) was utilised to calculate factor scores, identifying evaluation levels of main factors. Factor scores were identified for every quartile in analysing different impacts of factors on travel intentions. For corresponding factors, commuters were classified in high-level groups or low-level groups, by comparing factor scores with the average. The combination of these levels resulted in different commuter groups. Based on commuter classification, comparisons were conducted in respondents' characteristics such as socio-demographic, trip attributes, bus access

preferences, behavioural intentions, and future MRT use. The analysis of variance (ANOVA) was conducted to find significant differences in bus access preferences among commuter groups. In addition, t-test was applied to find the relationship between motorcycle uses and attitudes toward travel modes, bus access preferences, behavioural intentions, and future MRT use; the relationship between bus access preference and bus use intention; and the relationship between bus access preferences and bus use intentions and future MRT uses.

4.4.1 Classification of commuters

The reliability analysis was performed on attitudinal items related to travel modes. Some items were deleted until the Cronbach's apha values achieved the minimum requirement >=0.6. It aims to reduce redundancy and to ensure sufficient internal consistency. The SPSS program (version 22.0) is used to conduct Principal Component Analysis (PCA) with rotated component matrix for identifying main factors of travel modes. Only attitudinal items having loading factor >=0.5 are noted. The result of PCA identified three factors, which represent the respondents' orientation toward mode use. They were named "*motorcycle oriented*" (Factor 1), "*car oriented*" (Factor 2), and "*bus oriented*" (Factor 3) respectively (Table 4.4).

Table 4.4 : Factor loading of travel mode items

Item	Statement	Factor loading matrix		
		Motorcycle oriented	*Car oriented*	*Bus oriented*
C14	Riding motorcycle likes daily basic need.	.812		
C15	Motorcycle is not only a vehicle but also a necessary tool in life.	.809		
C16	I rarely think of alternative mode different motorcycle for going somewhere.	.503		
C21	I might keep car purchase intention even though car parking is not available in my house		.804	
C19	I always dream of owning passenger car even though it is unfeasible.		.798	
C20	For attending important meeting, I prefer taxi to motorcycle.		.577	
C24	I used to select bus even though I could use private vehicle.			.823
C25	I probably use bus in case free buses are available in city centre.			.749
C23	I have information about bus schedules and bus routes surrounding my household.			.656
C22	I prefer bus service to motorcycle taxi to go somewhere in case no vehicle is available in my household.			.581

The scores on main factors were calculated by the following factor scoring method (DiStefano et al., 2009).

$$S = \sum WiXi \qquad (4.1)$$

Where S is factor score
Wi is unit weight of item i
Xi is evaluation score of item i

In equation (4.1), the unit weight Wi is derived from factors loading of item i after principal component analysis. Factor scores were identified for every quartile as shown in Table 4.5. For example, motorcycle oriented factor has the lowest quartile having values

lower than 5.867, the second quartile with values in the range of 5.867 and 6.987, the third quartile with values in the range of 6.987 and 7.688, and the fourth quartile having value higher than 7.688.

Table 4.5 : Description of attitudinal factor score

	Factor score		
	Factor 1 *Motorcycle oriented*	Factor 2 *Car oriented*	Factor 3 *Bus oriented*
Minimum	2.124	2.180	2.809
Maximum	8.497	8.718	11.236
Mean	6.610	5.706	7.917
Std. Deviation	1.446	1.813	2.281
Percentiles			
25	5.867	4.575	6.255
50	6.987	5.735	8.260
75	7.688	7.116	9.831

Table 4.6 : Correlation among attitudinal factors

	Motorcycle oriented	Car oriented	Bus oriented
Motorcycle oriented	1	-.094	-.305*
Car oriented		1	-.027
Bus oriented			1

*. Correlation is significant at the 0.01 level (2-tailed).

Table 4.6 shows Pearson's correlations between attitudinal factors. Since the Pearson's correlation of "*motorcycle oriented*" and "*bus oriented*" is higher than that of others, it indicates that the relationship between "*motorcycle oriented*" and "*bus oriented*" is stronger than other pairs of attitudinal factors. Therefore, the combination of "*bus oriented*" and "*car oriented*" factors are enough to reflect the mutual relationship of motorcycle, car, and bus use. Consequently, factors of "*bus oriented*" and "*car oriented*" were selected for commuter classification which aims to clarify differences in socio-economic characteristics, travel patterns, bus access preferences, behavioural intentions, and future MRT uses among commuter groups.

Table 4.7: Travel patterns of commuter groups

Group	Evaluation		Motorcycle use *(>5 days/week)*	Weekly car use	Weekly bus use	Commuting mode		
	Bus oriented	Car oriented				Motorcycle	Car	Bus
1	High	High	**39**%	**22**%	**49**%	**49**%	**20**%	**31**%
2	High	Low	57%	8%	**51**%	66%	4%	**30**%
3	Low	High	**81**%	**38**%	6%	**87**%	11%	2%
4	Low	Low	**85**%	17%	10%	**98**%	0%	2%

The comparison between the factor scores and the averages identified high evaluation and low evaluation in bus and car orientation (see Table 4.7). The combination of four levels results in four commuter groups including: (1) Respondents are high bus oriented and high car oriented (group 1); (2) Respondents are high bus oriented and low car oriented (group 2); (3) Respondents are low bus oriented and high car oriented (group 3); (4) Respondents are low bus oriented and low car oriented (group 4).

Table 4.8 shows that commuters who are high bus oriented have the high rate of weekly bus use and bus ridership in commuting trips. There is more balance in using motorcycles,

cars, and buses for commuting trips among commuters who are both high bus oriented and high car oriented. Most of these people also choose motorcycles as their commuting mode. Respondents who are highly car oriented have more weekly car use in comparison to other groups. Based on these results, commuter groups should be named "*choice oriented*", "*bus preferred*", "*car preferred*", and "*motorcycle dependent*". It is assumed that commuters who are both bus oriented and car oriented are satisfied with the existing performance of bus services and also prefer the comfort of car use. Therefore, this group is named '*choice oriented*'. Similarly commuters who have low evaluation in both '*bus oriented*' and '*car oriented*' might prefer only motorcycle use. Consequently, they are then categorised as *motorcycle dependent*.

Table 4.8 : Attributes of commuter groups

Category	Commuter group			
	Choice oriented	Bus preferred	Car preferred	Motorcycle dependent
Gender (Male)	43%	47%	47%	59%
Age	*18-30 (*55%)	*18-30 (*56%)	*26-40 (*66%)	*26-35 (*56%)
Occupation				
Manager	**20**%	4%	**23**%	5%
Professional	6%	15%	9%	15%
Official	12%	8%	**23**%	**20**%
Office worker	**24**%	**23**%	**32**%	**20**%
Labor	16%	**32**%	13%	**27**%
Student	**22**%	**15**%	4%	5%
Household income				
<=20 mil. VND	69%	72%	47%	63%
>20 mil. VND	31%	28%	**53**%	37%
Car ownership	24%	8%	**40**%	17%
Commuting trip distance (<=10 km in one way)	64%	62%	**83**%	**78**%
Outside trips in working hours	37%	**13**%	42%	29%
Total (persons)	51	53	53	41

Based on socio-economic characteristics and travel patterns, the commuters' profiles are clustered by different commuter groups, as shown in Table 4.7. It can be seen that men tend to be more motorcycle dependent than women. People who belong to the car preferred group are mostly aged between 26 and 40, and almost 56% of motorcycle dependent commuters are aged between 26 and 35. Moreover, those of the other groups are aged between 18 and 30. This result indicates that car preferred commuters are older than the others, and respondents who are car preferred and motorcycle dependent are comprised mainly in the 26-35 year old bracket. Age and stage in life is a precursor on transit oriented, like that within any social group.

Regarding occupation, office workers account for a significant proportion of all commuter groups. While students make up 22% of choice preferred group and 15% of bus preferred group. Managers comprise 23 % of car preferred group and 20% of choice preferred group. A large percentage of bus preferred and motorcycle dependent groups are labourers. Officials constitute a considerable percentage of cars preferred and motorcycle dependent

groups. The results indicate that officials favour motorised modes over transit and students always have a propensity for preferring buses, in comparison to other commuters.

It has been found that only approximately 40% of car preferred commuters have household car ownership. This group also earns more than 20 million VND per month while the other groups have monthly household incomes between 4 million VND and 20 million VND. This shows that income has a strong effect on car oriented preference.

Respondents belonging to car preferred and motorcycle dependent groups tend to have commuting distances lower than 10 kilometres. Bus preferred people have average travel distances higher than 10 kilometres in accordance with their preference. Moreover, the ratio of motorcycle dependent commuters who park private vehicles inside an office/school is relatively higher than that figure of the other groups. Respondents who choose buses for commuting trips have the lowest rate of outside trip frequency. Such results suggest that factors such as distance, parking availability, and outside trip frequency might have impacts on commuters' travel modes.

4.4.2 Relationships among motorcycle uses, preferences, and attitudes

Table 4.9 shows the mean value of bus access preferences by motorcycle uses. The categorisation of motorcycle taxi experience is based on motorcycle taxi use frequency (see Table 4.1). It can be seen that motorcycle taxi experience associates with differences in bus access preferences (motorcycle ride). The use of motorcycle taxis increases the probability of motorcycle rides for bus access. Motorcycle use frequency has no relationship with bus access preferences.

Table 4.9 : Mean score (SD) of bus access preferences by motorcycle uses

Item	Bus access preferences	Motorcycle Use Frequency (> 5 days per week)		Motorcycle taxi experience	
		No (n=70)	Yes (n=128)	No (n=97)	Yes (n=101)
C28	It is possible that my relatives/friends use motorcycle to take me to bus stops	3.00 (1.10)	2.75 (0.99)	2.78 (1.01)	2.89 (1.06)
C27	I probably use motorcycle to access bus stops from the origin	2.37 (1.07)	2.33 (1.09)	**2.12**** (1.06)	**2.55**** (1.05)
C29	I may use motorcycle taxi to access bus stops from the origin	2.10 (1.08)	2.16 (1.07)	2.02 (1.03)	2.25 (1.09)

**Significant difference at 0.05 probability level (t-test)

Table 4.10 : Mean score (SD) of attitudinal factors by motorcycle uses

Factor score	Motorcycle Use Frequency (> 5 days per week)		Motorcycle taxi experience	
	No (n=70)	Yes (n=128)	No (n=97)	Yes (n=101)
Motorcycle oriented	**6.07**** (1.52)	**6.90**** (1.32)	6.46 (1.06)	6.75 (1.05)
Car oriented	6.02 (1.93)	5.53 (1.73)	5.65 (1.84)	5.77 (1.79)
Bus oriented	**9.13**** (2.07)	**7.25**** (2.12)	**7.58**** (2.18)	**8.27**** (2.33)

**Significant difference at 0.05 probability level (t-test)

As it can be seen in Table 4.10, motorcycle use frequency influences the levels of *motorcycle oriented* and *bus oriented*. The more people ride motorcycles or use motorcycle taxis, the less they are likely to be bus oriented. Motorcycle uses have no influence on levels of *car oriented*.

Table 4.11 : Mean score of bus access preferences by commuter groups

Item	Bus access preferences	Commuter group			
		Choice oriented	Bus preferred	Car preferred	Motorcycle dependent
C26	It is normal to have 5-10 minutes for walking to bus stops from the origin.	3.41	**3.76****	**3.28**	3.42
C30	It is acceptable to take two bus routes to arrive the destination from the origin.	**2.95****	**3.08****	**2.49**	**2.88****
C28	It is possible that my relatives/friends use motorcycle to take me to bus stops	2.88	3.00	2.56	2.82
C27	I probably use motorcycle to access bus stops from the origin	2.34	2.34	2.26	2.46
C29	I may use motorcycle taxi to access bus stops from the origin	2.23	1.94	2.21	2.15

**Significantly different at 0.05 probability level in comparison with car preferred group (ANOVA);

In terms of bus access preferences, the average scores of attitudinal items are presented in Table 4.11. Significant differences in statements relating to walking to bus stops and taking two bus routes shows that bus preferred people have high levels of bus access preferences. Although commuter groups express a low level of driving motorcycles to access bus transit, motorcycle dependent people have high mean scores of using motorcycles as a bus access mode than the others. In other words, attitudes toward travel modes have little influence on motorcycle use for bus access.

4.4.3 Relationships between distances and travel intentions

Table 4.12 presents the t-test results of future MRT uses by distances. It is confirmed that there are significant differences in trip distances for future MRT uses. The same results are found for every commuter group (see Table 4.13). However, there are few differences for *bus preferred* groups. It indicates that *bus preferred* commuters are familiar with long trips by high frequency in bus use.

Table 4.12 : t-test results of future MRT uses by distances

	Future MRT uses (1= MRT use; 0= No MRT use)		Paired- Samples t-test
	Long trip	Short trip	Long trip-Short trip
Mean	.75	.59	.162
Standard deviation	.436	.494	.42
Sig.			.000

Table 4.13 : t-test results of future MRT uses by distances and commuter groups

	Paired- Samples t-test (Long trip-Short trip)			
	Choice oriented	Bus preferred	Car preferred	Motorcycle dependent
Mean	.137	.094	.226	.195
Standard deviation	.448	.405	.423	.401
Sig.	.033**	.096 ***	.000	.003

**Significant difference at 0.05 probability level ;
*** Significant difference at 0.1 probability level

4.4.4 Relationships between motorcycle uses and travel intentions

It was found that different levels of motorcycle use are associated with behavioural intentions (Table 4.14). The more experience people have on motorcycles, the less bus use they intend to have if it is possible. People are more likely to use alternative transportation modes than motorcycles for long trip if they have low motorcycle use frequency. Commuters who have low motorcycle use frequency prefer to drive cars more than motorcycles if both are available in their households.

Table 4.14 : Mean score (SD) of behavioural intentions by motorcycle uses

Item	Behavioural intentions	Motorcycle Use Frequency (> 5 days per week)		Motorcycle taxi experience	
		No (n=70)	Yes (n=128)	No (n=97)	Yes (n=101)
C31	For long trip, I might consider transportation modes different from motorcycle.	**3.69**** (.58)	**3.41**** (.79)	3.49 (.81)	3.51 (.66)
C33	I still have motorcycle use in case car is available in my household.	**2.60**** (1.13)	**3.09**** (.87)	**2.77**** (1.09)	**3.06**** (.89)
C35	I intend to use bus more if it is possible.	**3.34**** (.87)	**2.58**** (1.02)	**2.99***** (1.07)	**2.71***** (.99)
C34	I might use car more than motorcycle in case both are available in my household.	**2.73**** (1.03)	**2.36**** (.90)	2.53 (.97)	2.46 (.97)

**Significant difference at 0.05 probability level (t-test);
*** Significant difference at 0.1 probability level (t-test)

Table 4.15 : Mean score (SD) of future MRT uses by motorcycle uses

Future MRT uses	Motorcycle Use Frequency (> 5 days per week)		Motorcycle taxi experience	
	No (n=70)	Yes (n=128)	No (n=97)	Yes (n=101)
Long trip	.76 (.43)	.74 (.44)	.74 (.44)	.75 (.43)
Short trip	.56 (.50)	.60 (.49)	**.52**** (.50)	**.65**** (.48)

**Significant difference at 0.05 probability level (t-test);
*** Significant difference at 0.1 probability level (t-test).

The results of Table 4.15 show that experiences in motorcycle taxis have a relationship with future MRT use for short trips. It seems that there is little association between motorcycle uses and future MRT uses.

4.4.5 Relationships between attitudes and travel intentions

The graph on Figures 4.6 illustrates behavioural intentions by different commuter groups. In case both passenger cars and motorcycles are available in households, car preferred and motorcycle dependent commuters are likely to use motorcycles. However, bus preferred people and those that are motorcycle dependent are less likely to consider more car use than motorcycle use. This result suggests that car ownership has low effect on private vehicle use of bus preferred people and motorcycle dependent ones. Motorcycle use habit continues to exist even if respondents have purchased a car in their households.

Regarding bus use intention, commuters that state they have a high rate of using buses, concentrate more on *bus preferred* group. Compared to *car preferred* groups, *motorcycle dependent* groups are less likely to access bus services if it is possible. It can be explained that people who preferred car use are not so dependent on motorcycle use and they might choose buses in some circumstances, where they are high-quality services. Although motorcycles and cars are both private modes, there is great difficulty encouraging bus use within *motorcycle dependent* people.

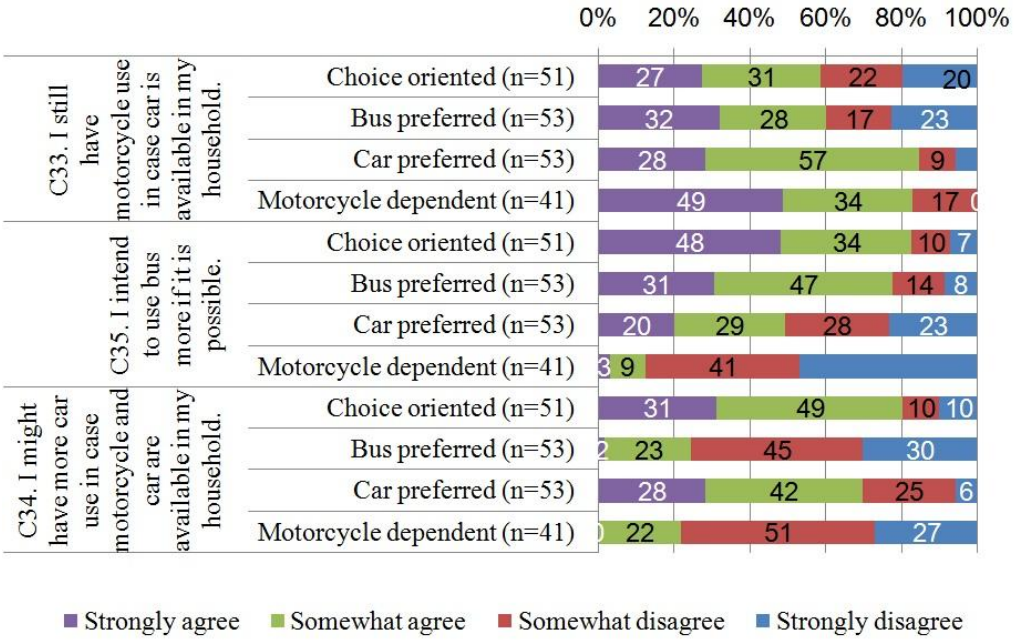


Figure 4.6: Behavioural intentions by commuter groups

Following a detailed analysis, Figures 4.7 shows there is bus use intention by motorcycle oriented; car oriented, and bus oriented quartiles. While bus use intention has only changed a little by car oriented quartiles, its agreement rate is significantly different between the lowest quartile (1st) and the highest quartile (4th) of motorcycle oriented and bus oriented. In comparison with changes on motorcycle oriented quartiles, changes on bus oriented quartiles result in more differences in bus use intention.

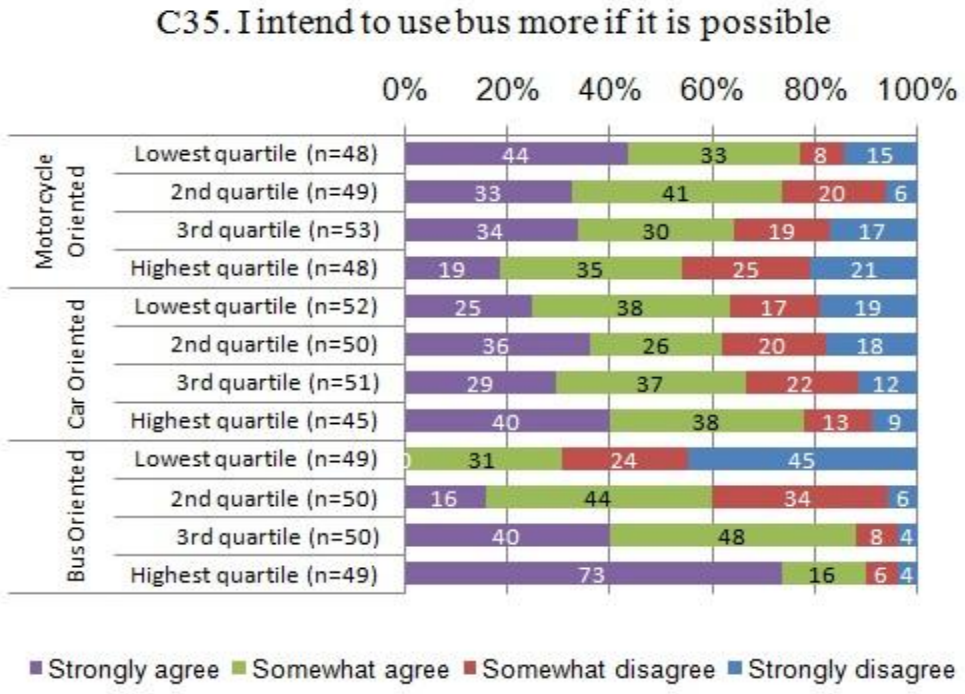


Figure 4.7 : Bus use intentions by travel mode quartiles

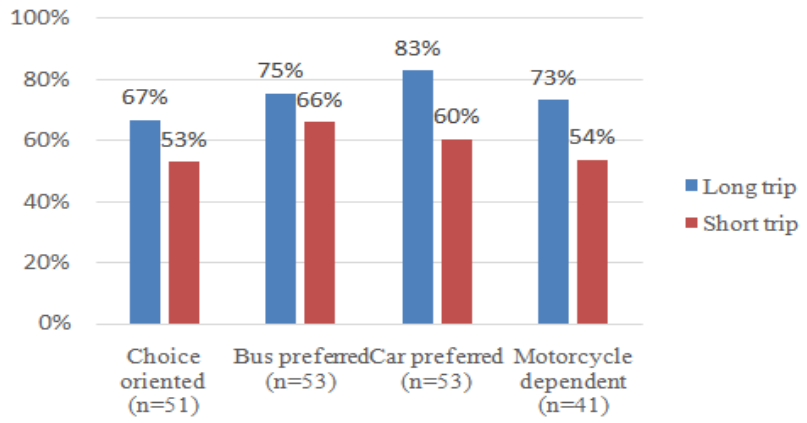


Figure 4.8 : Future MRT uses by commuter groups

Regarding future MRT use, there are no differences among commuter groups. Attitudes toward travel mode have little influence on future MRT uses (see Figure 4.8). It might be explained that commuters lacked the contextual effects of MRT in comparison with other travel modes (motorcycle, car, and bus). It is noted that there are more car preferred commuters selecting MRT than the others in long trips. This can be explained that car preferred people having a high evaluation of punctuality and convenience. Therefore, they might choose MRT with high speed and service quality in comparison to other transport modes.

4.4.6 Relationships between preferences and travel intentions

Independent–sample t-tests were performed for exploring significant differences in bus access preferences between future bus use groups and future MRT use groups. Test variables' values are based on the evaluation scores of bus access preferences (from 1=Strongly disagree to 4=Strongly agree). The categorisation of the first grouping variable (Future bus use) is based on the attitudinal responses of bus use intention (*Item C35*). Commuters who select *Strongly disagree* and *Somewhat disagree* are categorised in *Disagree group* while the others belong to the *Agree group*. Other grouping variables are based on future MRT uses for long trips and short trips (see Figure 4.4).

As seen in Table 4.16, a comparison of future bus use and future MRT use yielded only significant differences for bus access preferences. For future bus use, there are significant differences at a 0.05 probability level in walking and bus transfer. This indicates that commuters who are likely to use buses in the future favour walking or bus transfer to access bus services. Commuters are less likely to combine motorcycle and bus use for their daily travel. For future MRT uses, no significant differences were found for walking access and motorcycle access as passengers. Commuters who prefer to use motorcycles as the driver, motorcycle taxis, and buses to access bus services have a higher probability of using MRT in the future. Similar t-test was applied to find differences in bus use intention by future MRT use groups. The results show that bus use intention is insignificantly associated with future MRT use. This implies that commuters who do not intend to use buses when possible might use MRT in some circumstances.

Table 4.16 : Mean score (SD) of bus access preferences and bus use intentions

Variables (Items)	Future bus use *(Grouped by C35 values)*			Future MRT use (Long trip)			Future MRT use (Short trip)		
	Disagree (n=65)	Agree (n=133)	Sig.	No (n=50)	Yes (n=148)	Sig.	No (n=82)	Yes (n=116)	Sig.
Bus access preference									
Walking(C26)	3.29 (.81)	3.57 (.69)	**.018****	3.44 (.73)	3.49 (.74)	.660	3.40 (.75)	3.53 (.73)	.216
Bus transfer(C30)	2.63 (1.05)	3.00 (1.03)	**.020****	2.64 (1.17)	2.96 (1.00)	**.089*****	2.56 (1.16)	3.10 (.91)	**.001****
Motorcycle-Passenger (C28)	2.69 (1.05)	2.91 (1.03)	.165	2.70 (1.11)	2.89 (1.01)	.275	2.84 (1.06)	2.84 (1.02)	.972
Motorcycle-Driver (C27)	2.28 (1.01)	2.38 (1.11)	.545	2.08 (1.07)	2.43 (1.07)	**.045****	2.13 (1.09)	2.49 (1.05)	.021*
Motorcycle taxi (C29)	2.26 (1.05)	2.08 (1.08)	.251	1.70 (1.04)	2.28 (1.04)	**.001****	1.84 (.97)	2.34 (1.09)	**.001****
Bus use intention (*C35*)				2.92 (1.07)	2.82 (1.03)	.574	2.90 (1.00)	2.81 (1.06)	.539

** Significant difference at 0.05 probability level ;

*** Significant difference at 0.1 probability level

4. 5 SUMMARY OF FINDINGS

This chapter has investigated the potential changes of travel behaviour in a motorcycle-based context of developing countries. In particular, the analysis reveals four commuter groups that differ in travel mode use: "*choice oriented*", "*bus preferred*", "*car preferred*", and

"*motorcycle dependent*". Since the sample size (n=198) is limited for disaggregating data, a cross analysis was based on the combination of "*bus oriented*" and "*car oriented*" factors rather than socio-economic characteristics or travel patterns. Some findings below are summarised for further researches and practices.

It was found that motorcycle use has a relationship with behavioural intentions, but high motorcycle use might undermine bus use intention. Motorcycle taxi experiences contribute to bus access preferences on motorcycle rides, relating to future MRT use. In the long term, motorcycle use has correlations with attitudinal factors, influencing travel intentions, but has no impact on future MRT use.

Focusing on motorcycle dependent or car preferred groups, it is noted that commuters tend not to use buses in the future even though they might use buses presently. Moreover, bus oriented has more influence on bus use intention than motorcycle oriented. Reducing levels of motorcycle oriented contributes little to the intention of bus use in comparison to increasing bus oriented levels. It provides useful information for the potential market of increasing the patronage of transit use. In HCMC, bus use provides less mobility and convenience in daily travel. Unless the quality of bus service is improved remarkably, it is hardly enough to encourage motorcycle dependent or car preferred commuters to use buses more. This finding is consistent with the previous evidence that motorcycle users have negative judgment on the quality of bus services in HCMC (Fujii and Van, 2009). Policies for bus transport should focus on encouraging potential passengers who have a high level of transit use.

This research has also shown that MRT might be preferable for long trips in motorcycle-dependent areas of developing countries. An urban rail network is necessary for a megacity like HCMC. Since access time comprises a higher proportion of travel duration in short trips, private vehicles, especially motorcycle, will be favoured more than MRT. Furthermore, the inefficient performances of future feeder modes such as buses and motorcycle taxis might become significant barriers for MRT use in long distance.

It was found that attitudes toward travel modes have no relationship with future MRT use. However, bus access preferences might contribute to MRT use. Therefore, the integration of motorcycle taxis as para-transit mode into bus transport is necessary for MRT development. Since motorcycles continue to hold vital roles in a mega city like HCMC, the combination of MRT and motorcycles is reasonable for commuters who intend to use new alternatives of public transport and still keep their motorcycle habits. There should be more policies to encourage 'Park and Ride', to induce motorcycle to bus services and future MRT system.

Megacities in developing countries are growing in accordance with urbanisation and motorisation. Motorcycles become a significant phenomenon which raises questions for sustainable motorisation, while MRT emerges as an effective solution to meet high travel demand in the Asian region. Motorcycles continue to be an important mode in future transport of motorcycle dependent regions. Since MRT systems have not been implemented in HCMC yet, the relationship between motorcycle use and future MRT uses were explored through attitudes and preferences. Another significance of this chapter is commuter categorisation that contributes to market segmentation for bus passengers. The limitation of this research only enables the possibility of finding correlations among motorcycle uses, attitudinal factors, bus access preferences, behavioural intentions, and future MRT uses. Further research should focus on how strong the relationships are between travel behaviour variables and socio-

demographics, travel patterns, contexts, and psychological determinants. Improvement of motorcycle taxi services might enhance bus patronage and contribute to the integration of motorcycles into MRT systems as an access mode. Unless there are effective policies to enhance conventional bus systems, bus services provide little support to the future MRT market of HCMC.

CHAPTER 5

5. MOTORCYCLE USE INTENTIONS CONSIDERING MASS RAPID TRANSIT PERFORMANCE

5. 1 INTRODUCTION

In developing countries, motorisation is characterised not only by the growth of car ownership and usage but also by the similar trend for motorcycles. Although motorcycle use raises concerns in low environmental performance and traffic safety, the popularity of motorcycle use can be explained with many reasons. High economic growth of developing countries stimulates the rise of private vehicle ownership. In low-income and middle-income economics, motorcycles become affordable due to its low costs for purchase and operation. Furthermore, motorcycles offer a high level of personal mobility, particularly in low-income cities (Hsu et al., 2003; Hayashi, 2004; Gwilliam, 2013; Uy, & F. Regidor, 2011). Little parking space and convenient movement in traffic congestion are other advantages explaining the high use of motorcycles in dense cities (Nishitateno & Burke, 2014). The rise of motorcycle ownership and usage exists as an inevitable phenomenon of motorisation.

Megacities within developing-countries are experiencing not only rapid motorisation but also fast urbanisation. In recent decades, urban expansion has resulted in significant changes in transportation patterns including the demand for long-distance travel and the rise of car use. Although decentralisation processes were implemented, central areas continue to hold important roles for trip attraction. In suburbs, an increase in car is similar to characteristics of developed countries. In addition, transit alternatives such as mass rapid transit (MRT) and bus rapid transit (BRT) have been introduced for improving service quality of public transport and tackling traffic congestion in city centres. MRT developments contribute to limitation of motorcycle use for long trips and provide connections between suburbs and city centres. New land use patterns such as car–oriented suburbs and Transit Oriented Development areas are also emerging. The changing context challenges motorcycle mobility in some Asian metropolitans. Future motorcycle use in suburbs or new urban areas raise challenges for policy makers. Motorcycle use often causes concerns about safety and environment (Feng & Sun, 2013). Therefore, it is necessary to identify future motorcycle use to utilise the positive role of motorcycles, and minimise their negative effects. Previous studies on motorcycle use have been conducted in both developed and developing countries. It is found that the broader literatures focus on the regions where there is a balance of modal shares, such as Taiwan, Thailand, and Indonesia. This is different from motorcycle-based contexts where motorcycles have become a dominant mode in urban transport. In order to fill this gap, this chapter aims to explore behavioural intentions with regards to the effects of urban development and new alternative transit. While motorcycle use is the main focus of behavioural intentions, the intentions of car, bus, and alternative transit are also considered in this chapter.

Within the transport literatures, the factors influencing people's motorcycle use are classified in the following main groups: (1) Socio-demographic category; (2) Travel pattern category; (3) Contextual category; and (4) Psychological category. Socio-demographic factors such as age, gender, income, children status, and household motorcycle availability likely affect to the behaviour of motorcycle use (Lai & Lu, 2007; Chang & Wu, 2008). In addition,

gender and age influence motorcycle users' BRT ridership with Park-and-Ride (Satiennam et al., 2013). Tsao (2010) found that low income people prefer motorcycle use, particularly over MRT access.

Since motorcycles provide convenient and flexible movement, such as door-to-door trips, motorcycles are regarded for short trip, short-medium distance, and MRT access (Vu, 2011; Feng and Sun, 2013). Therefore, it is preferable for low-duration trips in comparison to automobile and public transport (Chen and Lai, 2011). Motorcycles are not recommended for long distance trips due to safety driving concerns. Travel time and travel cost are important factors affecting riding motorcycles as access mode of BRT ridership (Satiennam et al., 2013).

Land use, geography, and transport systems are found to be contextual factors relating to motorcycle use. Inappropriate road hierarchy such as narrow local roads and no secondary roads are likely to contribute to motorcycle rides in urban area, or in city centres under traffic congestion (Acharya & Morichi, 2007; Feng & Sun, 2013). Motorcycles hold an important role in rural areas or in areas lacking public transport services (Nagai et al., 2003; Wen et al., 2012). The introduction of mass rapid transit has a significant influence on motorcyclist's mode choice behaviours (Chen &Lai, 2011).

Previous studies discuss little about psychological determinants of motorcycle use. In exploring mode choice behaviour in Taiwan, a motorcycle dependent region, Chen and Lai (2011) found that intention and habit have more significant effects on choice probability of motorcycle use, in comparison to socio-economic factors. Moreover, personal norm toward environmental friendly travellers is found to be determinants for the usage of private vehicle (automobile and motorcycle) under the fuel price rise (Chang and Lai, 2013).

While worsening congestion is traditionally understood as a reason for popular motorcycle use in city centres, the causal link between congestion and motorcycle use might be changed in a motorcycle-based context. Since motorcycle use becomes a dominant mode in HCMC, the high usage of motorcycles results in more served congestion in the city centre (Van & Fuji, 2009). Consequently, congestion might result in people using motorcycles less. In addition, motorcycles are regarded as the most dangerous mode due to high levels of motorcyclist fatalities in developing countries. For example, motorcycles were involved in more than 60 % of the total road accidents in Thailand, Indonesia, and Malaysia (Esmael, 2013). As city boundaries are extended, it is more critical to consider motorcycle safety for long-distance trips. Therefore, people's traffic concerns related to congestion and safety may be other psychological determinants for motorcycle use intentions in motorcycle dependent cities.

In megacities within developing countries, urban transport problems are described by particular characteristics such as premature congestion, deteriorating environment, high concern in safety and security, and low affordability for the poor (Gwilliam, 2003). Therefore, traffic conditions in developing nations are more chaotic than that of developed countries (Van, 2011). The differences are found not only in vehicle performances and public transport systems but also in people's travel behaviours relating to driving and law enforcement. Choocharukul et al. (2006) found that people's travel behaviours are related to attitudinal image variables for cars and public transport, and the levels of these variables' impacts can vary across different urban transport contexts such as Thailand and Japan. Since many of the urban transport problems of megacities in developing countries mainly exist in city centres or

urban scores, it is argued that a new context of urban transport, which is different from chaotic situation, might result in significant changes in travel behaviours. These kinds of contexts can be found in new residential areas of suburban districts. While bus-based public transport services are still inefficient in suburbs or at the urban fringes, people continue to use motorcycles, which raise concerns about traffic safety for long-distance travel. Car use might be increased by high-income people, but it does not completely replace daily motorcycle rides. The introduction of MRT contributes to connectivity between city centre and suburbs. Consequently, people might perceive transit preferences for new public transport differently, from that of conventional services. An empirical study by Chen and Lai (2011) found that differences on public transport development affect mode choice behaviours of motorcycle users. For example, people who perceive good public transport such as mass rapid transit, also evaluate public transport as positively as motorcycle use, even though they still use motorcycles. Since it is challenging to shift people from motorcycle rides to MRT ridership, motorcycles are recommended to become a feeder mode for MRT (Vu, 2013a). Similar to Western-country cities, many Asian metropolitans have recently promoted Park-and-Ride schemes in alignment with mass rapid transit. However, there are few studies focusing on Park-and-Ride for motorcycle access in developing-countries, while Taiwan is an example of Park-and-Ride schemes in motorcycle-based contexts of a developed region.

Based on backgrounds and previous studies, this chapter aims to explore motorcycle use intentions, considering mass rapid transit performance in motorcycle dependent cities by achieving the following objectives:

• To evaluate how people perceive differences of urban transport contexts between central area and local neighbourhood.

• To analyse the associations between behavioural intentions and corresponding factors including not only socio-demographics, travel patterns, and transit preferences but also psychological factors, which were rarely considered in previous studies.

• To clarify Park-and-Ride preferences for the combination of motorcycle and mass rapid transit.

It is hypothesised that traffic concerns have an association with not only motorcycle use intention but also other behavioural intentions; and motorcycles can be utilised as part of mass rapid transit use in some circumstances.

5. 2 DATA MEASURES

The survey questionnaire consists of the following parts: (1) Individual and household information; (2) Travel patterns; (3) Perceived urban transport; (4) Attitudes and Opinions; (5) Park-and-Ride preferences (see Appendix 2). The first part provides information about gender, age, driving license, occupation, income, household size, household vehicle ownership, residence type, and location characteristics. The second part consists of present travel patterns such as commuting mode, mode use frequency, commuting distance and duration, weekly travel expense, contexts for walking and driving private vehicle for Park-and Ride trips, parking at home and working place/school.

As shown in Table 5.1, three quarters of interviewees (75%) were young and middle-aged. Almost all households (98.6 %) owned motorcycles while the rate of car ownership is only 19%. This is because many middle and high income households are living in the survey

area. It has been found that the percentage of households with a monthly income more than 20 million VND is 47%.

Table 5.1 : Sample characteristics (n=215)

Category	Description
Gender	Male (60%), Female (40%)
Age group	<22 (7%), 23-30 (36%), 30-40 (40%), >40 (18%)
Occupation	Manager (7%), Government official (21%), Office Staff (29%), Professional (14%), Teacher/Lecturer (4%), Sale persons (8%), Laborer/Worker (7%), Other (9%)
Household income (mil. VND)	< 10 (8%), 10-20 (45%), >20 (47%)
Vehicle ownership	Motorcycle (98.6%), Passenger car (19%), Bicycle (46%)
Commuting mode	Motorcycle (89%), Car (5%), Bus (2.3%), Bicycle (2.3%)
Commuting duration	<=15 minutes (41%); 15-30 minutes (44%); >30 minutes (15%)
Motorcycle use frequency	> 5 days week (88%), 3-5 days/week (4%), <=2 days/week (3%), Sometimes (4%), No usage or rarely (1%)
Car use frequency	> 5 days week (5%), 3-5 days/week (4%), <=2 days/week (11%), Sometimes (27%), No usage or rarely (53%)
Bus use frequency	> 5 days week (3%), 3-5 days/week (3%), <=2 days/week (6%), Sometimes (20%); No usage or rarely (68%)
Walking activity	No walking trip (48%), Work (7%), Study (3%), Business (3%), Public event (17%), Shopping/Market (16%); Private matter (5%), Other (0.5%)

* 10,000 VND ≈ 0. 5 USD (2015)

Motorcycle, car, bus, and bicycle are popular modes in daily transport. Nearly 89% of respondents used motorcycles as their main vehicle for daily commuting. Moreover, 88% of respondents took a motorcycle ride more than 5 days per week. While about 53% of respondents never or rarely had car use, this rate was 68% for bus use. The low frequency of buses is explained because there are no bus routes in new residential areas, while most of bus services are operated along main roads within the survey site. Around 85% of respondents have a commuting duration lower than 30 minutes. More than half of interviewees (52%) used to walk certain trips. The majority of walking trips were generated for shopping, going to the market, and attending public events.

The third part requires respondents to indicate how they perceive traffic condition, traffic safety, driving behaviour, and traffic law enforcement in central areas and local neighbourhood. Degrees of responses were formatted in five-point Likert-type using Semantic Differential Method (see Table 5.2). For example, the question "*How comfortable do you feel about the traffic conditions in the central area*?" was raised and respondents evaluated traffic conditions by choosing scales from 1 ("*Uncomfortable*") to 5 ("*Comfortable*"). The reason for using five-point Likert-type is that respondents might have neutral decisions for evaluation.

The fourth part comprises attitudinal items regarding traffic concerns and transit preferences and behavioural intentions. Respondents' opinions were measured in the four-point Likert type format from 1 ("*Strongly disagree*") to 4 ("*Strongly agree*"). Transit preferences include statements relating to conditions in which public transport would be used.

Transit preferences are understood as indicators for acceptability of transit use when public transport services meet some certain requirements in distance, time, access, services, and convenience. For example, respondents might agree or disagree statements such as "*I might use the bus services if it takes 5 or 10 minutes for walking access*", "*For the trips with lengths longer than 10 km, I prefer public transport to private modes*" or *"I might get on the bus if its service quality is improved*". Traffic concern statements include congestion items such as "*Traffic congestion influences my daily trip a lot*" and safety items such as "*Using motorcycles is more hazardous overall than travelling by car*", "*It is risky to drive passenger cars in conditions where the roads are overwhelmed by motorcycles*", and "*Taking transit is safer than driving a car*". Since private vehicle use and bus ridership are influenced mutually, safety items are not only related to motorcycles but also cars and buses. Finally, respondents must select the level of their intentions in bus use, alternative transit use, and private vehicle use.

Table 5.2 : Questions on perceived urban transport

Question	Scale (1-5)
How comfortable do you feel about the traffic condition in central area?	Uncomfortable- Comfortable
How do you think about traffic safety when travelling in central area ?	Risky- Safe
How do you assume people's driving behaviour when riding in central area?	Egotistic-Altruistic
How do you assess traffic law enforcement in central area?	Violently- Seriously
How comfortable do you feel about the traffic condition in local neighbourhood?	Uncomfortable- Comfortable
How do you think about traffic safety when travelling in local neighbourhood?	Risky- Safe
How do you assume people's driving behaviour when riding in local neighbourhood?	Egotistic-Altruistic
How do you assess traffic law enforcement in local neighbourhood?	Violently- Seriously

The last part focuses on future motorcycle use combined with mass rapid transit ridership. Since the survey site is located in a future MRT catchment, it is necessary to understand the preferences in which people might combine motorcycle use and mass rapid transit ridership. Information about the project of mass rapid transit line No.1 (MRT 1) is provided for respondents. Theoretically, it is supposed that the construction of MRT 1 was finished and respondents could drive motorcycle to train stations with parking facilities nearby. Since mass rapid transit is not popular in many cities within developing countries such as HCMC, Phnom Penh, and Vientiane, people have not experienced mass rapid transit ridership yet. Therefore, it is difficult to apply Stated preference (SP) method to grasp people's choices on using mass rapid transit. People might not understand the complexity of the SP-based questionnaire structure. It is better to simplify the SP application rather than suggest alternatives with many attribute levels. SP questions are redesigned by focusing on some specific situations or variables. First, respondents were asked about their responses on different Park-and-Ride scenarios. It aims to identify in which situations people are likely to

drive motorcycles to MRT stations and have MRT ridership later without specific conditions. Second, respondents were asked about Park and Ride choices with specific conditions such as equal travel duration and equal travel cost. It aims to grasp respondent's Park-and-Ride preferences with trade-off consideration.

Table 5.3 : Illustration for motorcycle parking fee and MRT fare

Motorcycle parking fee (VND)		MRT cost (VND)			
		3 stations	6 stations	9 stations	12 stations
Half day	One day	6 minutes	12 minutes	18 minutes	24 minutes
5,000	10,000	7,000	14,000	21,000	28,000

* 10,000 VND ≈ 0. 5 USD (2015)

For Park-and-Ride scenarios, motorcycle parking charges and MRT fares are provided for references (See Table 5.3). The scenarios relate to trip purpose, distance, duration, working time, frequency, parking, and traffic (see Table 5.4). Statements about Park-and-Ride scenarios were measured in four-point Likert type format from 1 ("*Strongly disagree*") to 4 ("*Strongly agree*").

Table 5.4 : Park-and-Ride scenarios

Statement	Scale
I only commute in some specific weekdays.	Four -point
My work place/school is not so far from last station (e.g 5-10 minute walk)	Liker type
I can commute with free parking for motorcycle or discount parking for passenger car at transit stations.	1 (Strongly disagree)
The working time begins late (e.g 9 am) at my work place/school.	2 (Somewhat disagree)
I have occasional trips (e.g shopping, leisure, private matter, event participation) at city centre or area surrounding MRT stations.	3 (Somewhat agree)
I have a long trip (e.g more than 10 km or more than one hour) and go back my residence in the same day.	4 (Strongly agree)
I have urgent trips in peak hours or at the time there might be traffic congestion	
I might be aware that it is difficult to find parking places in city centre.	

Table 5.5 : Park-and-Ride choices

Condition	Alternative A Motorcycle use						Alternative B Park-and-Ride trip
		Strongly prefer A	Somewhat prefer A	Neutral	Somewhat prefer B	Strongly prefer B	
Equal travel cost		1	2	3	4	5	
Equal travel time		1	2	3	4	5	

For Park-and-Ride choices, respondents were instructed to go to the area surrounding MRT 1 stations. Different conditions such as travel modes (motorcycle, passenger car), equal duration, and equal expense were mentioned. Respondents were requested to answer the question "*Which alternative would you prefer for the trips to the city centre*?" by choosing the levels of preferences between alternative A ("*Motorcycle use*") and alternative B (" *Park-and-Ride trip*") (see Table 5.5). Similar questions were also raised for car use. Their trade-off

choices were measured in five-point Likert-type, using the Semantic Differential Method. The reason for using this Likert-type is that respondents might have neutral decisions for trade-off choices.

5. 3 RESULTS

5.3.1 Perceived urban transport

As presented in Figure 5.1 and Figure 5.2, central urban transport is regarded more negatively than local urban transport. In central areas, traffic conditions and safety are more negatively evaluated than driving behaviours and law enforcement. In local neighbourhoods, traffic conditions are more positively evaluated than traffic safety, driving behaviour, and law enforcement. There is little difference in law enforcement evaluation between central area and local neighbourhood. Traffic condition, safety, and driving behaviours are more positively evaluated in local neighbourhoods than in central areas. However, there is a significant difference in traffic condition evaluation in comparison with safety and driving behaviour evaluation. It indicates that traffic conditions are the main characteristic indicating differences between inner city and newly developed areas.

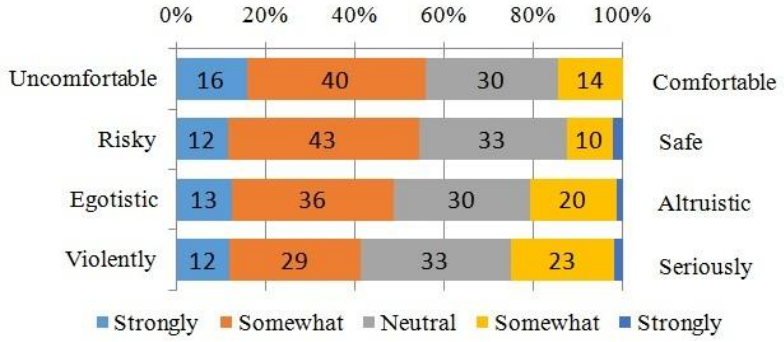


Figure 5.1: Responses for perceived urban transport in central area

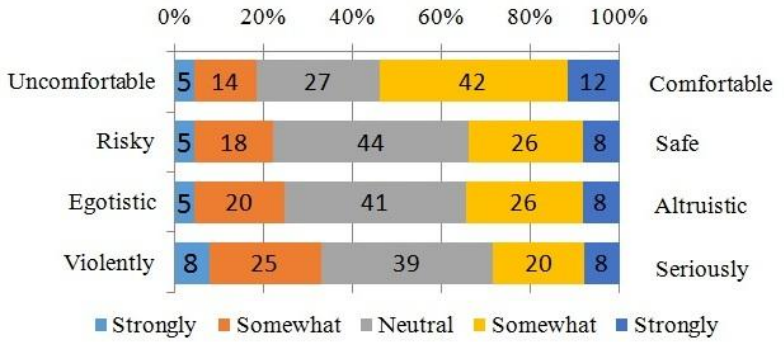


Figure 5.2 : Responses for perceived urban transport in local neighbourhood

5.3.2 Attitudes toward traffic concerns, transit preferences, and behavioural intentions

In general, the results show high acceptance of statements surrounding traffic concerns. (See Table 5.6). However, some statements result in approximately equal responses. More than haft of interviewees (54%) think it is impossible to drive motorcycles in bad weather. This rate is not very different from that of the others. 71% of interviewees feel nervous when using cars. 62 % of respondents like to be passengers rather than to be a driver when

travelling. There is a similar agreement rate (59%) for statements that believe taking transit is safer than travelling by car.

Table 5.6 : Responses for attitudes toward traffic concerns

Id	Statement	Response (%)			
		1	2	3	4
1	It is unsafe for driving motorcycle on highways.	2	14	51	33
2	It is impossible to drive motorcycle in bad weather.	9	37	34	20
3	The majority of road accident fatalities relates to motorcycle usage.	5	14	53	28
4	Using motorcycle is more hazardous overall than traveling by car.	4	13	53	30
5	Driving motorcycle is more dangerous overall than taking transit.	3	13	48	35
6	I feel unsafe in driving motorcycle when I see bus fleets on streets.	3	28	43	26
7	It is risky to drive passenger car in such conditions overwhelmed by motorcycles.	5	23	50	22
8	I always feel nervous in travelling by car	7	32	36	25
9	I almost remember to fasten seatbelt when I get in a car.	2	13	40	46
10	Taking transit is safer than driving car.	10	30	33	26
11	I like to be a passenger than a driver even though I have a chance to drive.	5	33	39	23
12	Using public transport make me feel safer in daily travel.	10	19	33	38
13	I would like to leave my home early or to remain in my office late until traffic congestion eases.	8	30	40	22
14	If possible, I try not to travel in peak hours to avoid traffic congestion.	1	11	51	37
15	Traffic congestion influences much on my daily trip.	3	24	41	31

1: Strong ly disagree; 2: Somewhat disagree; 3: Somewhat agree; 4: Strongly agree

As shown in Table 5.7, only 45% of respondents will accept walking for a duration lower than 15 minutes. Around 67 % of commuters accept to use bus services if it takes a short time for access and egress trips. Interviewees have high acceptance in transit use if its service quality and access neighbourhood receives improvement. For long trips, two-thirds of respondents (67%) might drive motorcycles to bus stations and get on a bus later. There are balances among responses about bus use for shopping, or 15-minute walks.

Table 5.7 : Responses for attitudes toward transit preferences

Id	Statement	Response (%)			
		1	2	3	4
1	I might use bus service if it takes 5 or 10 minutes for walking access.	10	24	47	20
2	I might use bus service if walking distance from last stop to destination is acceptable (e.g. walking in 5 or 10 minutes)	7	26	51	16
3	I might get on bus if its service quality is improved.	0	9	45	46
4	If the neighbourhood from my residence to bus-serviced road were more walkable, I would like to use bus for regular trips.	2	14	52	32
5	For the trips with length longer than 10 km, I prefer public transport to private modes.	9	30	43	18
6	For long trip, I might get on bus after driving motorcycle to bus station.	9	25	51	16
7	If possible, I might get on bus for shopping purposes.	9	40	33	18
8	It is acceptable to walk with duration lower than 15 minutes.	15	40	30	15

1: Strong ly disagree; 2: Somewhat disagree; 3: Somewhat agree; 4: Strongly agree

Table 5.8 : Responses to behavioural intentions

Behavioural intention	Statement	Response (%)			
		1	2	3	4
Bus use	I intend to have more bus ridership rather than mainly use private vehicle.	15	40	30	14
Alternative transit use	I am willing to use alternative transits those are not influenced by traffic congestion to travel to city centre even thought I never or rarely use public transport.	4	28	41	27
Park-and-Ride	If possible, I intend to have more 'park and ride' trip for motorcycle and bus use.	23	27	36	14
Motorcycle use reduction	I really want to drive motorcycle as less as possible.	7	36	35	22
Car use	I always want to have more car use frequency.	7	31	38	25

1: Strong ly disagree; 2: Somewhat disagree; 3: Somewhat agree; 4: Strongly agree

Responses to behavioural intentions are presented in Table 5.8. In general, the rate of bus use is always lower than that of others. The next rates are identified relating to motorcycle, car, and alternative transit. About 44% of respondents would like to have more bus ridership in comparison to private vehicles being their main mode of transport. In addition, 68% of respondents are willing to have alternative transit use that is not influenced by traffic congestion to travel to city centres. This means if public transport could provide good services in punctuality, speed, and frequency, it would be considered as the preferred form of travel, more than conventional bus use. More than half of respondents (57%) want to drive motorcycle as little as possible. However, this rate is not significantly high to justify the majority of respondents wanting to stop the use of motorcycles as their main travel mode. Since the survey site is located in a newly developed area that is far from the city centre, and is adjacent to the highway where there is a high volume of daily traffic, people might have safety awareness in motorcycle use reduction, particularly for long-distance trips. Finally, the rate of commuters who would like to increase their frequency of car use is around 63 %. It can be explained that the survey was conducted in new residential areas where high income households account for significant percentages of the samples.

5.3.3 Park-and-Ride preferences

Figure 5.3 shows the responses to Park-and-Ride scenarios for future motorcycle and MRT use. The scenarios are reordered based on the rate of agreement. The results are divided into three categories. High agreements concentrate on low parking fee, long trip, traffic congestion, and parking constraints in the city centre. The second category includes scenarios related to commuting in limited weekdays and egress distance. In the last category, late working schedules and occasional trips are less likely to influence MRT access by motorcycle. In brief, long-distance journeys, parking difficulties, and traffic conditions are important preferences influencing the intentions of Park-and-Ride trips for motorcycle users.

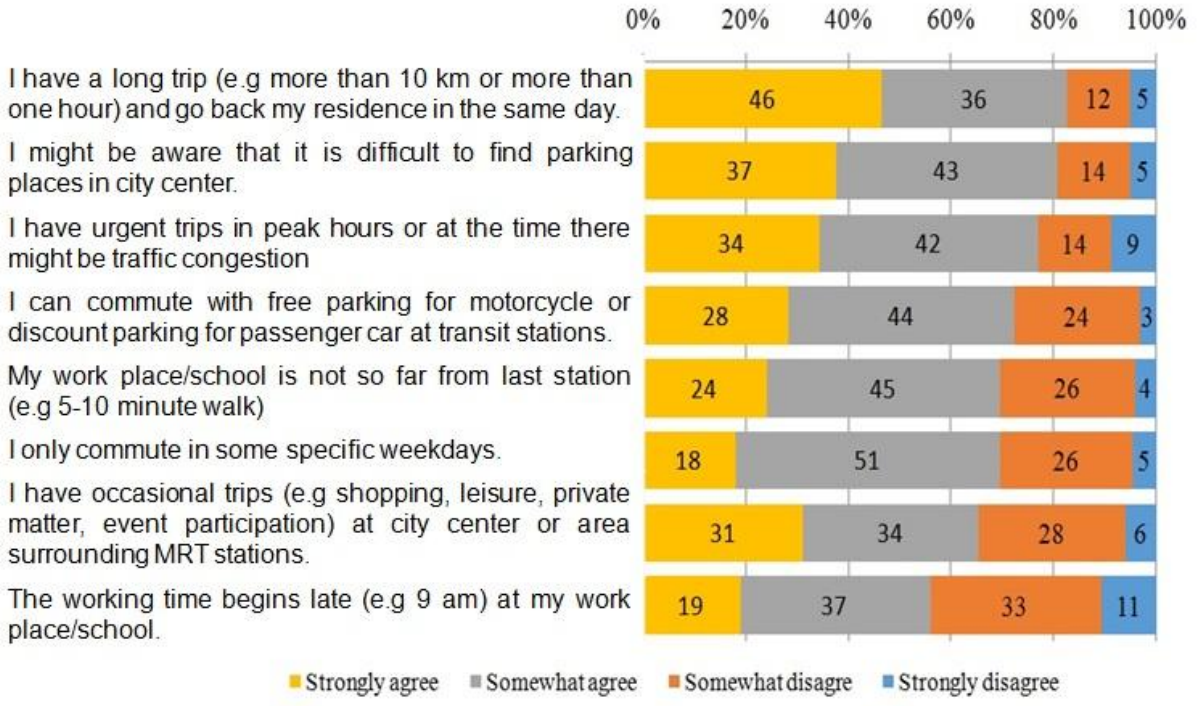
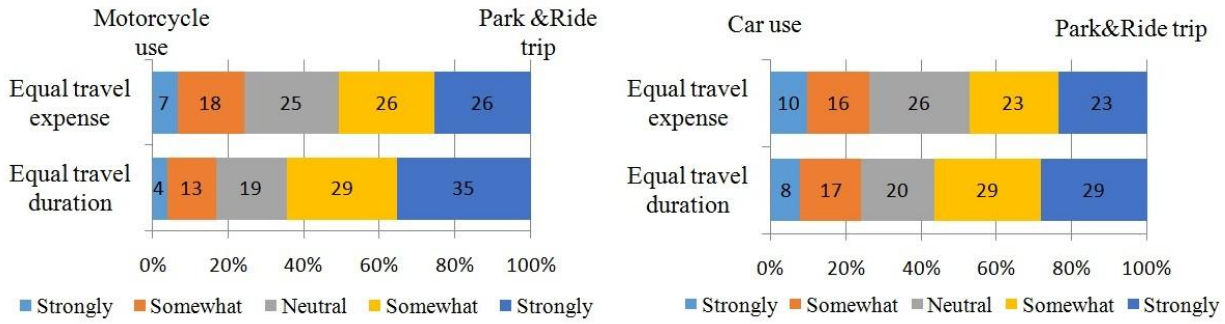


Figure 5.3 : Responses for Park-and-Ride scenarios

When choosing Park-and-Ride, respondents who selected *Strongly agree* and *Somewhat agree* account for more than 40% in all cases (Figure 5.4). The rate of Park-and-Ride trips preferred is lower in car use than in motorcycle use. This means there are more difficulties in Park-and-Ride trip considerations for car use. However, the rates of Park-and-Ride choices are lower in cost constraints than in time controls. It indicates that travel cost has a higher influence on Park-and-Ride trips than that of travel time.



(a) (b)

Figure 5.4 : Responses for Park-and-Ride choices

The model of Park-and-Ride was originally aimed to increase parking capacity in urban areas, then to be encouraged to deal with traffic problems and environmental impacts (Meek et al., 2010). It provides commuters living in the outer suburban areas with alternative options to car access trips to railway stations and flexible rides to city centres (Holguin-Veras et al., 2012). Theoretically, it encourages car users to switch to the combination of car and public transport. This would result in a decrease of vehicle kilometres travelled (VKT), an increase of public transport patronage, and a decline of private automobile use (Zijlstra et al.,

2015). Consequently, the positive effects include parking pressure, congestion, and emissions being reduced. The results show that traffic problems and travel distances are similarly major reasons for motorcycle access trips to mass transit stations in comparison with previous studies on automobile. It is necessary to remember that motorcycles require less parking space and provide more flexible rides in traffic congestion than automobiles. It seems that traffic condition has little influence on motorcycle use. If people consider parking constraints and congestion for the combination of motorcycle and mass rapid transit, it means that people are currently aware of traffic condition influenced by high motorcycle use.

5. 4 ANALYSIS AND COMPARISON

Firstly, two factors of analysis were conducted to extract different preferences and psychological factors. The first analysis was based on traffic concern statements. The second analysis was based on transit preference statements. Varimax rotation technique was also applied, since more factors were extracted in factor analysis. Varimax rotation is by far the most orthogonal rotation that produces uncorrelated factors (Costello & Osborne, 2005). Only attitude items having factor loading >=0.5 are noted. The factor scores were calculated by regression methods and were normalized to set the neutral position at zero. Individuals were assigned factor scores for these factors. Since data did not meet the requirements for regression analysis, these values were categorized into quartiles for further comparisons. Secondly, statistical analyses were employed to assess if there was a significant different in the likelihood of people intending to travel in some circumstances. T-tests were conducted to assess if mean scores of behavioural intentions were significantly different by groups of socio- demographics and travel patterns. Respondents were categorized based on their gender, age, household income, bus use frequency, and walking activity. ANOVA analysis was performed to explore how each quartiles of traffic concerns and transit preferences have significant differences in mean scores of behavioural intentions. All analyses were performed by using the statistical software-SPSS Statistic 22.0. Finally, Structural Equation Modelling techniques were applied to explain how much transit preferences influenced behavioural intentions. Amos 19.0 software was used to estimate the standardised regression weights, covariances, and model significant parameters (Arbuckle, 2010).

5.4.1 Factor analysis and quartile

Factor analysis using the varimax rotation technique was applied for attitudes relating to traffic concerns. Cronbach's alpha values were also calculated in order to assess internal consistency and factors' reliability. Four factors were identified, namely as Motorcycle safety awareness, Car use concern, Bus safety belief, and Congestion concern. Table 5.9 shows mean scores, factor loadings, and Cronbach's alpha values of indicators for traffic concerns.

It can be seen that *Motorcycle safety awareness* has a mean score higher than that of other factors. It indicates that most of respondents are aware of motorcycle use danger. Although fastening seatbelts is usually remembered, this indicator contributes little to *Car use concern* in comparison with driving cars overwhelmed by motorcycle fleets, or feeling nervous in car use. *Bus safety belief* is mainly influenced by the preference of being a passenger during travel. In *Congestion concern*, mean scores of statements such as "*If possible, I try not to travel in peak hours to avoid traffic congestion*" and "*Traffic congestion influences much on my daily trip*" are higher than that of the other statement "*I would like to leave my home early or to remain in my office late until traffic congestion eases*". This means

that people are aware of traffic congestion but they do not want to change their schedules to adapt to congestion conditions.

Table 5.9 : Factor loading of traffic concerns

Factors/Statements	Mean	Factor loading	α
Motorcycle safety awareness			
It is unsafe for driving motorcycle on highways.	3.13	.716	.772
The majority of road accident fatalities relate to motorcycle usage.	3.04	.743	
Using motorcycle is more hazardous overall than traveling by car.	3.10	.814	
Driving motorcycle is more dangerous overall than taking transit.	3.16	.725	
Car use concern			
It is risky to drive a passenger car in such conditions overwhelmed by motorcycles.	2.88	.709	.584
I always feel nervous when travelling by car.	2.78	.788	
I almost remember to fasten seatbelt when I get in a car.	3.29	.629	
Bus safety belief			
Taking transit is safer than driving car.	2.75	.805	.738
I would rather be a passenger than a driver even though I have a chance to drive.	2.80	.845	
Congestion concern			
I would like to leave my home early or to remain in my office late until traffic congestion eases.	2.76	.609	.616
If possible, I try not to travel during peak hours to avoid traffic congestion.	3.23	.782	
Traffic congestion influences much on my daily trip.	3.00	.709	

Table 5.10 : Factor loading of transit preferences

Factors/Statements	Mean	Factor loading	α
Time-Distance			
I might use bus service if it takes 5 or 10 minutes for walking access (AT).	2.76	.837	.758
I might use bus service if walking distance from last stop to destination is acceptable (e.g. walking in 5 or 10 minutes) (ET)	2.77	.773	
For the trips with length longer than 10 km, I prefer public transport to private modes (LT).	2.69	.679	
For long trip, I might get on bus after driving motorcycle to bus station (PR).	2.73	.649	
Comfort-Convenience			
I might get on bus if its service quality is improved (SQ).	3.37	.769	.667
If the neighbourhood from my residence to bus-serviced road were more walkable, I would like to use bus for regular trips (WA).	3.13	.860	
If possible, I might get on bus for shopping purposes (SP).	2.60	.613	

Factor analysis using the varimax rotation technique was also applied for statements relating to transit preferences. Two factors were extracted, namely Time-Distance and Comfort-Convenience. Mean scores and factor loadings of indicators for transit preferences are presented in Table 5.10. In Time-Distance, factor loadings of travel time in access and egress are higher than that of trip distance and motorcycle-accessed bus use. This means that transit proximity holds an important role for making Time-Distance preference. In Comfort-Convenience, mean scores and factor loadings of service quality and walking environment are higher than that of shopping purpose. This indicates that the way people perceive walkable

access has more influence on Comfort-Convenience preference than transit service and shopping convenience.

Table 5.11 : Value limitations and percentiles of factor scores normalised

	Motorcycle safety awareness	Car use concern	Bus safety belief	Congestion concern	Time-Distance	Comfort-Convenience
Min	-2.45	-3.24	-2.43	-3.30	-2.78	-3.01
Max	2.18	1.67	1.54	1.65	1.87	2.16
Percentiles						
25	-0.88	-0.54	-0.73	-0.55	-0.67	-0.61
50	-0.07	0.04	0.14	0.00	0.17	-0.01
75	0.85	0.58	0.72	0.56	0.66	0.71

Table 5.11 shows the range of factor scores from minimum values to maximum values. Quartiling of factor scores results in values of different quartiles. For example, the factor labelled Motorcycle safety awareness has factor scores valuing from -2.45 to 2.18. Its lowest quartiles have values less than or equal to -0.88, while the second quartiles have values greater than -0.88, and less than or equal to -0.07. The third quartiles have values greater than -0.07 and less than or equal to 0.85. Finally, the fourth quartiles have values greater than 0.85.

5.4.2 Relationships between socio-demographics and travel patterns and behavioural intentions

Table 5.12 shows mean scores of behavioural intentions by gender, age, household income, bus use frequency, and walking activity. t-test results indicate significant differences between every category.

Table 5.12 : Mean scores of behavioural intentions by socio-demographics and travel patterns

	Category	Bus use	Alternative transit use	Motorcycle use reduction	Car use
Gender	Female (n=85)	2.42	2.85	2.87**	2.73
	Male (n=130)	2.43	2.95	2.62**	2.85
Age	<=30 years old (n=92)	2.60**	2.95	2.76	2.71
	>30 years old (n=123)	2.30**	2.89	2.68	2.88
Income	<=10 mil. VND (n=138)	2.47	2.93	2.73	2.75**
	>10 mil. VND (n=77)	2.25	2.83	2.68	3.03**
Car ownership	No (n=175)	2.47	2.94	2.77	2.67***
	Yes (n=40)	2.35	2.79	2.62	3.04***
Bus Use Frequency	Never or rarely (n=129)	2.40	2.80**	2.66	2.88
	Weekly or sometime (n=86)	2.48	3.08**	2.80	2.69
Walking activity	No (n=104)	2.27**	2.82	2.50**	2.75
	Yes (n=111)	2.58**	3.00	2.92**	2.86

**Significant difference at 0.05 probability level (t- test)

***Significantly different 0.1 probability level (t- test)

First, it is confirmed that women want to drive motorcycles less. It can be explained that there are many highways passing by the study area. Since high volumes of traffic occur along

future MRT corridor, female respondents feel more concerns in driving motorcycles than male respondents. Second, young people are likely to have bus use intention. It might be that the environment of bus accessibility is not convenient for people who are more than 30 years old. Most of bus routes are concentrated along main roads. Therefore, old people find it is difficult to access bus stops, especially in bad weather. Third, income and car ownership are associated with car use intention. Since the survey is conducted in new residential developments, most households belong to high-middle-income groups, and are likely to have car ownership in the future. Fourth, weekly bus ridership contributes to the intention of alternative transit use. People who use buses might understand the benefits of public transport. Since respondents are not captive bus users who are usually low income people, they can afford to use mass rapid transit and bus rapid transit in the future. Finally, the likelihood of bus use and motorcycle use reduction is significantly higher among respondents who have walking activities. It is assumed that the context of new residential areas encourage more walking activities. Consequently, people find it is acceptable to walk to bus stops for bus ridership or to walk in short distance instead of driving motorcycle.

5.4.3 Relationships between traffic concerns and behavioural intentions

Table 5.13 presents mean scores of behavioural intentions by different quartiles of traffic concerns. ANOVA results indicate significant differences between every category.

Table 5.13 : Mean scores of behavioural intentions by traffic concerns

Factor quartiles	Bus use	Alternative transit use	Motorcycle use reduction	Car use
Motorcycle safety awareness				
1st quartile (n=54)	2.30	2.65	2.30	2.50
2nd quartile (n=54)	2.33	2.89	2.61	2.81
3rd quartile (n=53)	2.38	3.17**	2.92**	2.92
4th quartile (n=54)	2.70	2.94	3.04**	3.04**
Car use concern				
1st quartile (n=53)	2.23	2.81	2.60	2.77
2nd quartile (n=54)	2.44	2.74	2.70	2.76
3rd quartile (n=54)	2.48	2.93	2.76	2.80
4th quartile (n=54)	2.56	3.17***	2.80	2.89
Bus safety belief				
1st quartile (n=53)	2.09	2.66	2.38	2.85
2nd quartile (n=54)	2.48	2.96	2.69	2.69
3rd quartile (n=54)	2.52	2.94	2.80**	2.78
4th quartile (n=54)	2.61**	3.07***	3.00**	2.91
Congestion concern				
1st quartile (n=54)	2.24	2.76	2.72	2.74
2nd quartile (n=54)	2.44	3.00	2.69	2.65
3rd quartile (n=54)	2.46	2.80	2.50	2.70
4th quartile (n=53)	2.57	3.09	2.96	3.13***

**Significantly different than the lowest quartile group at 0.05 probability level (ANOVA)

***Significantly different than the lowest quartile group at 0.10 probability level (ANOVA)

First, the likelihood of private vehicle use intentions is significantly higher with each quartile increase in motorcycle safety awareness. Second, alternative transit use intention is only higher in the last quartiles of car use concern and bus safety belief. Third, the likelihood of bus use and motorcycle use reduction is significantly higher with each quartile increase in

bus safety belief. Finally, differences by congestion concern are less common, examining the likelihood of car use intention. There are no differences across quartiles of congestion concern in behavioural intentions of alternative transit use and motorcycle use reduction. It is found that motorcycle safety awareness is related to the intentions of private vehicle use. Moreover, bus safety belief is associated with the intentions of public transport and motorcycle use reduction. There are similar relationships between car use concern and alternative transit use intention, and between congestion concern and car use intention.

5.4.4 Relationships between transit preferences and behavioural intentions

Table 5.14 shows how mean scores of behavioural intentions are changed by transit preference quartiles. ANOVA results indicate that the likelihood of alternative transit use and motorcycle use reduction is significantly higher with each quartile increase in transit preferences. While the likelihood of bus use intention is significantly higher in the third and the fourth Time-Distance quartiles, differences by Comfort-Convenience quartiles are less common. There are no differences across transit preference quartiles in car use intention. It is found that transit preferences are associated with the intention of bus use, alternative transit use, and motorcycle use reduction. The more people have preferences on Time-Distance and Comfort-Convenience, the more people want to use public transport and reduce motorcycle use. However, transit preferences are not associated with car use intention.

Table 5.14 : Mean scores of behavioural intentions by transit preference quartiles

Factor quartiles	Bus use	Alternative transit use	Motorcycle use reduction	Car use
Time-Distance				
1st quartile (n=55)	1.98	2.56	2.29	2.78
2nd quartile (n=53)	2.28	2.79	2.58	2.87
3rd quartile (n=54)	2.52**	3.09**	2.85**	2.74
4th quartile (n=53)	2.94**	3.21**	3.15**	2.83
Comfort-Convenience				
1st quartile (n=53)	2.13	2.56	2.31	2.83
2nd quartile (n=55)	2.30	2.72	2.54	2.81
3rd quartile (n=54)	2.44	3.06**	2.78**	2.69
4th quartile (n=53)	2.85**	3.32**	3.25**	2.89

**Significantly different than the lowest quartile group at 0.05 probability level (ANOVA)

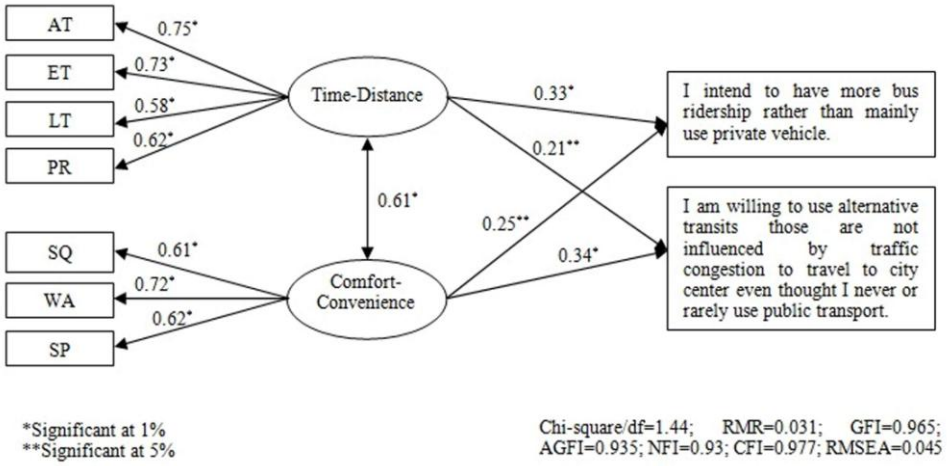


Figure 5.5: Influences of transit preferences on behavioural intentions

The relationships between the intentions of public transport use and transit preferences are analysed by Structural Equation Modelling techniques (see Figure 5.5). While Time-Distance preference has more influence on bus use intention than Comfort-Convenience preference, the intention of alternative transit use is more affected by Comfort-Convenience preference. This indicates that bus performance should be improved for long-distance trip, bus stop proximity, and motorcycle parking, while service quality, walking environment, and land use surrounding transit station, e.g shopping centres, keep important roles for encouraging the intention of mass rapid transit and bus rapid transit.

5. 5 SUMMARY OF FINDINGS

Developing countries are experiencing fast motorisation and rapid urbanisation. Motorcycles have become a phenomenon in many Asian cities. As the city boundary expanded, motorcycle use for long trips has become a challenge in traffic safety. In motorcycle dependent cities, the way which motorcycles maintain important roles in facilitating the process of urbanisation has raised questions about future motorcycle use in new urban area. It is more critical when motorcycles are the main mode of urban transport and public transport service is limited in the area outside city centre. This chapter explored the future of motorcycle mobility, considering urban development in motorcycle dependent cities with a psychological approach. Since the survey area belongs to new residential developments and future MRT catchment, the influences of urban development and mass rapid transit are included. Park-and-Ride preferences were collected for grasping future motorcycle-and-MRT use. Factor analysis using the varimax rotation technique identified transit preferences and psychological factors of motorcycle safety awareness, car use concern, bus safety belief, and congestion concern. Study results showed that there is an association between behavioural intentions and some socio-demographics, travel patterns, transit preferences and psychological factors. Motorcycles have become an important mode in many Asian cities within developing countries. The concept of motorcycle dependent cities is not only applicable to megacities such as Ho Chi Minh City (Vietnam) but also for other medium-sized cities where motorcycle growth is higher than other megacities (Kidokoro & Kubota, 2007). Therefore, the research results can be used for policy implication, not only in Ho Chi Minh City but also in other motorcycle dependent cities of developing Asian countries.

It is plausible that a number of limitations could have influenced the results obtained. First, respondents do not have experience in using transit alternatives such as mass rapid transit. Therefore, behavioural intentions and corresponding factors can be changed when people become familiar with MRT. In order to overcome this limitation, interviewers tried to describe the context of future urban transport before participants had their own selection of behavioural intentions. Second, the study only focused on new urban areas where high and middle-income people are main residents. In many cities within developing countries, the urban poor still preponderate in the emerging peripheral and suburban areas. The characteristics of behavioural intentions have not been dealt with in depth in the areas where urban poor reside. This issue should be focused on in further studies relating to motorcycle use intention.

5.5.1 Future public transport use

The results of the analysis show that bus use frequencies are associated with alternative transit use intentions, while walking activities are correlated with the intentions of bus use. It

means that the intention of public transport has a relationship with existing travel behaviours. However, only young people are likely to have bus use intention. It differs from the results reported by Van and Fuji (2009), stating that old people have higher intention of using bus in comparison with young respondents. The lack of bus routes might influence on old people's bus use intention. Therefore, transit accessibility should be improved so that older people can access bus services in new urban areas.

Previous studies found the casual relationship between perceived quality of public transport and passengers' service intention (Jen & Hu, 2003; Van & Fuji, 2009). In HCMC, it actually takes a long time to improve bus service quality, since public transport was low at the beginning. Motorcycle users have little bus ridership experience so they rarely perceive bus service improvements. The more people consider bus use safety, the more they intend to have public transport use intention. Therefore, convincing people to believe in bus use safety is another approach to make people intend to have more bus use.

The results show that there is no relationship between congestion concern and alternative transit use. However, people who have car use concern intend to have alternative transit use for overcoming future congestion. It indicates that existing traffic in HCMC has not reached worse conditions yet, but such overcrowded motorcycle traffic might result in car use concern, making people consider alternative transit use. It is noted that most commuters ride motorcycles in daily travel. Therefore, they might not perceive serious congestions caused by future widespread car use on urban road. Traffic congestion will affect motorcycle users using Mass Rapid Transit until it reaches a critical level.

5.5.2 Future for new residential developments

It was found that people who have high levels of transit preference tend to use public transport more. However, transit preferences might depend on different transit services. While Time-Distance preference holds a vital role for bus use intention, Comfort-Convenience preference has more impact on the intention of alternative transit use. Therefore, bus operation should be improved in network coverage and accessibility while alternative transit planning should focus on service, walkable environment, and land use around transit stations. This means that bus accessibility needs improvement in walking access, and then travellers might accept further walking distances for MRT use in comparison with bus ridership. This finding is consistent with specific characteristics of future MRT stations and should be considered for affecting propensity to walk to transit stations (Chalermpong & Wibowo, 2007). It can be explained that a motorcycle-based context like HCMC results in more motorcycle dependency in travellers. Consequently, people find it is difficult to walk to bus stops while the similar distances to MRT stations are accepted under walkable environment. Therefore, transport planning should be integrated into land use so that newly developing areas enhance public transport services. It is necessary to explore whether current land use will contribute to sustainable outcomes around transit stations. Unplanned sprawling along roads must be controlled in order to reduce future barriers for bus accessibility.

Beside problems on public transport development, car-oriented transport is also another issue of residential development areas. Although 57 % of people want to have less motorcycle use, 63% of respondents want to have more car use. People who have more congestion concerns in daily travel intend to have more car use. It might be explained that the popularity of motorcycle traffic makes car users feel it is difficult to travel in the city centre. For

example, motorcycle traffic comprises at least 80% of urban road in peak hours in Ho Chi Minh City (Hsu et al., 2003). Therefore, people might want to have more car use in local neighbourhoods. The efficient infrastructure of residential developments makes people perceive little difficulties of motorcycle traffic during car use. It raises the question about the need to develop public transport services, in particular mass transit systems, in new residential areas before car traffic accounts considerate composition in urban transport.

5.5.3 Future motorcycle use

As mentioned above, motorcycle safety awareness and bus safety belief are related to commuters' motorcycle use reduction. The level of motorcycle use will decline when motorcycle safety awareness and bus safety belief increase. However, motorcycle safety awareness might lead to more car use intention. As a result, bus safety belief has an important role for changing motorcycle use in new urban areas of motorcycle-dependent cities. In the long term, planning for bus services should focus on safety belief enhancement to encourage more public transport use and less motorcycle rides.

Descriptive results show that low parking fee, long trip, congestion, and parking constraint are main scenarios related to Park-and-Ride preferences for inducing motorcycles into MRT. In addition, travel cost plays an important role in Park-and-Ride choices in comparison with travel time. Previous studies found that travel cost is one of determinants affecting BRT choice with Park-and-Ride (Satiennam et al., 2013). Since MRT systems need high capital in construction investment, travel fare might be higher than that of BRT for feasible operation. Therefore, parking fee might be an important factor contributing to affordable costs of MRT choices. As a result, future policies should focus on parking costs at MRT stations, parking control in city centres, parking facilities at peripheral stations, and MRT fare for encouraging motorcycle use in Park-and-Ride trips.

Previous studies found some unintended effects of Park-and-Ride. Some travellers who used non-motorised modes or local buses to access public transport node might shift to car use for Park-and-Ride trips (Mingardo, 2008; Wiseman et al., 2012). Consequently, increased car usage leads to more vehicle kilometres travelled. In the context of suburban area, this negative effect will be less severe because the train trip is relatively longer than the car access trip (Mingardo, 2013). Such effects for motorcycle access trips have not been explored yet. Further research should be conducted to find out whether motorcycle use related to rail-based Park-and-Ride trips decreases, and how motorcycle access trips to mass transit station influence the modal split between other transport modes.

In conclusion, developing countries are undergoing rapid motorisation in which motorcycle growth emerges as a phenomenon. This process is encouraged by fast urbanisation. It raises questions about future motorcycle use in new urban areas of motorcycle-based regions. Similar to cities within developed countries, people living in residential developments of new urban areas have more car use intention. Motorcycles continue to be the main mode, but less motorcycle use is also considered. More bus ridership is not intended as much in comparison with private vehicle use intention. In new urban areas, residential developments might encourage car accessibility by efficient infrastructure; however, there is low accessibility for public transport system. Unless conventional buses are improved, new residential developments impose challenges for public transport service. Therefore, urban development should be controlled in accordance with public transport

development. The introduction of mass rapid transit should be enhanced by policy implications in parking management in order to induce motorcycle use into mass rapid transit. While the use of motorcycles and cars should be controlled in city centres, motorcycle use should be encouraged as MRT accessibility in emerging peripheral areas. The significance of this chapter is to explore behavioural intentions in regards to mass rapid transit in new urban areas of a motorcycle-dependent city. As people have more long-distance trips, safety becomes a critical issue in motorcycle use. Transit preferences and psychological factors such as motorcycle safety awareness and bus safety belief become significant determinants of behavioural intentions. Further research should focus on how strong these variables contribute to travel behaviours. Whether bus safety belief has a higher influence on motorcycle use reduction than motorcycle safety awareness, is still questionable.

CHAPTER 6

6. FACTORS INFLUENCING THE CHOICES OF MASS RAPID TRANSIT USE

6. 1 INTRODUCTION

Developing countries are facing accelerated motorisation that results in increased private vehicles and limited public transport services (Koizumi et al., 2003). Motorcycles have become an important mode in many cities of developing countries, particularly in Asia (Araya &Morchi, 2007). Motorcycles accounted for a high proportion of urban transport in Ha Noi (Vietnam), Jakarta (Indonesia), Bangkok (Thailand), Phnom Penh (Cambodia), and Vientiane (Laos). Barter (1999) mentioned the concept of 'motorcycle cities' or ‘motorcycle oriented cities’ when the author discussed the imbalance between high motorcycle growth and limited public transport services in many Asian cities during the late 1990s.

Since it is impossible to develop road infrastructure to meet the demand of private mobility, many cities within developing countries have adopted policies and strategies to implement mass transit systems including MRT and BRT for tackling traffic congestion and pollution. Due to high population density and limited road networks, many cities do not have "automobile dependent" characteristics, but are full of diverse transportation means (Barter, 2000). Para-transits such as motorcycle taxis or minibuses provide flexible trips with low rates, but also have low capacity and other negative limitations (Cervero& Golub 2007). The popularity of motorcycle use challenges public transport, particularly mass rapid transit. It is noted that many medium-sized cities lacking economic resources to develop mass rapid transit, have high motorcycle growth. These cities will potentially become megacities facing urban problems such as inefficient public transport service, high population growth, overloaded infrastructure, and high private vehicles. If motorcycle use becomes popular in the long term, before public transport is developed into a high quality service, motorcycle dependence will undermine the performance of public transport, particularly mass rapid transit. Therefore, motorcycle management should be conducted before MRT development, in order to limit future difficulties by motorcycle dependence, and to encourage motorcycle users to use public transport more. In this context, it is important to understand people’s intentions and choices regarding new transit alternatives to assist with implementing appropriate measures in motorcycle use.

This chapter aims to identify factors influencing the future choices of mass rapid transit use by meeting the following objectives:

- To clarify the main determinants clarifying motorcycle users and non-motorcycle ones.
- To assess the causal relationship between mass rapid transit intention and other predictors
- To identify the main predictors affecting mass rapid transit choice, considering policy implications

It is hypothesized that the intention of mass rapid transit has stronger impacts on mode choice behaviour over other influencing factors; and predictors of MRT intentions may be different from that of MRT choices.

6. 2 DATA MEASURES

The survey questionnaire consists of the following four parts: (1) Individual information; (2) Travel attributes; (3) Preferences, attitudes; and intentions; and (4) Mass rapid transit choices (see Table 6.1 and Appendix 3). The first part includes socio-demographic characteristics. The second part consists of current travel behaviours and trip patterns. The third part comprises preferences and attitudinal items, regarding travel modes and policy measures, and travel intentions. The fourth part aims to understand commuters' choices in scenarios relating to future MRT use.

Table 6.1 : Questionnaire content

Part	Content	Items	Measurement method
1	Individual information (Q1-Q11)	11	Categorical scales Continuous values
2	Travel attributes (Q12-Q16)	5	Categorical scales
3	Preferences, Attitudes, and Intentions		
	Preferences (Q17, Q18, Q19)	3	Categorical scales
	Attitudes (Q20-Q38)	19	Four-point Likert scales (Strongly disagree, Somewhat agree, Somewhat agree, Strongly agree)
	Intentions (Q39-Q45)	7	Four-point Likert scales (Strongly disagree, Somewhat agree, Somewhat agree, Strongly agree)
4	Mass rapid transit choice (Q46)	8	Stated choices

6.2.1 Socio- demographic variables

Participants provided information on gender, age, occupation, monthly individual income, car driving license, household vehicle ownership, the presence of children in the household, the status of housing rent, and housing type. Based on residence locations, such as MRT zones and access distances to station were identified. Socio-demographic variables may help to explain travel intentions and future travel choices.

As can be seen in Table 6.2, while there are more respondents living near the city centre than the others, most of respondents' residence are located outside 1-km distance from future stations.

Table 6.2 : Distribution of residence location

		MRT Zone		
		Zone 1	Zone 2	
Access distance	<= 1 km	68	20	88 (40.2%)
	> 1 km	54	77	131 (50.8%)
		122 (55.7%)	97 (44.3%)	

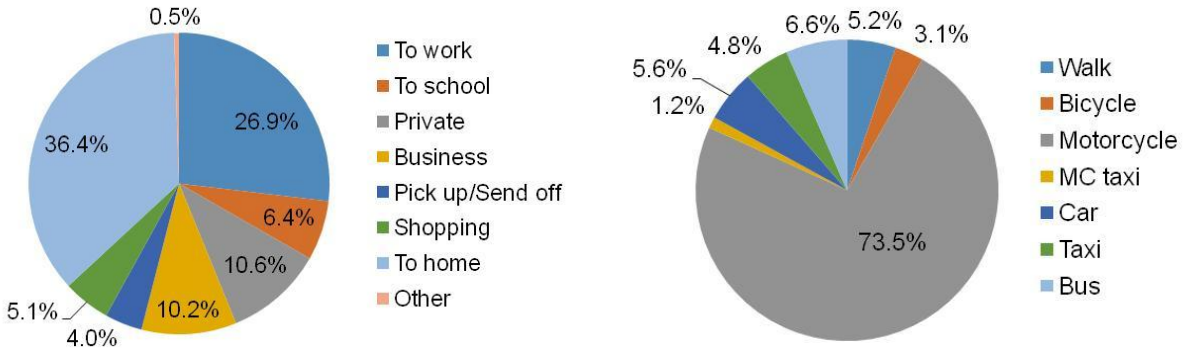
Table 6.3 shows that the majority of respondents were female (55%) and mostly aged between 21 and 40 years (73%). Office staff, officials, professionals, and students were the main groups of the survey samples. Personal monthly income ranges mainly from 5 million VND to 10 million VND (37 %). Most of respondents' household had motorcycle ownership (90%). While the rate of car ownership was 10%, 27% of respondents had car driving

licenses. While two-thirds of respondents (69%) were living with their family, the rate of tenants was 30%.

Table 6.3 : Distribution of samples' socio-demographics (n=219)

Category	Description
Gender	Male (45%), Female (55%)
Age group	<=20 (10%), 21-30 (31%), 31-40 (42%), 41-50 (11%), >50 (17%)
Occupation	Office Staff (17.4%), Official (15.5%), Manager (7.8%), Professional (21.9%), Sale persons (4.1%), Laborer/Worker (1.8%), Student (16.9%), Teacher/Lecturer (5%), Housewife (3.7%), Retired (2.3%), Other (3.7%)
Individual income (mil. VND)	<= 1 (14%), 1-5 (22%), 5-10 (37%), 10-15 (12%), 15-20 (5%), >20 (11%)
Car driving license	No (73%), Yes (27%)
Vehicle ownership	Bicycle (16%), Motorcycle (90%), Car (10%)

* 10,000 VND ≈ 0. 5 USD (2015)



(a) (b)

Figure 6.1 : Trip chain characteristics

Table 6.4 : Distribution of samples' travel attributes

Category	Description
Weekly travel expense (thousand VND)	<=50 (20%), 50-100 (42%), 100-150 (13%), 150-200 (8%), 200-300 (6%), > 300 (11%)
Duration to city centre (minutes)	<= 15 (4%), 16-30 (51%), 31-45 (28%), 46-60 (14%), >60 (4%)
Main mode for commuting trips	Walk (2.9 %), Bicycle (4.4%), Motorcycle (79.9%), Car (3.4%), Bus (9.3%)
Commuting duration (minutes)	<=15 (22.5 %), 16-30 (44.6%), 31-45(22.1%), 46-60 (9.3%), >60 (1.5%)

Figure 6.1a shows the main destinations of trips were workplaces, schools, and homes. Motorcycles were used for 73.5% of trips and also the main mode for commuters' travel (79.9%) (see Figure 6.1b). According to Table 6.4, the majority of people (42%) spent from 50 thousand VND to 100 thousand VND for weekly travel. Moreover, the average duration to CBD ranged from 16 to 30 minutes (51%) while this duration was also popular for commuting trips (44.6%).

6.2.2 Travel variables

Main trips made on the day before interview or last weekdays were derived to capture trip chains by purposes and by modes. Trip purposes were described as 'to work', 'to school', private, business, pick up/send off, shopping, 'to home', and others. Travel modes include walking, bicycle, motorcycle, motorcycle taxi, car, taxi, bus, and others. Weekly travel expenses and the average travel duration from respondents' house to city centre were collected. For commuters, travel modes and duration were requested for their commuting trips.

6.2.3 Preference variables and attitudinal variables

Travel preferences include statements about convenience, comfort, bus services, motorcycle taxis, motorcycle rides for bus access. These preferences were identified by yes or no questions. The questions were designed in order to achieve trade-off answers. For example, people were asked to select travel modes that provide convenient trips even though it might be uncomfortable. Bus service or motorcycle taxis were considered in case no vehicle was available at the household.

Travel attitudes contain statements relating to travel modes (motorcycle, bus, and car) and policy measures. Previous studies explored latent variables relating to private vehicle dependence such as car dependent, auto oriented, car oriented, and pro car (Handy et al., 2005; Tangphaisankun et al., 2011; Javid et al., 2012; Okamura et al., 2013; Kamruzzaman et al., 2013). Attitudes toward motorcycles aim to evaluate motorcycle dependence by trade- off comparisons between motorcycle use and other travel modes. For instance, respondents were asked whether they would want to ride motorcycles if it would take only 15 minute to walk from the origin to the destination. Attitudes toward bus and car include some attitudinal items in previous chapters. The other attitudes focus on policy measures for motorcycle use, such as: '*Motorcycle use should be limited for emission reduction*' or ' *I am willing to accept policies increasing penalties and fines for acts of violating safety rules in order to reduce motorcycle accident fatalities*'. Respondents also provided their intentions in using buses, motorcycles, and mass rapid transit. All attitudinal items were measured in Likert scale for further construction of latent variables.

6.2.4 Choice variables

In the last part, respondents were requested to answer the question "*Which alternative would you like to choose between MRT and motorcycle*?" They were provided two scenarios based on destination locations. In the first scenario, the destination is located nearby Ben Thanh station. In the second scenario, destination is located around Ben Thanh station.

For MRT use with non-egress trips, access modes such as walking, motorcycle, and motorcycle taxis are considered (Figure 6.2). For MRT use with egress trips, walking, buses, and motorcycles are assumed as egress modes, while motorcycles are the main access mode (Figure 6.3). It is assumed that it takes 15 minutes by walking, 10 minutes by bus, and 5 minutes by motorcycle taxi from Ben Thanh station to the destination. It is the same duration from the respondent's house to both places. The waiting time for MRT use is 10 minutes for all cases.

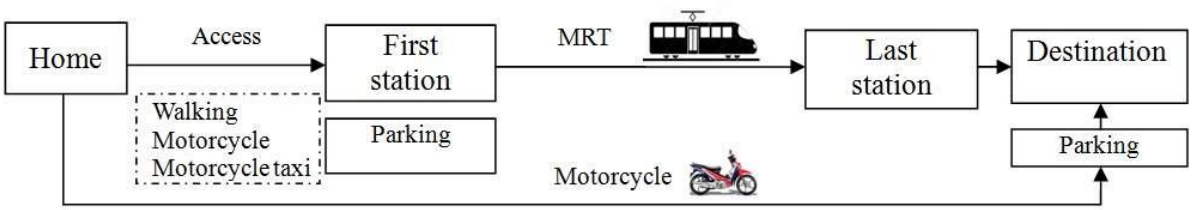


Figure 6.2 : MRT use with non egress trips (Scenario 1)

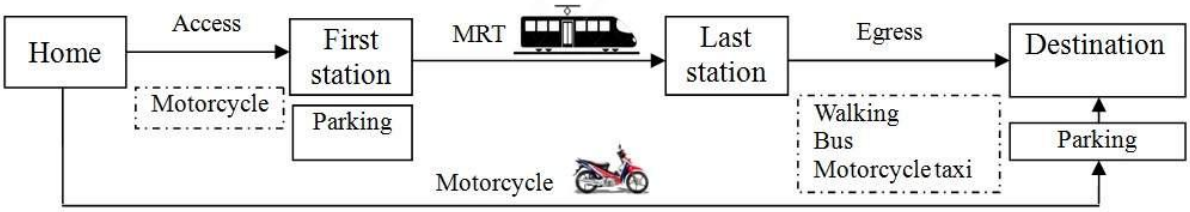


Figure 6.3 : MRT use with egress trips (Scenario 2)

Table 6.5 : Variables for Stated preference questions

Code	Description (Station……)	Value
A	Travel time by motorcycle from respondent's house to city centre (minutes)	
B	Fuel cost from respondent's house to city centre by motorcycle(VND)	
C	Travel time by motorcycle from respondent's house to MRT corridor (minutes)	
D	Fuel cost by motorcycle from respondent's house to MRT station (VND)	
E	Travel time by MRT from the nearest station to city centre (minutes)	
F1 F2	Travel cost from the nearest station to city centre by MRT (VND)	
G	Walking duration from respondent's house to MRT station (minutes)	

Table 6.6 : Levels of Stated preference variables

Variable	Level	
	Scenario 1	Scenario 2
Traffic flow (Delay duration by congestion)	0 (no congestion)	0 (no congestion)
	15 (traffic congestion)	15 (traffic congestion)
Access mode	Walking	Motorcycle
	Motorcycle	
	Motorcycle taxi	
Parking fee for motorcycle in CBD (VND)	5,000	5,000
	10,000	10,000
Parking fee for motorcycle at stations (VND)	2000	2000
	5000	5000
MRT fare (VND)	F1	F1
	F2	F2
Egress mode		Walking
		Bus
		Motorcycle taxi

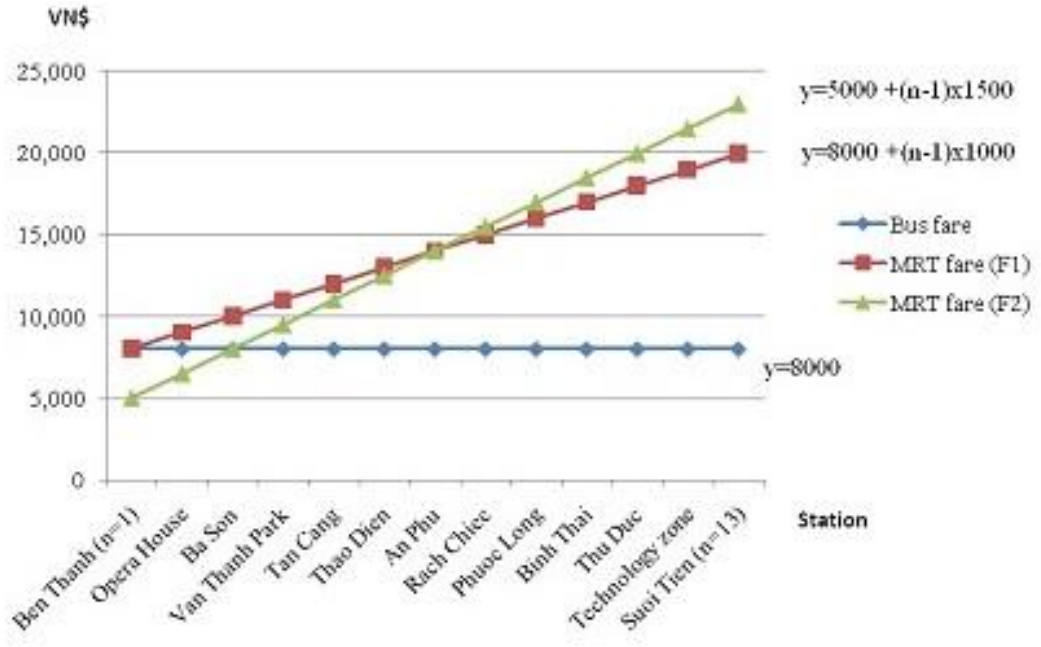


Figure 6.4 : MRT fare to city centres by stations

Card 1 (Peak hours)

Alternative	Motorcycle	MRT	
		Access	On MRT
	Travel time (min.): A +15= ..... (1) Fuel cost (VND): B=..... (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=..... (4) Fuel cost (VND): D =..... (5) Parking fee (VND): 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=..... (8) Fare (VND): F1=..... (9)
	Total time (1) = ...minutes Total cost (2) + (3) =.....VND	Total time (4) + (7) + (8) = ...minutes Total cost (5)+ (6) + (9) =.....VND	
Choice	□	□	

Figure 6.5 : Answer sample for MRT choices (Scenario 1)

Card 4 (Off peak hours)

Alternative	Motorcycle	MRT		
		Access	On MRT	Egress
	Travel time (min.) : A = ...(1) Fuel cost (VND): B=..... (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=..... (4) Fuel cost (VND): D=..... (5) Parking fee (VND) : 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=..... (8) Fare (VND): F2=..... (9)	Mode: Walking Travel time (min.): 15 (10) Travel cost (VND) : 0 (11)
	Total time (1) = ...minutes Total cost (2)+(3) =.....VND	Total time (4)+ (7)+ (8) + (10)= .....minutes Total cost (5)+ (6) + (9) + (11) =.....VND		
Choice	□	□		

Figure 6.6 : Answer sample for MRT choices (Scenario 2)

Variables for SP questions are summarized in table 6.5. Based on respondent's house location, fuel cost and travel duration by motorcycle were calculated for SP questions. Travel cost and duration by train were identified by assumptions (see Figure 6.4). In every scenario, travel patterns including travel time (access, in vehicle, egress) and travel cost (fuel cost, parking fee, motorcycle taxi expense, MRT fare) are presented for alternative consideration (see Figure 6.5 & 6.6). Respondents might understand that access mode, parking fee, MRT

fare, and traffic condition varies in some levels. The levels of variables for SP questions are summarized in table 6.6. For example, parking fee will be increased or decreased, MRT fare will be changed by distance, and travel time of motorcycle ride can be longer in peak hours than in off peak hours.

6. 3 RESULTS

Table 6.7 presents respondent's preferences on convenience, bus service, and motorcycle access to bus stops. While it was found that people slightly prefer travel modes that provide comfortable trips more than a convenient mode of transport, buses were selected more than motorcycle taxis. There was a balance in the preference of using motorcycle to access bus stops.

Table 6.7 : Distribution of preference statements

Item	Variable	Statement	Frequency (%)
Q17	Convenience mind	I prefer the travel mode that provides convenience, though it might be an uncomfortable mode of travel.	104 (47 %)
Q18	Bus preferred than motorcycle taxi	I prefer to go somewhere by bus service rather than motorcycle taxi when no vehicle is available in my household.	131 (60%)
Q19	Bus access by motorcycle	I like to drive motorcycle to access bus service if I intend to get on bus.	111 (51%)

Table 6.8 presents the evaluation of statements relating to travel modes, policy measures, and intentions. Statements relating to motorcycles (*Q20, Q21, &Q22*) show that people are less likely to ride motorcycles when the distance is only a 15-minute walk (*Q20*) or near to a workplace/school (*Q21*) in comparison with a long trip (*Q22*). This indicates that people still have a strong habit to ride motorcycles long distances. In statements relating to buses (*Q23, Q24, Q25, Q26, Q27, & Q28*), people have similar feelings regarding the comparison of riding a bus and driving motorcycle. This shows that motorcycles are more risky than cars in comparison with bus. Respondents have a low evaluation for the feeling joyful in riding bus. It can be explained that people do not satisfy with present status of bus service. For statements relating to policy measures, people are less likely to support regular motorcycle inspection (Q37) than the other measures (*Q34, Q35, Q36, & Q38*). For travel intentions, high evaluation on using free bus in city centre (*Q28*), eco bus and high quality public transport with high fare (*Q39* & *Q41*) show that people are likely to use public transport that has been improved in service and availability. Moreover, respondents have low evaluation for going to destinations far from their last station (*Q43*) over other MRT intentions (*Q42, Q44, & Q45*). This reveals that people prefer MRT use without egress trips.

Table 6.8 : Mean score and standard deviation of statement evaluation

Item	Statement	Mean	Std. Deviation
Q20	I always ride a motorcycle even if it takes only 15 minutes to walk from the origin to the destination.	2.55	1.130
Q21	Though my work place/school is near my house, I still want to ride a motorcycle there.	2.37	1.131
Q22	During a long trip, I would like to ride a motorcycle even though it is probably faster to use a bus.	2.65	1.157
Q23	Taking transit is safer than driving a car.	2.86	1.066
Q24	Riding on a bus is safer than driving a motorcycle.	3.16	0.968
Q25	Using public transport make me feel safe during daily travel.	2.70	0.990
Q26	I feel joyful while riding on a bus.	2.22	0.919
Q27	I have information regarding available bus services surrounding my household.	2.34	1.073
Q28	I am more inclined to ride the bus, if the bus service was made free in the city centre.	3.18	0.969
Q29	I have always dreamt of owning a passenger car, though it is unfeasible.	2.40	1.224
Q30	I might keep my intentions of a car-purchase even though car parking is not available at my house.	2.22	1.165
Q31	Car ownership increases my social status.	2.69	1.102
Q32	Driving car makes me feel more confident in communication.	2.68	1.100
Q33	Using a car makes me more efficient at work.	2.58	1.095
Q34	Motorcycle use should be limited for emission reduction.	2.93	1.029
Q35	Motorcycle fleets that do not meet environmental standard, should be forbidden for daily-use	3.10	1.040
Q36	I am willing to accept Traffic Demand Management measures such as bans on motorcycle use based on specified hours and specified areas for congestion reduction.	3.31	0.869
Q37	I am willing to accept regular inspections for motorcycle fleets in order to contribute to air quality improvement.	2.93	0.988
Q38	I am willing to accept policies that increase penalties and fines for acts of violating safety rules in order to reduce motorcycle accident fatalities.	3.44	0.829
Q39	I intend to use eco-bus even though the travel fare might be more expensive than that of conventional ones.	3.09	0.914
Q40	For a long-distance trip, I intend to drive a motorcycle as less as possible.	2.92	1.102
Q41	I intend to use public transport with higher-fare if its service (travel time, comfort, and reliability) is improved.	3.37	0.865
Q42	Though I have my own car, under certain circumstances I might use MRT.	3.31	0.853
Q43	I intend to use MRT if my destination is only a 15-minute-walk from the closest station.	3.04	0.974
Q44	In case of increased parking charge in the city centre, I am willing to use mass rapid transit for the trip to the city centre.	3.26	0.908
Q45	If the parking-charge at train stations is lower than the normal cost, I would use mass rapid transit after driving motorcycle to MRT stations.	3.14	0.950

6. 4 DATA ANALYSIS

Different analyses were performed to explore predictors for existing behaviours, travel intentions, and future MRT choices. First, discriminate analysis was employed to clarify

important factors influencing motorcycle use in commuting trips. Samples for this step were only commuters.

Table 6.9 : Factor loadings, and Cronbach's alpha of factor extracted

Item	Factors/ Statements	Factor loading	α
	Pro-Motorcycle		.572
Q21	Though my work place/school is near my house, I still want to ride a motorcycle there.	.812	
Q20	I always ride a motorcycle even if it takes only 15 minutes to walk from the origin to the destination.	.689	
Q22	During a long trip, I would like to ride a motorcycle even though it is probably faster to use a bus.	.657	
	Bus Safety Belief		.840
Q23	Taking transit is safer than driving a car.	.886	
Q25	Using public transport make me feel safe during daily travel.	.848	
Q24	Riding on a bus is safer than driving a motorcycle.	.818	
	Pro-Automobile		.870
Q31	Car ownership increases my social status.	.885	
Q32	Driving car makes me feel more confident in communication.	.879	
Q33	Using a car makes me more efficient at work.	.843	
	Pro-Environment		.573
Q35	Motorcycle fleets that do not meet environmental standard, should be forbidden for daily-use	.820	
Q34	Motorcycle use should be limited for emission reduction.	.709	
	Measure Acceptance		.775
Q36	I am willing to accept Traffic Demand Management measures such as bans on motorcycle use based on specified hours and specified areas for congestion reduction.	.850	
Q38	I am willing to accept policies that increase penalties and fines for acts of violating safety rules in order to reduce motorcycle accident fatalities.	.790	
Q37	I am willing to accept regular inspections for motorcycle fleets in order to contribute to air quality improvement.	.782	
	Mass rapid transit intention		.756
Q42	Though I have my own car, under certain circumstances I might use MRT.	.805	
Q44	In case of increased parking charge in the city centre, I am willing to use mass rapid transit for the trip to the city centre.	.743	
Q45	If the parking-charge at train stations is lower than the normal cost, I would use mass rapid transit after driving motorcycle to MRT stations.	.740	
Q43	I intend to use MRT if my destination is only a 15-minute-walk from the closest station.	.611	

Second, factor analysis was conducted to identify underlying dimensions. A factor analysis was run in IBM SPSS Statistics 22.0.0.0 with varimax rotation on the attitudinal items (see Table 6.9). Six factors were identied and named as Pro-Motorcycle, Bus safety belief, Pro-Automobile, Pro-Enviroment, Measure Acceptance, and Mass rapid transit intention. The factor scores were calculated by regression method and are normalized to set

the neutral position at zero. Cronbach's alphas were computed to confirm factor reliability. Factor loadings are presented in Table 6.9, which include all item loadings >.3. Cronbach's alpha values were calculated for reliability analysis. It was found that alpha values for Pro-Motorcycle and Pro-Environment are lower than that of the other factors. This indicates that people still have diverse opinions about motorcycle dependence and environment reservation.

Thirdly, Structural Equation Modelling was conducted to find structural relationships among underlying factors and mass rapid transit intention. Observed and latent variables were identified by factor analysis with varimax rotation. Other observed variables were constructed by coding socio-economic characteristics and preferences on convenience, bus, and motorcycle. Finally, Binary logit models were applied to assess the relative impacts of predictors to mass rapid transit choices. Independent variables included not only previous variables of Discriminate Analysis and Structural Equation Modelling but also stated preference variabless such as trip chain complexity and traffic flow.

6.4.1 Discriminant analysis

A discriminant analysis using the stepwise method was performed in IBM SPSS Statistics 22.0.0.0 to identify predictors for motorcycle user classification (see Table 6.10). Based on main modes for commuting trips, respondents are grouped as motorcycle users and non-motorcycle users. Since there are two discriminating variables, only Function 1 is calculated. Function 1 has negative values for motorcycle user and positive values for non-motorcycle users. The percentage of original cases is correctly classified as 89.7%.

Table 6.10 : Discriminants variables for motorcycle users (n=204)

		Function 1
Eigenvalues	Eigenvalue	.950
	Canonical Correlation	.698
Wilks' Lambda	Wilks' Lambda	.513
	Sig.	.000
Standardized Canonical Discriminant Function Coefficients	Gender	-.364
	Student	.604
	Income (<= 1 mil. VND)	.497
	Car ownership	.498
	Convenience mind	-.290
Functions at Group Centroids	Non motorcycle user	1.934
	Motorcycle user	-.487
Classification Results	Non motorcycle user	82.9
	Motorcycle user	91.4
	All	89.7%

It is found that gender, occupation, income, car ownership, and preference on convenient trip are discriminant variables of classification. Men and people who have a mindset of convenience are likely to use motorcycles as their main mode in commuting trips. People who have incomes lower than 1 million VND; people who have car ownership; and students are less likely to be motorcycle users.

The importance of predictors is assessed by the standardised discriminant coefficients. The magnitude of these coefficients shows how strongly the discriminating variables influence discriminant scores. It can be seen that the standardised coefficients for Students is greater in magnitude than the coefficients for the other variables. As a result, Student predictors will have the greatest impact on the discriminant scores in comparison with the others.

6.4.2 Structural equation modelling

Based on the results of factor analysis, Structural Equation Modelling by AMOS (an add-on module for IBM SPSS Statistics 22.0.0.0) was utilised to identify structural relationships among latent variables.

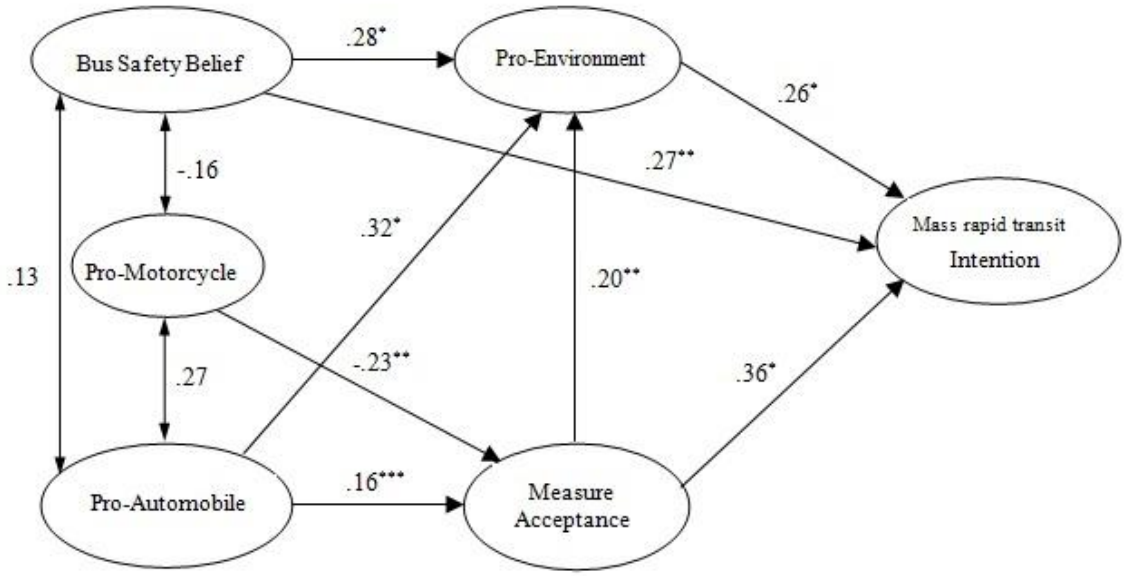


Figure 6.7 : Structure of attitudinal variables and intention

The final model with significant regression coefficients is shown in Figure 6.7. The majority of structural relationships were significant at 99% and 95% level of confidence. Parameters for model fit are described as $\chi 2/DF < 5$, GFI ≈ 0.90, AGFI ≈.90, CFI> 0.90 and RMSEA < .08. There are different measures assessing goodness of fit of SEM model. For example, Marsh and Hocevar (1985) suggest the ratio of chi-square to the degree of freedom ($\chi 2/DF$) should be less than 5. Moreover, GFI, AGFI, and CFI values must be greater than .90 and RMSEA values less than .08 (Bentler and Bonett, 1980; Bentler, 1982; MacCallum et al. 1996). Since it is difficult to attain full goodness-of-fit statistics, and sample size is limited, the model is reasonably considered as a good-enough fit.

It has been found that Bus Safety Belief, Pro-Environment, and Measure Acceptance has a positive effect on MRT intention. High belief in bus safety and high concerns on environment corresponded with respondents being more likely to choose MRT. The positive coefficient (0.36) for the path from Measure Acceptance to Mass rapid transit intention

indicates that how people accept motorcycle controls has the highest impact on MRT intention in comparison with the others variables.

6.4.3 Binary logistic regression

The binary logit model may be appropriate in a motorcycle-dependent context, where motorcycles hold a major role in daily transport. A binary logistic regression was conducted by SPSS 22.0.0 application. Independent variables include socio-economic information (Gender, Age), attitudinal factors extracted, preferences on bus access, residence location (MRT zone and access distance), and Stated preference data (Total travel time, total travel cost, trip chain complexity, and traffic flow).

Table 6.11 : Estimation results for binary logit model

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
	B	B	B	B	B
Gender (*1=Male; 0=Female*)	-.437*	-.458*	-.420*	-.551*	-.548*
Age (*Years*)	.021*	.024*	.022*	.024*	.022*
MRT zone (1= > 10 km; 0= <=10 km)	1.692*	1.787*	1.676*	1.605*	1.641*
Access distance (1= > 1 km; 0= <= 1km)	-.322**	-.356*	-.299**	-.294**	-.368*
Total travel time (minutes)	-.041*	-.043*	-.041*	-.036*	-.036*
Total travel cost (1,000 VND)	-.081*	-.085*	-.083*	-.081*	-.079*
Trip chain complexity *(1=MRT use with egress trip; 0=MRT use without egress trip)*	-.414*	-.474*	-.514*	-.601*	-.620*
Traffic flow *(1=Congested; 0=No)*		1.362*	1.394*	1.454*	1.482*
Bus access by motorcycle (1= Yes; 0=No)			.529*	.507*	.398**
Pro-Motorcycle				-.296*	-.304*
Pro-Automobile				-.297*	-.284*
Bus Safety Belief				.009	.022
Pro-Environment				-.102	-.103
Measure Acceptance				.063	.057
MRT Intention					.284*
Constant	2.087	1.413*	1.106**	.889	1.014***
Number of observation	1496				
Initial log likelihood	1995.944				
Converged log likelihood	1826.251	1690.216	1671.153	1623.184	1603.581
Cox & Snell R Square	.107	.185	.195	.221	.231
Nagelkerke R Square	.146	.251	.265	.299	.313
McFadden ρ^2	.085	.153	.163	.187	.197
Percentage correct (%)	66.6	71.9	71.9	72.7	73.0

B: Coefficient

* Significant at 0.01 level; ** Significant at 0.05 level; *** Significant at 0.1 level;

Table 6.11 provides results of five Binary logit models on predicting mass rapid transit choices. While variables of Model 1 are Gender, Age, MRT zone, Access zone, Total travel time, Total travel cost, and trip chain complexity, Model 2 includes variables of Model 1 and Traffic flow. Model 3 includes variables of Model 2 and Bus access by motorcycle. Model 3 adding attitudinal factors such as Pro-Motorcycle, Pro-Automobile, Bus Safety Belief, Pro-Environment, and Measure Acceptance to becomes Model 4. Finally, variables of Model 4 and MRT intentions are included in Model 5. For assessment of overall model fit, McFadden's

pseudo R-squared of Model 1 (0.085) is lower than that of Model 2 (0.153), Model 3 (0.163), Model 4 (0.187) and Model 5 (0.197). This indicates that SP variables (trip chain complexity and traffic flow), preferences, attitudes, and intentions result in the improvement of model fit.

In Model 1, it can be seen that being female, older age, long-distance trip, and the proximity to MRT station are all significant predictors of increased mass rapid transit choices. Travel time and travel costs are traditional variables decreasing the probability of using MRT. In Model 2, significant variables include predictors found in Model 1 and traffic congestion. In Model 3, significant variables include predictors found in Model 3 and preference for driving motorcycles to gain bus access. In Model 4, significant variables include predictors found in Model 4 and attitudinal factors such as Pro-Motorcycle, Pro-Automobile. Bus Safety Belief, Pro-Environment, and Measure Acceptance are not to be significant in binary logit models. In Model 5, significant variables include predictors found in Model 4 and mass rapid transit intention. In five models, all significant relationships are evaluated at 1% or 5% level of significance.

6. 5 SUMMARY OF FINDINGS

The growth of motorcycle use is a distinctive characteristic of motorisation in developing countries. There is a high rate of motorcycle ownership and use in Asia in comparison to other regions in the world. Additionally, cities within developing countries have built mass rapid transit system in recent decades. The challenge faced is to understand how to shift private vehicle users, especially motorcycle users, to mass rapid transit. In the case of Taiwan, motorcycle use continues to prevail in spite of improved public transport and higher capita income. There is an assumption that motorcycle dependence has existed for a long time, which has an effect on public transport behaviour. Due to limited resources, cities within developing countries, particularly small and medium sized cities, may develop MRT system in the future after motorcycle use has become popular. In that condition, shifting motorcycle users to MRT will be more difficult and challenging due to motorcycle dependence. However, analysis results show that motorcycle dependence can negatively influence MRT choices, but it is not the most important predictor. Trip chaining complexity and traffic condition have more impacts on MRT choices than the others, such as parking fare change in CBD's and MRT intention. Moreover, Pro-Environment, Measure Acceptance, and Bus Safety Belief have relationships with MRT intention, whereas these factors are not predictors of MRT choice. In contrary, Pro-Motorcycle and Pro-Automobile have negative impacts on MRT choice, while they are not associated with MRT intention. Preference of driving motorcycles to access bus services has an effect on both MRT intentions and choices.

The results need to be interpreted and analysed in comparison with previous studies. A study in Northern California shows that car dependency has a higher influence on vehicle miles driven (VMD) per week than other underlying factors (Handy et al., 2005). Tangphaisankun et al. (2011) find that car oriented commuters tend to have more car use than non-car oriented groups in Bangkok (Thailand). Javid et al. (2012) identify that being auto oriented has negative impacts on public transport use intention, but the magnitude of being auto oriented is still lower than that of transit oriented. In Manila (Philippines), car oriented has more influence on the limitation of using jeepney's in comparison to service oriented (Okamura et al., 2013). Corresponding to previous studies, the results are consistent with the

view that private vehicle dependence has negative effects on public transport use and positive influences on private vehicle use.

It was found that being Pro-Motorcycle has direct effects on MRT choices but has no relationship with MRT intention. This is different from previous studies in which auto/car oriented was negatively associated with the intention of public transport use (Javid et al., 2012; Okamura et al., 2013). It can be explained that the lack of MRT use experience makes respondents have MRT intention without any considerations. Therefore, there is no association between Pro-Motorcycle and MRT intention. SP questions with detailed descriptions make respondents understand MRT use in real conditions. Therefore, the results of binary logistic regression identify the relationships between Pro-Motorcycle and MRT choice behaviours.

The results of the SEM model and Binary logit model shows that independent variables have different influences on MRT intentions and choice behaviours. Some factors such as Pro-Motorcycle and Pro-Automobile are insignificantly related to MRT intention, but they undermine MRT choice over time. Bus safety belief, Pro-Environment, and Measure Acceptance contribute to MRT intention that directly affect MRT choice. Therefore, it is necessary to have policies on raising environmental awareness, emphasising safety functions of bus services, and managing motorcycle use in order to enhance future MRT development.

The important roles of trip chaining complexity and traffic condition can be explained by local characteristics. First, door-to-door trips make motorcycle transportation the most convenient mode. Commuters prefer a travel mode that provides trip chain that is less complex. Therefore, destinations that are far away from their previous station will not be a priority for MRT use. Second, motorcycle use accounts for more than 90% of travel demand in Ho Chi Minh City. As a result there are many motorcycles on the streets during peak hours. Previous studies indicate that motorcycle use is very useful to overcome traffic congestion. If people prefer MRT to motorcycles in peak hours, it means that the number of motorcycles has reached a critical level. If there is a higher possibility of traffic congestion then travellers will choose to select of alternative mode of transport for a more reliable trip. In SP questions, 15 minutes is assumed as delay time in peak hours. Since traffic condition affect MRT choices, it indicates that fifteen-minute periods of time may be the threshold for behaviour change in motorcycle use. In comparison with Bangkok (Thailand), this duration is not so high. It is likely that motorcycle dependence makes motorcycle users have different definitions on what is an acceptable waiting time during peak hours.

It can be seen that the application of SEM identifies important factors contributing to MRT intention, while the Binary logit model combined with Stated preference data is appropriate for mode choice modelling. The combination of the two methods is consistent with MRT choice forecast while MRT has not yet operated in a motorcycle dependent context.

The results confirm that Pro-Motorcycle negatively affects MRT choices. However, the acceptance of trip chaining complexity and the concerns on traffic congestion are important predictors influencing MRT choices. The relationships among predictors, travel intentions, and travel choices are summarised in a conceptual framework (see Figure 6.8). This result can be used to implement transport planning policies for motorcycle dependent regions where MRT systems have not yet been constructed, and public transport services cannot meet increasing travel demand. Although data is collected in Ho Chi Minh City- a megacity, this

result can be applicable for medium-sized cities that may become motorcycle dependent cities in the future.

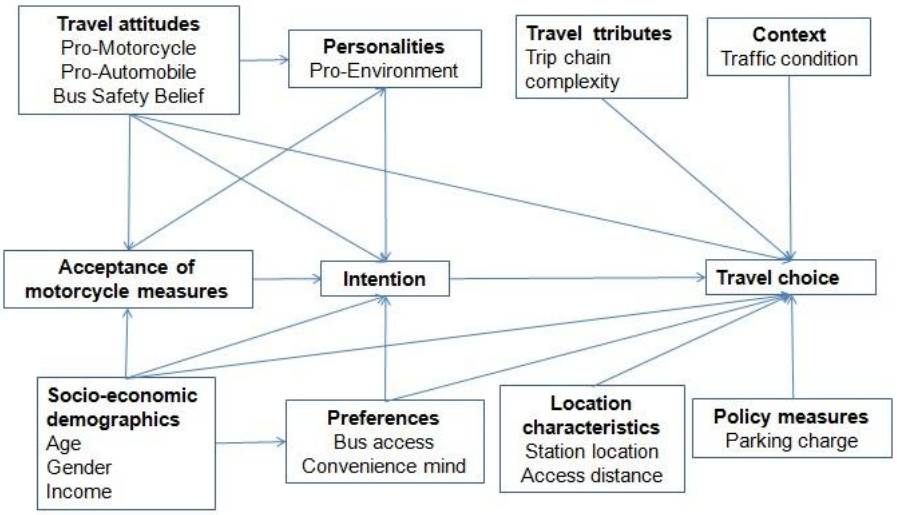


Figure 6.8 : Conceptual framework

Since motorcycle is the dominant mode of transport in Ho Chi Minh City, most of the respondents have great reliance on motorcycles in daily travel. The application of the binary logit model is appropriate since the other modes such as bus, car, motorcycle taxi, and taxi account for just a small proportion of travel demand. However, the findings must be interpreted in the context of a number of potential limitations. First, MRT systems have not been implemented in HCMC yet. Therefore, it is challenging to expect respondents to perceive the advantages and disadvantages of using MRT in data sampling process. Second, the comparison between motorcycle and other public transport modes such as bus and taxi are un-balanced. Motorcycle taxis are regarded as a personal service with high travel costs. Buses provide affordable fares, but are limited in service quality and accessibility. On the contrary, motorcycle use is always more convenient and cheaper than taking buses and motorcycle taxis. Consequently, respondents may have bias answers for many "trade-off" questions.

In conclusion, motorcycle dependence will affect future MRT use although it may have no relationship with MRT intention. However, trip chaining complexity and traffic condition are found to be main factors affecting travellers MRT choices. The association between motorcycle dependence and trip chaining complexity, and how traffic congestion affects other modal shifts in motorcycle dependent cities should be explored more for achieving the goals of sustainable mobility.

CHAPTER 7

7. POLICY RECOMMENDATION AND CONCLUSION

This thesis focuses on people's travel intentions to answer the possibility to integrate motorcycles into the mass rapid transit system and the potential success of the integration. This chapter examines the process in which research questions were answered (see Figure 7.1). Finally, the thesis discusses research contributions to present policy implications for Ho Chi Minh City and other cities within developing countries. Moreover, limitations of the study and future studies are outlined.

7. 1 SUMMARY OF FINDINGS

7.1.1 The emerging role of motorcycle

The overview of motorcycle phenomenon in developing countries is presented in Chapter 2. Contrary to developed countries, increasing automobile and motorcycle use are two aspects of motorisation in developing countries. There is a high growth of motorcycle ownership and use in some cities within Asia, while motorcycle use is growing in many cities of Africa and Latin America. Motorcycles are used not only as a personal mode of transport but also as a form of public transport and commercial utility. Many metropolitans have implemented mass rapid transit system in order to improve public transport services, to reduce the use of private transport, and to tackle the consequences of urban transport problems such as traffic congestion and environmental pollution. However, the construction of MRT systems may be implemented too late in many low and medium economics where motorcycles have already potentially become an important mode of urban transport. When motorcycle use becomes a long standing habit, there are more challenges for developing public transport services, especially mass rapid transit system. Policies need to be implemented before the state of motorcycle dependence begins. Understanding travel intention is necessary to conduct appropriate approaches that contribute to the future integration of mass rapid transit and motorcycles.

7.1.2 Potential changes of travel behaviours

The relationships between travel intentions and attitudes and preferences have been explored. First, the evaluation of attitudinal factors contribute to the division of commuters into four groups, named: '*Choice oriented*', '*Bus preferred'*, '*Car preferred'*, and '*Motorcycle dependent'*. These groups have different socio-economic characteristics and travel patterns, preferences, and travel intentions. '*Choice oriented*' and '*Bus preferred'* groups tend to accept trip chaining complexity. These groups also intend to use public transport, and limit private vehicle use more than the others. The more commuters are bus oriented, the more they intend to use existing public transport. Motorcycle dependent group is less likely to access bus service if it is possible. However, there are no differences on future MRT use among commuter groups. Second, the relationship between preferences and travel intentions are examined. In reference to bus access, preferences on the walking and bus transfer affect bus use intention, while bus access preferences by motorcycle have more of an association with future MRT use.

Analysis results show that frequent motorcycle use has relationship with increase of motorcycle oriented and decrease of bus oriented. People who frequently use motorcycle taxi

tend to be more bus oriented and to favour riding motorcycle to bus station. However, motorcycle use is not related to car oriented. Motorcycle use is directly associated with some travel intentions. People who rarely use motorcycles will consider using other means for long trips. Commuters who have frequent motorcycle use do not intend to use buses when it is possible. Where there is an option of either motorcycles and cars, commuters who drive motorcycles will choose to use automobile less. People who have less motorcycles use intend to have more bus use.

In brief, different commuter groups will have different travel intentions based on diverse of attitudes, preferences, and motorcycle use frequency. People who are bus oriented intend to have bus use and to reduce motorcycle use. People with specific preferences in bus access and motorcycle taxi experiences have the intentions of mass rapid transit use. Long trip are preferred for future mass rapid transit use. It indicates that travel behaviours of motorcycle dependent cities have potential to be changed under new transit developments.

7.1.3 Motorcycle use intentions

It is found that commuters have different assessments of urban traffic context between city centre and local area. The central area is negatively evaluated in term of traffic condition and safety. In new residential developments, good public transport has potential market for motorcycle users in comparison with conventional bus.

Behavioural intentions vary by differences on demographic characteristics, travel patterns, traffic concerns, and transit preferences. While gender and walking habits have a relationship with motorcycle use reduction, income is associated more with car use intention. Bus use frequency contributes to alternative transit use in case of traffic congestion. People who have walking habit or young people also intend to have more bus use. Motorcycle safety awareness affects car use intention, but has less effect on motorcycle use reduction. Commuters who have high car use concern also have more alternative transit use to avoid traffic congestion. Bus safety belief holds an important role in explaining motorcycle use reduction and further intention to use public transportation. Transit preferences related to time and distance were more important than comfort and convenience for bus use intention. It is understood that bus services are limited in reliability and long trip. Therefore, the improvement of bus services should be focused, including service quality (schedule, parking, bus stops). Since comfort and convenience hold vital roles for alternative transit intention, walking environment should be considered in order to attract people to MRT use. People consider Park-and-Ride trips are for long journeys, parking difficulties, and congestion conditions. Travel cost has a higher influence on P&R choices than travel time.

It is summarized that motorcycle use intentions are associated with gender, walking activity, motorcycle safety awareness, and bus safety belief. Park-and-Ride trips are preferable for the combination of motorcycle and mass rapid transit under some circumstances.

7.1.4 Factors influencing the future choices of mass rapid transit use

Socio-economic factors and preferences have been found to be predictors of motorcycle use. Women, students, low-income people, people who have car ownership or prefer comfort to convenience are less likely to use motorcycles for commuting trips. Those who have a high level of bus safety belief, are pro-environment or have measure acceptance are likely to have mass rapid transit intention.

Although Pro-Automobile and Pro-Motorcycle have no relationship with MRT intention, these factors do have an influence on MRT choices. However, trip complexity and traffic conditions are major predictors of MRT choice behaviour in comparison with other factors. It indicates that the motorcycle dependence will not be a main obstacle for future MRT use. Motorcycle use for bus access is an important factor affecting both MRT intentions and choices.

The results of Structural Equation Modelling and the Binary logit model shows that applying the Stated preference technique alongside the Reveal preference data contributes to commuters' MRT choices with consideration. In addition, it indicates that there is a gap in identifying important determinants of MRT intentions and that of MRT choices.

7. 2 POLICY DEVELOPMENT

7.2.1 Implication for Ho Chi Minh City

Since motorcycles became the dominant mode in urban transport, it is challenging to shift commuters from motorcycle to public transport. Even though MRT systems were established, there would still be many challenges for motorcycle use management. Based on research findings, some policies can be proposed as follows.

+ Regulations of motorcycle taxi service

Motorcycle taxi use experience contributes to bus oriented and bus access preferences, affecting bus use intention as well as motorcycle use. However, motorcycle taxi services are limited in travel capacity and travel cost is higher than conventional buses. Since motorcycle taxis play a minor role as para-transit, it is necessary to reform the provisions of motorcycle taxis and regulate motorcycle taxis to become a feeder mode of conventional buses and future MRT. It aims to improve symbolic and functional images of motorcycle taxi, encouraging affordable access for bus use.

+ Bus reforms in new urban developments

Bus service currently plays the main role of public transport. Experiences from Bangkok (Thailand) and Manila (the Philippines) prove that para-transit can provide mobility for short distances at a reasonable cost. The absence of para-transit results in difficulties for gaining bus access. Using motorcycle taxis is more expensive than riding the bus. Therefore, small and medium-sized buses should be encouraged to become para –transit modes, particularly in new urban area, in order to collect passengers for conventional buses.

It is found that students and workers are the main users of bus services due to their being highly bus oriented. Students and people whose income is classed as low, earning less than 1 million VND prefer to ride motorcycles for commuting trips. Bus subsidy policies mainly support students and workers, and contribute to maintain bus patronage. However, in the future it may undermine further improvement of bus service quality and MRT performance. Therefore, more commuter groups based on income and commuting time should be included in bus subsidy programmes.

+ Transit fare encouragement

People who accept bus transfers are likely to use MRT in the future. In addition, people who use buses more frequently in new residential developments also intend to use MRT to access city centres. Therefore, fare discount should be considered for bus users to encourage multi trips on bus and MRT. Since MRT uses are statistically preferred for long trips, basic

fare for short trips should be reduced to promote more MRT use. The reduction of MRT fares should be conducted in peak hours, so people can have Park-and-Ride trips.

+ *Parking controls in city centre and suburban stations*

Since Park-and-Ride trips can be affected by parking constraints in city centres, limitation of motorcycle parking areas can be an option of parking controls. Providing low parking fees at suburban stations can encourage commuters living far from city centres to have Park-and-Ride trips.

+ *Park-and-Ride schemes for bus uses and suburban areas*

Motorcycle is considered as an access mode to future MRT. Since bus access preferences on motorcycle use are related to MRT intentions and choices, it is important to make commuters familiar with bus-based Park-and-Ride. The combination of bus and motorcycle should be encouraged for long trips. Park-and-Ride facilities should be located at city peripherals. When people get used to bus-based Park-and-Ride practice, rail-based Park-and-Ride will be more widely accepted.

+ *Campaign programs for traffic safety and environment*

Lack of safety is the biggest limitation of motorcycle use. Therefore, safety awareness will encourage people to have use motorcycles less and increase bus use intention. Bus safety belief should be emphasized so that more bus use is intended in new urban areas. While bus safety belief only has a relationship with MRT intentions, this factor does not affect MRT choice. Bus service quality should be improved soon because bus safety belief is not enough to make travellers maintain bus use intention.

Pro-Environment is found to be an important factor influencing MRT intentions. MRT performance that reduces private vehicle use will contribute to maintaining a clean environment. Therefore, environment protection campaigns such eco fuel use, garbage classification, and non-plastic use should be implemented in order to enhance MRT intentions.

When the MRT system is up and running, motorcycle controls must be implemented in order to encourage travellers to shift from motorcycle to MRT. Therefore, the acceptance of motorcycle management is extremely important. Campaign programs should focus on motorcycle's disadvantages and MRT's benefits to help people accept measures in motorcycle use.

+ *Land use and transport planning integration*

Besides para-transit policies and Park-and-Ride schemes, land use and transport planning should be considered to assist in changing trip chaining behaviour. Research results indicate that MRT use without egress trips would be preferred more than other trips. Therefore, the integration of land use and transport planning should be implemented in surrounding station areas in order to encourage MRT station areas to become more liveable neighbourhoods.

7.2.2 Implication for developing-country cities

Based on the results of this study, a set of broad policy suggestions are considered for cities within developing countries where motorcycle are becoming an important mode of urban transport. Implications for developing-countries are summarised as follows:

It has been found that experience of using motorcycle taxis contribute to travellers' transit habits. However, motorcycle taxis are regarded as private services competing with

taxis and conventional buses in Ho Chi Minh City. Since motorcycles can be used as feeder modes of public transport or as motorcycle-based public transport services in other cities within developing countries, the effect of motorcycle taxi use on future MRT choices may be slightly changed.

Since motorcycle is the dominant mode of transport in Ho Chi Minh City, limited alternatives including motorcycle and mass rapid transit has been hypothesised for modelling mode choice behaviours. However, cities of others developing countries have the diversity of transport modes such as motorcycle, car, bus, para-transit, mass rapid transit, bus rapid transit, mono-rail, and tramway. People have to decide their choices among a set of alternatives. Therefore, other logit models such as multinomial logit model and nested logit model can be applied for modelling travel behaviours regarding mass rapid transit use.

Among the common characteristics of cities within developing countries, the security problems mainly relate to pedestrians, cyclists, car users, and public transport passengers (Gwilliam, 2003). While motorcycle use is generally considered in terms of environment and safety, security aspects have been forgotten about in some circumstances. It was found that women prefer to use public transport and are less likely to be riders of motorbike taxis in sub-Sahara cities (Sietching et al., 2012). Therefore, security problems are probably determinants of motorcycle use of women in some cities within developing countries. In this context, additional attitudes and preferences may be required to identify the impact of security problems on travel intentions.

Although HCMC was selected as a case study, the research findings are also useful for small and medium-sized cities that are likely to become metropolitans in the future. It was found that these cities are likely to become motorcycle-dependent due to high growth of motorcycle use and inefficient performance of existing public transport. In this context, travel distance may not have many influences on MRT choice, in comparison with other factors. In addition, Park-and-Ride schemes may be applicable in some circumstances contrary from that of the HCMC case.

Since investment on mass rapid transit systems need high capital for implementation, other transit alternatives such as bus rapid transit and monorail can be suggested for low income countries. In this case, survey instruments of this study can be revised and utilised to grasp people's attitudes, preferences, and intentions regarding new transit alternatives.

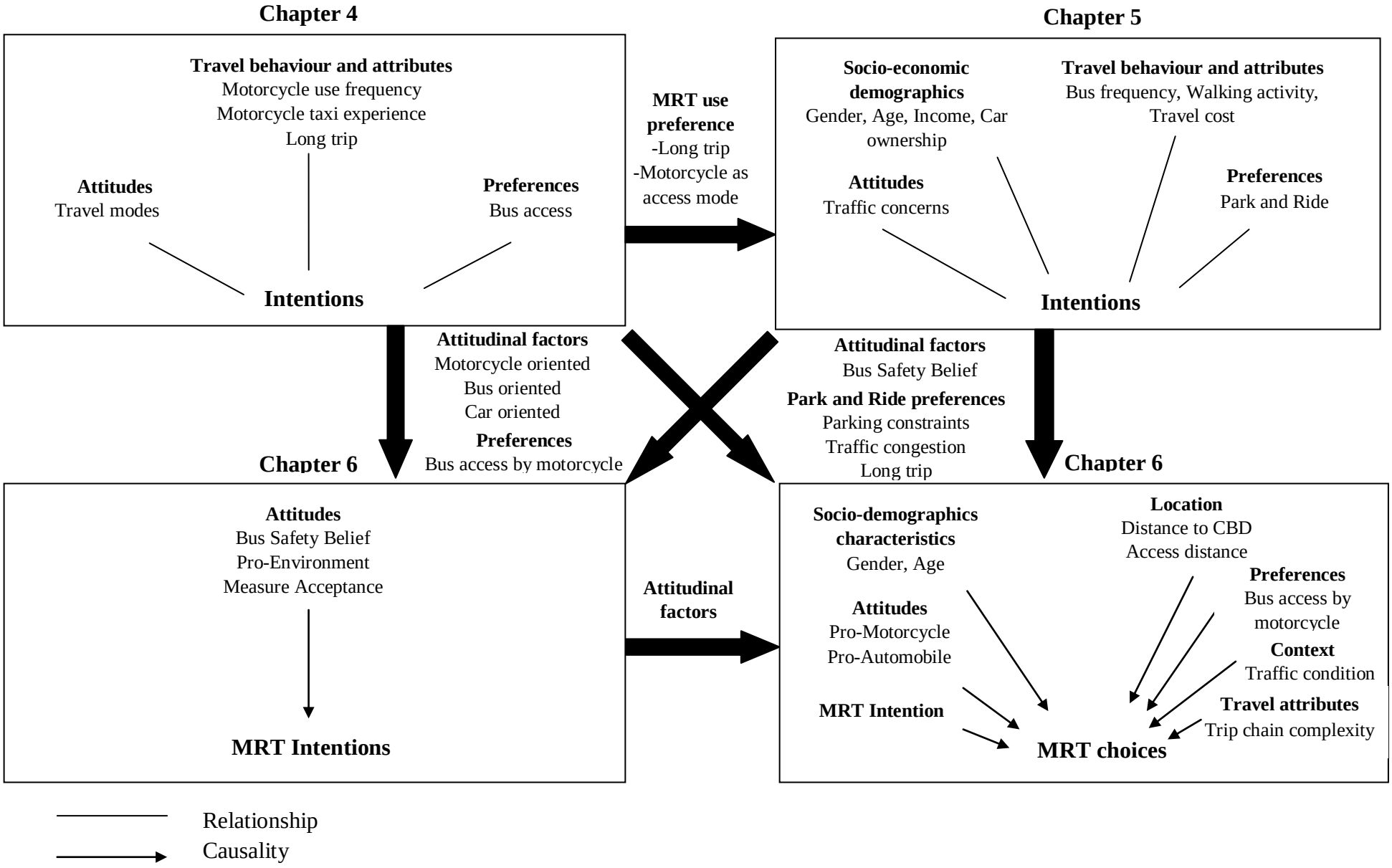


Figure 7.1 : Inter relationships among chapters

7. 3 FUTURE PROSPECTS

As a phenomenon of motorisation, motorcycle use becomes an important aspect of urban transport within many cities in developing countries. The popularity of motorcycle use provides opportunities for personal mobility and creates challenges for transport planning. Since MRT systems were introduced in megacities of developing countries, it is important to identify the new role of motorcycles to meet the goal of sustainable development. This study has explored factors influencing travel intention in a motorcycle-based city, in order to contribute to the integration of mass rapid transit and motorcycle use.

Although this thesis focuses on travel intention, the effects of intention on mode choice behaviour are also explored. Travel intention is seen as a mediating factor affecting future mass rapid transit choice. However, predictors of travel intention do not always have a correlating relationship with the actual choices made. Whether mass rapid transit systems will be implemented soon and whether motorcycle use will become a long standing habit will result in a different outcome for the role of motorcycles in cities within developing countries. Reliance on motorcycle use will negatively affect transit choices. However, the existence of mass rapid transit systems also affects the intentions of using public transport in a motorcycle-based context. It is necessary to explore travel intentions regarding the difference in time in order to verify changes in determinants of travel intentions and mode choice behaviours in motorcycle dependent cities.

It was found that traffic conditions and trip chaining complexity have a higher impact on mass rapid transit choices rather than intention. However, these predictors were assumed in Stated preference questions. Although respondents received a careful explanation about the condition of mass rapid transit use, hypothetical bias may still occur. The effects of trip chaining complexity might be overestimated if respondents have prejudices on congestion and multi-chain trip. Therefore, influences of trip chaining complexity on travel intention need to be explored more.

While motorcycles are used as a private mode of urban transport in many cities of South and South East Asia, motorcycles are primarily utilised as public transport modes in sub-Sahara cities. It is forecasted that motorcycles will soon be used as private modes of transport, and the implementation of MRT systems will begin late in African cities. Therefore, the findings of this thesis may be considered for motorcycle mobility management in those cities. Further studies should focus more on travel intentions of low and high income people to provide comprehensive views. It aims to encourage motorcycle to become a part, rather than a dominant mode in the diversity of urban transport.

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APPENDIX 1

QUESTIONNAIRE SHEET FOR THE FIRST FIELD SURVEY

A questionnaire survey for commuting trip in city center

Conducted by HCMC University of Transport/Toyo University

A. General information

A1. Gender □ Male □ Female **A2**. Age (years) ……

A3.Residence address: City/Province……District……
Ward/Commune…….Street name…….Land mark……

A4.Work place/School address: City/Province……District……
Ward/Commune…….Street name…….Land mark……

A5. Occupation

□ Manager *(e.g. Director, vice-director, team leader, etc)*	□ Professional *(e.g. doctors, engineers, architects, lawyers, etc)*	□ Skilled worker *(e.g. mechanics, technicians, computer specialists, etc)*	□ Handicrafts person *(e.g. all kinds of artisans)*
□ Office Staff	□ Government official	□ Laborer	□ Salesperson
□ Soldier	□ Policeman	□ Driver	□ Home helper
□ Housewife	□ Unemployed	□ Retired	□ Teacher
□ School staff	□ Student (working)	□ Student (not working)	□ Others……

For A6, A7, A8, the term of 'household' is understood as 'single-person household' or 'individual' in case you live alone or you do not live with your family, e.g. student.

A6. Household composition

Age group	<6 yrs	6-18 yrs	18-22 yrs	22-60 yrs	>60 yrs
Commuter (*)					
Being not commuter					

(*) Commuters are persons who have regular trips in weekday between specific origin and destinations. Going to schools, going to offices are some kind of regular trips.

A7.Number vehicles used by household

Bicycle		Motorcycle		Passenger car		Others
E-bike	Normal	<50 cc	>=50 cc	<=5 pax	>5 pax	(……..)

A8. How much is your household income? (Unit: million VND/month)

□ No income □ Under 1 □ 1 -1.5 □ 1.5-2.5 □2.5-4 □4-6 □6-8
□ 8-10 □ 10-15 □ 15-20 □ 20-25 □ 25-30 □ 30-50 □ 50 or more

B. Travel and trip patterns

B1. The frequency of transportation mode which you have experienced in recent year

	Bicycle	Motorcycle	Motorcycle taxi	Passenger car	Taxi	School/Company bus	City bus
1 -2days/week	□	□	□	□	□	□	□
3-5 days/week	□	□	□	□	□	□	□
5 days/week and more	□	□	□	□	□	□	□
At least 1-2 days/month	□	□	□	□	□	□	□
At least 3-5 days/month	□	□	□	□	□	□	□
At least 1 day/6 months	□	□	□	□	□	□	□
At least 1 day/year	□	□	□	□	□	□	□
No usage	□	□	□	□	□	□	□

B2. What is the main transport mode for commuting trip?

□ Walking □ Bicycle □ Motorcycle □ Car □ Bus □Other (……)

B3. How long is the travel time from your house to office/school?

Present duration	……minutes
Max duration accepted	……minutes

B4. Where do you possibly park your vehicle at office/school?

□School area □ Working place area □Parking nearby □ Other (……)

B5. How much is the parking fee you have experienced? (Unit: VND/day)

□ No information □ 1,000 □ 2,000 □3,000 □4,000 □ 5,000
□ 5,000-10,000 □ 10,000-20,000 □20,000-50,000 □ 50,000-100,000 □ 100,000-150,000 □>150,000

B6. How much is the maximum amount you willing to spend for daily transportation? (Unit: VND/day)

□ 5,000 □10,000 □15,000 □ 20,000 □ 50,000 □ 100,000 □ 150,000 □ >150,000

B7.The daily frequency of business trips outside office/school

□ At least one time per day □ At least two times per day □ At least three times per day □ At least one time per week

B8. What is the maximum duration for your waiting time at bus stops? *(If you have not experienced bus use yet, suppose you have a chance to use bus)*

□ 5 minutes □10 minutes □15 minutes □ 20 minutes □ 25 minutes □ >25 minutes

B9.What are your main reasons for using bus ? *(If you have not experienced bus use yet, suppose you have a chance to use bus)*

□ I have travel concession in using bus.
□ Bus fare is acceptable for my budget.
□There are many bus routes surrounding my house/school/office
□ The bus fleets I experienced are modern and air conditioned
□ Bus stops are near to my house/school/office
□ There is not private vehicle available in my household
□ I am still immature to have driving right
□ I rarely go out during working hour
□ I do not have trip sharing with my family members.
□ I dislike travelling in hot weather and rainy seasons
□ I feel safer to stay in bus.
□ My health is weak for driving motorcycle/car
□ Bus schedule is punctual
□ I have not got driving license
□ The bus routes I usually use is frequent.
□ My family have no private vehicles
□ Bus use is more economic than private vehicle use
□ Other (Please specify……)

From **B10** to **B13**, please circle appropriate choice based on answers for question B2

1= At least one time in last week; 2= At least one time in last months; 3= At least one time in last three month
4= At least one time in last six months; 5= At least one time in last year; 4=No

For commuters using bicycle/motorcycle/car to office/school

B10	Do you usually have sharing trips to office/school?	1	2	3	4
B11	Have you ever used bus for commuting trip?	1	2	3	4

For commuters using bus to office/school

B12	Have you ever use motorcycle/car to office/school?	1	2	3	4
B13	Have you ever used bus for other trips different from commuting trips?	1	2	3	4

B14. Please select the regular access/egress modes of bus trips *(For commuters using bus to office/school)*

a.Walking b. Bicycle c.Motorcycle (driver) d. Motorcycle (passenger) e. Motorcycle taxi f. Car

	Access						Egress					
To office/school	a	b	c	d	e	f	a	b	c	d	e	f
To home	a	b	c	d	e	f	a	b	c	d	e	f

C. Attitudes and opinions

How do you agree or disagree to the following statement? Please show your level of agreement described by the following scale

1= Strongly disagree 2= Somewhat disagree 3= Somewhat agree 4= Strongly agree

Id	Statement	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
	Trip preferences				
1	I always feel concerned as gasoline price increases.	1	2	3	4
2	I know relatively my weekly transport cost.	1	2	3	4
3	I often consider travel cost for inner city trip.	1	2	3	4
4	I like to be a passenger rather than a driver even though I have a chance to drive.	1	2	3	4
5	I feel stressful when I travel on crowed streets.	1	2	3	4
6	I hate traveling in bad condition (e.g. rush hours, rainy weather)	1	2	3	4
7	Continuous traffic is my priority in daily travel.	1	2	3	4
8	Safety is more important than cost in my daily transportation.	1	2	3	4
9	Saving time is more important than cost in my daily transportation.	1	2	3	4

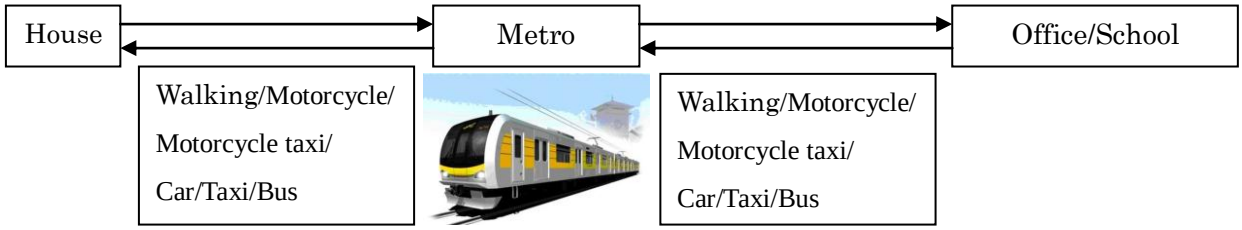
10	I like travel time in control.	1	2	3	4
11	Punctual trip is the priority in daily transportation.	1	2	3	4
12	Convenient trip is my first priority to select the transport mode to go somewhere.	1	2	3	4
13	Convenience is more important than cost in my daily transportation.	1	2	3	4
	Attitudes toward travel modes				
14	Riding motorcycle likes daily basic need.	1	2	3	4
15	Motorcycle is not only a vehicle but also a necessary tool in life.	1	2	3	4
16	I rarely think of alternative mode different motorcycle for going somewhere.	1	2	3	4
17	I still use motorcycle even though it takes only 15 minute walk from the origin to the destination.	1	2	3	4
18	It is normal to have one-hour trip by using motorcycle.	1	2	3	4
19	I always dream of owning passenger car even though it is unfeasible.	1	2	3	4
20	For attending important meeting, I prefer taxi to motorcycle.	1	2	3	4
21	I might keep car purchase intention even thought car parking is not available in my house.	1	2	3	4
22	I prefer bus service to motorcycle taxi to go somewhere in case no vehicle is available in my household.	1	2	3	4
23	I have information about bus schedules and bus routes surrounding my household.	1	2	3	4
24	I used to select bus even though I could use private vehicle.	1	2	3	4
25	I probably use bus in case free buses are available in city center.	1	2	3	4
	Bus access *(Even though you have no experience in bus usage, suppose you may use bus in the future)*				
26	It is normal to have 5-10 minutes for walking to bus stops from the origin.	1	2	3	4
27	I probably use motorcycle to access bus stops from the origin.	1	2	3	4
28	It is possible that my relatives/friends use motorcycle to take me to bus stops.	1	2	3	4
29	I may use motorcycle taxi to access bus stops from the origin.	1	2	3	4
30	It is acceptable to take two bus routes to arrive the destination from the origin.	1	2	3	4
	Behavioral intention				
31	For long trip, I might consider transportation modes different from motorcycle.	1	2	3	4
32	In case I have or will own a car, traffic congestion is not critical for my driving car in city center.	1	2	3	4
33	I still have motorcycle use in case car is available in my household.	1	2	3	4
34	I might use car more than motorcycle in case both are available in my household.	1	2	3	4
35	I intend to use bus more if it is possible.	1	2	3	4

D. Stated scenario

Mass Rapid Transit system has high capacity and frequent schedule. The average speed of MRT is approximately 30-40 km/hour. It usually takes 2 -3 minutes for the distance of 1.5-2 km between two stations nearby. The MRT projects (MRT 1 and MRT 2) are being implemented in Ho Chi Minh City. It is forecasted that construction work of MRT1 and MRT2 will be finished in 2018 and 2019 respectively. For a trip length of 10 km, the cost and the time of different transportation modes are presented in the table below. Suppose bus routes and other transportation modes (motorcycle taxi, taxi) are available around MRT stations. Parking facilities are also set up nearby.

	MRT	Motorcycle	Motorcycle taxi	Car	Taxi	Bus
Time (minutes)	18	20	20	25	25	30
Cost (VND)	>7,000	13,000	40,000	35,000	330,000	8,000

Table 1: Time and cost illustration for 10-km trip



Suppose you are going to office/school or returning back your house in which MRT route is located between your origin and destination. It means that you may be not going to your destination directly by using MRT. Please select you travel choice based on differences on trip types, access and egress modes, and fares. If there is not any specific instruction for answers, please continue to the next alternatives.

Would you like to use future MRT in case…?

	Alternatives	Long trip (>5 km)	Short trip (<=5 km)
D1	It takes only 15 minute to walk to station near your origin	□Yes □ No (Please go to **D4**)	□Yes □ No (Please go to **D4**)
D2	- It takes only 15 minute to walk to station near your origin. -You can use motorcycle/motorcycle taxi/car/taxi/ bus from last station to your destination	□Yes (Please go to **D8**) Egress mode……. □No	□Yes (Please go to **D8**) Egress mode……. □No
D3	- It takes only 15 minute to walk to station near your house. - It takes only 15 minute to walk from last station to your destination	□Yes (Please go to **D8**) □No	□Yes (Please go to **D8**) □No
D4	You can use motorcycle/motorcycle taxi/car/taxi/ bus to access station	□Yes □No (Please go to **D7**)	□Yes □No (Please go to **D7**)
D5	- You can use motorcycle/motorcycle taxi/car/taxi/ bus to access station - You can use motorcycle/motorcycle taxi/car/taxi/ bus from last station to your destination.	□Yes (Please go to **D8**) Access mode…… Egress mode…… □No	□Yes (Please go to **D8**) Access mode…… Egress mode…… □No
D6	-You can use motorcycle/motorcycle taxi/car/taxi/ bus to access station - It takes only 15 minute to walk from last station to your destination.	□Yes (Please go to **D8**) Access mode…… □No	□Yes (Please go to **D8**) Access mode…… □No
D7	The fare minimum is decreased to 5,000 VND? (*)	□Yes □No (No answer for **D8**)	□Yes □No (No answer for **D8**)
D8	The fare minimum is increased to 10,000 VND? (*)	□Yes □No	□Yes □No

(*) The final cost might be higher than the minimum of MRT fare.

Thank you for your cooperation. The information you provided is used only for research.

APPENDIX 2

QUESTIONNAIRE SHEET FOR THE SECOND FIELD SURVEY

A household survey for new residential developments

Conducted by HCMC University of Transport/Toyo University

Questionnaire survey by Mr Hoang Le Quan (Graduate student at Toyo University, Japan and official of Department of Transportation, Ho Chi Minh City)

This questionnaire survey is being conducted to know your attitudes toward traffic awareness, behavioral intentions and opinions about perceived urban transport and 'park and ride' trip. Your responses will be good contribution to this research and this questionnaire consists of total five (5) pages. It is assured you that any information or data collected here will remain fully confidential and will be used only for research purpose.

General

1. Questionnaire No……**2**.Date (yyyy-mm-dd)……..……..**3**. Time (hh:mm)……..…….
4. Interviewer: ……..……**5**. Interviewee ...…….……
6. Residence address: …… ……..……..…….
7.Work place/school address: …… ……..……

Part A- Individual and household information

Please mark √ in □ or fill in the blank…….

1. Gender	□ Male □ Female	**2**. Age (years)	…….
3. Occupation/Position	□ Manager □ Official □ Office Staff □ Professional □ Teacher/Lecturer □ Sale person □ Laborer/Worker □ Others (……)		
4.Motorcycle driving license	□ Yes □ No	**5**. Car driving license	□ Yes □ No
6. Monthly individual income (million dong)	□ Below 1 □ 1 -2 □ 2-3 □3-4 □4-6 □6-8 □ 8-10 □ 10-15 □ 15-20 □ 20-25 □ 25-30 □ 30-50 □ 50-100 □ 100 or more		
7. Household composition	Total members …… Commuters …… Children lower than 6 years old ……. Children between 6 and 18 years old…….		
8. Number of vehicle	Bicycle:…… Motorcycle:……... Passenger car:……..		
9.Reasons for not purchasing car (*household without car ownership*)	□ No need □ Financial limitation □ No car driver □ No car parking □ Little car use □ Motorcycle dependence		
10. Monthly household income (million dong)	□ Below 1 □ 1 -2 □ 2-3 □3-4 □4-6 □6-8 □ 8-10 □ 10-15 □ 15-20 □ 20-25 □ 25-30 □ 30-50 □ 50-100 □ 100 or more		
11. Housing type at present residence	□ Villa □ Apartment □ Dwelling on street frontage □ Dwelling in valley □ Other (…..……...…..)		
12. Walking distances from your residence to the nearest car-accessed road	□10 m or less □10-20 m □20-50 m □ 50 m or more		
13. Walking distances from your residence to the bus-serviced road	□200 m or less □200-500 m □ 500-1000 m □1000 m or more		
14. Road-based distances from residence to mass transit rapid corridor	□200 m or less □200-500 m □ 500-1000 m □1000-2000 m □2000 m or more		
15. Road-based distances from residence to city center	□ 5 km or less □ 5-8 km □ 8-10 km □ 10-15 km □ 15 km or more		

Part B-Travel patterns

Please mark √ in □ or fill in the blank…….

1. Main transport mode for commuting trip	□ Walking	□ Bicycle	□ Motorcycle	□ Car	□ Bus	□ Other (……)
2. Mode use frequency	Bicycle	Motorcycle	MC taxi	Car	Taxi	Bus
1 -2 days per week	□	□	□	□	□	□
3-4 days per week	□	□	□	□	□	□
5-7 days per week	□	□	□	□	□	□
Sometimes	□	□	□	□	□	□
No usage or rarely	□	□	□	□	□	□

3. Road-based distance for commuting trip	□ 1km or less	□ 1-2 km	□ 2-5 km	□ 5-10 km	□ 10-15 km	□15km or more
4. Average travel duration for commuting trip (Unit : minute)	…….	**5**. Weekly travel expense (including fare, fuel, toll, or parking fee) (Unit :thousand dong)	…….			
6. The context/situation/purpose in which walking is usually a chain for a certain trip	□ Working	□ Studying	□Business	□ Public event	□Shopping	□ Private matter	□ Other (…….……...)	□ No
7. The context/situation/purpose in which you used to drive motorcycle and get on a bus for a certain trip	□ Working	□ Studying	□Business	□ Public event	□Shopping	□ Private matter	□ Other (…….……...)	□ No
8. The context/situation/purpose in which you used to access bus service by car use	□ Working	□ Studying	□Business	□ Public event	□Shopping	□ Private matter	□ Other (…….……)	□ No
9. Parking area for using private vehicle in commuting trips	□School	□ Working place	□ Parking nearby	□ Other (…….……)				
10. Car parking location at house (*For households with car ownership*)	□ Inside house	□On road	□ Local parking	□ Other (…….……)				

Part C-Perceived urban transport

This part aims to know how much you perceive the urban transport of city center and local neighborhood. Please show your level of evaluation in different perspectives such as traffic condition, safety, driving behavior, law enforcement. The evaluation scale is illustrated in the following table.

Example		Strongly	Somewhat	Neutral	Somewhat	Strongly	
Strongly quiet	*Noisy*	*1*	*2*	*3*	*4*	*(5)*	*Quiet*
Somewhat polluted	*Polluted*	*1*	*(2)*	*3*	*4*	*5*	*Fresh*

	Question	Evaluation						
1	How comfortable do you feel about traffic condition in city center?	Uncomfortable	1	2	3	4	5	Comfortable
2	How do you think about traffic safety when travelling in city center?	Risky	1	2	3	4	5	Safe
3	How do you assume people's driving behavior when riding in city center?	Egotistic	1	2	3	4	5	Altruistic
4	How do you assess traffic law enforcement in city center?	Violently	1	2	3	4	5	Seriously
5	How comfortable do you feel about traffic condition in local neighborhood?	Uncomfortable	1	2	3	4	5	Comfortable
6	How do you think about traffic safety when travelling in local neighborhood?	Risky	1	2	3	4	5	Safe
7	How do you assume people's driving behavior when riding in local neighborhood?	Egotistic	1	2	3	4	5	Altruistic
8	How do you assess traffic law enforcement in local neighborhood?	Violently	1	2	3	4	5	Seriously

Part D- Attitudes and Opinions

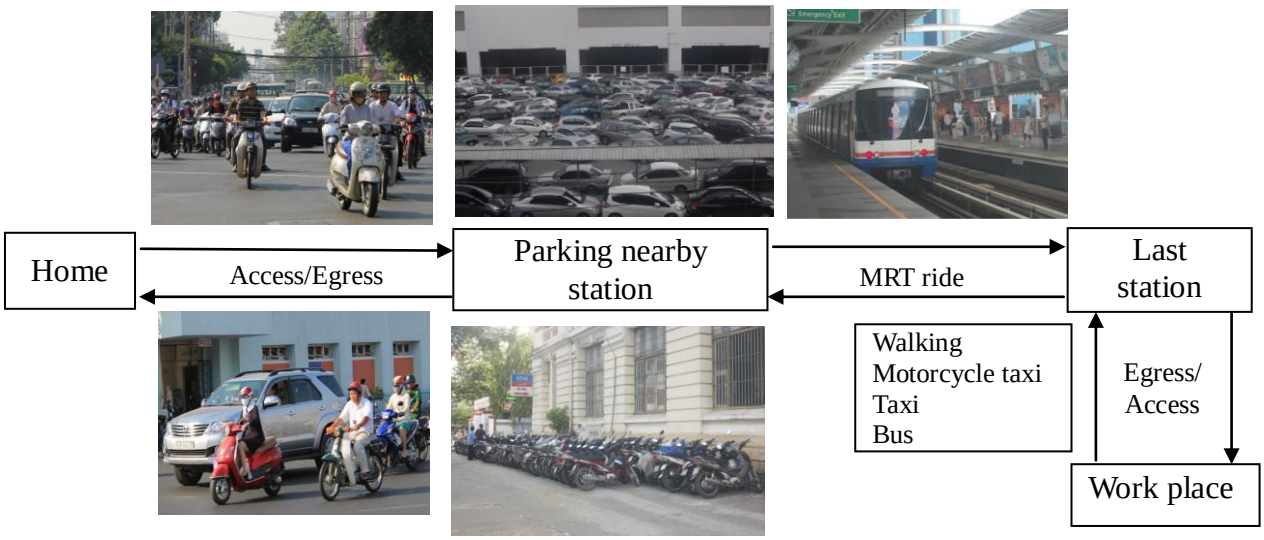
The statements below relate traffic congestion, safety awareness, transit preference, and behavioral intention. Please show your level of agreement described by the following scale: 1= Strongly disagree; 2= Somewhat disagree; 3= Somewhat agree; and 4= Strongly agree.

	Please circle the appropriate number for your best option	**Strongly disagree** →			**Strongly agree**
	Example: I hate traveling in bad condition (e.g. rush hours, rainy weather).	*1*	*2*	*(3)*	*4*
1	It is unsafe for driving motorcycle on highways.	1	2	3	4
2	It is impossible to drive motorcycle in bad weather.	1	2	3	4
3	The majority of road accident fatalities relates to motorcycle usage.	1	2	3	4
4	Using motorcycle is more hazardous overall than traveling by car.	1	2	3	4
5	Driving motorcycle is more dangerous overall than taking transit.	1	2	3	4
6	I feel unsafe in driving motorcycle when I see bus fleets on streets.	1	2	3	4
7	It is risky to drive passenger car in such conditions overwhelmed by motorcycles.	1	2	3	4
8	I always feel nervous in travelling by car	1	2	3	4
9	I almost remember to fasten seatbelt when I get in a car.	1	2	3	4
10	Taking transit is safer than driving car.	1	2	3	4
11	I like to be a passenger than a driver even though I have a chance to drive.	1	2	3	4
12	Using public transport make me feel safer in daily travel.	1	2	3	4
13	I would like to leave my home early or to remain in my office late until traffic congestion eases.	1	2	3	4
14	If possible, I try not to travel in peak hours to avoid traffic congestion.	1	2	3	4
15	Traffic congestion influences much on my daily trip.	1	2	3	4
16	I might use bus service if it takes 5 or 10 minutes for walking access.	1	2	3	4
17	I might use bus service if walking distance from last stop to destination is acceptable (e.g. walking in 5 or 10 minutes)	1	2	3	4
18	I might get on bus if its service quality is improved.	1	2	3	4
19	If the neighborhood from my residence to bus-serviced road were more walkable, I would like to use bus for regular trips.	1	2	3	4
20	For the trips with length longer than 10 km, I prefer public transport to private modes.	1	2	3	4
21	For long trip, I might get on bus after driving motorcycle to bus station.	1	2	3	4
22	If possible, I might get on bus for shopping purposes.	1	2	3	4
23	It is acceptable to walk with duration lower than 15 minutes.	1	2	3	4
24	I intend to have more bus ridership rather than mainly use private vehicle.	1	2	3	4
25	I am willing to use alternative transits those are not influenced by traffic congestion to travel to city center even thought I never or rarely use public transport.	1	2	3	4
26	If possible, I intend to have more ‘park and ride’ trips for motorcycle and bus use.	1	2	3	4
27	I really want to drive motorcycle as less as possible.	1	2	3	4
28	I always want to have more car use frequency.	1	2	3	4

Part E- Park and Ride preferences

The project of mass rapid trasit line No.1 (MRT 1) is being implemented. Suppose the construction of MRT 1 were finished and you could drive motorcycle/car to train stations with parking facilities nearby. Compared to other modes, it is faster to ride MRT in specific distance along railway corridor. In addition, riding MRT is not influenced by traffic congestion. Parking charge, MRT fee, duration and cost of motorcycle, car, and MRT are provided for references.

Parking charge (VND)				MRT cost (VND)			
Motorcycle		Passenger car		3 stations	6 stations	9 stations	12 stations
Half day	One day	1 hour	8 hours	6 minutes	12 minutes	18 minutes	24 minutes
5,000	10,000	10,000	70,000	7,000	14,000	21,000	28,000



1. Park-and-Ride scenarios

Based on the scenarios below, please select choices appropriate for your trip purpose and private vehicle used. In case you have no car ownership, suppose you can use car in some specific conditions. The level of agreement is described by the following scale: 1= Strongly disagree; 2= Somewhat disagree; 3= Somewhat agree; and 4= Strongly agree.

	Scenario	Private vehicle used for 'Park and Ride' trips	
	I might drive motorcycle/car and ride MRT later in case ….	Motorcycle →	Passenger car →
1	I only commute in some specific weekdays.	1 2 3 4	1 2 3 4
2	My work place/school is not so far from last station (e.g 5-10 minute walk)	1 2 3 4	1 2 3 4
3	I can commute with free parking for motorcycle or discount parking for passenger car at transit stations.	1 2 3 4	1 2 3 4
4	The working time begins late (e.g 9 am) at my work place/school.	1 2 3 4	1 2 3 4
5	I have occasional trips (e.g shopping, leisure, private matter, event participation) at city center or area surrounding MRT stations.	1 2 3 4	1 2 3 4
6	I have a long trip (e.g more than 10 km or more than one hour) and go back my residence in the same day.	1 2 3 4	1 2 3 4
7	I have urgent trips in peak hours or at the time there might be traffic congestion	1 2 3 4	1 2 3 4
8	I might be aware that it is difficult to find parking places in city center.	1 2 3 4	1 2 3 4

2. Park-and-Ride choices

Suppose you intend to go to the area surrounding MRT 1 stations. There are some alternatives for your travel modes described below. The pairs of alternatives have both advantages and disadvantages.

Alternative	Description	Alternative	Description
A	Driving motorcycle directly to intended destination with benefits and constraints below. Benefits: - High mobility - Flexible movement Constraints: - Fuel consumption - Possible traffic congestion or flood - High risks of traffic accidents on main roads, highways, truck-allowed roads - Influenced by weather, polluted environment - Difficulties for parking at city center such as no parking near the destination or more extra parking cost	B	Driving motorcycle to MRT station and ride MRT later to intended destination with benefits and constraints below. Benefits: - Only fuel consumption from house to transit station - Free parking at transit station - No influences from traffic congestion or flood Constraints: - Far distance from last station to the destination - Possible influences by weather for egress trip - Extra travel expense for motorcycle taxi/taxi/bus from last station to the destination - Extra time for egress trip to last destination
C	Driving car directly to intended destination with benefits and constraints below. Benefits: - High mobility - High protection from weather, flood, traffic flow Constraints: - Fuel consumption - Possible traffic congestion or flood - Influenced by weather, polluted environment - Difficulties for parking at city center such as no parking near the destination, streets with high traffic flow, narrow roads, car- restricted streets	D	Driving car to MRT station and ride MRT later to intended destination with benefits and constraints below. Benefits: - Only fuel consumption from house to transit station - Discount parking at transit station - No influences from traffic congestion or flood Constraints: - Far distance from last station to the destination - Possible influences by weather for egress trip - Extra travel expense for motorcycle taxi/taxi/bus from last station to the destination - Extra time for egress trip to last destination

Please show your choices for trade off alternatives with different conditions of travel modes (motorcycle, passenger car), duration, and expense.

Which alternative would you prefer for the trips to city centre?

Level of preferences			Strongly	Somewhat	Neutral	Somewhat	Strongly	
		Alternative	◄				►	Alternative
Example: Strongly prefer C		C	①	2	3	4	5	D
Equal travel duration	9	A	1	2	3	4	5	B
	10	C	1	2	3	4	5	D
Equal travel cost	11	A	1	2	3	4	5	B
	12	C	1	2	3	4	5	D

Thank you for your cooperation. The information you provided is used only for research.

APPENDIX 3

QUESTIONNAIRE SHEET FOR THE THIRD FIELD SURVEY

A survey for mass rapid transit demand

Conducted by HCMC University of Transport/Toyo University

Questionnaire survey by Mr Hoang Le Quan (Graduate student at Toyo University, Japan and official of Department of Transportation, Ho Chi Minh City)

This questionnaire survey is being conducted to know your attitudes, opinions, intentions and future choices relating to mass rapid transit demand. Your responses will be good contribution to this research and this questionnaire consists of total four (4) pages. It is assured you that any information or data collected here will remain fully confidential and will be used only for research purpose.

General

1. Questionnaire No…… **2**. Date:……..…….**3**.Interviewer: ……**4**. Interviewee ...…… ……
5. Residence address: District……Ward……..Street……
6.Work place/school address: District……Ward……**7**. Email/Phone…….

Part 1- Individual information

Please mark √ in □ or fill in the blank…….

Q1. Gender	□ Female □ Male	**Q2**. Age (years)	……
Q3. Occupation	□ Office staff □ Official	□ Manager *(e.g. Director, vice-director, , etc)*	□ Professional *(e.g. doctors, engineers, lawyers, etc)*
	□ Sale person □ Worker	□ Student	□ Teacher/Lecturer
	□ Housewife □ Retired	□ Others (…..…….)	
Q4.Monthly individual income (VND)	□ Below 1,000,000	□ 1,000,001 -5,000,000	□ 5,000,001-10,000,000
	□10,000,001-15,000,000	□15,000,001-20,000,000	□>-20,000,000
Q5.Car driving license	□ No □ Yes	**Q6**.Vehicle in household	□Bicycle □Motorcycle □ Car
Q7. Presence of children	□ No □ Yes	**Q8**.House rented	□ No □ Yes
Q9. Household type	□ Living alone □ Married couple	□ Living with family	□ Unrelated house sharers
Q10. Residence location	□ MRT zone 1 □ MRT zone 2	**Q11**. Distance to station	□ < 1 km □ > 1 km

Part 2-Travel attributes

Please mark √ in □ or fill in the blank…….

Q12. Please describe main trips that you made yesterday or on a regular weekday if interview date falls on weekend

Example :	You ride motorcycle to go to workplace from your home.	=> 1st trip:	□ To work	□ Motorcycle
	You use taxi to meet your customers.	=> 2nd trip	□ Business	□Taxi
	You go back work place by bus.	=> 3rd trip	□ To work	□ Bus
	You leave workplace and go to school to pick up your children.	=> 4th trip	□ Pickup	□ Motorcycle
	You go home by motorcycle.	=> 5th trip	□ To home	□ Motorcycle

Note : *Private trips means the trips in which you intend to do your private matters such as having lunch/dinner.*
Business trips means the trips in which you intend to do something relevant to your work such as meeting customers.

1st trip	□ To work	□ To school	□ Private	□ Business	□ Walk	□ Bicycle	□ Motorcycle	□Motorcycle taxi
	□Pickup/Send off	□ Shopping	□ To home	□ Other (……)	□ Car	□ Taxi	□ Bus	□ Other (……..)
2nd trip	□ To work	□ To school	□ Private	□ Business	□ Walk	□ Bicycle	□ Motorcycle	□Motorcycle taxi
	□Pickup/Send off	□ Shopping	□ To home	□ Other (……)	□ Car	□ Taxi	□ Bus	□ Other (……..)
3rd trip	□ To work	□ To school	□ Private	□ Business	□ Walk	□ Bicycle	□ Motorcycle	□Motorcycle taxi
	□Pickup/Send off	□ Shopping	□ To home	□ Other (……)	□ Car	□ Taxi	□ Bus	□ Other (……..)
4th trip	□ To work	□ To school	□ Private	□ Business	□ Walk	□ Bicycle	□ Motorcycle	□Motorcycle taxi
	□Pickup/Send off	□ Shopping	□ To home	□ Other (……)	□ Car	□ Taxi	□ Bus	□ Other (……..)
5th trip	□ To work	□ To school	□ Private	□ Business	□ Walk	□ Bicycle	□ Motorcycle	□Motorcycle taxi
	□Pickup/Send off	□ Shopping	□ To home	□ Other (……)	□ Car	□ Taxi	□ Bus	□ Other (……..)

Q13. Weekly travel expense (including fare, fuel, toll, or parking fee) (VND)	□ Below 50,000 □ 50,001 -100,000 □ 100,001 -150,000 □ 150,001-200,000 □ 200,001-300,000 □ More than 300,000
Q14.Average travel duration from your house to city center (minutes)	□ Below 15 □ 16-30 □ 31-45 □ 46-60 □ More than 60
Only for commuters	
Q15. Main mode for commuting	□ Walking □ Bicycle □ Bus(small bus included) □Car(taxi included) □ Motorcycle (including motorcycle taxi) □ Other (……)
Q16.Travel duration from your house to work place/school (minutes)	□ Below 15 □ 16-30 □ 31-45 □ 46-60 □ More than 60

Part 3- Preference, attitudes, and intentions

This part aims to know your opinions about travel preferences, attitudes toward travel modes, policy measures, and intentions. Statements relate to walking, motorcycle, car, bus, and mass rapid transit. Mass rapid transit (MRT) is an urban transport system that can provide high capacity in transportation. MRT is operated in fixed schedule with waiting time identified. Its average velocity is approximately 30-40 kilometer per hour. Since MRT runs in seperate tracks, its operaration is not influecned by mixed traffic on road-based transport. As a result, travel time of MRT use is shorter and more reliable than other modes in specific distances. In addition, using MRT is safer than driving motorcycle and faster than riding bus in long trips. The availability of air conditioners provide MRT trips as comfortable as car driving. Different from motorcycle, car, and bus, riding MRT is not influenced by traffic congestion and bad weather.

3.1. Travel preferences

Please answer No or Yes for the following statements based on your preferences.

Q17	I prefer the travel mode that provides convenience, though it might be an uncomfortable mode of travel.	□ No	□ Yes
Q18	I prefer to go somewhere by bus service rather than motorcycle taxi when no vehicle is available in my household.	□ No	□ Yes
Q19	I like to drive motorcycle to access bus service if I intend to get on bus.	□ No	□ Yes

3.2. Attitudes toward travel modes, policy measures, and intentions

Please show your level of agreement by described by the following scale: 1= Strongly disagree; 2= Somewhat disagree; 3= Somewhat agree; and 4= Strongly agree.

	Statement	**Strongly disagree** →			**Strongly agree**
	Example: I do not like traveling in bad conditions such as traffic congestion and rainy weather.	(1)	2	3	4
Q20	I always ride a motorcycle even if it takes only 15 minutes to walk from the origin to the destination.	1	2	3	4
Q21	Though my work place/school is near my house, I still want to ride a motorcycle there.	1	2	3	4
Q22	During a long trip, I would like to ride a motorcycle even though it is probably faster to use a bus.	1	2	3	4
Q23	Taking transit is safer than driving a car.	1	2	3	4
Q24	Riding on a bus is safer than driving a motorcycle.	1	2	3	4
Q25	Using public transport make me feel safe during daily travel.	1	2	3	4
Q26	I feel joyful while riding on a bus.	1	2	3	4
Q27	I have information regarding available bus services surrounding my household.	1	2	3	4
Q28	I am more inclined to ride the bus, if the bus service was made free in the city center.	1	2	3	4
Q29	I have always dreamt of owning a passenger car, though it is unfeasible.	1	2	3	4
Q30	I might keep my intentions of a car-purchase even though car parking is not available at my house.	1	2	3	4
Q31	Car ownership increases my social status.	1	2	3	4
Q32	Driving car makes me feel more confident in communication.	1	2	3	4
Q33	Using a car makes me more efficient at work.	1	2	3	4
Q34	Motorcycle use should be limited for emission reduction.	1	2	3	4
Q35	Motorcycle fleets that do not meet environmental standard, should be forbidden for daily-use	1	2	3	4
Q36	I am willing to accept Traffic Demand Management measures such as bans on motorcycle use based on specified hours and specified areas for congestion reduction.	1	2	3	4
Q37	I am willing to accept regular inspections for motorcycle fleets in order to contribute to air quality improvement.	1	2	3	4
Q38	I am willing to accept policies that increase penalties and fines for acts of violating safety rules in order to reduce motorcycle accident fatalities.	1	2	3	4

	Statement	Strongly disagree			Strongly agree
Q39	I intend to use eco-bus even though the travel fare might be more expensive than that of conventional ones.	1	2	3	4
Q40	For a long-distance trip, I intend to drive a motorcycle as less as possible.	1	2	3	4
Q41	I intend to use public transport with higher-fare if its service (travel time, comfort, and reliability) is improved.	1	2	3	4
Q42	Though I have my own car, under certain circumstances I might use MRT.	1	2	3	4
Q43	I intend to use MRT if my destination is only a 15-minute-walk from the closest station.	1	2	3	4
Q44	In case of increased parking charge in the city center, I am willing to use mass rapid transit for the trip to the city center.	1	2	3	4
Q45	If the parking-charge at train stations is lower than the normal cost, I would use mass rapid transit after driving motorcycle to MRT stations.	1	2	3	4

Part 4- Mass rapid transit choices

The project of mass rapid trasit line No.1 (MRT 1) is being implemented in the area along Ha Noi highway. Suppose the construction of MRT 1 was finised. If MRT service had been oprated, it would take half hour from Suoi Tien Amusement park to Ben Thanh market. For going to city center, please answer the below question:

Q46. Which alternative would you like to choose between MRT and motorcycle?

Based on destination locations, two scenarios are comprised as the following.

-Scenario 1: Destination is located nearby Ben Thanh station.

-Scenario 2: Destination is located around Ben Thanh station.

For MRT use with non egress trips, access modes such as walking, motorcycle, and motorcycle taxi are considered (Figure 1). For MRT use with egress trips, walking, bus, and motorcycle are focused as egress modes while motorcycle is the main access mode (Figure 2). It is assumed that it takes 15 minutes for walking from Ben Thanh station to your destination. It is the same duration from your house to both of places. The waiting time for MRT use is 5 minutes for all cases.

In every scenario, travel patterns including travel time (access, in vehicle, egress) and travel cost (fuel cost, parking fee, motorcycle taxi expense, MRT fare) are presented for alternative consideration (Appendix 1-2). You might understand that access mode, parking fee, MRT fare, and traffic condition varies in some levels. For example, parking fee will be increased or decreased, MRT fare will be changed by distance, and travel time of motorcycle ride can be longer in peak hours than in off peak hours.

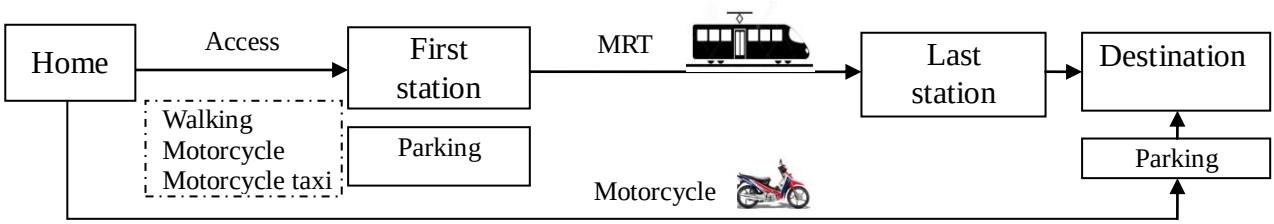


Figure 1: MRT use with non egress trips

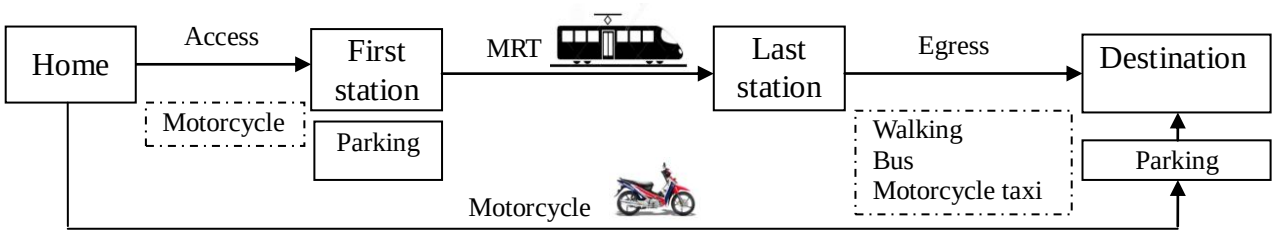


Figure 2: MRT use with egress trips

Thank you for your cooperation. The information you provided is used only for research.

Appendix 1 (Questionnaire No……)

Code	Description (Station……)	Value
A	Travel time by motorcycle from respondent's house to city center (minutes)	
B	Fuel cost from respondent's house to city center by motorcycle(VND)	
C	Travel time by motorcycle from respondent's house to MRT corridor (minutes)	
D	Fuel cost by motorcycle from respondent's house to MRT station (VND)	
E	Travel time by MRT from the nearest station to city center (minutes)	
F1	Travel cost from the nearest station to city center by MRT (VND)	
F2		
G	Walking duration from respondent's house to MRT station (minutes)	

Card 1 (Peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A +15= ……. (1) Fuel cost (VND): B=……..…… (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=……..… (4) Fuel cost (VND): D =…..…..... (5) Parking fee (VND): 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..….... (8) Fare (VND): F1=…..……..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =……..……VND	
Choice	□	□	

Card 2 (Off peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A= ……..…. (1) Fuel cost (VND): B=……..…… (2) Parking fee (VND): 10,000 (3)	Mode: Motorcycle Travel time (min.): C=……..… (4) Fuel cost (VND): D =…..…..... (5) Parking fee (VND): 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..….... (8) Fare (VND): F2=…..……..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =……..……VND	
Choice	□	□	

Card 3 (Off peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A= ……..…. (1) Fuel cost (VND): B=……..…… (2) Parking fee (VND): 5,000 (3)	Mode: Walking Travel time (min.): G=…….. (4) Fuel cost (VND): 0 (5) Parking fee (VND): 0 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..….... (8) Fare (VND): F1=…..……..….. (9)
	Total time (1) = ……minutes Total cost (2)+ (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =……..……VND	
Choice	□	□	

Card 4 (Off peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A= ……..…. (1) Fuel cost (VND): B=…….…… (2) Parking fee (VND): 10,000 (3)	Mode: Motorcycle Travel time (min.): C=……...… (4) Fuel cost (VND): D =…..…..... (5) Parking fee (VND): 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..….... (8) Fare (VND): F2=…..……..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =……..……VND	
Choice	□	□	

Appendix 1 (Questionnaire No……)

Code	Description (Station……)	Value
A	Travel time by motorcycle from respondent's house to city center (minutes)	
B	Fuel cost from respondent's house to city center by motorcycle(VND)	
C	Travel time by motorcycle from respondent's house to MRT corridor (minutes)	
D	Fuel cost by motorcycle from respondent's house to MRT station (VND)	
E	Travel time by MRT from the nearest station to city center (minutes)	
F1	Travel cost from the nearest station to city center by MRT (VND)	
F2		
G	Walking duration from respondent's house to MRT station (minutes)	

Card 5 (Peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A +15= ……. (1) Fuel cost (VND): B=……. (2) Parking fee (VND): 10,000 (3)	Mode: Walking Travel time (min.): G=…… (4) Fuel cost (VND): 0 (5) Parking fee (VND): 0 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..... (8) Fare (VND): F2=…..…..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =…….……VND	
Choice	□	□	

Card 6 (Peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A +15= ……. (1) Fuel cost (VND): B=……. (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=……. (4) Fuel cost (VND): D =…..…..... (5) Parking fee (VND): 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..... (8) Fare (VND): F2=…..…..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =…….……VND	
Choice	□	□	

Card 7 (Off peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A= ……..…. (1) Fuel cost (VND): B=……. (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle taxi Travel time (min.): C =…..… (4) Fuel cost (VND): 0 (5) Travel cost (VND): 10,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..... (8) Fare (VND): F2=…..…..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =…….……VND	
Choice	□	□	

Card 8 (Peak hours)

Alternative	**Motorcycle**	**MRT**	
		Access	On MRT
	Travel time (min.): A +15= ……. (1) Fuel cost (VND): B=……. (2) Parking fee (VND: 10,000 (3)	Mode: Motorcycle taxi Travel time (min.): C=……. (4) Fuel cost (VND): 0 (5) Travel cost (VND): 10,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=…..... (8) Fare (VND): F1=…..…..….. (9)
	Total time (1) = ……minutes Total cost (2) + (3) =……...VND	Total time (4) + (7) + (8) = ……minutes Total cost (5)+ (6) + (9) =…….……VND	
Choice	□	□	

Appendix 2 (Questionnaire No……)

Code	Description (Station……)	Value
A	Travel time by motorcycle from respondent's house to city center (minutes)	
B	Fuel cost from respondent's house to city center by motorcycle(VND)	
C	Travel time by motorcycle from respondent's house to MRT corridor (minutes)	
D	Fuel cost by motorcycle from respondent's house to MRT station (VND)	
E	Travel time by MRT from the nearest station to city center (minutes)	
F1	Travel cost from the nearest station to city center by MRT (VND)	
F2		
G	Walking duration from respondent's house to MRT station (minutes)	

Card 1 (Peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A +15= ……...(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F1=…….. (9)	Mode: Motorcycle taxi Travel time (min.): 5 (10) Travel cost (VND) : 10,000 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =……VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Card 2 (Off peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A = …..……...(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 10,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F1=…….. (9)	Mode: Bus Travel time (min.): 10 (10) Fare (VND) : 5,000 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =……VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Card 3 (Peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A +15= ……...(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F2=…….. (9)	Mode: Bus Travel time (min.): 10 (10) Fare (VND) : 5,000 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =……VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Card 4 (Off peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A = …..……...(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F2=…….. (9)	Mode: Walking Travel time (min.): 15 (10) Travel cost (VND) : 0 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =……VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Appendix 2 (Questionnaire No……)

Code	Description (Station……)	Value
A	Travel time by motorcycle from respondent's house to city center (minutes)	
B	Fuel cost from respondent's house to city center by motorcycle(VND)	
C	Travel time by motorcycle from respondent's house to MRT corridor (minutes)	
D	Fuel cost by motorcycle from respondent's house to MRT station (VND)	
E	Travel time by MRT from the nearest station to city center (minutes)	
F1	Travel cost from the nearest station to city center by MRT (VND)	
F2		
G	Walking duration from respondent's house to MRT station (minutes)	

Card 5 (Peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A +15= ……...(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 10,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F1=…….. (9)	Mode: Waking Travel time (min.): 15 (10) Travel cost (VND) : 0 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =…….....VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Card 6 (Off peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A = …..……..(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 5,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 5,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F1=…….. (9)	Mode: Walking Travel time (min.): 15 (10) Travel cost (VND) : 0 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =…….....VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Card 7 (Peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A +15= ……...(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 10,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F2=…….. (9)	Mode: Waking Travel time (min.): 15 (10) Travel cost (VND) : 0 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =…….....VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		

Card 8 (Off peak hours)

Alternative	**Motorcycle**	**MRT**		
		Access	On MRT	Egress
	Travel time (min.) : A = …..……..(1) Fuel cost (VND): B=…… (2) Parking fee (VND): 10,000 (3)	Mode: Motorcycle Travel time (min.): C=…… (4) Fuel cost (VND): D=…….. (5) Parking fee (VND) : 2,000 (6)	Waiting time (min.): 10 (7) Travel time (min.): E=……. (8) Fare (VND): F2=…….. (9)	Mode: Motorcycle taxi Travel time (min.): 5 (10) Travel cost (VND) : 10,000 (11)
	Total time (1) = ……minutes Total cost (2)+(3) =…….....VND	Total time (4)+ (7)+ (8) + (10)= ……minutes Total cost (5)+ (6) + (9) + (11) =……VND		
Choice	□	□		