

**DOCTORAL DISSERTATION**

博 士 論 文

**A STUDY ON THE EVALUATION OF PARATRANSIT SYSTEM  
TO SUPPORT THE SUSTAINABLE TRANSPORTATION IN  
DEVELOPING COUNTRIES: A CASE STUDY OF SONGTAEW  
IN THAILAND**

発展途上国における持続可能な交通に資するパラトランジットの  
評価に関する研究：タイのソンテウのケーススタディを通して

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**Doctor of Engineering**

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## **ABSTRACT**

These days transport situation in many developing countries including Thailand changes quite rapidly especially an increasing number of private vehicles. The use of public transport in Thailand tends to decrease, and automobile tends to increase. The problem with private vehicle-dependent societies lies with its large impact on the environment and the quality of life in many urban areas. This dissertation addresses the challenge of planning and creating an urban transportation system that considers social aspects, environmental quality, and economic development. In other words, our challenge is to create a sustainable transport system.

Since the percentage of the urban population of the total population has been increasing continuously in Thailand, increasing from 29.4% in 1990 to 44.1% in 2010. (Social Statistic Bureau, 2011) The urban population growth forced the cities to expand into the rural areas. This situation of the urban areas has resulted in an increased need for mobility. The mobility of goods and people is an essential part of all social and economic activities. One of the transportation problems in developing countries is how to provide mobility services for all segment of the community. Besides the problem of providing mobility services in the cities, the lack of public transportation and traffic congestion are also the major problems of the developing country cities.

The major cause leading to traffic congestion is the high number of the vehicle, the private transportation, which was caused by the population growth and the economic development. Reducing the number of vehicles on roads and improving the transportation infrastructures are important ways to reduce the traffic density in the urban area. However, the reduction in the vehicles, especially private vehicles that constitute the majority will not be possible unless the public is provided with an option for accessibility, affordable, convenient and quality public transport.

Acknowledging the challenging nature of at a sustainable transport system, this research investigates the potential of paratransit namely Songtaew in Thailand which is the main urban

transport mode in many medium-sized cities to improve sustainability within an urban transport system. Considering paratransit system in Thailand, there are various paratransit modes. Nowadays paratransit plays a role as the predominant urban public transport mode in many developing countries, especially in Thailand where has various types of paratransit such as motorcycle-taxi, Tuk-tuk, Songtaew, and Silor-lek. Especially, Songtaew or a modified pick-up truck taking passengers on the back with an overhead cage and two-row seat in the back that can accommodate up to 20 passengers, operating as a main public transport mode in many medium-sized cities of Thailand was selected as a case study in this research. Although new transportation modes have been introduced in some medium-sized cities such as Khon Kaen, Phuket, Chiang Mai, and Nakhon Ratchasima. Songtaew services remain the main public transport mode in many cities even in the suburban areas of Bangkok as a feeder of the Mass transit system.

Focusing on Songtaew, in cities especially in the regional capitals and medium-sized cities of Thailand, Songtaew operates as a main urban public transport which is served areas along the main and the local streets with a fixed route. According to the future planning for urban public transportation in medium-sized cities of Thailand, Khon Kaen, Chiang Mai, and Nakhon Ratchasima are interested and in the process of Bus Rapid Transit (BRT) planning and also Light Rail Transit (LRT) planning. The feasibility studies have been already studied in those cities, but only Khon Kaen City has been in the process of detail design of BRT and LRT (Jaensirisak et al., 2013). Therefore, this research is focusing on the role of Songtaew in Khon Kean City where there are the studies only about the new transport mode, BRT, and LRT, and the preparation progress of those new transport modes is fastest among the other cities but the existing urban transport mode, Songtaew, in Khon Kaen city has not been studied about the possibility of Songtaew service continuing in the future yet, especially the studies related to its role in Khon Kaen urban transport and its user perception (Jaensirisak et al., 2013). Another significant issue concerns with the study of Songtaew is it has not yet well understood especially the issues related to the possibilities of Songtaew system in supporting the sustainable transportation. This study is the first attempt to

focus on all the institutional side, the supply side, and the demand side of Songtaew system in Thailand. Since Songtaew is a unique transport mode that its service is a small scale, a flexible service. Moreover, Songtaew is legal service since its operation has to be licensed by the Land Transport Department of Thailand. This research examined the regulation related to Songtaew and investigated the Songtaew service system by considering the supply side of Songtaew and the use of Songtaew from the demand side by examining the travelers and drivers' point of view to better understand about its service system and the factors that influence this mode use. Admittedly, it is important to evaluate Songtaew system to understand various aspects of paratransit system as mentioned previously.

The main goal of this study is to motivate a modal shift to public transportation towards the sustainable transport system. The policy deliberation is based on an evaluation of the Songtaew service regarding institutional side, supply side and demand side to attract the people in Khon Kaen City to shift their modes from private vehicles to Songtaew.

To study both supply and demand side of Songtaew service, the questionnaire was developed. Especially for the demand side studies, the author analyzed results from a comprehensive field survey conducted among Songtaew users and non-users in Khon Kaen City, in order to measure their perception of the service provided. The surveys were carried out on interviewing randomly selected passengers in the Central Business District (CBD) of Khon Kaen city. Then data were analyzed through percentage, cross-tabulation, Chi-square statistical techniques and multiple regression analysis for examining the Songtaew perception for the users the non-users and the drivers. Moreover, for the study of travel mode choice behavior, the multinomial logit model of regular trips in Khon Kaen City is developed to analyze the mode choice behavior.

The originality of the methodological approach adopted for this research is given by the integrated evaluation of three main aspects in paratransit system; institutional, supply and demand sides. Furthermore, to encourage the widespread use of Songtaew, it is essential to understand the

multifaceted issue of trip satisfaction, and its implication for travel behavior in Khon Kaen city. Another originality of this research is to increase user satisfaction should be better understand about users' perception regarding the service from both the users and also from the drivers of Songtaew. Since users' perceptions are affected by the performance of the attributes of the service provided by the drivers. Thus this study also focused on differentiating between the users and drivers' perception regarding the provided service, since users' satisfaction requires an experience of the service, while the drivers are responsible for providing the service by supplying users to their destinations. To put in other words, the drivers are responsible for making users' experience by their provided service. Furthermore, the drivers' service is affected by their perception as well. Therefore, it is needed to investigate the drivers' perception, not only the users' perception to seek whether they have the different perceptions or not. If we could know the different perceptions of them, it would be able to recommend the improvement of the service they offered by bridging these differences to meet the users' need for providing the most satisfaction to the users to retain the existing users in the future.

Therefore, this study would be useful to Khon Kaen City as well as other medium-sized cities in developing countries to motivate more public transportation use in the future and to assure the citizen that they can "leave their car behind" for motivating modal shift and contributing to sustainable transportation.

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## CHAPTER 1

### INTRODUCTION

#### 1.1 RESEARCH BACKGROUND AND MOTIVATION

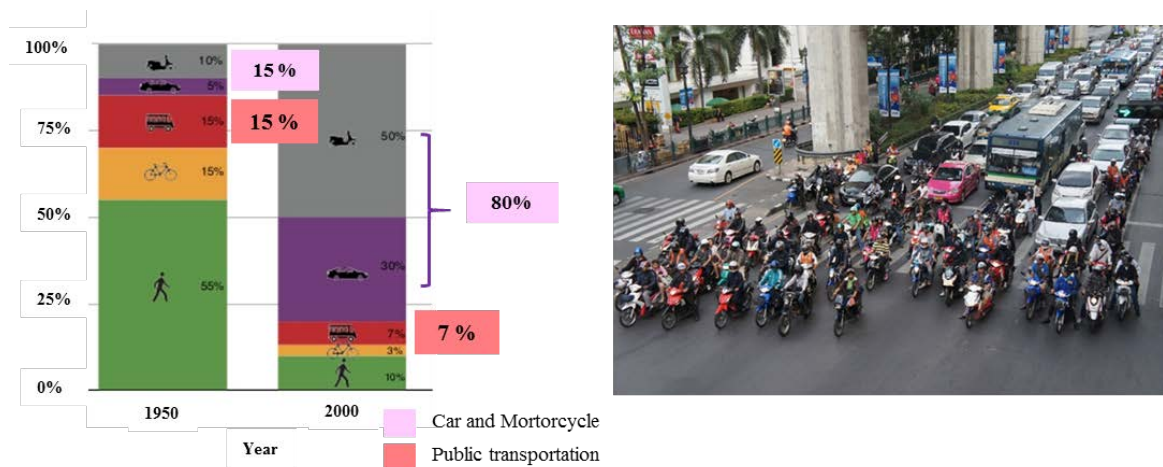
It is manifest that transportation is one of the essential parts of life for all social and economic activities. These days transport situation in many developing countries especially Thailand changes quite rapidly especially an increasing number of private vehicles. The use of public transport in Thailand tends to decrease, and automobile tends to increase as can be seen in **Figure1.1**. This tendency has been attributed to the sustained growth of private vehicle ownership caused by factors such as the poor quality of public transport service, the lack of public transport service routes. The problem with private vehicle-dependent societies lies with its large impact on the environment and the quality of life in urban areas. The modern day necessity for motorized transportation presents us with a dilemma which, if ignored, has the potential to create problems of enormous magnitude. How can we take advantage of all the positive attributes of transport developments and mitigate the harmful consequences to our social and physical environment? The challenge is to plan and create an urban transportation system that considers social aspects, environmental quality, and economic development. In other words, the challenge is to create a sustainable transport system, defined as achieving the following goal:

“To ensure that our transport systems meet society’s economic, social and environmental needs while minimizing their undesirable impacts on the economy, society, and the environment.” (Litman, 2008)

Therefore, it has been challenged to all Thai transportation planners for coping with this situation, One of the challenges is how to attract more public transportation users. In other words, the study to support the reduction of the private vehicle usage is needed in Thai society. Thus, the study for encouraging Thai people to shift their mode to public transport should not look over. There is a crucial need to understand travel behavior pattern of people in each city and its urban transport system.

Considering transport system in Thailand, there are various transport modes including paratransit. Nowadays paratransit plays a role as the predominant urban public transport mode in many developing countries, especially in Thailand where has various types of paratransit such as motorcycle-taxi, Tuk-tuk, Songtaew (ST), and Silor-lek. Especially, Songtaew or a modified pick-up truck taking passengers on the back with an overhead cage and two-row seat in the back that can accommodate up to 20 passengers, operates as the primary mode of public transportation in many medium-sized cities of Thailand. Although new transportation modes have been introduced in some medium-sized cities such as Khon Kaen, Phuket, Chiang Mai, and Nakhon Ratchasima.

Songtaew (ST) services remain the main public transport mode in many cities even in the suburban areas of Bangkok as a feeder of the Mass transit system.



**Figure 1.1** Thailand Modal Share within an urban area in 1950 and 2000

Source: Adapted from Challenges and Potential of e-mobility in Thailand's Transport Future, 2015.

Presently, Songtaew provides people movement within cities and for longer routes between cities and villages. Moreover, Songtaew is known as one of the major means of transportation in the urban areas in Thailand. This mode is popular in Thailand because of its intermediate size which can easily move around the city (Wongwiriya et al., 2015). Furthermore, Songtaew is cheaper than other transport modes in many cities. In Bangkok, Songtaew is a ride-sharing pick-up truck because of the lack of the bus service along local street (Oshima et al., 2007) and plays a role as a feeder of mass transit system especially the Metropolitan Rapid Transit (MRT) and the Bangkok Mass Transit System (BTS) (Tangphaisankun, 2010). In other cities, it plays a role as the main public transport mode.

Studies regarding paratransit in Developing countries are mainly concerned with issues such as the role of paratransit focusing on the supply side in terms of service characteristics and service quality, and on the demand side especially regarding users' perception of paratransit. (Cervero, 1990; Joewono et al., 2005; Loo, 2007; Luthra, 2006; Tangphaisankun, 2010; Shimazaki and Rahman, 1996) Nevertheless, studies regarding paratransit in Thailand are mainly concerned with the role of paratransit issues only focusing on the supply side regarding service characteristics and service quality. (Jittrapirom, 2015) Moreover, there is the lack of the study on Songtaew service in Thailand even it plays an important role as the main public transport mode in many cities of Thailand. Thus, it is needed to study more on the issue regarding Songtaew service in order to encourage and attract Thai people to use public transport to support the sustainable transportation in Thailand.



In cities especially in the regional capitals and medium-sized cities of Thailand, Songtaew operates as a main urban public transport which is served areas along the main and the local streets with a fixed route. According to the future planning for urban public transportation in medium-sized cities of Thailand, Khon Kaen, Chiang Mai, and Nakhon Ratchasima are interested and in the process of Bus Rapid Transit (BRT) planning. The feasibility studies have been already studied in those cities, but only Khon Kaen City has been in the process of detail design of BRT and Light Rail Transit (LRT) (Jaensirisak et al., 2013). Therefore, this research is focusing on the role of Songtaew in Khon Kean City where there are the studies only about the new transport mode, BRT, and LRT, and the preparation progress of those new transport modes is fastest among the other cities but the existing urban transport mode, Songtaew, in Khon Kaen city has not been studied about the possibility of Songtaew service continuing in the future yet, especially the studies related to its role in Khon Kaen urban transport and its user perception (Jaensirisak et al., 2013). Another significant issue concerns with the study of Songtaew is it has not yet well understood especially the issues related to the possibilities of Songtaew system in supporting the sustainable transportation. This study is the first attempt to focus on all the institutional side, the supply side, and the demand side of Songtaew system in Khon Kaen City by examining the regulation related to Songtaew, the Songtaew service system by considering the supply side of Songtaew and the use of Songtaew from demand side by investigating the result from the travelers' point of view to better understand about its service system and the factors that influence this mode use.

Therefore, this study would be useful to Khon Kaen City as well as other medium-sized cities in developing countries to motivate more public transportation use in the future and to assure the citizen that they can “leave their car behind” for motivating modal shift and contributing to sustainable transportation.

## **1.2 RESEARCH OBJECTIVES**

The aim of this study is to develop a comprehensive study in order to provide policy suggestions to improve the paratransit service which is Songtaew towards the sustainable transport system in Khon Kaen city. The policy deliberation is based on examination of the Songtaew service regarding institutional side, supply side and demand side to attract the people in Khon Kaen City to shift their modes from private vehicles to Songtaew.

To achieve the research goal which is a desire for a modal shift to public transportation, there are four specific objectives to be performed as follows:

1. To explore the current Songtaew service system in Khon Kaen City.
2. To examine travel behavior pattern in Khon Kaen City.
3. To investigate the influencing factors of traveler attitudes toward Songtaew service satisfaction and willing to use Songtaew in the future.

4. To examine urban travelers' travel choice consideration.
5. To develop and recommend an appropriate policy and useful insights related to the improvements of operation and future management for Songtaew.

### **1.3 RESEARCH SCOPE AND LIMITATIONS**

The research scope of this study is limited to Songtaew service within the city of Khon Kaen. It will seek to provide a new line of understanding on the city's public transport situation as well as the commuters behavior in the city focusing on Songtaew user and non-user on both school trip and work trip to provide the related policy to improve its service in the future in order to encourage Khon Kaen citizen to use Songtaew more in the future.

Moreover, this study has limited sample size of field surveys which may generate under/overestimated results, and the findings may not reflect the perceptions of the whole community or all groups.

### **1.4 ORGANIZATION OF DISSERTATION**

This dissertation contains a total of ten chapters and appendices. The background for this research, the aim and objectives and also the research scope and limitations for this research have already been described in this chapter. The remaining chapters and their brief contents are arranged as follows:

Chapter 2 presents literature reviews of the relevant studies and ideas which are discussed.

Chapter 3 aims to describe the present situation of the study area, data collection procedure, and collected data are described. The study design of all analysis processes and methodologies applied in this research is explicated.

Chapter 4 presents the issue related to Songtaew in Thailand regarding the institutional side by the international comparative study about Songtaew and the similar vehicle in the Southeast Asia country in the case of Songtaew and Jeepney in the Philippines.

Chapter 5 explains the current issues of Songtaew service in Khon Kaen City regarding the supply side which focused on the supply characteristics of Songtaew (especially the cost characteristics).

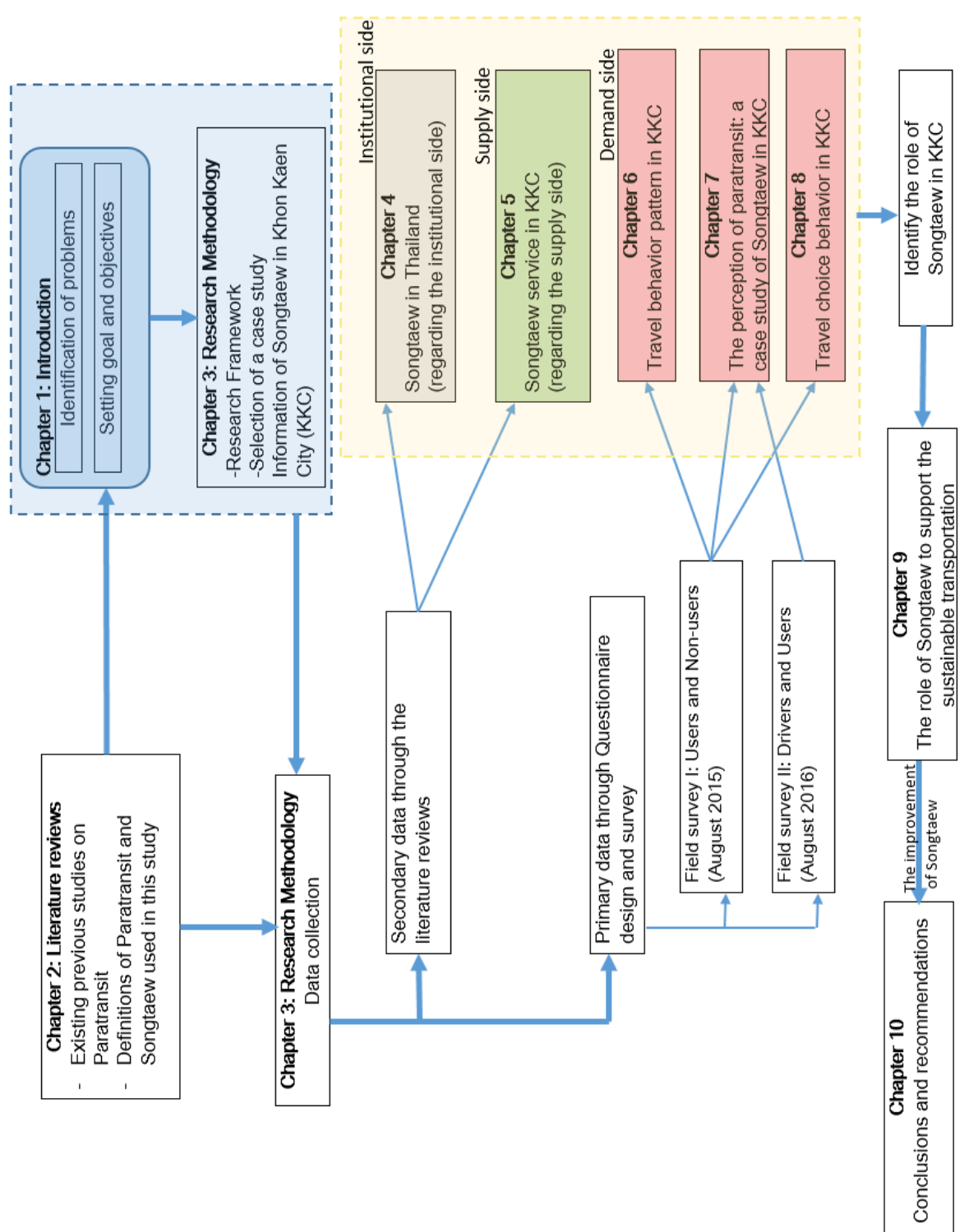
Chapter 6 presents a study of travel behavior pattern in Khon Kaen City as well as a relationship between the travel behavior pattern and city structure of Khon Kaen City.

Chapter 7 describes a study of the perception of Songtaew service from both Songtaew user and non-user's point of view by their participation in rating the condition of Songtaew and loyalty to it. Moreover, this chapter also investigates the Songtaew perception differences between drivers and users. Since the drivers' service is affected by their perception as well. Therefore, it is needed to investigate the drivers' perception, not only the users' perception.

Chapter 8 aims to examine the travel choice consideration of people in Khon Kaen City.

Chapter 9 presents the role of Songtaew in Khon Kaen City to support the sustainable transportation.

Chapter 10 summarizes the main findings and policy implications of this study. Finally, recommendations are made for future research.



**Figure 1.2** Interrelated outline of dissertation

## CHAPTER 2

### LITERATURE REVIEWS

The purpose of this chapter is to provide the relevant studies and ideas regarding this dissertation. The chapter begins by providing an introduction of paratransit focusing on the previous studies relating to the definition of paratransit and the various types of paratransit in Thailand in Chapter 2.1. Then the definition of Songtaew is detailed in Chapter 2.2. In Chapter 2.3, the existing previous studies on the paratransit is detailed. Chapter 2.4 summarizes the findings from literature reviews.

#### 2.1 INTRODUCTION OF PARATRANSIT

##### 2.1.1 The previous studies regarding Paratransit definition

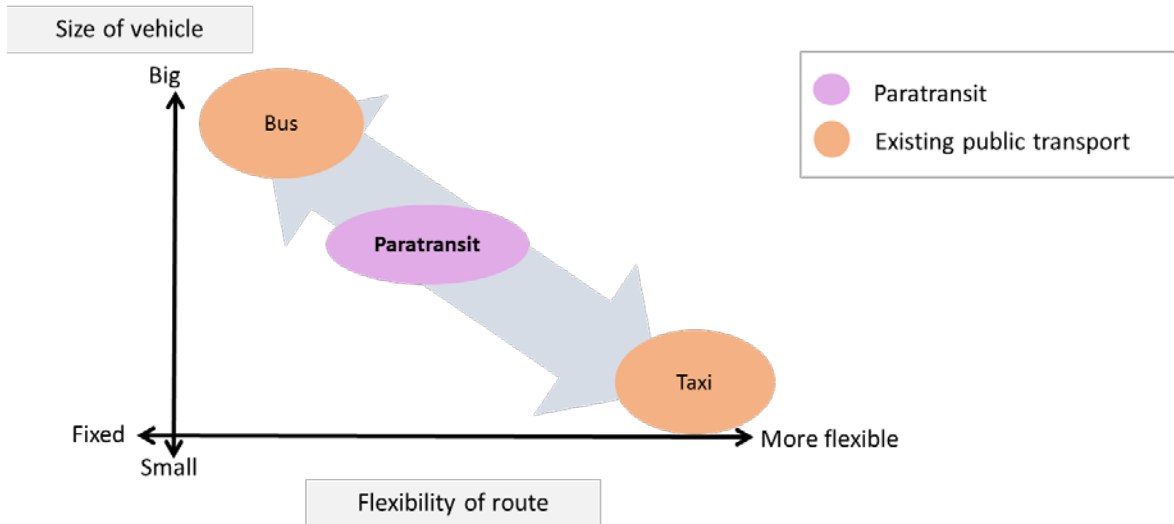
In many developing countries in Southeast Asia, paratransit is an important urban public transport mode. Paratransit services are mostly operated in terms of different size and forms such as those of Thailand's motorcycle-taxi, Tuk-tuk, Songtaew, and Silor-lek, Indonesia's Bajaj and Angkutan Kota, Philippines' Jeepney and the motos of Vietnam and Cambodia. (Guillen et al., 2007) Nowadays the role of paratransit becomes the dominant transport mode in many urban areas in developing countries because paratransit vehicle can be more accessible, more flexible, faster and cheaper than the other public transport vehicles.

This subchapter provides the detail of previous studies to summarize the definition of Paratransit. It is noted that the concept of Paratransit definition is rather different between developed and developing countries regarding the study by Shimazaki and Rahman (1996).

Lave and Mathias addressed that "Paratransit" means "alongside transit" and it was first used to explain public transit service that would approximate the ubiquity of vehicles which would ensure the efficiency of public transportation (Lave and Mathias, 2000; Orski, 1975). Although "paratransit" has been known worldwide, understandings of its meaning differ among developed and developing countries. In North America, paratransit is a flexible door-to-door transport service provided specifically for elderly or physically disabled people (Lave and Mathias, 2000). Considering in Europe, paratransit refers to particular public transport services including dial-a-ride and ridesharing (Orski, 1975; Mulley and Nelson, 2009) In developing countries, the term "paratransit" is a public mode of transport that operates in mixed traffic and usually without a fixed schedule, on urban streets in many cities (Joewono and Kubota, 2007). With regard to other definitions, they were also described such as paratransit service is a group of mainly urban transit services somewhere between private transport and conventional public transport regarding cost and quality of the service and it was also explained as a transit mode which is not quite full public

transport service, utilizing smaller vehicles, and its operation has developed to fill the service void left by private vehicles and regular bus systems where there is no official authorization (Etherington and Simon, 1995; Weningtyas, 2013; Cervero and Golub, 2007)

Further definition of paratransit can be found in Hirabayashi et al. (2013). Hirabayashi's study describes paratransit mode that it is a transport mode which is in between of bus and taxi in terms of the size of vehicle and flexibility of route as shown in **Figure 2.1**.



**Figure 2.1** Paratransit definition in terms of the size of vehicle and flexibility of route

Source: Hirabayashi et al., 2013.

Although various descriptions have previously been provided, there is no common definition of “paratransit” that covers all modes and types of operation of paratransit services in Asian developing countries. In this study, paratransit is defined following the common definition which variously describes public transport modes in developing countries that are operated on a small scale, a low-cost transport mode which is similar to a bus but provided more flexible service. Moreover, its operation can be either legal or illegal as defined by local regulations in difference cities. (Phun et al., 2016)

### 2.1.2 The various types of paratransit in Thailand

There are various kinds of paratransit that developed in Thailand for people's traveling in the urban and rural areas. In the case of paratransit in Thailand, there are mainly three types of paratransit which serve the transportation services for the people in many cities, including Songtaew, motorcycle-taxi, and Silor-lek which is a four-wheel compact car as shown in **Figure 2.2**. (Oshima et al., 2007)

As discussed earlier, Songtaew or a modified pick-up truck taking passengers on the back with an overhead cage and two-row seat in the back that can accommodate up to 18 passengers or more, operates as a fixed - route service in Bangkok and other provinces especially in many medium-sized cities of Thailand. Moreover, it plays different roles in different areas in Thailand which are a) a feeder of mass transit system in Bangkok and b) a main public transport in other provincial urban areas.

Silor-lek or a four-wheel compact car plays a role as a feeder in the narrow dead-end side street branching off a major street, connecting to local communities especially in Bangkok. (Oshima et al., 2007) In other cities especially in the rural area, Silor-lek operates as a local public transport with the non-fixed route.

Motorcycle-taxi in Thailand plays an important role as a minor transport mode servicing urban transportation demands along the narrow and deep road connecting their local communities and main street where the other main public modes are operating such as the Metropolitan Rapid Transit (MRT) and the Bangkok Mass Transit System (BTS). (Oshima et al., 2007)

## **2.2 INTRODUCTION OF SONGTAEW IN THAILAND**

### **2.2.1 Songtaew definition**

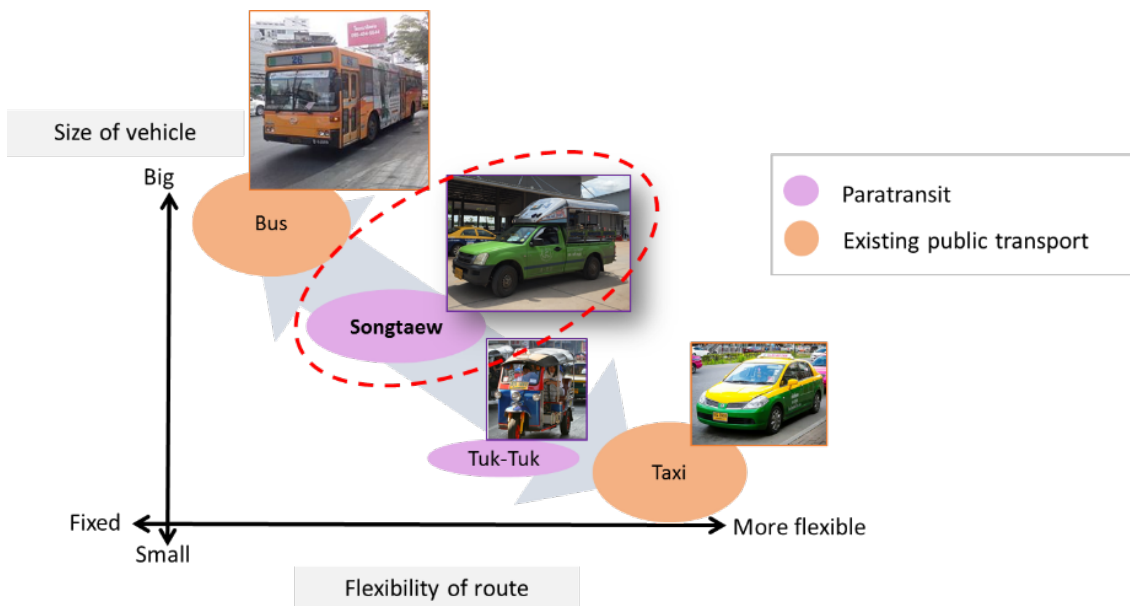
Songtaew in Thailand is modified from a pick-up or a larger truck with two rows of seats in the back carrying about 20 passengers. At present, Songtaew provides passenger movement in both within towns and cities and for longer routes between cities and villages. In Bangkok Songtaew plays a role as a feeder of mass transit system especially bus, train, the Metropolitan Rapid Transit (MRT) and the Bangkok Mass Transit System (BTS). (Tangphaisankun, 2010) For the transportation in other cities especially in the primary cities of different regions in Thailand, Songtaew plays a role as the main public transportation in urban and rural areas (Kikuchi et al., 2013) as shown in **Figure 2.4**.

### **2.2.2 Various design of Songtaew in Thailand**

In Thailand, there are two mainly types of Songtaew related to its design and vehicle as shown in **Figure 2.5**. The first type of Songtaew is some vehicles are modified from Toyota Dyna, Mitsubishi Fuso Canter, Isuzu Elf and similar large trucks which can accommodate more than 30 passengers and operates as a fixed - route bus to run on the fixed route between province area connecting the rural and the urban area through the different parts of Thailand. The second type of Songtaew is some vehicles are modified from a pick-up truck such as Toyota Hilux, ISUZU D-MAX, ISUZU D-LUX, etc. which can accommodate more than 20 passengers and operates as a fixed-route bus to run on the fixed route in Bangkok both downtown and suburb, urban and rural areas in other provinces especially in the primary cities in the different regions of Thailand.



**Figure 2.2** The various types of paratransit in Thailand (Songtaew, Silor-lek, and Motorcycle-taxi)



**Figure 2.3** Songtaew definition in terms of the size of vehicle and flexibility of route

Source: Adapted from Hirabayashi et al., 2013.



Bangkok	Other cities
A feeder of mass transit system.	A main public transport mode in the city.
	

**Figure 2.4** The Role of Songtaew in Thailand



**Figure 2.5** The various design of Songtaew

### 2.3 PREVIOUS PARATRANSIT STUDIES

The studies on paratransit have been widely studied and become more famous started in the last ten years, especially the studies in Asian developing countries. In 1979, Walters studied paratransit by focusing on the benefits of minibus services in Malaysia (Walters, 1979). Then Shimazaki and Rahman were investigated more regarding the physical and operational characteristics of various paratransit types in Asian countries (Shimazaki and Rahman 1995 and 1996). Cervero (2000) studied further on the organization, market and relevant policy background from a global viewpoint of paratransit sector in many Asian countries such as Indonesia, Thailand, Malaysia, Philippines, and Singapore. In particular, Joewono and Kubota discussed in detail about the paratransit characteristics and non-motorized transport in Indonesia (Joewono and Kubota, 2005). Moreover, Joewono studied further about the willingness and ability to pay for paratransit focusing on Jitney in Indonesia (Joewono, 2009).

There are some studies which took place in African cities such as the studies regarding the quality of paratransit service, the engaging paratransit on public transportation to reform initiatives,

the use of paratransit among low-income group people, and the paratransit modal choice (Ommeh, 2012; Schalekamp and Behrens, 2010; Nwaogbe, 2012; Owolabi, 2009).

Another field of study focuses on the role of paratransit in Hong Kong which was suggested that policymaker should consider on the integration of paratransit system into all public transport system (Loo, 2007) Moreover, Tangphaisankun study paratransit as a feeder service to a mass transit system in Bangkok, Thailand and addressed that paratransit still plays a major role in providing public transport service to people in many Asian developing countries (Tangphaisankun, 2010), Satiennam et al. (2006) addressed that a good organizing feeder of paratransit in city to a Bus Rapid Transit (BRT) system could improve the performance of urban transit network with lower emission level which contributed to the sustainable transportation in the city (Phun, 2016).

Considering the supply side study, Wenintyas et al. (2013) examined on how an improvement of paratransit service would affect the quality of life of the drivers. Another example is Fujiwara and Zhang (2013) investigated the importance of paratransit-adaptive transportation policies for a shift to the paratransit sustainability. They recommended keeping using the paratransit services in developing countries because it would increase unemployment rate among paratransit drivers and encourage the mobility for low-income group. However, it should produce lower air pollution. Not only supply side but demand side of paratransit services were also studied. In the demand side, user perception such as the service satisfaction, and behavioral intentions regarding paratransit services is often considered to evaluate the possibility of paratransit to support the sustainable transportation in many cities (Joewono and Kubota, 2007; Tarigan et al., 2010; Sumaedi et al., 2012). The user perception on paratransit services was analyzed based on various statistical methods including structural equation model, binomial logistic regression, and multiple regression (Joewono and Kubota, 2007; Tarigan et al., 2010).

With regard to the previous studies of Paratransit, it can be summarized that the most of the Paratransit study especially in developing countries focusing on the supply side to understand various aspects of it such as drivers and vehicles, service characteristics, service quality, and the operation and operators. Considering in the studies in Thailand, the study of Paratransit on the demand and supply have been studied only in Bangkok where Songtaew operates as a feeder of mass transit system. There is still the lack of paratransit study mainly focusing on Songtaew which is the primary urban transit mode in many medium-sized cities in Thailand. Thus, the originality of the methodological approach adopted for this research derived from the literature reviews in this chapter is given by the integrated evaluation of three main aspects in paratransit system; institutional, supply and demand sides in Khon Kaen City where Songtaew operates as a primary public transport mode.

**Table 2.1** Sample of the existing paratransit study

No.	Author/ Year	Location	Focus on	Type of Paratransit	Research Tools
1	Cervero (1990)	Indonesia, Thailand, Philippines, Malaysia and Singapore	Service characteristics	All type	Descriptive statistics
2	Shimazaki and Rahman (1996)	Developing Countries of Asia	Physical characteristics	All type	comparative study
3	A.K. Somasundaraswaran (2006)	Sri Lanka	Three-Wheeler drivers view	Three-Wheeler	Structural interview/Descriptive statistics
4	Luthra (2006)	India	Paratransit system and problems	All type	comparative study/Descriptive statistics
5	Shinomura, Ogita, Colette, Nakagawa, Kuranami and Kato (2007)	Thailand, Indonesia and Cambodia	Scheduled Bus Services	Bus	comparative study
6	Joewono (2009)	Indonesia	The Willingness and Ability to Pay for Paratransit	Jitney	Descriptive Statistics /Ordinal probit and binomial logistic regression
7	H. Schalekamp, R. Behrens (2010)	South Africa	Engaging paratransit on public transport reform initiatives		Literature analysis
8	M. S. OMMEH (2012)	Nairobi, Kenya	Paratransit use among low income industrial workers	Matatu	Structural interview /Descriptive statistics
9	R. Nwaogbe (2012)	Nigeria	Quality of paratransit service	Tricycle	Structural interview /Descriptive statistics
10	A. Verseckiene (2013)		The aspects of organizing and using paratransit service	All type	Literature analysis
11	Vu Anh TUAN (2013)	Hochiminh, Vietnam	Socioeconomic Impacts and Policy Consideration	Motorcycle taxi	Structural interview/Descriptive statistics
12	A. D. Golub (2003)	Brazil	Welfare Analysis of Informal Transit Services and the Effects of Regulation	Train, Bus, Van	Model of Welfare Change/Model of Mode Choice
13	D. Diaz, C. Cal (2005)	Philippines	Impacts of government regulation on the paratransit services	Tamaraw FX	Financial Analysis
14	Becky P.Y. Loo (2007)	Hong kong	The role of paratransit	Coach services	Modal shift analysis
15	Joewono (2007)	Indonesia	Public perception /paratransit cost	All type	Path analysis/ Bionomial logistic regression model
16	A O. Owolabi (2009)	Nigeria	Paratransit Modal Choice	Motorcycles and unregistered taxis	Behavioral travel demand model
17	A. Tangphaisankun (2010)	Bangkok, Thailand	The role of paratransit as a feeder into Mass Transit Systems	Motorcycle taxi, Silor lek (Songtaew)	SEM
18	Kanalli and Hublikar (2014)	India	Effect of paratransit on other modes	All type	SEM/Modal shift analysis

**Table 2.2** Sample of the existing paratransit study focusing on the aspect of institutional side, supply side, and demand side

No.	Author/ Year	Location	Focusing on		
			Demand side	Supply side	Institutional side
1	Cervero (1990)	Indonesia, Thailand, Philippines, Malaysia and Singapore	-	Vehicles, services, operation	-
2	Shimazaki and Rahman (1996)	Developing Countries of Asia	-	Vehicles, services, operation	-
3	A.K. Somasundaraswaran (2006)	Sri Lanka	-	Drivers	-
4	Luthra (2006)	India	-	Drivers, services, operation	-
5	Shinomura, Ogita, Colette, Nakagawa, Kuranami and Kato (2007)	Thailand, Indonesia and Cambodia	-	the management and operation	develop the transport plan
6	Joewono (2009)	Indonesia	User perception	-	-
7	H. Schalekamp, R. Behrens (2010)	South Africa	-	services and operation	-
8	M. S. OMMEH (2012)	Nairobi, Kenya	user perception	-	-
9	R. Nwaogbe (2012)	Nigeria	user perception	services and operation	the policy
10	A. Verseckiene (2013)		-	services and operation	-
11	Vu Anh TUAN (2013)	Hochiminh, Vietnam	Usage characteristics, user perception	operational characteristics	
12	A. D. Golub (2003)	Brazil	people's modal choice	-	the regulation
13	D. Diaz, C. Cal (2005)	Philippines	-	services and operation	the regulation
14	Becky P.Y. Loo (2007)	Hong kong	people's modal choice, residential location, user perception	-	develop the policy
15	Joewono (2007)	Indonesia	user perception	-	develop the policy
16	A. Tangphaisankun (2010)	Bangkok, Thailand	users' travel choice consideration, user satisfaction	the potential service	develop the policy

## 2.4 SUMMARY

According to the literature reviews, although various descriptions of paratransit have previously been provided, there is no common definition of “paratransit” that covers all modes and types of operation of paratransit services in Asian developing countries. Therefore, in this study, paratransit is defined following the common definition which variously describes public transport modes in developing countries that are operated on a small scale, a low-cost transport mode which is similar to bus but provided more flexible service and its operation can be either legal or illegal as defined by local rules and regulations. Paratransit, namely Songtaew is very popular in Thailand because of its intermediate size which can easily move around the city even the smallest interior areas. Furthermore, Songtaew is more flexible and cheaper than other transport modes in many cities of Thailand. Compared to Jeepney in the Philippines, the characteristics of the vehicle between Songtaew and Jeepney are similar to each other, but the institutional system varies between them depending on their government agency and Transportation Act. However, they also play the role as the popular paratransit mode in the urban area.

As the result of a large number of population in Thailand relying on Songtaew as an important public transport mode leads to its future potential that will be still number one transportation mode in the many cities in Thailand especially in the medium-sized city. Thus it is necessary for the government to formally recognize it as a public transport mode. Furthermore, a suitable policy for Songtaew shall be made to formalize it for the benefit of the passengers in the operated areas of its service.

The previous studies regarding paratransit covered all institutional side, demand side and supply side of paratransit system and possible policy implications, which serve as useful information for transportation planners in formulating an appropriate policy and regulation towards the sustainable public transport system in Asian developing countries. However, there is a few of the study regarding the institutional side. Furthermore, studies on paratransit should also be done in other Asian developing cities. Due to the differences in city characteristics, the operations of paratransit might not be the same and policy implications might follow. In Thailand, the studied about paratransit focused on the supply side more than the demand side. Therefore it should be explored more in detail on demand side of paratransit system in Thailand including the study regarding the importance of paratransit management policies for a shift to the sustainability of paratransit services and for supporting the sustainable transportation in the future.

## CHAPTER 3

### RESEARCH METHODOLOGY

This chapter begins by providing the reason why Khon Kaen City is chosen as a case study. Then the overview of Khon Kaen City and Songtaew service in the city which is a case study of this dissertation is detailed. After that, this chapter focuses on the methodology applied in this research. The methodology adopted in this study thoroughly evaluates the current Songtaew service in Khon Kaen city, especially in supply and demand side. In conclusion, this chapter presents the research framework, data collection and the analytical tool used in this study.

#### 3.1 CASE STUDY OF SONGTAEW IN KHON KAEN CITY

##### 3.1.1 Why Khon Kaen City?

As stated in Chapter 1, Songtaew in Thailand has been well known in the country as a paratransit mode which is modified from a pickup truck or a larger truck with two rows of seats in the back carrying about 18 passengers. Presently, Songtaew provides passenger movement in both within towns and cities and for longer routes between towns and villages. Moreover, Songtaew is known as one of the major means of transportation in the urban areas and even in the rural areas in Thailand. This mode is popular in Thailand because of its intermediate size which can easily move around the area in the city. Furthermore, Songtaew is more flexible and cheaper than other transport modes in many cities of Thailand. The price is usually between 5 or 10 baht per journey. As a result of a large number of population in Thailand, the number of registered Songtaew has been increased substantially in many cities such as Nonthaburi, Hat Yai, Nakhon Ratchasima, Chiang Mai, Khon Kaen, Chonburi and Nakhon Si Thammarat.

In cities especially in the regional capitals and medium-sized cities of Thailand Songtaew operates as a main urban public transport which is served areas along the main and local street with a fixed route. According to the future planning for urban public transportation in medium-sized cities of Thailand, Khon Kaen, Chiang Mai, and Nakhon Ratchasima are interested and in the process of BRT planning. The feasibility studies have been already studied in those cities, but only Khon Kaen City has been in the process of detail design (Jaensirisak et al., 2013)

Therefore, this research selected Khon Kaen City as a case study and focused on the role of Songtaew in Khon Kean City to support the sustainable transportation where there are the studies only about the new transport mode, BRT, and the preparation progress of BRT is fastest among the other cities but the existing urban transport mode, Songtaew in Khon Kaen, has not been studied about the possibility of Songtaew service continuing in the future yet, especially the studies related to its role in Khon Kaen urban transport and its user perception. This study would be useful

to Khon Kaen City for motivating Songtaew use in the future and contribute to the urban transport sustainability.

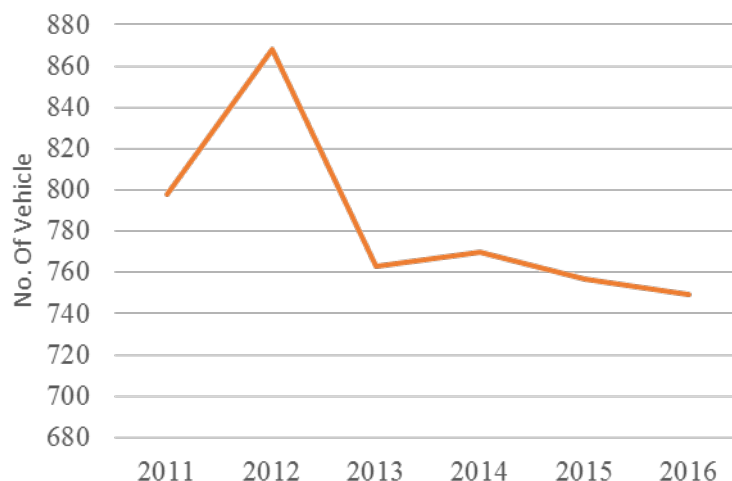
### **3.1.2 Overview of Khon Kaen City and Songtaew service in the city**

Khon Kaen City is centrally located in the north-east region of Thailand as shown in Figure 3.2. Its total area is 46 square kilometers. The city is home to 326,643 people (in 2014). Moreover, Khon Kaen City has known as the central of economic, education, traffic and urban development in the north-east region part of Thailand. Khon Kaen City has the polycentric pattern of employment and education centers that allow people make many trips around the city. Sri-Jan Road is one significant arterial road of Khon Kaen City which is crossing the heart of its central business district (CBD).

Based on the authors' field survey conducted in August 2015 about the existing Songtaew service as can be seen in Table 3.1, there is a total of 19 Songtaew service routes operated in Khon Kaen City as shown in Figure 3.3. It can accommodate up to 20 passengers on any trip. Moreover, a flat-fare system is used, with adults costing 9 Baht and students costing 5 Baht. In Khon Kaen City, Songtaew is usually modified from a pick-up truck such as Toyota Hilux, ISUZU D-MAX, and ISUZU D-LUX as shown in Figure 3.7. It operates by the private sector and local cooperative as a hail and ride service on fixed-route in the city.

According to Figure 3.1, we can see that the number of registered Songtaew in Khon Kaen City has declined since the year 2012. One reason that caused this situation is the policy "First car" in 2012 which Thai people especially low-income group have been encouraged to buy or reserve a car and benefit from generous tax bonuses. This situation affected most people in Thailand switch transport mode from the motorcycle and public transport to cars. Moreover, there are some people who overstretched their finances which had to keep the new car unused because they could not afford gasoline. Another effect in many cities including Khon Kaen City is a much denser traffic congestion. Furthermore, the number of Songtaew passengers has also decreased. Thus the number of registered Songtaew in Khon Kaen City also dropped because of this situation. Since Songtaew ridership has declined, the coverage area of Songtaew service is not cover all the 19 number of routes as shown in Figure 3.3. It can be seen that most of current Songtaew routes provide the service along the main roads. Even Songtaew is flexible service with the intermediate size of vehicle that can provide the service on some narrow streets in the city. However, just a few routes that ply through the narrow roads in some communities especially in the city center of Khon Kaen City because of the declining number of Songtaew users in those areas. The areas outside the city center are not cover all areas by Songtaew service since most of the people who live outside the city center they already have a private vehicle such as car and motorcycle. Therefore, how to attract more people in Khon Kaen City reduce their private vehicle use and switch to Songtaew is very necessary to consider the coverage areas of Songtaew service.

Considering the waiting areas of Songtaew in Khon Kaen City, at present, most of the Songtaew waiting areas in Khon Kaen City can be categorized into two types which are 1) normal shelter with no route information, providing the only number of Songtaew route on the Songtaew stop stand as shown in Figure 3.5, and 2) no shelter and no route information as shown in Figure 3.6. The waiting areas of Songtaew must not be overlooked because the comfort of Songtaew stop can encourage the people to use Songtaew service as well as can decrease the risk of safety issues.



**Figure 3.1** Number of Registered Songtaew in Khon Kaen City

Source: Khon Kaen Provincial of Land Transport, 2016

**Table 3.1** Basic information of Songtaew in Khon Kaen City.

Elements	Values
Number of Route	19
Vehicle capacity (person/vehicle)	20
Average travel time (one way) (h)	0.50
Average Route Length (km)	18
Fare (per person per trip)	30 JPY ( 9 THB: Adults) 17 JPY ( 5 THB: Students)
Operation time	6:00 AM – 6:00 PM

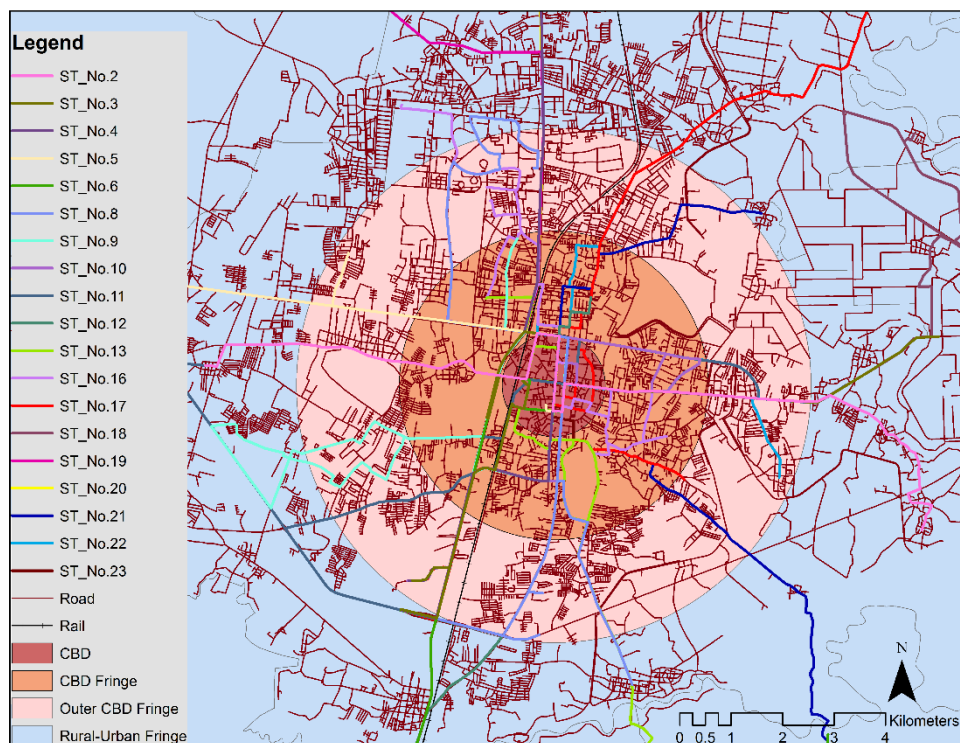
Source: Field survey conducted in 2015





**Figure 3.2** Khon Kaen City Map

Source: Created by Esri's ArcGIS software



**Figure 3.3** Songtaew (ST) route service in Khon Kaen City.

Source: Created by Field survey and ArcGIS software



**Figure 3.4** Songtaew in Khon Kaen City.



**Figure 3.5** Songtaew waiting area: normal shelter with no route information.



**Figure 3.6** Songtaew waiting area: no shelter and no route information.





**Figure 3.7** The design of Songtaew in Khon Kaen city.



**Figure 3.8** Songtaew: Different color, Different route.

### 3.2 RESEARCH FRAMEWORK

Methodological framework was developed to achieve the main goal of research which is a modal shift in providing policy development and recommendation to improve the paratransit service which is Songtaew in Khon Kaen City. Figure 3.9 describes all overall process that had been done. A brief explanation of the research structure is as follows.

1. Firstly, a review on paratransit, especially in developing countries focusing on all institutional side, supply side and demand side of paratransit system, had been done to better understand about the paratransit studies. (For more detail, see Chapter 2)
2. Secondly, the study regarding the regulation and policy of Songtaew had been done by

both literature review on the previous study about this issue and the comparative study regarding Songtaew in Thailand and Jeepney in the Philippines to explore the role of paratransit in Thailand focusing on Songtaew, in order to provide a data of developing countries' paratransit issues for the further study on paratransit in Southeast Asia in the future. (For more detail, see Chapter 4)

3. Next, the supply side analysis was conducted by focusing on the Songtaew service performance regarding the study of the supply side characteristics especially cost characteristic and then the cost analysis of Songtaew operation had been done. (For more detail, see Chapter 5)
4. After that, the demand side analysis was focused by 1) analyzing the existing travel behavior of travelers in Khon Kaen City both Songtaew user and non-user (For more detail, see Chapter 6), 2) examining the Songtaew perception by analyzing travelers' satisfaction on Songtaew service (For more detail, see Chapter 7), and 3) investigating travel choice behavior and the influence of Songtaew service on Khon Kaen urban commuting (For more detail, see chapter 8).
5. Then, the role of Songtaew in Khon Kaen City to support the sustainable transportation is detailed. (For more detail, see chapter 9).
6. Finally, the significant factors in explaining Songtaew ridership are revealed. Then the recommendation regarding important policies and the improvement of operation performance and future management will be developed to support the sustainable transport in Khon Kaen city, especially contributing to a modal shift. (For more detail, see Chapter 10)

### 3.3 DATA COLLECTION AND METHODOLOGY

To study both supply and demand side of Songtaew service, the questionnaire was developed. Especially for both the demand side and the supply side studies, the detail of questionnaire design and survey of this study is shown below.

#### 1) Field survey I: Users and Non-users (August 2015)

In this demand side study, the author analyzed results from a comprehensive field survey conducted among Songtaew users and non-users in Khon Kaen City, in order to measure their perception of the service provided by using the satisfaction of Songtaew service as the indicator to evaluate their perception. The surveys were carried out on interviewing randomly selected passengers in the Central Business District (CBD) of Khon Kaen city where there are many offices, shops, and schools located in this area.

A 4-page questionnaire (See the questionnaire sheet in Appendix A), divided into six parts as shown in Figure 3.11, was developed for this study. The first part of the questionnaire consists of 15 general questions relating to the respondents' socioeconomic information such as gender, age,

occupation, driving license, and the experiences with Songtaew. The second part addresses questions about the present travel pattern for going to work or school on regular weekdays. The third part is a set of service satisfaction for the users consisting of 9 factors which are safety, waiting time, in-vehicle time, availability, cost, comfort, flexibility, the image of Songtaew, and service information. The fourth and fifth parts are the questions related to 11 factors for respondents' mode selection which are safety, waiting time, in-vehicle time, availability, cost, comfort, flexibility, the image of Songtaew, service information, service reliability, and convenient. The last part is a set of the questions related to 7 factors for non-users satisfaction on the Songtaew improvement in the future which are the driver and riding safety, vehicle standard, service reliability, availability, comfort, operation and service information, and providing express-Songtaew. In all questions about service satisfaction, the respondents are asked to rate the aspects on a 4-point scale of satisfaction, ranging from very dissatisfied to very satisfied.

Then data were analyzed through percentage, cross-tabulation, Chi-square statistical techniques and multiple regression analysis for examining the Songtaew perception for the users and the non-users. Moreover, for the study of travel mode choice behavior, the multinomial logit model of regular trips in Khon Kaen City is developed to analyze the mode choice behavior.

## **2) Field survey II: Drivers and Users (August 2016)**

A comprehensive field survey of Songtaew drivers and users was carried out for investigating their perception on various aspects of Songtaew service considered as the major factors related to the usage of Songtaew in Khon Kaen City: safety, comfort, reliability, and flexibility which derive from the results of the study from the field survey I in 2015.

A survey was conducted among Songtaew drivers and users in Khon Kaen City, the major city of the northeastern region of Thailand, in order to define their perception on each factor of Songtaew service. The survey was carried out by interviewing the drivers and the users on working days and interviewing randomly selected drivers and passengers. The questionnaire for users and drivers consisted of two parts; the first part contains general questions relating to the respondents' demographic and socio-economic information such as gender, age, education, occupation and driving license possession. The second part is the major part which consists of Songtaew service factors such as safety, comfort, reliability, flexibility, cost, the image of Songtaew, emotion and travel time (See the questionnaire sheet in Appendix B). All respondents were asked to rate the each factor on a 5-point scale of their perception as shown in Figure 3.12. Then data were analyzed through percentage, cross-tabulation, Chi-square and multiple regression analysis for testing the hypotheses and examining the Songtaew perception from the drivers and users.

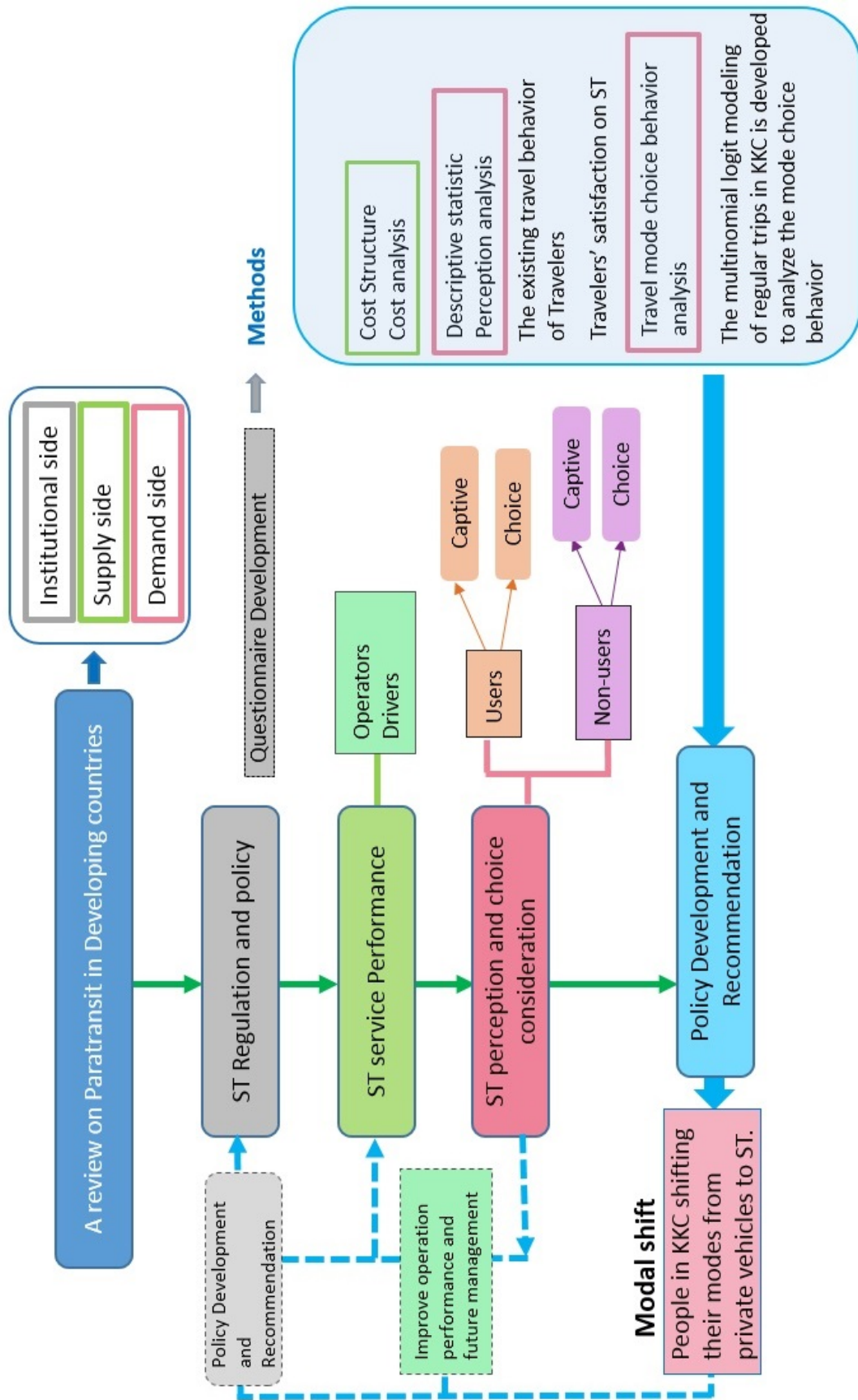
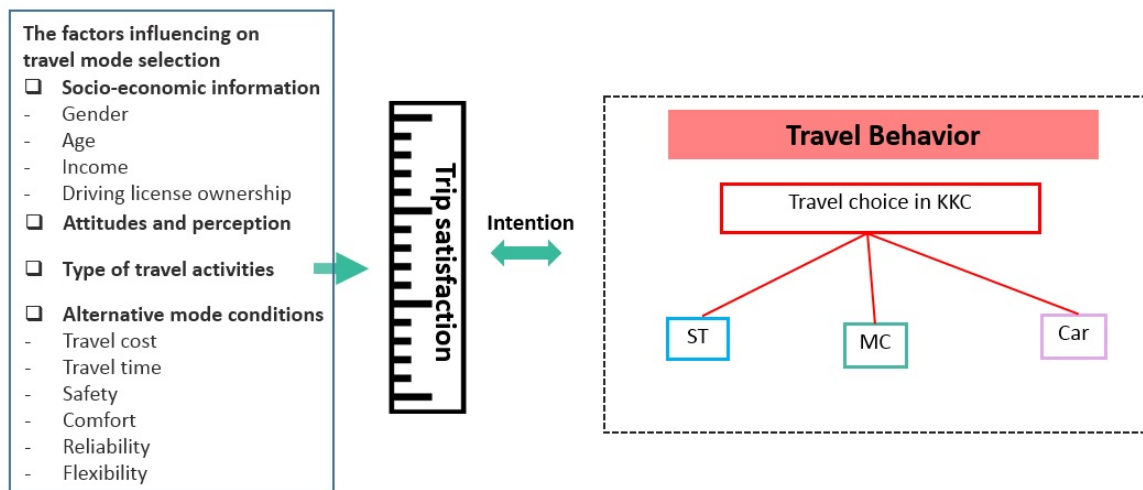


Figure 3.9 Research Framework.

The framework of developing the logit model for travel choice analysis to identify significant factors tending individuals to decide travel mode in Khon Kaen City (KKC) as shown in Figure 3.10. There are three modes; 1) Songtaew (ST), 2) Motorcycle (MC), and 3) Car for Khon Kaen citizen to choose for their regular trip both going to school and going to work.

For both field survey, the author and the survey team conducted the first field survey in August, 2015. The total collected sample size is 602 samplings. For the second field survey, it was conducted in August 2016. The total collected sample size for the users is 287 samplings, and for Songtaew drivers are 150 samplings. Both surveys were carried out on interviewing randomly selected car users, motorcycle users, Songtaew passengers and drivers in the Central Business District (CBD) of Khon Kaen city where there are many offices, shops, and schools located in this area as shown in Figure 3.13 and Figure 3.14.



**Figure 3.10** The framework of travel choice analysis.

### 3) Multinomial Logit Model

In particular, the discrete choice model is the random utility theory used for comparing choice behavior. This model is familiar to analyze both individuals and household's behavior mainly related to the transportation policy. Discrete choice model is widely used in the demand analysis, the evaluation of the effectiveness of the transportation strategies (Chen et al., 2014). Many studies examined the significant factors in the commuters mode choice to support urban transit management by developing Multinomial Logit Model (MNL) which is one of the discrete choice models, and MNL can deal with more than two alternatives which suit to the situation of the urban transport in this study since there are mainly three different options for the travelers in Khon Kaen City.

In this study, the author adapted multinomial logit model (MNL) using the mlogit packages developed by Yves Croissant, Universite de la Reunion. Croissant noted that "Mlogit is a package

for R which enables the estimation of the multinomial logit models with individual and alternative specific variables (Croissant, 2015)

Considering Multinomial Logit Model, the basic utility equation for individual  $n$  choosing alternative  $j$  an MNL model is shown below.

$$U_{nj} = V_{nj} + \varepsilon_{nj}$$

The systematic component of the utility function is given as:

$$V_{nj} = Z_n \gamma_j$$

So,

$$U_{nj} = Z_n \gamma_j + \varepsilon_{nj}$$

$\gamma_j$  is a vector of alternative-specific parameters, i.e. the parameters are subscripted by  $j$ . These parameters relate the characteristics of a respondent ( $Z$ ) to the respondent's utility for the  $j$ th choice –they are individual-specific characteristics. This means that the effect of the independent variables will vary across all of the choices. In other words, there will be a separate coefficient on each independent variable for each possible outcome. For example, if the age of the individual were an independent variable, then the effect of age on choosing alternative 1 would be different to its effect on choosing alternative 2, alternative 3 etc.  $Z_n$  is a matrix of individual or case-specific characteristics. Estimation of this model is relatively easy since the log likelihood function is globally concave. To specify the likelihood, first define  $d_{ni} = 1$  if individual  $n$  chooses alternative  $i$ ,  $d_{ni} = 0$  otherwise. This means that there are  $J$  lots of  $d_{ni}$ , each indicating a choice. These indicators are then used to select the appropriate terms in the likelihood function. Thus, the likelihood function for individual  $n$  is:

$$L_n = P_{n1}^{d_{n1}} \times P_{n2}^{d_{n2}} \times P_{n3}^{d_{n3}} \times \dots \times P_{nj}^{d_{nj}}$$

where  $P_{ni}$  is the probability that individual  $n$  chooses alternative  $i$ . The likelihood function for the entire sample is:

$$L = \prod_{n=1}^N (P_{n1}^{d_{n1}} \times P_{n2}^{d_{n2}} \times P_{n3}^{d_{n3}} \times \dots \times P_{nj}^{d_{nj}})$$




Thus, the log-likelihood function is just:

$$\ln L = \sum_{n=1}^N \sum_{i=1}^J d_{ni} \ln \left( \frac{e^{x_{ni}\beta}}{\sum_j e^{x_{ni}\beta}} \right)$$

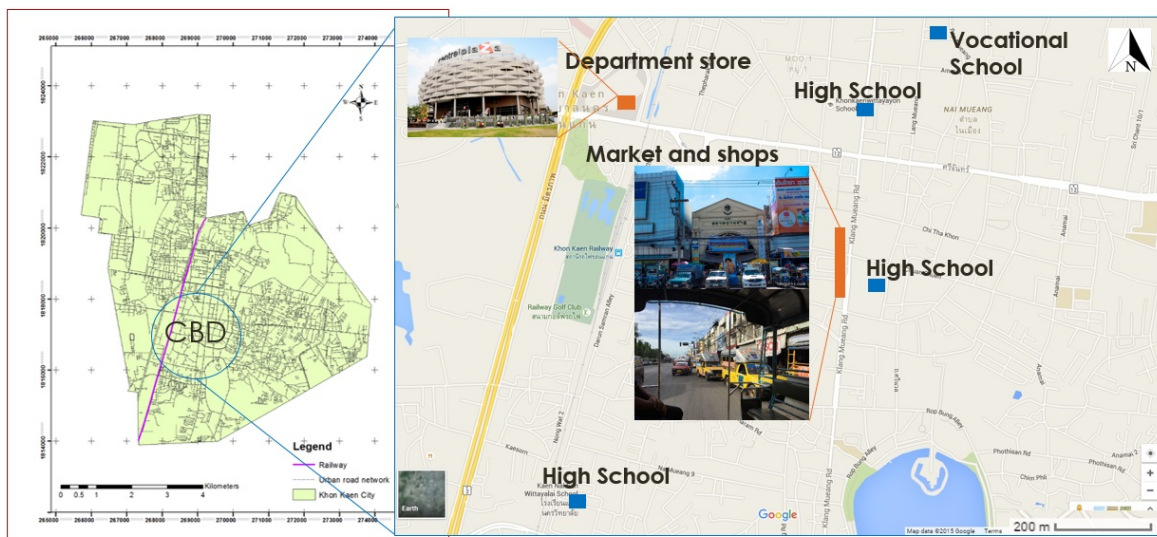


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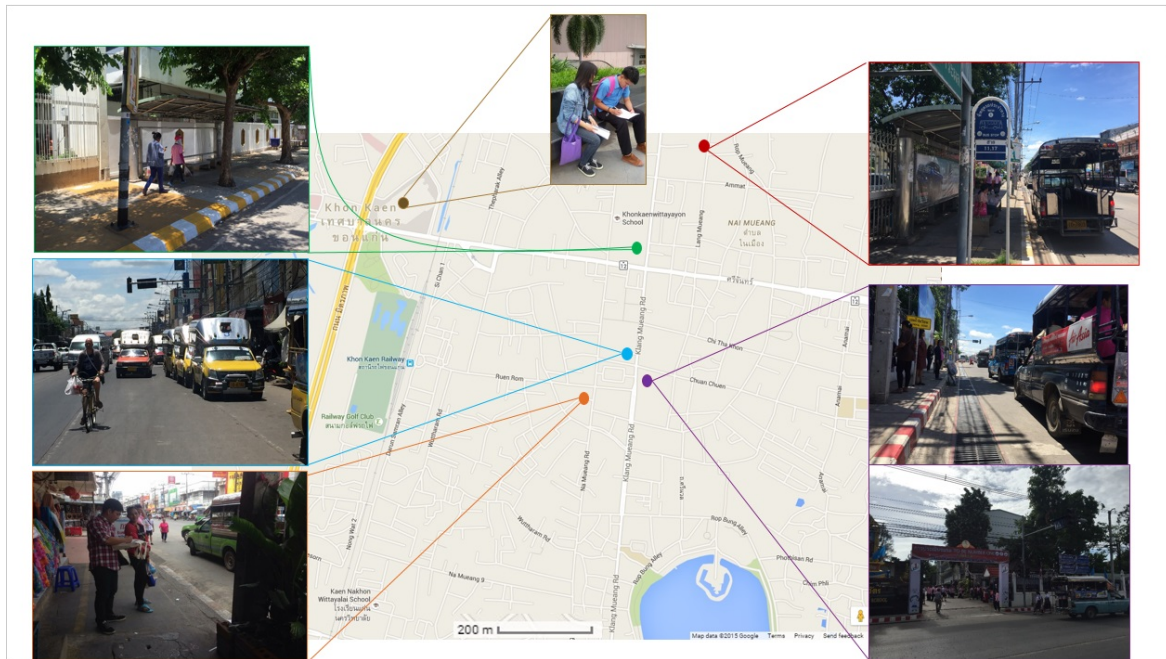
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Variables	Attributes ( 5 points Likert Scale)				
	Negative perception				Positive perception
	1	2	3	4	5
Comfort (C)	Uncomfortable (1) – Comfortable (5)				
Safety (S)	Risky (1) – Safe (5)				
Travel time (T)	Long time (1) – Short time (5)				
Cost (Co)	Expensive (1) – Cheap (5)				
Image of ST (I)	Bad image: lower than bus (1) – Good image: Same as bus or higher (5)				
Flexibility (F)	Inflexible (1) – Flexible (5)				
Reliability (R)	Unreliable (1) – Reliable (5)				
Emotion (E)	Bored (1) – Happy (5)				

**Figure 3.12** Factors of Songtaew service perception questionnaire design for field survey II.



**Figure 3.13** Map of Field Survey in Khon Kaen City.



**Figure 3.14** Field Survey in Khon Kaen City.

## CHAPTER 4

### SONGTAEW IN THAILAND

The purpose of this chapter is to provide the information regarding Songtaew service in Thailand which is the traditional paratransit mode in Thailand. The institutional side of Songtaew system focusing on its regulation is detailed in this chapter. Moreover, the comparison study between Jeepney in the Philippines and Songtaew in Thailand is also provided in this Chapter to explore the role of paratransit in Thailand focusing on Songtaew's institutional side, in order to provide a data of developing countries' paratransit issues for the further study on paratransit in Southeast Asia in the future.

#### 4.1 BACKGROUND

In many developing countries in Southeast Asia, paratransit is an important urban public transport mode. Paratransit services are mostly operated in terms of different size and forms such as those of Thailand's motorcycle-taxi, Tuk-tuk, Songtaew, and Silor-lek, Indonesia's Bajaj and Angkutan Kota, Philippines' Jeepney and the motos of Vietnam and Cambodia. (Guillen et al., 2007) Nowadays the role of paratransit becomes the dominant transport mode in many urban areas in developing countries because paratransit vehicle can be more accessible, more flexible, faster and cheaper than other public transport vehicles.

The four wheel vehicle with two rows benches in the back is one of the paratransit services in many developing countries in Southeast Asia which is known by various local names such as Laos and Thailand's Songtaew, Myanmar's Hilux, Vietnam's 12-seat-bus, Indonesia's Angkutan pedestrian and Philippines' Jeepney.

The main goal of this chapter is to explore the role of paratransit in Thailand focusing on Songtaew's institutional side, in order to provide a data of developing countries' paratransit issues for the further study on paratransit in Southeast Asia in the future. The structure of the chapter contains several sections in which, the next section, Chapter 4.2 begins with the international comparative study about Songtaew and the other similar vehicles in the Southeast Asia country in the case of Songtaew and Jeepney in the Philippines. The domestic comparison about Songtaew in Thailand focusing on the various types of paratransit in Thailand, the various design of Songtaew and the current situation of Songtaew in different cities are described in Chapter 4.3. Finally, the future potential of Songtaew in Thailand is presented in the summary section in Chapter 4.4.

## **4.2 INTERNATIONAL COMPARISON**

### **4.2.1 Songtaew in Thailand**

#### **4.2.1.1 Overview of Songtaew in Thailand**

Songtaew in Thailand is modified from a pick-up or a larger truck with two rows of seats in the back carrying about 18 passengers. At present, Songtaew provides passenger movement in both within towns and cities and for longer routes between towns and villages. In Bangkok Songtaew plays a role as a feeder of mass transit system especially bus, train, the Metropolitan Rapid Transit (MRT) and the Bangkok Mass Transit System (BTS). (Tangphaisankun, 2010) For the transportation in other cities especially in the primary cities of different regions in Thailand, Songtaew plays a role as the main public transportation in urban and rural areas. (Kikuchi et al., 2013)

#### **4.2.1.2 Songtaew Regulation**

Thai central government is responsible for public transportation in Bangkok and other provincial areas, which includes the Office of Transport and Traffic Policy and Planning, and Department of Land Transport. To regulate policy of fixed-route bus as well as Songtaew in Thailand is implemented under Land Transport Act 1979 (B.E. 2522) by having Land Transport Policy Committee, Central Land Transport Control Board (CLTCB) and Provincial Land Transport Control Board (PLTCB) that have the authority to fix the routes, the number of Songtaew operator, and the number of vehicles for fixed routes in Bangkok and other provincial areas. (Department of Land Transport, 2014)

There are two types of fixed-route bus as well as Songtaew in Thailand that operated by government agency and by private agency which is a) Government agency which is two agencies to operate bus transport: The Transport Company Limited and the Bangkok Mass Transit Authority (BMTA) are state enterprises that the government shareholder is 51%, and private shareholder is 49%. The Transport Company Limited is permitted to operate the route which links between Bangkok and other provinces. The Bangkok Mass Transit Authority (BMTA) is permitted to operate the routes which are in Bangkok Metropolitan area, and b) Private agency which is given the approval by the government to operate the bus and Songtaew in the bus route in Bangkok Metropolitan area, the municipalities and the village in the provincial areas. (Department of Land Transport, 2014)

The fare-setting process is defined in the acts. The CLTCB has the authority to fix the share rates of transportation and other service charges. Those charges are determined by referring to the discussion in the cabinet. The fare of the urban bus, as well as Songtaew, is calculated under the cost-plus pricing, which determines the fare on the basis of the estimated total cost. Section 23 of the 1979 Local Transport Act presents the licenses by route and by vehicle size which related to Songtaew is the license of the fixed-route transportation is valid for seven years while the licenses of the non-fixed route and small-vehicle transportation are valid for five years. These licenses are

given by the provincial board under the Ministerial regulation. (Saito, 2011)

## **4.2.2 Jeepney in the Philippines**

### **4.2.2.1 Overview of Jeepney in the Philippines**

In the Philippines, the American jeep used in the Second World War was remodeled by extending the body to accommodate more passengers. Compared to the original jeep, Jeepney can carry 20 passengers. It is known to be the poor man's transport, versatile, durable and colorful vehicle. (Guillen et al., 2007) At present, Jeepney is still the dominant mode of transport throughout the Philippines especially in Metro Manila and other large cities such as Cebu, Davao, Iloilo, and Bacolod which are regional capitals of different parts of Philippines. In other cities' urban areas and rural areas, the dominant mode is not Jeepney but the tricycle (motorcycle with sidecar). In these cases, Jeepney is used only for inter-city or inter-town travel, which is basically long-distance compared to the short and medium distance routes of tricycles. (Regidor, 2015)

### **4.2.2.2 Jeepney Regulation**

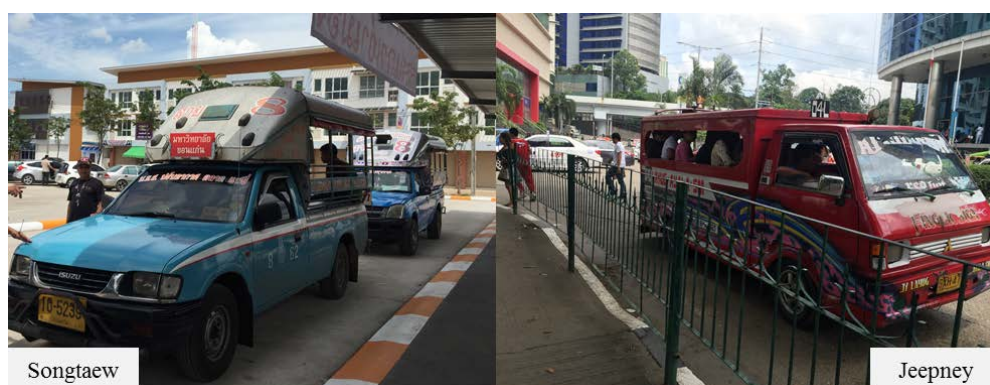
The Land Transportation Franchising and Regulatory Board (LTFRB) is responsible for the regulation of franchise to public utility vehicles. A Certificate of Public Convenience (CPC), an authorization issued by the LTFRB for the operation of land-based public transportation utilities must first be obtained before an operator can provide transport services. This certificate could be issued only upon submission of the requirements as provided in the Public Service Act 146 and approved by the Board. The whole process normally takes sixty (60) days. (Bayan et al., 1995)

Jeepney generally operates along fixed routes nowadays, which are determined and proposed initially by prospective Jeepney operators. The proposed route is evaluated by the Department of Transportation and Communications (DOTC) Road Transport Planning Division (RTPD). The rule is that at least 75% of the proposed route should not overlap with an existing road public transport routes. Some entirely new routes for new communities or developments can be classified as "developmental" routes and usually comply with the 75% rule. For existing routes, the DOTC-RTPD determines first if the current supply of jeepneys can no longer address the demand. The agency then determines how many additional jeepneys can be approved. Next Jeepney operators are able to comply with this rule and other requirements, for instance, the insurance and the financial statements. Then their cases are endorsed by the Land Transportation Franchising and Regulatory Board (LTFRB) for franchising. For the fares of road public transport vehicles like bus, Jeepney, UV Express and taxis are regulated by the LTFRB. Before any increase in the fares is approved, the proposal must go through a public hearing and deliberation by the LTFRB. In the public hearing, both the supporters and opposition to the proposed fare increase are invited and present their arguments. (Regidor, 2015)



### 4.2.3 Comparisons of Songtaew and Jeepney

First, the characteristics of Songtaew and Jeepney are similar to each other which also contain two facing benches as shown in Figure 4.1. These vehicles can accommodate more than 20 passengers plus standees both inside the vehicle and at the rare exit. On the other hand, they are different in their design which Songtaew is basically a modified pickup truck, with two rows seats, a roof and some railings at the back and Jeepney is informally designed and decorated in vibrant colors with chrome-plated ornaments on the sides and hood.



**Figure 4.1** Songtaew and Jeepney

Second, the role of Songtaew and Jeepney are similar to each other which also is the important and popular public transport mode, especially in the urban area. However, they play the different role in a different area in each country as summarized in Table 4.1. In Thailand Songtaew plays a role as a feeder of mass transit system in Bangkok downtown. On the other hand, it plays a role as a main public transport mode in both urban and rural areas especially in Bangkok suburbs and in other medium-sized cities such as Khon Kaen, Chiang Mai, Nonthaburi, Chonburi, etc. Compared to Jeepney in the Philippines, Jeepney also plays a role as a main public transport mode especially in Metro Manila and other large cities such as Cebu, Davao, Iloilo, Bacolod, etc., which are regional capitals of different parts of Philippines like in Thailand. On the other hand, there is no Jeepney service in other cities' urban areas and rural areas which the dominant mode is the tricycle.

Third, the route setting process also varies between Songtaew and Jeepney as summarized in Table 4.2. The Jeepney operator chooses its route based on demand to increase their revenues and proposes the route to the Department of Transportation and Communications (DOTC) Road Transport Planning Division (RTPD) for evaluating and franchising. Compared to Songtaew, the route setting process of it is fixed by The Transport Company Limited and the Bangkok Mass Transit Authority (BMTA) for the routes in Bangkok Metropolitan area and the private agency which is given the approval by government to operate the route of Songtaew in Bangkok Metropolitan area, the municipalities and the village in the provincial areas.

**Table 4.1** The role of Songtaew and Jeepney.

Type	Area	
	Urban	Rural
Songtaew	a) A feeder of mass transit system in Bangkok downtown b) A main public transport in other provinces	A public transport
Jeepney	A main public transport especially in Metro Manila and regional capitals	-

**Table 4.2** The route regulation systems of Songtaew and Jeepney.

Type	Songtaew	Jeepney
Determined by	Central Land Transport Control Board (CLTCB)	Department of Transportation and Communications (DOTC) Road Transport Planning Division (RTPD)
Regulation on the route	A) The Transport Company Limited and the Bangkok Mass Transit Authority (BMTA) fix the route in Bangkok. B) The private agency given the approval by government fix the route in Bangkok and other provinces.	The Jeepney operators propose the route and the Department of Transportation and Communications (DOTC) Road Transport Planning Division (RTPD) evaluates and approves the route.

Fourth, the fare regulation systems also vary between Songtaew and Jeepney as summarized in Table 4.3 The fare of Jeepney is regulated by the Land Transportation Franchising and Regulatory Board (LTFRB) which approved through public hearings conducted by the Board. For the fare of Songtaew, it can be divided into two types which are a) the fare of Songtaew in Bangkok is regulated by the Central Land Transport Control Board (CLTCB) and b) the fare of Songtaew in provincial areas is regulated by the Provincial Land Transport Control Board (PLTCB).



**Table 4.3** The fare regulation systems of Songtaew and Jeepney.

Type	Songtaew	Jeepney
Determined by	Central Land Transport Control Board (CLTCB)	Department of Transportation and Communications (DOTC) Road Transport Planning Division (RTPD)
Regulation on the fare	a) The Central Land Transport Control Board (CLTCB) fix the fare in Bangkok. B) The Provincial Land Transport Control Board (PLTCB) fix the fare in other provinces.	Public hearings and approving the fare by the Land Transportation Franchising and Regulatory Board (LTFRB)

### 4.3 DOMESTIC COMPARISON

#### 4.3.1 Songtaew and the various types of paratransit in Thailand

There are various kinds of paratransit that developed in Thailand for people's traveling in the urban and rural areas. In the case of paratransit in Thailand, there are mainly three types of paratransit which serve the transportation services for the people in many cities, including Songtaew, motorcycle-taxi, and Silor-lek which is four-wheel compact car as shown in Figure 2. (Oshima et al., 2007)

As discussed earlier, Songtaew or a modified pick-up truck taking passengers on the back with an overhead cage and two-row seats in the back that can accommodate up to 18 passengers or more, operates as a fixed - route service in Bangkok and other provinces especially in many medium-sized cities of Thailand. Moreover, it plays different roles in different areas in Thailand which are a) a feeder of mass transit system in Bangkok and b) a main public transport in other provincial urban areas.

Silor-lek or a four-wheel compact car plays a role as a feeder in the narrow dead-end side street branching off a major street, connecting to local communities especially in Bangkok. (Oshima et al., 2007) In other cities especially in the rural area, Silor-lek operates as a local public transport with the non-fixed route.

Motorcycle-taxi in Thailand plays an important role as a minor transport mode servicing urban transportation demands along the narrow and deep road connecting their local communities and main street where other major public modes are operating such as the Metropolitan Rapid Transit (MRT) and the Bangkok Mass Transit System (BTS). (Oshima et al., 2007)



**Figure 4.2** The various types of paratransit in Thailand  
(Songtaew, Silor-lek, and Motorcycle-taxi)

#### 4.3.2 Various design of Songtaew in Thailand

In Thailand, there are two mainly types of Songtaew related to its design and vehicle as shown in Figure 4.3. The first type of Songtaew is some vehicles are modified from Toyota Dyna, Mitsubishi Fuso Canter, Isuzu Elf and similar large trucks which can accommodate more than 30 passengers and operates as a fixed - route bus to run on the fixed route between province area connecting the rural and the urban area through the different parts of Thailand. The second type of Songtaew is some vehicles are modified from a pick-up truck such as Toyota Hilux, ISUZU D-MAX, ISUZU D-LUX, etc. which can accommodate more than 20 passengers and operates as a fixed-route bus to run on the fixed route in Bangkok both downtown and suburb, urban and rural areas in other provinces especially in the primary cities in the different regions of Thailand.



**Figure 4.3** The various design of Songtaew.

#### 4.3.3 Songtaew in different cities in Thailand

Songtaew is known as one of the major means of transportation in the urban areas and even in the rural areas in Thailand. This mode is popular in Thailand because of its intermediate size which can easily move around the area even the smallest interior areas. Furthermore, Songtaew is more flexible and cheaper than other transport modes in many cities of Thailand. The price is usually between 8 or 10 baht per journey. In many medium-sized cities, Songtaew service serves as a dominant public transportation for people through many cities besides Bangkok such as Nonthaburi, Hat Yai, Nakhon Ratchasima, Khon Kaen, Chonburi and Nakhon Si Thammarat.

In Bangkok Songtaew is a ride-sharing pick-up truck because of the lack of the bus service along with local street (Oshima et al., 2007) and plays a role as a feeder of mass transit system especially the Metropolitan Rapid Transit (MRT) and the Bangkok Mass Transit System (BTS). (Tangphaisankun, 2010) In other cities especially in the regional capitals and medium-sized cities of Thailand Songtaew operates as a main urban public transport which is served areas along the main and local street with a fixed route.

#### 4.4 SUMMARY

As the result of a large number of population in Thailand relying on Songtaew as a main public transport mode leads to its future potential that will be still popular transportation mode in the many cities in Thailand especially in the medium-sized city. Thus it is necessary for the government to formally recognize it as a public transport mode. Furthermore, a suitable policy for Songtaew shall be made to formalize it for the benefit of the passengers in the operated areas of its service to encourage more use of Songtaew towards the sustainable transportation of the city.

In addition, this chapter provided the information on important aspects relating to the institutional side of Songtaew in Thailand which is the popular paratransit mode in many cities because it can be more accessible, more flexible, faster and cheaper than the other modes. Moreover, this chapter compared Songtaew in Thailand and Jeepney in the Philippines focusing on the institutional system, the vehicle characteristic and the role as public transportation mode which the

results can serve as a database for the future studies of paratransit in developing countries especially the study which is related to Songtaew and Jeepney. This chapter also presented the regulation and operation systems of Thailand's Songtaew and Philippines' Jeepney and analyzed the similarities and differences between them. The results showed that the vehicle characteristic is similar to each other which also contains two facing benches. On the other hand, the route and the fare regulation system vary between them depending on their government agency and Transportation Act. Furthermore, the comparison study between Songtaew and Jeepney shows that they also play the role as the popular paratransit mode in the urban area.

For the domestic comparison of Songtaew in Thailand, the study shows that there are two types of Songtaew related to its design and vehicle which are the modified large truck mainly operated in rural areas and the modified pick-up truck operated in Bangkok and urban areas in other provinces. In conclusion, Songtaew in Bangkok plays a role as a feeder of the mass transit system, and in other provinces especially in the medium-sized cities, it plays a role as a main public transport.

The further research issues should be studied with other aspects of Songtaew in Thailand such as supply side and the demand side of Songtaew service especially the demand side by exploring the travel behavior of the user to extend the local knowledge and experiences about this mode of paratransit in developing countries.

## CHAPTER 5

### SONGTAEW SERVICE IN KHON KAEN CITY

This chapter presents the present issues of Songtaew service in Khon Kaen city regarding the supply side which are the supply characteristics of Songtaew focusing on the cost characteristics and the cost analysis of current Songtaew operation by analyzing Songtaew route number 8's current operation in terms of using the fuel consumption because of the limited of available data.

#### 5.1 GENERAL CHARACTERISTICS OF SONGTAEW IN KHON KAEN CITY

Based on the existing public transport information studied in 2013 by Jaensirisak, there are 13 Songtaew service routes in Khon Kaen city which are operated by the private sector. This study can be summarized as follows: the average number of hours of work is 12 hours; the average fare is 5-10 Baht; Songtaew dispatch frequency is every 10 minutes; the average net income per day is 320 Baht; the average maintenance costs is 8,600 Baht per year; the highest expense on fuel is 500 Baht per day, and the most frequent drop-off spot is Khon Kaen Bus Station.

As shown in Table 5.1, Songtaew can accommodate up to 20 passengers on any trip. Furthermore, the average operating speed is 15 kilometers per hour, travel time for one way trip is 50 minutes, and the average route length of Songtaew is 18 kilometers. As can be seen in Table 5.2, daily hours of operation for all service routes of Songtaew are almost same. The number of service round per day ranged from three trips per day to eight trips per day. The daily fuel costs ranged from 300 to 500 Baht which most of the fuel used is diesel, CNG, and LPG, respectively. For the maintenance costs, Songtaew's maintenance costs for all service routes are ranged from 5,000 Baht to 9,600 Baht. Moreover, some cost elements such as routing costs, fuel costs, and maintenance costs are a very wide range depending on the route length of each route.

**Table 5.1** Service supply characteristics of Songtaew in Khon Kaen City.

Elements	Values
Vehicle Capacity (person/vehicle)	20
Average Operating Speed (km/h)	15
Travel Time (one way) (h)	0.50
Vehicle Operation Rate (1/h)	2
Average Route Length (km)	18

Source: S. Jaensirisak, et al. (2013)

**Table 5.2** Basic information of Songtaew in Khon Kaen City.

Route Number	Distance (km)	Fare (Baht)	Average daily working hours (hrs.)	No. of Service round (Trip)	Net revenues (Baht/day)	Routing Costs (Baht/day)	Fuel costs (Baht/day)	Maintenance Costs (Baht/year)
2	20	5/6/9/10	13	5	300	300	400	9,600
3	23	5/6/9	12	5	400	400	400	8,400
4	21	5/6/9	12	8	400	500	500	9,600
5	15	5/7/9	13	7	400	500	400	9,600
6	27	5/6/9/>10	10	5	250	300	400	8,400
8	12	5/6/9	12	7	400	500	500	9,600
9	13	5/6/9	13	8	300	500	400	9,600
10	15	5/9/9	12	7	300	450	300	5,000
12	16	5/6/9/10	12	5	300	250	400	8,400
13	22	5/6/9/10	12	3	200	150	300	8,400
16	12	5/6/9	12	5	300	250	300	8,400
20	18	5/9/9	12	7	400	400	400	8,400
23	15	5/6/9/>10	12	5	300	200	400	8,400

Source: S. Jaensirisak, et al. (2013)

## 5.2 COST CHARACTERISTICS

The total costs of providing Songtaew service in Khon Kaen city is not so complex as that of the other transport modes in Thailand such as buses. Since Songtaew drivers usually own only one unit and ply the route under the private sector's control, administration of Songtaew service is quite simple and thus does not entail any cost for it. Therefore, the total cost of Songtaew operation maybe divided into the following components: a) Operating costs, b) Maintenance costs, and c) Fixed costs.

Considering the operating costs from the structure of Songtaew operation, driver's wage per day ranged from 300 Baht to 400 Baht depending on the passenger capacity and some operating hours per day. The average fuel costs per day is 392 Baht. Fuel costs ranged from 300 to 500 Baht per day depending on the route length, operating hours per day, and a number of round trip per day.

Maintenance costs includes the cost of vehicle repairs which comprise tires, oil, and repairs. As shown in the previous table, the average of Songtaew maintenance costs is 8,600 Baht ranging from 5,000 Baht to 9,600 Baht.

Fixed costs in Songtaew operation includes licensing fees, registration fees, and other taxes which the average of paying the total fees is 1,500 Baht per unit.

The cost structure of Songtaew operation in Khon Kaen city shows that a large portion is spent on operating costs following by maintenance costs and fixed costs, respectively.

### 5.3 COST ANALYSIS OF CURRENT OPERATION

Depending on the availability of detailed data, the performance of Songtaew route number 8 which is the major route plying thoroughfare of Khon Kaen city has been selected for this study. It is useful to analyze operating costs by considering the important components of Songtaew operating costs, namely personnel, energy, and maintenance to figure out the influencing factors which affect the cost structure of Songtaew service. Unfortunately, no data relating to personnel component is available for Songtaew service at the time of this research. However, Songtaew drivers usually own Songtaew fleets and run their service. The payment for drivers is based on the number of passengers per day. For investigating the performance of Songtaew by the collected and secondary data, cost analysis in terms of operational performance is undertaken in the following sequences.

In order to obtain the Songtaew route number 8's density in terms of average values of Songtaew fleets per kilometer, route length was calculated, and its result shows that the current density of Songtaew route number 8 is 2.67 number of Songtaew per kilometer.

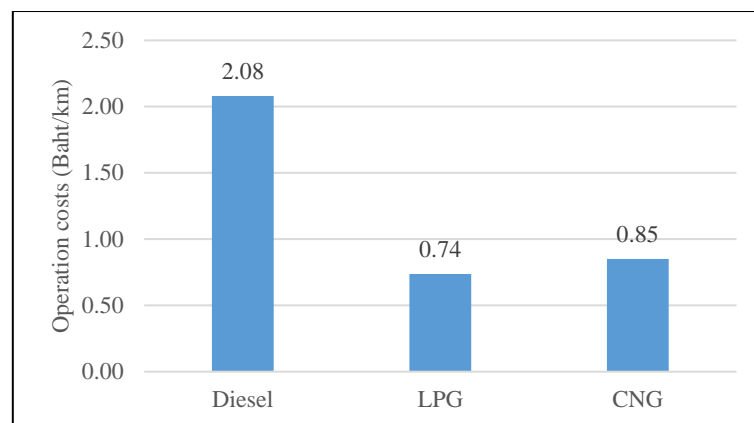
Moreover, from the collected data, the waiting time per unit of songthaew route number 8 can be analyzed in terms of average values of travel time per kilometer route length, and its result shows that the current waiting time per unit of Songthaew is 4.17 minutes. However, the waiting time is one of the important factors for evaluating the performance of the Songtaew service, the performance of Songtaew is still poor, especially in the real situation the waiting time is unreliable depending on the drivers such as some drivers stop the vehicles at each stop taking too much time to wait for the more passengers.

**Table 5.3** Service Characteristics and Costs of Songtaew route number 8 in Khon Kaen City.

Characteristics	Values
Vehicle capacity (person/vehicle)	20
Fleets size	32
Route length (one way) (km)	12
Number of Service round (Trip)	7
Travel time (one way) (h)	0.50
Average operating speed (km/h)	15
Waiting time (minutes)	4.17
Fuel consumption; Diesel (km/liter)	12.50
Fuel consumption; CNG (km/liter)	10
Fuel consumption; LPG (km/liter)	12.50
Cost of fuel consumption; Diesel (Baht/km)	2.66
Cost of fuel consumption; CNG (Baht/km)	0.85
Cost of fuel consumption; LPG (Baht/km)	0.74
Operation costs; Diesel (Baht/km)	2.08

Operation costs; CNG (Baht/km)	0.85
Operation costs; LPG (Baht/km)	0.74
Fuel costs; Diesel (Baht)	223.44
Fuel costs; CNG (Baht)	71.4
Fuel costs; LPG (Baht)	62.16
Maintenance costs (Baht/year)	9,600

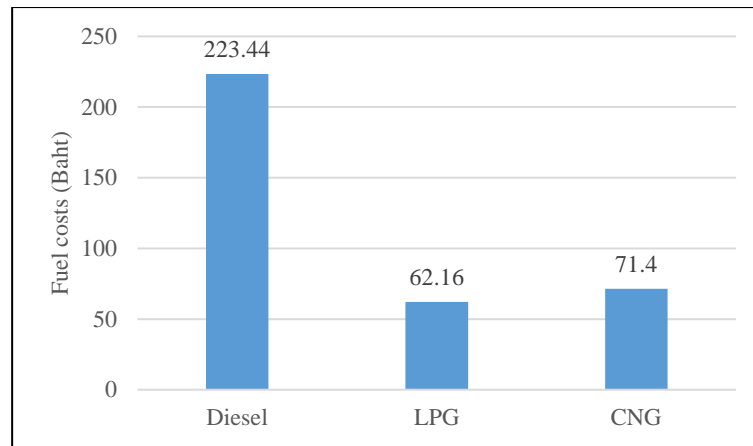
In order to analyze Songtaew route number 8's current operation in terms of using the fuel consumption, the result shows that the operation costs of Songtaew route number 8 using diesel, CNG, and LPG, are 2.08 Baht/km, 0.85 Baht/km, and 0.74 Baht/km, respectively as shown in Table 5.3. From cost analysis, it can be said that among various types of fuel that Songtaew using for its operation, although the cost of CNG (8.50 Baht/liter) is lower than LPG (9.20 Baht/liter) and diesel (25.99 Baht/liter), the operating cost using LPG is much lower than using CNG and diesel as shown in Figure 4.1.



**Figure 5.1** The operation costs of Songtaew route number 8 in Khon Kaen.

Furthermore, this study also considered total fuel costs for Songtaew operation performance in terms of fuel costs calculation, the fuel costs of Songtaew route number 8 using diesel, CNG, and LPG, are 223.44 Baht, 71.4 Baht, and 62.16 Baht, respectively as shown in Figure 5.2. According to the fuel costs of Songtaew route number 8 collected from Songtaew drivers as shown in Table 3 which is 500 Baht and the fuel costs from the calculation, it can be said that the cost of Songtaew operation can be reduced by using LPG, CNG, and Diesel, respectively. Additionally, Songtaew drivers' work practices also can increase fuel consumption such as always leaving the air-conditioning engine running in a vehicle even during traffic congestion to maintain the vehicle temperature.





**Figure 5.2** The fuel costs of Songtaew route number 8 in Khon Kaen.

#### 5.4 SUMMARY

Operational performance of Songtaew service based on cost analysis has been studied in this chapter to investigate the factors that might be affecting on Songtaew performance. According to the limited of available data relating to detailed Songtaew's cost structure, the results show that not only energy prices that affect the cost of Songtaew providing in Khon Kaen City but drivers' driving practice is also the influencing cost elements of Songtaew costs. In addition, the analysis of Songtaew costs points out that Songtaew using LPG is considerably providing lower cost than Songtaew using CNG and diesel. Therefore, changing the fuel consumption have a significant impact on the sustainability of the operation in the future. Furthermore, it is possible to introduce the Songtaew service as effective transportation which continues growing and still play a significant role in the city more than other public transportation vehicles such as motorcycle taxis, car taxis, and three-wheelers because of its advantages on accessibility and low-cost service.

Moreover, drivers can get a higher amount of revenue if they reduce fuel consumption by changing the type of fuel from diesel to LPG and CNG. Based on these findings from a cost perspective, there is a definite need to provide more LPG and CNG station in Khon Kaen for it significantly affects fuel consumption which is a large component of Songtaew operating costs.

As a result, we can consider that operating costs of Songtaew in Khon Kaen City has affected by not only energy costs and maintenance costs, but there are other exogenous variables which can affect costs of this mode such as drivers' salary, operating speed, road condition, maintenance standard, loading practices, vehicle capacity and vehicle age.

Furthermore, for contributing to the sustainable transportation in Khon Kaen City, the results in this chapter highlight that the operating cost using LPG and CNG is much lower than using diesel then towards the sustainable transportation in the city should encourage the Songtaew drivers to use LPG or CNG. Although, LPG releases CO<sub>2</sub> which is a greenhouse gas but is cleaner when compared to gasoline. Moreover, CNG releases lesser greenhouse gas. Therefore this encouragement would

contribute to the sustainable transportation of Khon Kaen City.

Lastly, due to the difficulty encountered in collecting data for this research, the government should require Songtaew owners to submit basic financial reports for making Songtaew database available for conducting the research and developing the policy relating to improving Songtaew performance in the future.

For next chapter, it is needed to study in details more about the travel patterns of people in Khon Kaen City, and the attitude and the behavior of each traveler group of Songtaew in order to improve the performance of this mode to fit the need for each group and it should focus on how to make the shift from private vehicles, both cars, and motorcycles. This would help to increase passengers on this mode of paratransit as well as to make Khon Kaen City more sustainable in the future.

## CHAPTER 6

### TRAVEL BEHAVIOR PATTERN IN KHON KAEN CITY

Urban Transportation problem especially the rapid growth of motorization has become one of the main problems faced by many cities in developing countries. This chapter focuses on the travel survey which identifies the origin and the destination of the home-based trip and the mode of travel as well as the socio-economic characteristics of the travelers in Khon Kaen City, Thailand. Moreover, the relationship between the travel behavior pattern and city structure also was examined in this study. The results show that people with higher income mostly lived in CBD area and made more travel than people with low income. The most of the home-based trip in Khon Kaen City is work trip which most of the workers took Songtaew going to their destination more than other modes. The results of this study could potentially aid in applying urban transportation policy to support the sustainable transportation in the future.

#### 6.1 BACKGROUND

Travel behavior in any city is complex and is guided by its land use distribution and transport network (Puntambekar, 2011). The urbanization in developing countries, including Thailand, is growing rapidly mainly due to heavy migration from rural areas and high growth of private mode of transportation (Domencish and McFadden, 1975). Khon Kaen City is the capital city of the north-eastern region of Thailand with total population ranks a third of the country and central business district (CBD) is experiencing one of the fastest growth rates in Thailand (Prabnasak and Yue, 2006). Therefore, the transport system in Khon Kaen City has been being challenged with rapid urbanization, unequal distribution, and a rapidly growing population. One of the main reasons of the transport problems in Khon Kaen City is no integration between transport management and economic growth of Khon Kaen City. Thus it needs urban transportation policy which will integrate economic growth with their future demand of the city. As home-based trips are concerned in Khon Kaen City, over 50 % take Songtaew for going to the workplace and to school which is the cheapest mode in Khon Kaen City (Wongwiriya et al., 2016).

Several previous studies have clearly shown that individual and household socio-economic characteristics have a strong influence on travel mode choice selection (Miller et al., 2005). Moreover, residential location also plays a significant role in travel mode choice selection (Pinjari et al., 2007). Many urban transportation studies have been done in several metropolitan areas such as in Bangkok, Thailand; Manila, Philippines; Kuala Lumpur, Malaysia, and Jakarta, Indonesia. However, there is the lack of the studies in medium-sized cities which are now challenged with rapid urbanization and transport problems, including Khon Kaen City in Thailand.

Therefore, the main goal of this chapter is to reveal travel patterns in terms of the relationship with city structure, which could potentially aid in applying urban and transportation policy in the future. Moreover, the existing dimensions of travel behavior in terms of socio-economic and travel characteristics such as trip types, trip modes, household income, the age of travelers and vehicle ownership in Khon Kaen City will be exposed in this study.

## **6.2 DATA AND METHODOLOGY**

To study the travel pattern focusing on the relationship with city structure and the existing dimensions of travel behavior in terms of socio-economic and travel characteristics such as trip types, trip modes, household income, age of travelers in Khon Kaen City, we analyzed results from a comprehensive field survey conducted among the travelers in Khon Kaen City considering the home-based trip. The surveys were carried out on interviewing randomly selected the travelers who made work trip and school trip in Khon Kaen city.

A 4-page questionnaire was developed for this study. The questionnaire consists of the general questions relating to the respondents' socioeconomic information such as gender, age, occupation, and household income. Another part addresses questions about the present travel pattern in terms of home-based trips both work trip and school trip in regular weekdays, especially in terms of travel mode and the location of the travelers' residence and the location of their destinations to reveal the relationship between the travel pattern and the city structure which is divided into CBD, CBD Fringe, Outer CBD Fringe and Rural-Urban Fringe. Then data were analyzed through a descriptive analysis such as percentage and cross-tabulation to reveal the current situation of transportation in Khon Kaen City and the travel behavior pattern of people in Khon Kaen City.

## **6.3 THE PRESENT SITUATION OF TRANSPORTATION IN KHON KAEN CITY**

This section summarizes the analysis carried out on the data obtained from the survey and the descriptive statistics of the respondents are provided in Table 1.

As shown in Table 6.1, the majority of respondents ( $n=602$ ) is female (69.1%). Furthermore, the most of the respondents are the labor (29.2 %) and the government officer (20.8%). However, among the total respondents, there is 45.8 % who do not have a driving license, and this group is the dominant users who select Songtaew as their urban transport mode for going to their regular destination.

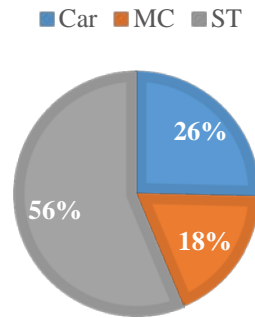
For the mode share of respondents, as can be seen in Figure 6.1, it revealed that there are the respondents who use public transport mode which is Songtaew 56% and the respondents who do not use this mode or the non-users 44%. Moreover, the non-users select car as their major transport mode (26%) because the most of them have car driving licenses and they claimed that driving car is more convenient and safer for them than using Songtaew then they prefer car more

than Songtaew. Nevertheless, the considering about the intention to use Songtaew in the future from Figure 6.2. which are if there will be a new transport mode for users and if there will be the improvement of Songtaew revealed that the choice users (37%) and the choice non-users (42%) are the majority groups who intend to keep using and stop using Songtaew (the users) and who intend to shift their modes from private vehicle to Songtaew (the non-users). Therefore, this study is very important to explore more about their perception on Songtaew use to retain the present users and attracting the non-users shifting their modes to use Songtaew in the future.

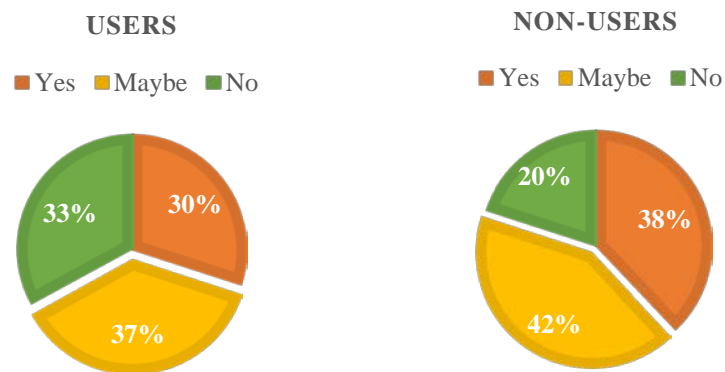
Considering about the loyalty users who want to keep using Songtaew in the future, it reveals that 78.6% of the Songtaew users expressing their attitude toward still using Songtaew in the future even there will be a new transport mode like Bus Rapid Transit (BRT) or tram.

**Table 6.1** General Characteristics of Respondents.

Characteristics	Statistics
1. Gender	Male (30.9%), Female (69.1%)
2. Age	< 15-year-olds (13.1%), 15-20-year-olds (22.3%), 21-30-year-olds (22.9%), 31-40-year-olds (18.3%), 41-50-year-olds (16.6%), 51-60-year-olds (6.0%), > 60-year-olds (0.9%)
3. Education	Lower than undergraduate (67.3%), Undergraduate (30.7%), Graduate (2.0%)
4. Household income	Low-income (26%), Middle-income (72%), High-income (2%)
5. Occupation	Junior high school student (17.1%), Senior high school student (16.4%), Government officer (20.8%), Private employee (5.5%), Business owner (9.1%), Labor (29.2%), Others (1.8%)
6. Driving license	None (45.8%), MC (17.1%), Car (13.5%), Both (17.3%)
7. Motorcycle driving	Do not drive MC (61.5%), drive MC (38.5%)
8. Car driving	Do not drive car (58.4%), drive car (41.6%)
9. Experiences with Songtaew (ST)	ST non-users (44%), ST users (56%)
10. Number of trips using Songtaew	>3 days/weeks (76.7%), 1-2 days/weeks (11.5%) Weekend or Holiday (4.6%), Few per month (7.8%)
11. The loyalty to keep using Songtaew in the future	78.6%

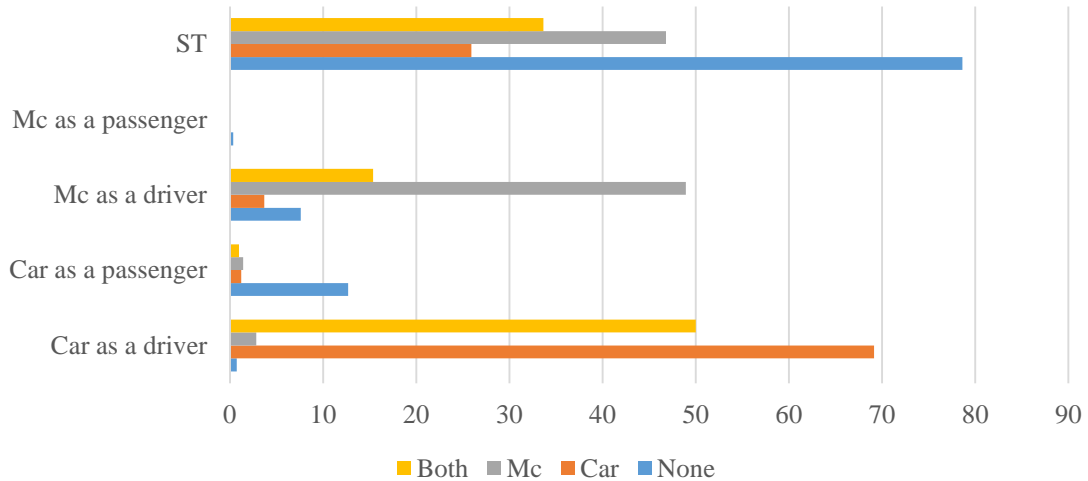


**Figure 6.1** Mode share of respondents



**Figure 6.2** The intention to use Songtaew in the future  
(If there will be a new transport mode for ST users and  
if there will be the improvement of ST for the ST non-users)

The relationship between driving license holding and work travel mode selection was also examined. According to Figure 6.3, it revealed that 79% of the Songtaew users have no driving license. Furthermore, Chi-square analysis revealed that there is a significant difference for the transport mode selection among the commuters who have vehicle licenses,  $P\text{-value} < 0.05$ . Most of them who have car license especially the workers going to work by car. On the other hand, the users who do not have both car and motorcycle driving licenses, 79 %, have gone to work and school by taking Songtaew more than the other modes.



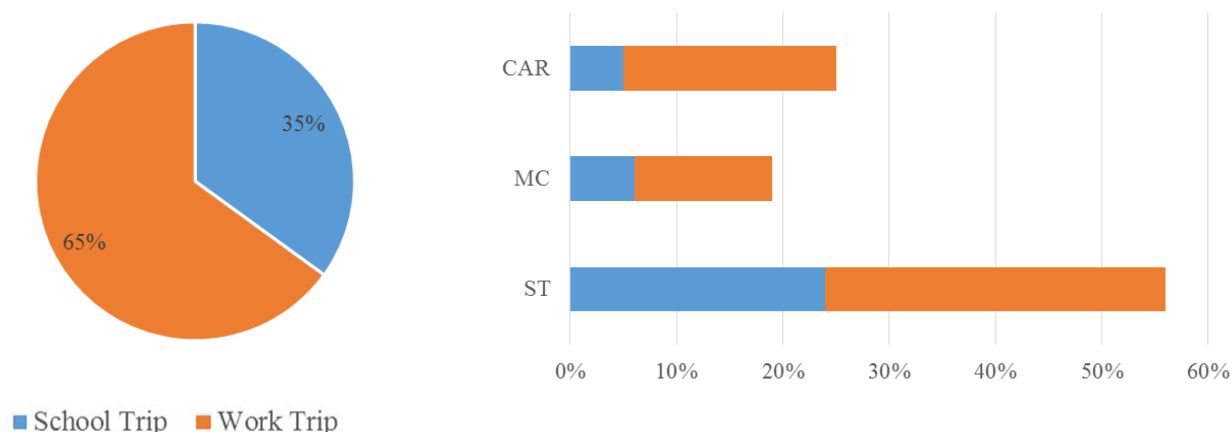
**Figure 6.3** Driving license holding and travel mode selection.

## 6.4 TRAVEL BEHAVIOR PATTERN IN KHON KAEN CITY

### 6.4.1 Trip types and Travel mode share

As the home-based trip explored in this study, the result highlights that the most of the home-based trip in Khon Kaen City is Work trip (65%) as shown in Figure 6.4. Furthermore, it's not surprising that over 70% of the destinations both workplaces and schools are in CBD area since the most of the government offices, private company offices, commercial shops, and schools are located in this area.

Considering about travel mode share of the home-based trip in Khon Kaen City, it reveals that the most of the workers travel to their workplaces by Songtaew (32%) more than by car and by motorcycle. For the school trip, the most of the students travel to school by Songtaew (24%) as well. However, the second share of school trip mode is motorcycle which is different from the second share of work trip mode as shown in Figure 6.4. The main reason is that the most of the students have motorcycle driving license more than car driving license because in Thailand they can get a motorcycle driving license at 15 years old which is earlier than getting a car driving license at 18 years old.



**Figure 6.4** Home-based Trip Types of Khon Kaen City and Mode Share.

#### 6.4.2 The relationships between city structure and travel behavior pattern

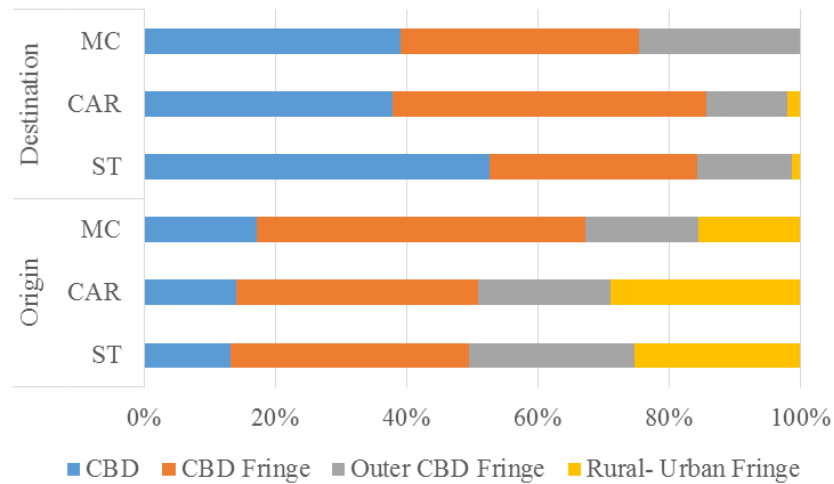
The structure of cities is closely related to the travel pattern of their residents. (Xi Liu et al., 2013) This section summarizes the relationships between city structure and travel behavior pattern in Khon Kaen City. A lot of trips were generated and attracted most between CBD and CBD fringe. One of the reasons to this might because of different land use facilities between these zones were not so far. As can be seen in Figure 6.5, it revealed that most of the origin locations among Songtaew user, car user, and motorcycle user are the same which is CBD fringe area. Turning to consider the destination locations, we found that CBD area is the most destination locations for all transport mode users in Khon Kaen City since Khon Kaen city has a concentration of workplaces, and other service functions in the CBD. In particular, this applies to public and private offices, schools, restaurants, entertainment and specialized stores. Thus, this concentration of workplaces and schools attracts most of the people travel to this areas especially the Songtaew user 52.8% as shown in Figure 6.5. Moreover, the CBD of Khon Kaen City has many narrow roads, and many intersections which alter some travelers drive into the CBD then we can see the percentage of car user who drives to workplaces in CBD area lower than other users.

Moreover, in this study, the age structure was grouped into seven age divisions as less than 15 years old, 15-20 years old, 21-30 years old, 31-40 years old, 41-50 years old, 51-60 years old and greater than 60 years old. It was assumed that people aged greater than 20 years old are active and independent travelers. Meanwhile, people aged under 20 years old can be active but have some limitations as they have no fixed income yet. Most of them are the students whose travel costs are compensated by their parents. Therefore, most of the people aged under 20 years old over 70 % traveled to their destinations by Songtaew.

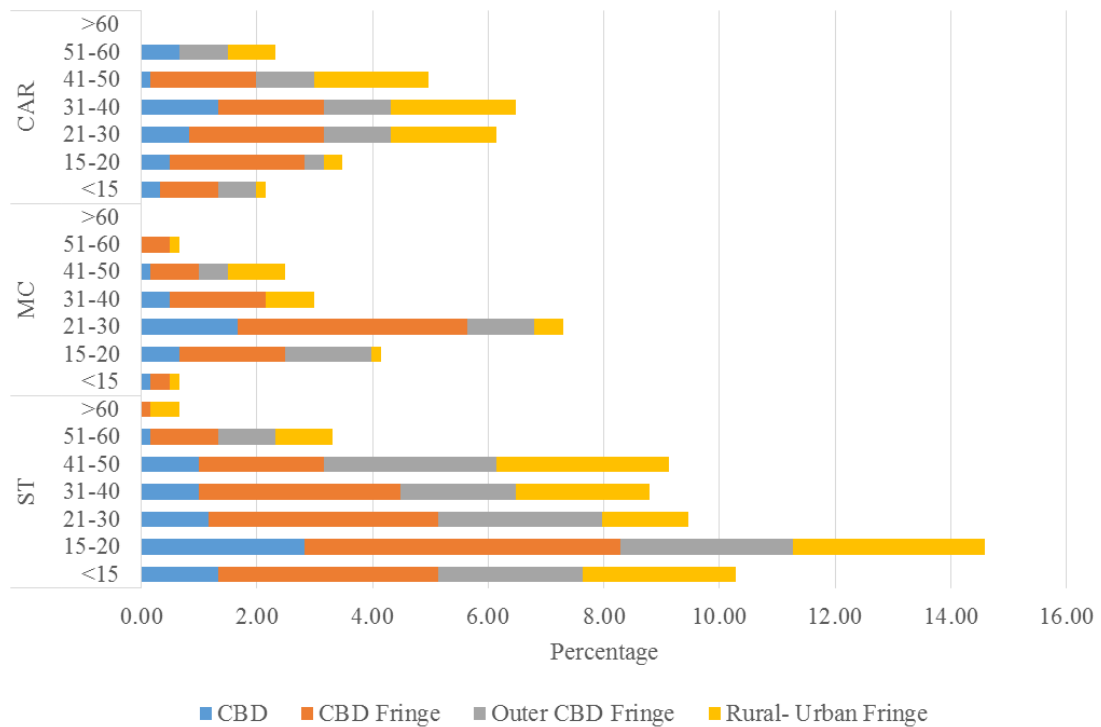
This study also considered on the travel behavior pattern by exploring the relationship between the location of residence and travel mode selection. Figure 6.6 and Figure 6.7 show the



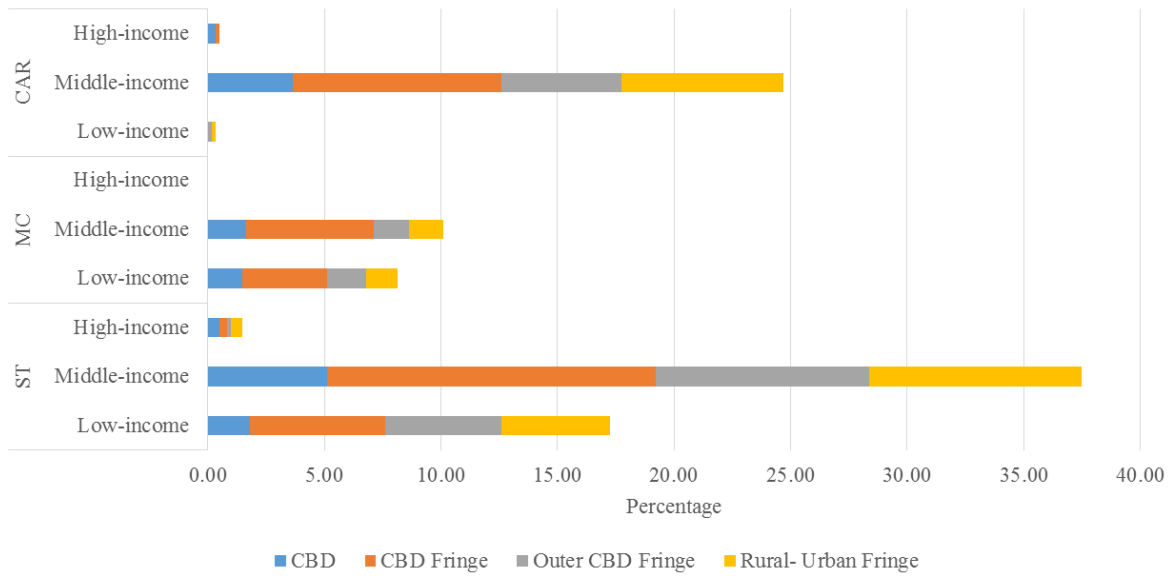
findings of the travel behavior pattern in terms of the relationship between the location of residence and travel mode selection focused on the difference of ages and income levels of the Khon Kaen City people. It is seen that most of the low-income people who use Songtaew and private car have the same origin location characteristic that most of them lived in CBD Fringe, Outer Fringe, and Rural-Urban Fringe. Meanwhile, the low-income motorcycle user lived in just CBD Fringe and Rural-Urban Fringe.



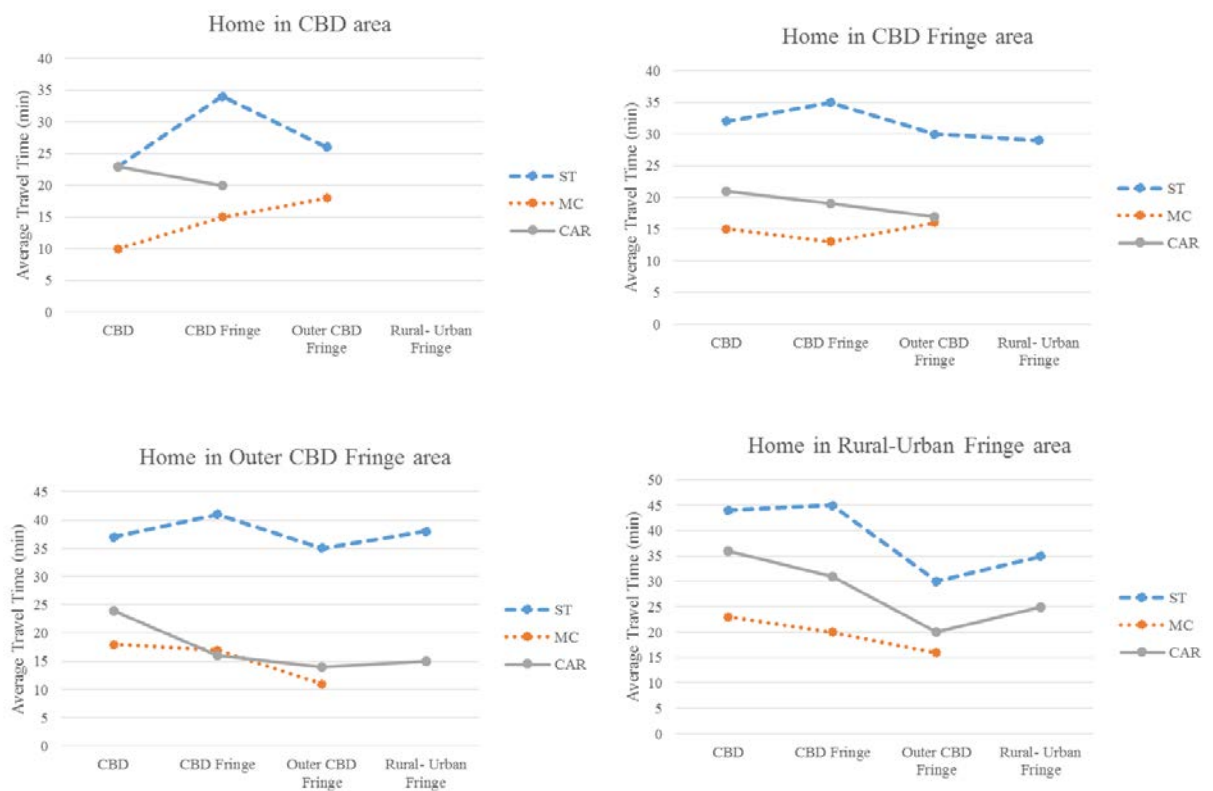
**Figure 6.5** Origin-Destination Areas and Travel Modes.



**Figure 6.6** The residential location and Travel mode selection considering the difference of ages.



**Figure 6.7** The residential location and Travel mode selection considering the difference of income level.



**Figure 6.8** The average travel time for home-based trips between the residential locations and the destination locations.

## 6.5 SUMMARY

This chapter focuses on the travel survey which identifies the origin and the destination of the home-based trip and the mode of travel as well as the socio-economic characteristics of the travelers in Khon Kaen City, Thailand. Moreover, the relationship between the travel behavior pattern and city structure also was examined in this study. The results show that people with higher income mostly lived in CBD area and made more travel than people with low income. The most of the home-based trip in Khon Kaen City is work trip which most of the workers took Songtaew going to their destination more than other modes.

Moreover, it is clear from the study that the city structure of Khon Kaen City which is the polycentric pattern of employment and education centers, along with the dispersal of many jobs and schools outside the CBD, creates more trips outside the CBD, especially for the people who live in the Outer CBD Fringe and Rural-Urban Fringe areas, with the shorter travel time than the people who travel for work trip and school trip in CBD area. Moreover, the accessibility by Songtaew is usually convenient for people who are traveling in the CBD because of the congestion and the lack of parking space in CBD area that alters some car users to drive cars in CBD. The results of this study could potentially aid in applying urban transportation policy in the future.

However, for next chapter, it is needed to study in details more about the perception of Khon Kaen City citizen of Songtaew service especially the satisfaction of each traveler group of Songtaew in order to improve the performance of this mode to fit the need for each group and it should focus on how to make the shift from private vehicles, both cars, and motorcycles. This would help to increase passengers on this mode of paratransit as well as to make Khon Kaen City more sustainable in the future.

## CHAPTER 7

### THE PERCEPTION ON PARATRANSIT: A CASE STUDY OF SONGTAEW

This chapter examines the use of Songtaew in Khon Kaen City, the northeastern region capital, from the users and non-users' point of view by their participation in rating the condition of Songtaew and loyalty to it. Its objectives are to investigate the motivations for using or not using Songtaew and to understand which factors influence commuters in Khon Kaen City for Songtaew use at a regular destination. Moreover, this chapter also investigates the Songtaew perception differences between drivers and users. Since the drivers' service is affected by their perception as well. Therefore, it is needed to investigate the drivers' perception, not only the users' perception.

#### 7.1 BACKGROUND

In many developing countries, such as Thailand, paratransit or informal public transport plays a role as a predominant urban public mode. There are various types of paratransit in Thailand such as motorcycle-taxi, Tuk-Tuk, Songtaew, and Silor-lek. Specially, Songtaew or a modified pick-up truck taking passengers on the back with an overhead cage and two-row seats in the back operates as a main public transport mode in many medium-sized cities of Thailand.

Studies regarding paratransit in Thailand are mainly concerned with issues such as the role of paratransit focusing on the supply side like service characteristics and service quality. However, the study on Songtaew service in Thailand has not yet well understood. This study is the attempt to focus on the demand side of Songtaew service in the medium-sized cities in Thailand, including Khon Kaen City by examining the use of Songtaew from the commuters' point of view by their participation in rating the condition of Songtaew and loyalty to it. Its main objectives are to investigate the motivations for using or not using Songtaew and to understand which factors influence commuters in Khon Kaen City for Songtaew use at a regular destination.

#### 7.2 DATA AND METHODOLOGY

To study the perception of Songtaew service, we analyzed results from a comprehensive field survey conducted among Songtaew users and non-users in Khon Kaen City, in order to measure their perception of the service provided. The surveys were carried out on interviewing randomly selected passengers in the Central Business District (CBD) of Khon Kaen City where there are many offices, shops, and schools located in this area.

A 4-page questionnaire, divided into six parts, was developed for this study. The first part of the questionnaire consists of 15 general questions relating to the respondents' socioeconomic information such as gender, age, occupation, driving license, and the experiences with Songtaew.

The second part addresses questions about the present travel pattern for going to work or school on regular weekdays. The third part is a set of service satisfaction for the users consisting of 9 factors which are safety, waiting time, in-vehicle time, availability, cost, comfort, flexibility, the image of Songtaew, and service information. The fourth and fifth parts are the questions related to 11 factors for respondents' mode selection which are safety, waiting time, in-vehicle time, availability, cost, comfort, flexibility, the image of Songtaew, service information, service reliability, and convenient. The last part is a set of the questions related to 7 factors for non-users satisfaction on the Songtaew improvement in the future which are the driver and riding safety, vehicle standard, service reliability, availability, comfort, operation and service information, and providing Express-Songtaew. In all questions about service satisfaction, the respondents are asked to rate the aspects on a 4-point scale of satisfaction, ranging from very dissatisfied to very satisfied.

Then data were analyzed through percentage, cross-tabulation, Chi-square statistical techniques and multiple regression analysis for testing the hypotheses and examining the Songtaew perception for the users and the non-users.

### **7.3 THE PERCEPTION ON SONGTAEW USE**

#### **7.3.1 Case study of Journey to school in Khon Kaen City**

Studies regarding paratransit in Thailand are mainly concerned with issues such as the role of paratransit focusing on service characteristics, service quality and user satisfaction of the service specially in Bangkok area. This study is the first attempt to focus on the role of Songtaew service in the medium-sized cities in Thailand for identifying the user perception of Songtaew service which is a popular mode in the city and particular for students who have a limitation on mode choice selection. However, the study on school trip pattern has not yet well understood.

The main objective of this study is to investigate the role of Songtaew service focusing on examining the user's perception of the journey to school in the city. Therefore, this chapter corroborates the authors' hypothesis regarding the decision of selecting the transport mode for going to school that there is a significant difference decision among the students who have vehicle licenses such as motorcycle license about the school travel pattern in Khon Kaen City.

##### **7.3.1.1 Research methods and data collection**

A comprehensive field survey of students was carried out for investigating the school travel patterns and the satisfaction with Songtaew service of the high school students in Khon Kaen City. To study the travel patterns and the satisfaction, we analyze results from a questionnaire survey which conducted among the junior and senior high school students in Khon Kaen City, in order to examine their school travel patterns and measure their satisfaction with the Songtaew service provided. The surveys were carried out on interviewing randomly selected students in the high school where located in Khon Kaen City. Then data were analyzed through percentage, cross-

tabulation, Chi-square statistical techniques and multiple regression analysis for testing the hypotheses and examining the school travel pattern and the Songtaew perception for the users and the non-users.

Students from high school both junior (13-15 years old) and senior (16-18 years old) high school students in Khon Kaen City were sampled as respondents in August 2015. They were asked personally by the surveyors at their schools. The questionnaire items were divided into three components: (1) general information such as gender, age, occupation, driving license, car and motorcycle use, experience with Songtaew (ST), the number of the trip using Songtaew, and loyalty to keep using Songtaew in the future. (2) detailed information on the school travel patterns such as travel mode, travel time, location of departure and alighting of the public transport (Songtaew) as well as its route number, walking time from home to the bus stop, waiting time, in-vehicle time, and transport cost, and (3) student satisfaction with Songtaew service relating to the factors which are availability, information, safety, cost, waiting time, in-vehicle time, comfort, flexibility, and image of Songtaew consisted in the final part of the questionnaire. These factors were measured in four-point Likert-type format from 1 (Very dissatisfied) to 4 (Very satisfied).

As shown in Table 7.1, the majority of respondents (n=202) is female (69.3%). Furthermore, the most of the respondents are the senior high school students who have motorcycle driving license 20.3 % of the total number of them. However, among the total respondents, there was 86.1 % who do not have a driving license, and this group is the dominant users who select Songtaew as their urban transport mode for going to school.

For the characteristic of experience with Songtaew, it is shown that there are the respondents who use Songtaew 75.7% and the respondents who do not use this mode or the non-users 24.3%. Moreover, the non-users selects motorcycle as their transport mode because the most of them have motorcycle driving license and riding motorcycle is more convenient for them than using Songtaew then they prefer motorcycle more than Songtaew.

Considering about the loyalty users who want to keep using Songtaew in the future, it revealed that 78.4% of the user of Songtaew expressing their attitude toward still using Songtaew in the future even there will be a new transport mode like Bus Rapid Transit (BRT).

**Table 7.1** General characteristics of respondents.

Characteristics	Statistics
1. Gender	Male (30.7%), Female (69.3%)
2. Age	< 15-year-olds (39.1%), 15-20-year-olds (60.9%)
3. Occupation	Junior high school student (51%), Senior high school student (49%)
4. Driving license	None (86.1%), Motorcycle (11.9%) Car (0.5%), Both (1.5%)
5. Motorcycle (MC) driving	Do not drive MC (79.7%), drive MC (20.3%)
6. Car driving	Do not drive car (94.4%), drive car (5.6%)
7. Experience with Songtaew (ST)	ST non-user (24.3%), ST user (75.7%)
8. Number of trips using Songtaew	>3 days/weeks (87.6%), 1-2 days/weeks (4.6%), weekend or holiday (3.9%), few per month (1.3%)
9. The loyalty to keep using Songtaew in the future	78.4%

### 7.3.1.2 Travel patterns of school trip

The school travel patterns, in terms of mode of transport, as shown in Figure 6.1 indicated that 72.28% of the high school students travel to school by Songtaew (the junior high school students 39.11% and the senior high school students 33.17%). The use of motorcycle accounted for just 11.88%, car 0.5% while those who are escorted to school by their parents were only 15.35%.

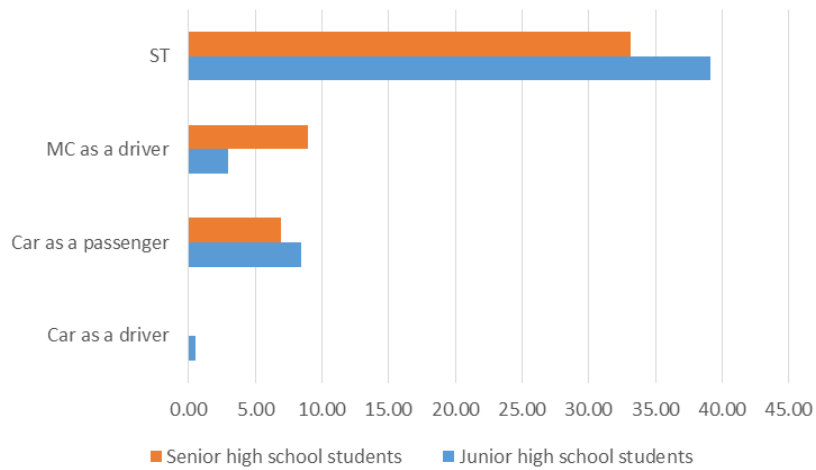
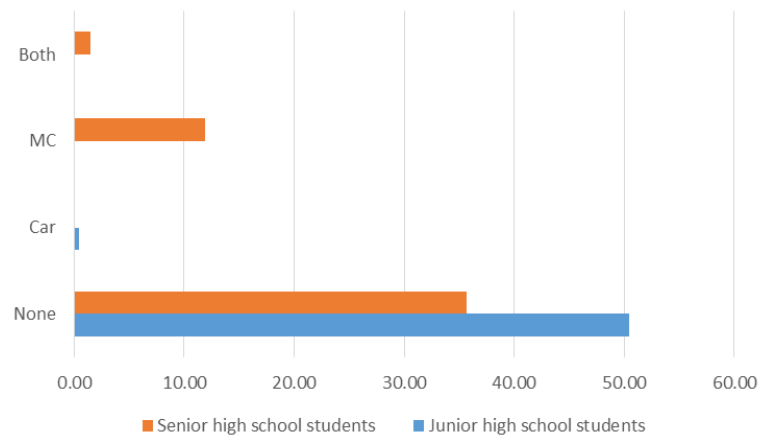
The large percentage of high school students that use Songtaew for going to school are due to various factors as shown in Table 7.2, they considered about the cost of travel, the service flexibility, and the service availability, respectively as the most important factors for using Songtaew. Conversely, the non-users considered about the safety in the vehicle, the convenient, and the service reliability, respectively.

For the average commuting time to school, the finding revealed that it was longer for Songtaew users (public transport users) than for private car users. It took Songtaew users about 40 minutes longer than private car users to get to school which took about 20 minutes.

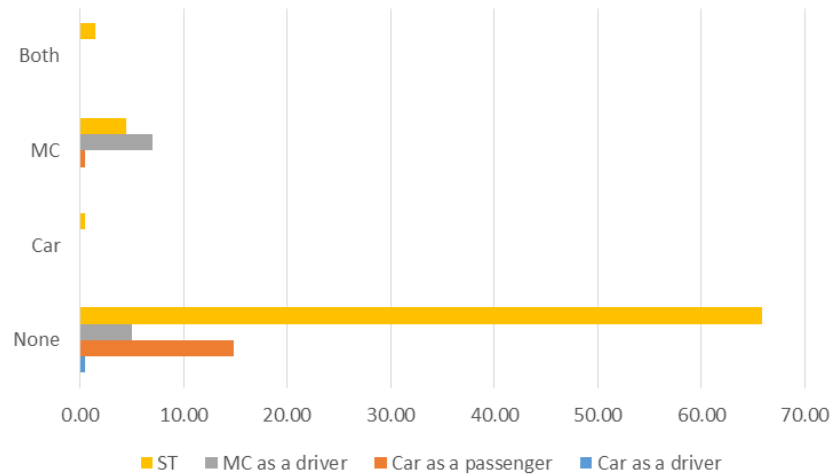
These differences may be due to the fact that the Songtaew users have to take more time on walking to the bus stop, waiting for the Songtaew and taking the time in the vehicle. On the other hand, the private car users take time only in the vehicle from their home to school.

**Table 7.2** Important factors affecting the usage of Songtaew.

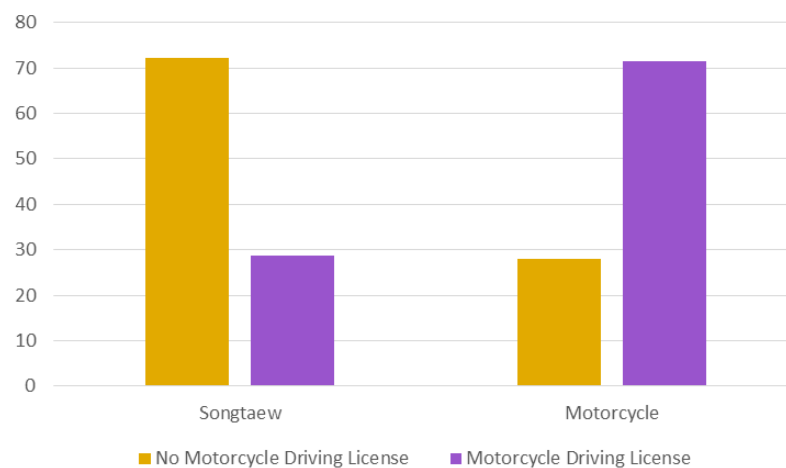
Rank	Users	Non-users
1	Cost of travel	Safety
2	Flexibility	Convenient
3	Availability	Service reliability

**Figure 7.1** School travel mode selection.**Figure 7.2** Driving license holding of junior and senior high school student.





**Figure 7.3** Driving license holding and school travel mode selection.



**Figure 7.4** School travel mode with motorcycle driving license.

The relationship between driving license holding and school travel mode selection was also examined. According to Figure 7.2 and Figure 7.3, they revealed that 86.1% of the high school student has no driving license. Because of this reason made them choose to use Songtaew travel to school more than 60%.

Only 1.49% of the students who have both motorcycle and car licenses. Although they have both driving licenses, they still travel to school by Songtaew. Some of them claimed that Songtaew is cheaper and more flexible than the other modes. Thus, they choose Songtaew as their main transport mode going to school every day.

Furthermore, Chi-square analysis revealed that there is a significant difference in the transport mode selection among the students who have vehicle licenses especially motorcycle

license,  $P\text{-value} < 0.05$ .

According to Figure 7.4, most of the senior high school students who have motorcycle license going to school by motorcycle. On the other hand, the junior high school students have gone to school by taking Songtaew more than the other modes.

Therefore, there is different in mode choice among the students who have motorcycle driving license and the students who do not have motorcycle driving license, younger than 15 years old.

### 7.3.1.3 Satisfaction on Using Songtaew Service

This section, Table 7.3 and Table 7.4 list the three attributes users and non-users were most satisfied and least satisfied with Songtaew service. These were derived from the important detailed ratings of each attribute.

From the satisfaction survey results in Table 7.3 and Table 7.4, they revealed that the Songtaew users were most satisfied with the cost of travel, the flexibility of the service, and the comfort of the vehicle, respectively. It is not surprising that the users were generally satisfied with the fare of Songtaew since it is cheaper than other modes (5-10 Baht per trip).

Moreover, the users were least satisfied with the waiting time for using service, the safety of the vehicle, especially about picking up the passengers more than the capacity, and the service information, respectively.

For the non-users satisfaction survey results, it is shown that the non-users were most satisfied with the cost of travel, the availability of the service, and the vehicle standard, respectively. Similarly, non-users were satisfied with the songtaew fare which is cheap for transport cost as well as the users. On the other hand, the non-users were least satisfied with the safety in the vehicle, the service reliability, and the service information, respectively.

The results of the non-users highlight that they were least satisfied with Songtaew safety, then this factor is most important to them for shifting the transport mode from a private vehicle to Songtaew. Nevertheless, the safety issue is reported due to the reckless driving and picking up the passengers more than the vehicle capacity. Therefore, safety is the most important factor for the non-users who intend to decide to select Songtaew as their transport mode in the future. Furthermore, the result of multiple regression analysis in Table 7.5 and Table 7.6 showed the important factors influencing the overall trip satisfaction of Songtaew use in Khon Kaen City. By using the stepwise method with PIN 0.25 and POUT 0.3, the best set of predictors was finally found. Moreover, regarding the previous studies examining trip satisfaction that also employed regression analysis display comparable adjusted  $R^2$  values.

The finding of the perception for the users in Table 7.5 indicated that the fare of Songtaew which is cheaper than other modes and the convenience of the service had a significant effect on the Songtaew user satisfaction. Turning to the perception for the non-users in Table 7.6, the result of

multiple regression analysis also explained the factors influencing the comprehensive perception of Songtaew service.

The reliability of the service and the comfort of the service are the important factors which had a significant influence on their perception about Songtaew service in Khon Kaen City.

This indicated that non-users do not select Songtaew as their transport mode because of two important reasons which are (1) they cannot predict the total travel time since the waiting time is too long and there is no service schedule and Songtaew seats are uncomfortable, and they do not like to sit close to other users.

As a result of multiple regression analysis, it highlighted that the cost and the convenience have strongly a positive impact on the decision to commute by Songtaew for the users because most of them are the junior high school students who have no driving license especially motorcycle driving license. Thus, they have a limitation on mode choice; then they prefer Songtaew because it is cheaper than other modes.

On the other hand, the reliability and the comfort have a strongly significant effect on the decision for not using Songtaew for the non-users. Most of the non-users, they prefer motorcycle for going to school because it is more comfortable than Songtaew and it took them about 10-20 minutes shorter than the users of Songtaew which make them can predict their travel time for going to school.

**Table 7.3** Songtaew users satisfaction results.

Rank	Users	
	Most satisfied	Least satisfied
1	Cost of travel	Waiting time
2	Flexibility	Safety
3	Comfort	Service information

**Table 7.4** Songtaew non-users satisfaction results.

Rank	Non-users	
	Most satisfied	Least satisfied
1	Cost of travel	Safety
2	Availability	Service reliability
3	Vehicle standard	Service information

**Table 7.5** Songtaew users trip perception.

Significant Variables	Users	
	B	t
Cost	0.369***	4.426
Convenience	0.169**	2.271
Model R-square	0.169	
Model Adjusted R-square	0.157	

\*\*\* Significant at 99% (p-value < 0.01)

\*\* Significant at 95% (p-value < 0.05)

\* Significant at 90% (p-value < 0.1)

**Table 7.6** Songtaew non-users trip perception.

Significant Variables	Non-users	
	B	t
Reliability	0.257**	2.034
Comfort	0.229*	1.346
Model R-square	0.208	
Model Adjusted R-square	0.136	

\*\*\* Significant at 99% (p-value &lt; 0.01)

\*\* Significant at 95% (p-value &lt; 0.05)

\* Significant at 90% (p-value &lt; 0.1)

### 7.3.2 Case study of Journey to work in Khon Kaen City

This study is the attempt to focus on the role of Songtaew service in the medium-sized cities in Thailand for identifying problems and suggesting the recommendation to improve Songtaew service. The main goal of this section is to investigate the role of Songtaew service focusing on examining the user perception of the journey to work in the city. Therefore, this section corroborates the authors' hypothesis regarding the decision of selecting the transport mode for going to work that there is a significant difference decision among the users who have vehicle licenses about the work travel pattern in Khon Kaen City.

#### 7.3.2.1 Research methods and data collection

A comprehensive field survey of workers was carried out for investigating the journey to work patterns and the satisfaction with Songtaew service of the workers in Khon Kaen City. To study the travel patterns and the satisfaction, we analyze results from a questionnaire survey conducted among the workers in Khon Kaen city. Then data were analyzed through percentage, Chi-square statistical techniques and multiple regression analysis for testing the hypotheses and examining the work travel pattern and the Songtaew perception for the users and the non-users. The total sample of 600 respondents who commute in Khon Kaen City was sampled as respondents in August 2015. According to this survey, there were 389 workers which the number of samples is more than 50 % of the total respondents.

**Table 7.7** General Characteristics of Respondents.

Characteristics		Users (%)	Non-users (%)
1.Gender	Male	22.1	37.2
	Female	77.9	62.8
2.Age	15-30	32.1	40.7
	31-40	28.4	28.1
	41-40	27.4	22.6
	> 50	12.1	8.5
3.Education	Lower than undergraduate	61.6	41.2
	Undergraduate	36.8	54.3
	Undergraduate	1.6	4.5
	Graduate		
4.Occupation	Government officer	25.3	38.7
	Private employee	5.8	11.1
	Labor	53.2	37.7
	Others	15.8	12.6
5.Driving license	None	42.6	8.5
	Car	10.5	30.2
	Motorcycle	30.0	27.6
	Both	16.8	33.7
6.Motorcycle driving	No, Yes	79.4, 20.6	22.3, 77.7
7.Car driving	No, Yes	60, 40	21.8, 78.2
9.The loyalty to keep using Songtaew in the future	Yes, No	78.7, 21.3	-

The questionnaire items were divided into three components: (1) general information such as gender, age, occupation, driving license, and loyalty to keep using Songtaew in the future. (2) detailed information on the journey to work patterns such as travel mode, travel time, location of departure and alighting of Songtaew, and transport cost, and (3) users satisfaction with Songtaew service relating to the factors which are availability, information, safety, cost, waiting time, in-vehicle time, comfort, flexibility, and image of Songtaew. These factors were measured in four-point Likert-type format from 1 (Very dissatisfied) to 4 (Very satisfied).

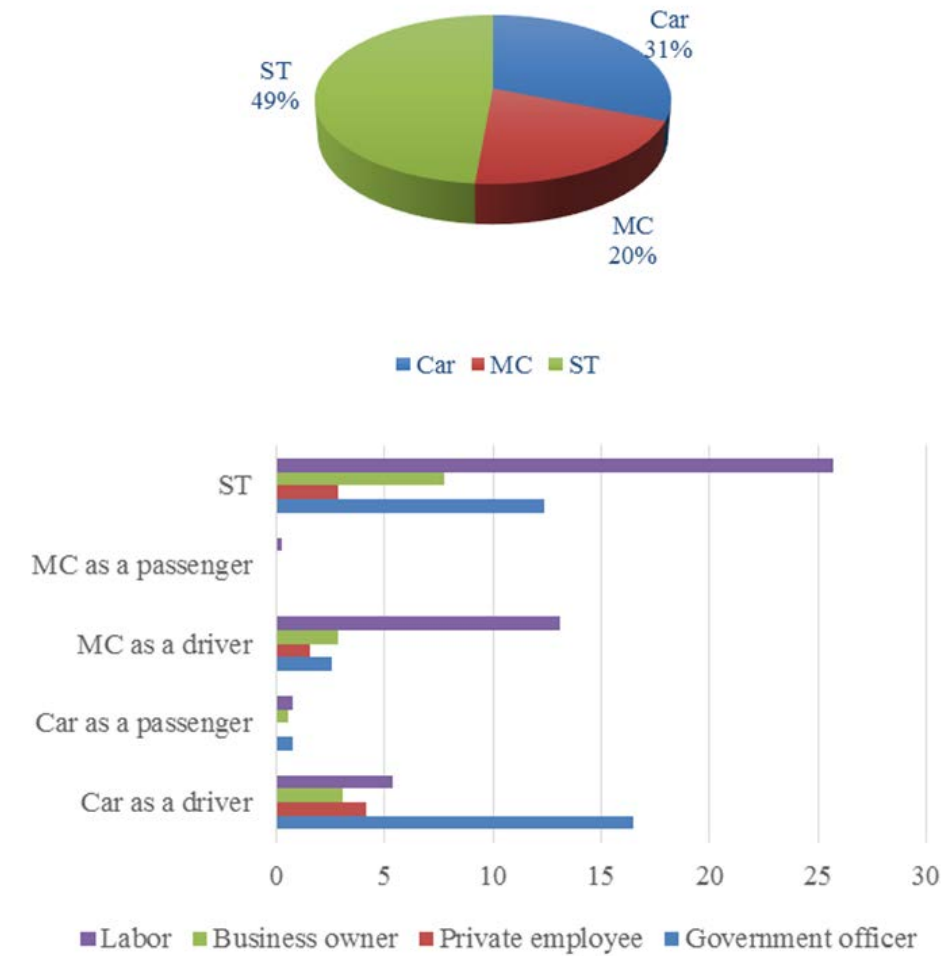
The study revealed that the majority of respondents is female (77.9% for users and 62.8% for non-users). The most of the respondents are the labors who had motorcycle driving license 42 %. However, among the total respondents, there is 42.6 % who do not have a driving license and this group is the dominant user who selects Songtaew as their urban transport mode for going to work.

For the experience with Songtaew, it is shown that there are the respondents who use Songtaew 48.6% and the non-users 51.4%. Moreover, the non-users selects car as their main transport mode (52%) because riding car is more convenient and safer than using other modes then they prefer car more than motorcycle and Songtaew. Considering about the loyalty users who want to keep using Songtaew in the future, it revealed that 78.7% of the Songtaew users expressing their attitude toward still using Songtaew in the future even there will be a new transport mode as can be seen in Table 7.7.

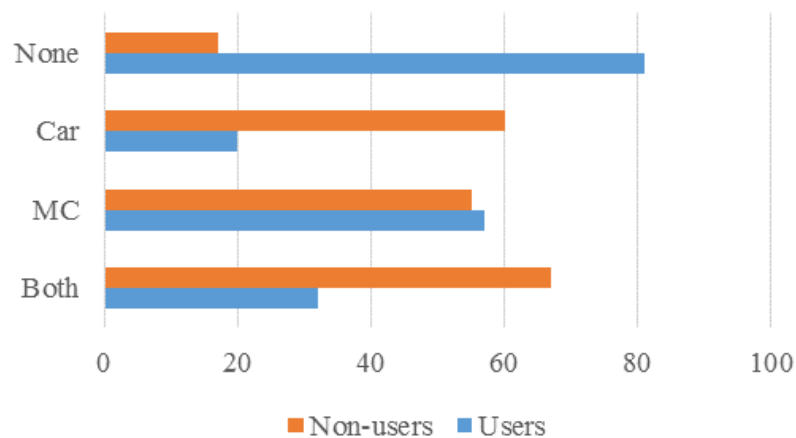
### 7.3.2.2 Travel patterns of work trip

The journey to work patterns, in terms of transport mode, as shown in Figure 7.5 indicated that 49% of the respondents travel to work by Songtaew. The respondents who use Songtaew are Labor (low-income workers) 26%, Government officer 12%, Business owner 8%, and Private employee 3%, respectively. The use of car accounted for 31.1%, and motorcycle 20%. The study revealed the reasons that the workers prefer private automobile because Songtaew was seen as less convenient than private vehicles for commuting to work included the belief that private vehicles were quicker and more direct (door to door) for traveling to their destination. For the average commuting time to work, the finding revealed that it took Songtaew users about 38 minutes longer than private car users to get to work which took about 16 minutes. These differences are due to the fact that the Songtaew users have to take more time on walking to the bus stop, waiting for the Songtaew and taking the time in the vehicle. On the other hand, the private car users take time only in the vehicle from their home to workplace.

The relationship between driving license holding and work travel mode selection was also examined. According to Figure 7.6, it revealed that 81% of the Songtaew users have no driving license. Furthermore, Chi-square analysis revealed that there is a significant difference for the transport mode selection among the workers who have vehicle licenses especially car license,  $P\text{-value} < 0.05$ . Most of the workers who have car license going to work by car. On the other hand, the users who do not have both car and motorcycle driving licenses, 81 %, have gone to work by taking Songtaew more than the other modes.



**Figure 7.5** Mode shares and Work travel mode selection.



**Figure 7.6** Driving license holding of Songtaew users and non-users.

### 7.3.2.3 Satisfaction on Using Songtaew Service

The result of multiple regression analysis in Table 7.8 showed the important factors influencing the overall trip satisfaction of Songtaew use in Khon Kaen City. By using the stepwise method with PIN 0.25 and POUT 0.3, the best set of predictors was finally found.

The finding about the perception for the users indicated that the fare of Songtaew which is cheaper than other modes, and the convenient of the service had a significant effect on the Songtaew users' satisfaction. Turning to the perception for the non-users, the results also explained the factors which are the cost, the availability, the waiting time, the safety and the comfort are the important factors which had a significant influence on their perception for not using Songtaew. This indicated that non-users do not select Songtaew as their transport mode because of the important reasons which are (1) they believe that going to work by private automobile is cheaper than by Songtaew, (2) there is not enough service availability covered the route going directly (door to door) to their destination, (3) the waiting time is too long, (4) it is unsafe because of the reckless driving and picking up the passengers more than the vehicle capacity, and (5) Seats are uncomfortable and they do not like to sit close to the other users. As a result of multiple regression analysis in Table 7.8, the perception on Songtaew service about the cost and the convenient have strongly a positive impact on the decision to commute by Songtaew for the users because most of them are the labor who has low income and no driving license. Thus, they have a limitation on mode choice; then they prefer Songtaew.

**Table 7.8** Regression results: Songtaew (ST) trip satisfaction for the users and non-users.

Variables	Users		Non-users	
	B	t	B	t
Information	.053	.666	-.098	-1.273
Image of ST	-.074	-.875	.013	.178
Availability	-.011	-.623	.153*	1.779
Reliability	.004	-.484	.236	0.575
Waiting time	.050	.623	.052	1.472
Boarding time	.043	.472	-.011	-.114
Safety	-.038	-.525	-.037	-1.426
Comfort	.002	.017	.105	1.302
Convenient	.360***	5.650	.019	.162
Flexibility	-.014	-.178	.034	.449
Cost	.194**	2.281	.181**	2.508

\*\*\* Significant at 99% (p-value < 0.01),

\*\* Significant at 95% (p-value < 0.05),

\* Significant at 90% (p-value < 0.1)



### 7.3.3 The Songtaew perception differences between drivers and users

This research is focusing on Songtaew in Khon Kean City which operates as a main urban public transport to better understand the factors that influence this mode use. The previous studies by the authors found that it is necessary to increase user satisfaction with the public transport system in the city in order to maintain existing users and attract new users. To our previous study regarding the user perception of Songtaew in Khon Kaen City focusing on the journey to school, the author found that the reliability and the comfort of the service have the strongly significant effect to the non-users of students in Khon Kaen City on the decision for not using Songtaew. Therefore, in order to maintain existing Songtaew passengers and attract new passengers, it is needed to study in more detail on the perception of these factors as well as study in more detail on all the passengers not only the students.

Although there are many studies regarding the public transit service perception, most of them are mainly focused on the users' perception especially their satisfaction with the service. Satisfaction could be represented as personal preferences of the users, their past experiences, and previous knowledge.

Accordingly, increasing user satisfaction should be better understand about users' perception regarding the service which their perceptions are affected by the performance of the attributes of the service provided by the drivers. It is important to differentiate between the users and drivers' perception regarding the provided service, since users' satisfaction requires an experience of the service, while the drivers are responsible for providing the service by supplying users to their destinations. To put in other words, the drivers are responsible for making users' experience by their provided service. Furthermore, the drivers' service is affected by their perception as well. Therefore, it is needed to investigate the drivers' perception, not only the users' perception to seek whether they have the different perceptions or not. If we could know the different perceptions between them, it would be able to recommend the improvement of the service they offered by bridging these differences to meet the users' need for providing the most satisfaction to the users to retain the existing users in the future.

Currently, the study on how to increase user satisfaction of paratransit service in Thailand have not yet well understood. According to the literature review, although there have been several types of research concerning transport users' perception, there are only the studies regarding the users' perception of the factors affecting their satisfaction. The drivers' perception of those factors is important as well because there might be some different perceptions among them that could affect the user of Songtaew behavior. Given this gap in the literature, this study aims to identify factors that influence Songtaew use through the drivers and the users' point of view by their participation in completing a developed survey instrument. Therefore, this chapter corroborates the authors' hypothesis regarding the Songtaew service perception that there is a significant difference perception between Songtaew drivers and users in Khon Kaen City. Moreover, this study also examined the

travel pattern and modal share in Khon Kaen City to understand the existing Khon Kaen travel situation.

### 7.3.3.1 Research methods and data collection

A comprehensive field survey of Songtaew drivers and users was carried out for investigating their perception on various aspects of Songtaew service considered as the major factors related to the usage of Songtaew in Khon Kaen City: safety, comfort, reliability, and flexibility.

A survey was conducted among Songtaew drivers and users in Khon Kaen City, the major city of the northeastern region of Thailand, in order to define their perception on each factor of Songtaew service. The survey was carried out by interviewing the drivers and the users on working days and interviewing randomly selected drivers and passengers. The survey consisted of two parts; the first part contains general questions relating to the respondents' demographic and socio-economic information such as gender, age, education, occupation and driving license possession. The second part is the major part which consists of Songtaew service factors.

**Table 7.9** Factors and attributes of Songtaew service.

Factors	Attributes
Safety	Overall safety from a road accident, Prevention from the offensive action inside the car and at the waiting, boarding and alighting areas, the risky action of the driver.
Comfort	The comfort of waiting environment, design, and arrangement of the stop, the quality, and condition of material inside the vehicle, e.g., seat, bell, etc.
Reliability	Length of waiting time, Length of staying on board.
Flexibility	Wide of coverage area service, the flexibility of waiting, boarding, and alighting areas.

**Table 7.10** General characteristics of respondents.

Characteristics		Statistics
Users		
Gender		Male (28.2%), Female (71.8%)
Age		< 15 year-olds (17.8%), 15-20 year-olds (39.7%), 21-30 year-olds (22.3%), 31-50 year-olds (19.8%), > 50 year-olds (0.3%)
Occupation		High school student (56.5%), Government officer (19.1) Private employee (10.5%) Labor (12.9%) Others (1%)
Driving license		None (34.8%), Motorcycle (46.3%) Car (4.9%), Both (13.9%)
Drivers		
Gender		Male (95.3%), Female (4.7%)
Age		21-30 year-olds (17.3%), 31-40 year-olds (66%), 41-50 year-olds (10%), > 50 year-olds (6.7%)

According to the previous literature, the most relevant aspects of the public transportation service regarding the user perception were found to be: availability, accessibility, reliability, information, staff's behavior, comfort, safety, fare, and environmental impact. Besides those, the previous studies, by the authors found that the factors which affect the user of Songtaew in Khon Kaen City are safety, comfort, reliability, and flexibility as shown in Table 7.9. Therefore, these factors have been considered in this study. All respondents were asked to rate the each factor on a 5-point scale of their perception, ranging from very dissatisfied to very satisfied.

Then data were analyzed through percentage, cross-tabulation, Chi-square and multiple regression analysis for testing the hypotheses and examining the Songtaew perception from the drivers and users.

As shown in Table 7.10, the majority of Songtaew users ( $n=287$ ) is female (71.8%), and most of Songtaew drivers ( $n=150$ ) is male (95.3%). Deeply considering the characteristics of Songtaew users, we found that most of Songtaew users are the high school students who have motorcycle driving license 81.6 %. However, among the total users, there is 34.8 % who do not have a driving license, and this group is the dominant users who select Songtaew as their urban transport mode for their regular trip.

### 7.3.3.2 Satisfaction on Using Songtaew Service

This section, Chi-square analysis revealed that there is a significantly different perception of Songtaew service in Khon Kaen City between the Songtaew drivers and the Songtaew users,  $P\text{-value} < 0.05$ . Consequently, it is needed to study more about the different perception of them in detail. Then, the result of multiple regression analysis in Table 7.11 showed the important factors influencing the overall trip satisfaction of Songtaew use in Khon Kaen City. By using the stepwise method with PIN 0.25 and POUT 0.3, the best set of predictors was finally found. Moreover, regarding the previous studies examining trip satisfaction that also employed regression analysis display comparable adjusted  $R^2$  values.

The finding of the perception for the drivers and the users in Table 7.11 indicated that the reliability and flexibility of Songtaew service had a significant effect on both Songtaew drivers and users' perception. However, there is the difference that for the users' perception not only the reliability and flexibility had a significant effect on their perception but also the safety of the service. This indicated that Songtaew users perceive the quality of Songtaew service in terms of reliability, safety and flexibility in a positive way which allures them to use Songtaew. Moreover, the result of ANOVA depicts overall fitness of the model with  $F\text{ value} = 28.306$ . Reliability, safety, and flexibility in this study truly relate to their overall service satisfaction with the Songtaew service in Khon Kaen City having a  $p\text{-value}$  of .000.

Turning to consider the drivers' perception of Songtaew service, sometimes they also use Songtaew for their trips making in the city. The study revealed that reliability and flexibility had strongly impact on their satisfaction to commute by Songtaew. For the ANOVA result of the drivers' perception, it also depicts overall fitness of the model with  $F\text{ value} = 24.414$ . Reliability and flexibility in this study truly relate to their overall service satisfaction with the Songtaew service in Khon Kaen City having a  $p\text{-value}$  of .000.

However, a safety issue is very interesting to study more deeply since some users claimed that they thought Songtaew is unsafe and it should be not overlooked. Thus, we studied in more detail about how the respondents responded to safety issue of Songtaew service, and we found that high-frequency users never perceive Songtaew service unsafe. On the other hand, low-frequency users perceive Songtaew service unsafe 25% (very dissatisfied and dissatisfied) as shown in Figure 7.7. The reason of this situation might because of their bad experiences regarding the safety issue of

Songtaew service which affected to their perception of safety in a negative way. Therefore, for the future work, it should be studied more in detail on the users' experience regarding Songtaew safety issue in order to find the best solution to improve the service in the future.

**Table 7.11** Regression results: Songtaew trip satisfaction for the drivers and users.

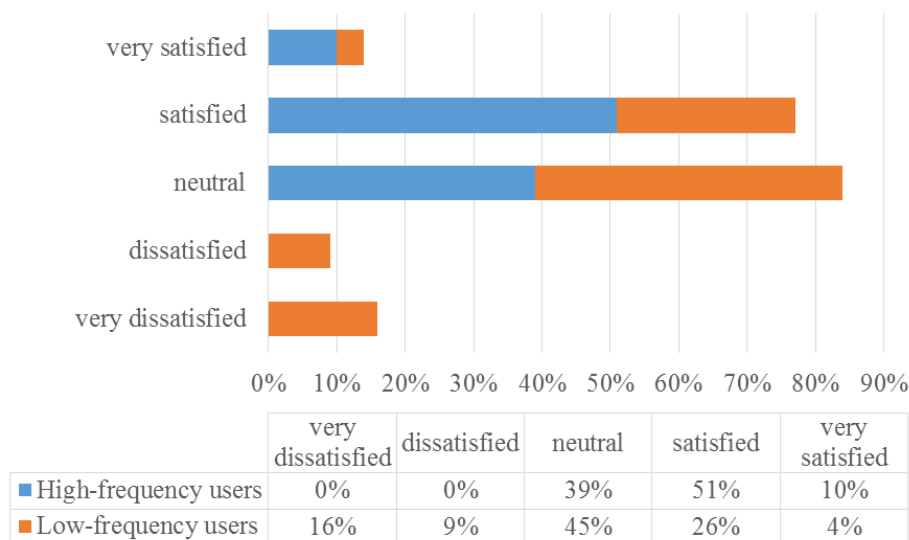
Significant Variables	Drivers	
	B	t
Reliability	0.536**	3.455
Flexibility	0.475**	6.481
Model R-square	0.334	
Model Adjusted R-square	0.320	

Significant Variables	Users	
	B	t
Reliability	0.308**	4.694
Safety	0.160**	2.945
Flexibility	0.116*	2.251
Model R-square	0.286	
Model Adjusted R-square	0.276	

\*\* Significant at 99% (p-value < 0.01)

\* Significant at 95% (p-value < 0.05)



**Figure 7.7** The different responses between high and low-frequency users on safety.

#### 7.4 SUMMARY

According to journey to school in Khon Kaen City, the present main modes are Songtaew, car, and motorcycle, respectively. There are also exist a significant difference in mode choice among the students who have driving licenses and the students who have no driving licenses, younger than 15 years old. As a result, the most of the senior high school students who already have motorcycle

license going to school by motorcycle. On the other hand, the junior high school students travel to school by taking Songtaew more than the other modes. The findings about the satisfaction also indicated that the students who use Songtaew for going to school in Khon Kaen City have different satisfaction among the students who always use Songtaew and the others who usually use motorcycle but sometimes using Songtaew regarding the characteristics of them such as gender, age and the status of holding the driving license. The overall satisfaction reflects that generally all student users are satisfied with Songtaew service because of the cheap fare and the convenience of the service. Moreover, the reliability and the comfort have the strongly significant effect to the non-users on the decision for not using Songtaew.

Turning to summarize the journey to work in Khon Kaen City, the present main modes of travel to work are the same with a journey to school. There are also exist a significant difference in mode choice among the commuters who have driving licenses and the commuters who have no driving licenses. The study highlights the main reasons for commuters' Songtaew usage in Khon Kaen City are driving license unavailability and the benefits of low fare. These results indicate that the main user of Songtaew is the captive user. However, the other Songtaew users are the users who have driving licenses especially motorcycle driving license which is the choice users who intend to use Songtaew when the parking at their destination is not available and when they bring many kinds of stuff with them which cannot carry on when they travel by Motorcycle. They claimed these reasons is called convenient factor which is one of the main factors inducing the choice users especially the low-income workers traveling by Songtaew.

Lastly, based on the examination regarding the perception of the drivers and users on factors related to the usage of Songtaew: safety, reliability, comfort, and flexibility. The results indicated that there is a significant difference perception between Songtaew drivers and users in Khon Kaen City. As a result of multiple regression analysis, it highlighted that reliability and Flexibility had strongly a positive impact on the decision to commute by Songtaew for both drivers and users' perception. This result is very interesting. Although there is no Songtaew schedule, and sometimes they have to wait for Songtaew more than 5 mins, but they still perceive Songtaew service is reliable especially in CBD area because there is high frequency of Songtaew service in CBD area then the waiting time around 5 to 10 mins can be acceptable for them and they could predict their arrival time at their destination from their travel experience. For the safety issue, it is also interesting to find that it might be not only the safety issue relating to driver behavior but the waiting area at Songtaew stop also might affect their perception on the safety issue.

However, some of the respondents raised the safety issue that there are some Songtaew waiting area problems currently occurring such as missing route information and no properly design of Songtaew waiting area especially at the crowded area in CBD. This results in discomfort and discourages people to use Songtaew as well as to increase the risk of a safety issue. Therefore, it should be studied more in detail on the users' experience regarding Songtaew safety issue to find the

best solution to improve Songtaew service in the future.

Implications of this study would be useful for the researcher to understand more about the factors which affect the paratransit use in other cities and to develop the policy from bridging the different perceptions with the drivers and users to improve paratransit performance. For the further work, to motivate Songtaew use, the study is necessary to understand users' behavior better and to improve its service for contributing to motivate modal shift and reduce the use of an automobile in the future.

For the next chapter, it is needed to study in details more about the travel choice behavior in Khon Kaen City among three modes which are Songtaew, motorcycle, and the car in order to identify significant factors tending individuals to decide travel mode in the city. The result will be useful for improving the performance of public transportation in Khon Kaen City. This would help to increase passengers on public transportation to support the sustainable transportation in the future.

## **CHAPTER 8**

### **TRAVEL CHOICE BEHAVIOR IN KHON KAEN CITY**

This chapter investigates the travel choice behavior in Khon Kaen City among three modes which are Songtaew, motorcycle, and car to identify significant factors tending individuals to decide travel mode in the city. The result will be useful for improving the performance of public transportation in Khon Kaen City. This study would help to increase passengers on public transportation to support the sustainable transportation in the future.

#### **8.1 BACKGROUND**

Recently, transport situation in many developing countries especially Thailand changes quite rapidly especially an increasing number of private vehicles especially the number of the registered motorcycles and cars. This situation is one of the main reasons which caused the reduction of public transport usage in Thailand. Furthermore, the problem with private vehicle-dependent societies lies with its significant impact in the urban areas on both the environment and the quality of life. Therefore, it has been challenged to all Thai transportation planners for coping with this situation, one of the challenges is how to attract more public transit users in the urban areas. In other words, the study to support the reduction of the private vehicle usage is needed in Thailand. Thus, the study for encouraging Thai people to shift their mode to public transport should not look over.

Then, the study to understand travel behavior of individuals in the city is the urgent issue. Therefore this chapter provided the research regarding the travel choice behavior in Khon Kaen City among three modes which are Songtaew, motorcycle, and car to identify significant factors tending individuals to decide travel mode in the city. The result will be useful for improving the performance of urban transit in Khon Kaen City. This study would help to increase passengers on public transportation to support the sustainable transportation in the future.

#### **8.2 DATA AND METHODOLOGY**

To study the travel choice behavior, the author analyzed results from a dataset derived from a comprehensive field survey conducted among urban travelers in Khon Kaen City, in order to investigate the travel choice consideration of people in Khon Kaen City. This study was carried out in Khon Kaen City to capture travel behavior, attitude on Songtaew service. 600 samplings were successfully obtained for respondents whose their trips were made for going to work or going to school in Khon Kaen City.

The modal shift might be defined as the primary goal of this research. The approach to be taken before considering modal shift are to identify individuals' perception and their travel behavior

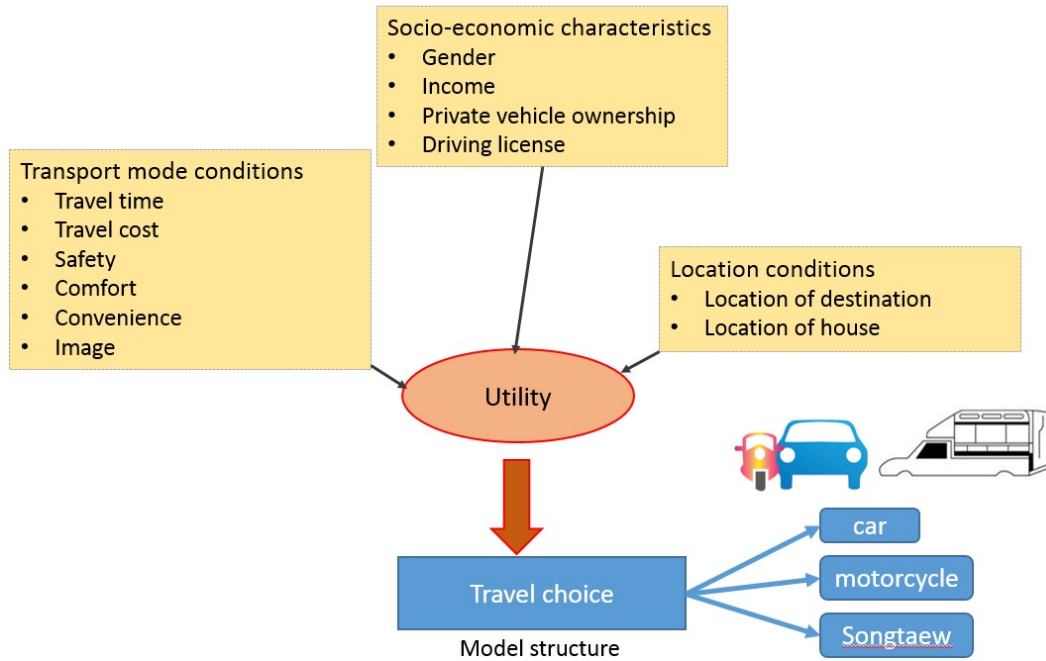


through the analysis of mode choice model among car, motorcycle, and Songtaew in the urban area of Khon Kaen City. To clarify this issue, the specific research objective is defined as to identify significant factors tending individuals to decide travel mode choice for regular trips in the urban area of Khon Kaen City. Moreover, taking into account possibility of Songtaew development in Khon Kaen City to support the sustainable transportation which aims to reduce the dependency of private vehicles, the research needs to identify policy variables influencing individual selecting Songtaew or private motorized vehicles through the comprehensive field survey conducted among urban travelers in Khon Kaen City. Then the recommendation for Khon Kaen City should be made to reduce the use of private vehicles as well as to encourage more Songtaew usage to support the sustainable transport in the future.

Based on the previous studies, there is a relationship between travel mode choice and individual characteristics such as their attitudes and perception, type of activities and socio-economic profile. The level of service of alternatives is also affecting travel mode option. Therefore, Figure 8.1 shows the framework of the trip mode choice study in Khon Kaen City. There are three primary transport modes in Khon Kaen City; 1) Songtaew (ST), 2) Motorcycle (MC), and 3) Car for Khon Kaen citizen to choose for their regular trip both going to school and going to work as can be seen in Figure 8.1. According to the study in Chapter 6, the factors which affect the user of Songtaew in Khon Kaen City are safety, comfort, reliability, and flexibility. Therefore, these factors also have been considered in this study to find the significant factors tending individuals to decide travel mode choice for regular trips in the city center of Khon Kaen City besides travel cost, travel time, driving license ownership, income, gender, age, and other socio-economic factors of the travelers.

The multinomial logit model of regular trips in Khon Kaen City was developed among car, motorcycle, and Songtaew to analyze the mode choice behavior in the city center. In particular, the discrete choice model is the random utility theory used for comparing choice behavior. This model is familiar to analyze both individuals and household's behavior mainly related to the transportation policy. Discrete choice model is widely used in the demand analysis, the evaluation of the effectiveness of the transportation strategies (Chen et al., 2014). Many studies examined the significant factors in the commuters mode choice to support urban transit management by developing Multinomial Logit Model (MNL) which is one of the discrete choice models, and MNL can deal with more than two alternatives which suit to the situation of the urban transport in this study since there are mainly three different options for the travelers in Khon Kaen City.

In this study, the author adapted multinomial logit model (MNL) using the mlogit packages developed by Yves Croissant, Universite de la Reunion. Croissant noted that "Mlogit is a package for R which enables the estimation of the multinomial logit models with individual and alternative specific variables" (Croissant, 2015).



**Figure 8.1** The framework of travel mode choice study

### 8.3 MODE CHOICE MODEL OF TRAVEL CHOICE BEHAVIOR IN KHON KAEN CITY

Since this chapter applied MNL to analyze the preference of travelers under different transport mode conditions and determine the factors that significantly affect their mode choice behavior, in order to improve the urban transportation in Khon Kaen City efficiency. Then MNL was developed among car, motorcycle, and Songtaew in the urban area of Khon Kaen City.

602 travelers were the respondents for modeling choice considering behavior among car, motorcycle, and Songtaew. Choice Set alternatives were defined as 1: for Car, 2 for Motorcycle (MC), and 3 for Songtaew (ST). The mode choice model estimation was summarized in Table 8.1. The model estimation results show that the overall model performance was significant. However, some of the explanatory variables were not significant. Considering the significance, some of the estimated parameters are significantly different from zero at 95% and 99% confidence level. All standard errors are reasonable. Moreover, the model performs rather well; McFadden's R squared was 0.529 suggesting a rather strong explanatory power of variables. In other words, a model is well fit. Values of 0.2 to 0.4 for rho-squared represent EXCELLENT fit (Hensher and Stopher, 1979). The output illustrated that the Songtaew constant obtained from the MNL model is statistically significant. Travel cost, travel time, Image of transport mode, safety condition of the transport mode and house location are playing an important role in traveler's choice behavior for regular trips in Khon Kaen City. This study excluded the status of car ownership, driving license, comfort, reliability and flexibility issues since the t-value was not significant. Moreover, the standard errors were also not stable.

It is not surprising to found that travel cost and travel time have a strong effect on urban transit behavior in Khon Kaen City especially travel cost since this factor plays a significant role in our daily lives decision making. In addition, the cost of car and motorcycle is considered the total of fuel cost, maintenance cost and also parking fee while the cost of Songtaew is a service fee. As previously mentioned that the cost is statically significant, which means the higher the cost of certain choice, the less possibility of choice is chosen.

**Table 8.1** Mode Choice Estimation Results by MNL

Variables	Std. Error	t-value	p-value
Travel Cost (Baht)	0.03	-2.40	0.04*
Travel Time (minutes)	0.05	-2.19	0.02*
Image of transport mode	0.24	2.81	0.02*
Safety of transport mode	0.10	1.98	0.00**
House location	0.18	3.01	0.05*
Log-Likelihood	-275.65		
McFadden R <sup>2</sup>	0.529		
No. of Observation	602		

\*\* Significant at 99%,

\* Significant at 95%,

Furthermore, people attitude on safety issue is also a major factor which affected to their mode choice decision. Therefore, it would lead to increase Songtaew use shifted from car and motorcycle, if there will be the improvement of Songtaew which can satisfy the travel time, the travel cost, image, and safety issue of Khon Kaen City's travelers.

Regarding the travel cost and the travel time, the results explained negatively significant which was that the travelers in Khon Kaen City tend to chose their mode if the trip cost is cheaper than other modes and travel time is shorter than other modes. In other words, the higher the cost and the longer the travel time of particular alternative, the less possibility of alternative is chosen.

#### 8.4 SUMMARY

According to this analysis, travel cost, travel time, safety, image condition of the transport mode and individual characteristics have considerable effects on Khon Kaen City travelers' travel choice. Based on the estimated model, it can be concluded that travel cost, travel time, safety and image condition of the transport mode should be the policy variables which are influencing people in Khon Kaen City selecting their travel mode choice. Considering the encouragement of reducing

private vehicles' dependency in the city to support the sustainable transportation in Khon Kaen City. The policy plan for Khon Kaen Transportation Development in order to encourage more Songtaew use is needed following the findings of this study.

Regarding model results, more travelers would shift to Songtaew if shortening the travel time, reducing the travel cost and increasing the satisfaction of safety issue. Thus the reduction of the travel time of Songtaew service which means all the waiting time and the in-vehicle time would significantly enhance the possibility of the Songtaew service chosen by people in Khon Kaen City. In conclusion, this chapter analyzed the travelers' choice behavior through discrete choices model in Khon Kaen City. The cost, travel time, safety and image were the essential variables that have a significant impact on the travel choice behavior in the city. Some recommendation was provided after identifying the influence of these factors on the selection model results. Such as improving the Songtaew service by shortening the travel time including the waiting and in-vehicle time, enlarging transit service coverage areas and increasing the safety issue primarily control the drivers' driving behavior. The fare of Songtaew is already acceptable since cheaper than another mode. However, it should not be set too high in the future. Because of the median and low-income people tend to choice Songtaew to make their trip.

Moreover, it is necessary to enhance the connection with the new public transport mode which will be proposed to the city in the future to form the role of Songtaew and integrate with the other modes such as feeding of the passengers. If all the recommendation policies can be carried out together, this can lead the car and motorcycle users to select public transportation which is Songtaew and improve the choice probability of public transit as well to support the sustainable transportation and make Khon Kaen City is more sustainable in the future.

## CHAPTER 9

### THE ROLE OF SONGTAEW TO SUPPORT THE SUSTAINABLE TRANSPORTATION

This dissertation mainly aims to develop a comprehensive study in order to provide policy suggestions to improve the paratransit service in developing countries to support the sustainable transportation investigating the Songtaew system in Khon Kaen City, Thailand. The objective of this chapter is to contribute towards the discussion about how to achieve sustainable transportation, in general, by focusing on and finding a solution at the urban level by the role of paratransit namely Songtaew. As reiterated throughout this dissertation, urban transportation is complex. In this study, the methodological approach adopted is given by the integrated evaluation of three main aspects in paratransit system; institutional, supply and demand sides in Khon Kaen City to understand its current transportation situation and to help find the answer to the question: What are the implications of the role of Songtaew in Khon Kaen City to support the sustainable transport system for the city?

#### 9.1 SUSTAINABLE TRANSPORT VISION FOR KHON KAEN CITY

In a planning context, a vision is a desirable ideal state of the future set by groups of decision makers or an individual. The vision can provide specific goals and objectives that will deliver the desired results. In Thailand, local authorities of every city are entitled to set their development vision and objectives, providing these are consistent with the policies of the central government.

Although, there are several administrative organizations in Khon Kaen City, three of them are most influential. They are Khon Kaen municipality (local level administrative organization), Khon Kaen Provincial Administrative (local level administrative organization), and Khon Kaen Province (provincial level administrative organization). The current visions of the three authorities are presented in Table 9.1.

The review of their infrastructure development strategies, which derived from these visions shows that the Khon Kaen Province's focus is on providing infrastructures that support sustainable prosperity according to the Sufficient Economy principle to create the liveable city and reach the specific goals such as development of land use by the principal plan, development of road infrastructure to ensure good accessibility, and development of traffic system and public transport system to support the city sustainability (Khon Kaen Province, 2017).

**Table 9.1** Current visions of three administrative organizations in Khon Kaen Province.

Vision	Main points
<b>Khon Kaen Municipality</b> “Khon Kaen Municipality is an international, sustainable and happiness city, with the high quality of life and strong communities with good governance.	Sustainable Livable Quality of life Good governance
<b>Khon Kaen Provincial Administrative Organization</b> “Develop the quality of life of Khon Kaen’s citizens through good governance and sufficient economy .”	Quality of life Good governance Sufficient economy
<b>Khon Kaen Province</b> “Liveable city, a gateway for domestic and international investment, and the logistic hub of the Greater Mekong Sub-region (GMS) countries. ”	Liveable City Economic development Quality of life

Source: Khon Kaen Province, 2017

### 9.1.1 Sustainable transport visions

In the transportation context, a sustainable city should adopt a design that is recognizable local. The sustainability level of Khon Kaen city is still high in comparison with other cities. Nevertheless, there are some factors that threaten to reduce Khon Kaen City’s sustainability such as new developments, lack of development quality, and lack of the study of existing resources to improve. The sustainability of the city can be maintained by encouraging school children, students and other young people to learn about the traditions and the existing resources of our city and to understand the necessity of sustainable development and are responsible for preserving for future generations.

Sustainability and Sufficiency Economies are related to one another. Sufficiency will lead to sustainability; to be sufficient is to ensure sustainability. Therefore, sustainability and sufficiency are ethical precepts which, to prevent society from degenerating.

Considering the transport situation in Khon Kaen City, the causes of Khon Kaen City’s transport problems are (a) human behavior, (b) the expansion of the city (urban sprawl), and (c) the physical limitations imposed by the old city layout. The city’s transport problems can be alleviated by improving motorist behavior, strengthening road discipline and enforcement, and improving the quality of public transportation, especially the main mode which is Songtaew. Moreover, to maintain its sustainability, the city should have a transport plan that promotes low energy use. Its transport

system should use energy effectively. The development of the system should actively reduce car use and the area occupied by cars by encouraging people to use public transportation instead of driving.

### 9.1.2 Sustainable transport objectives

Objectives provide guidelines toward goals and help to identify obstacles, challenges, and constraints that need to be overcome (Minken et al., 2003). In this subchapter, a list of objectives necessary to achieve the vision previously defined is made. There are seven categories of the objectives: 1) Safety, 2) Protection of the environment, 3) Accessibility, 4) Quality of living standard, 5) Equity and fairness within a generation and between generations, 6) Cultural heritage and traditions, and 7) Economy. These seven objectives can be shown in Table 9.2.

**Table 9.2** Objective and Sub-objective of the city's sustainable transport planning.

Aspect	Objective
Environmental	1. Efficient use of resources and protection of the environment
Social	2. Improve accessibility for all modes 3. Improve Transport Safety 4. Enhance living standard 5. Equity and fairness within and intergeneration 6. Preserve cultural heritage and traditions
Economy	7. Promote economy

Source: Adapted from Minken et al., 2003.

## 9.2 THE ROLE OF SONGTAEW IN KHON KAEN CITY TO SUPPORT THE SUSTAINABLE TRANSPORT SYSTEM

A sustainable transport system must provide mobility to all urban residents with safe and environmentally friendly modes of transport. For example, if the population cannot afford to use private motorized transport, they have to use public transport mode, walk or cycle to their destination. Therefore public transport, cyclists, and pedestrians should be provided with a safe infrastructure and good quality service.

As stated, Songtaew is the main mode of public transport in the city that has consistently served the residents of Khon Kaen City over time. In the meantime, the number of private vehicles increased rapidly. In Khon Kaen City, in particular, the lack of quality public transport resulted in phenomenal increases to the number of private vehicles on the road. In the eyes of the public, these factors further decreased the competitiveness and the need for the improvement of Songtaew.

In addition, its drivers are untrained, and its operations are not strictly regulated. These aspects contribute to reducing the significance of Songtaew to a marginal transport service

predominantly for people who have an access limitation to other vehicles, and people who are unable to drive as well as to non-local people such as the tourist.

This evaluation of the role of Songtaew in Khon Kaen City may reflect only part of the reality, but it attempts to provide an insight to help balance the typically negative opinion of the service. Moreover, the service's high leverage is also a high-potential factor to improve the transport system and provide a viable choice to the car and motorcycle.

It is widely accepted that the provision of quality public transport promotes sustainable transport. Some past studies have been done to identify a suitable form of public transport for the city. Implementation of BRT and LRT system have been proposed as a suitable form of public transportation for Khon Kaen City. Despite numerous plans, public consultations and approval of budgets, these systems have not been implemented yet due to various factors including the lack of the study of existing public transport mode, Songtaew.

As previously mentioned, setting the objectives towards the sustainable transport is needed. In this subchapter, a list of objectives necessary to achieve the vision previously defined is made which supported by Songtaew service study from this dissertation. There are three mainly categories of the objectives: 1) Protection of the environment, 2) Quality of living standard, and 3) Economy which adapted and modified from Minken et al., 2003. These three objectives and the suggested actions and policy considerations regarding the results of this research can be shown in Table 9.3.

### **9.2.1 The suggested actions and policy considerations**

Basic goals for policy and planning to support the sustainable transportation is the reduction of car use for daily mobility, strengthen non-motorized and efficient public transport (Prillwitz, 2011) With regard to the reduction of private vehicle use and the encouragement of Songtaew use in Khon Kaen City, many previous studies noted that the quality of public service is the most important aspect to attract people to shift their mode. Thus it is essential to improve the service of Songtaew to support the sustainable transportation in Khon Kaen City. Considering the results found from this dissertation, the sustainable transportation in Khon Kaen City depends on:

- (1) Promote the use of Songtaew which is the main public transport mode.
- (2) Reduce Greenhouse gas by encouraging the Songtaew drivers to use LPG or CNG.
- (3) Songtaew service improvement by considering factors tending to identify significant individuals to use ST which are Travel cost, Travel time, Image of ST, and Safety.
- (4) Integrating ST as a feeder of LRT or city bus service in the plan by connecting the people to use LRT or city bus on the main route's service.
- (5) Utilizing the existing public transport mode; Songtaew by improving ST service which will save city money more than building the new transport mode.



**Table 9.3** Khon Kaen City sustainable transport planning supported by Songtaew.

Aspect	Objective	The suggested actions and policy considerations
Environmental	Environment protection	<ul style="list-style-type: none"> <li>Promote the use of Songtaew &gt;&gt; Less dependence on the private vehicle.</li> <li>Reduce Greenhouse gas &gt;&gt; Encouraging the ST drivers to use LPG or CNG.(Chapter 5)</li> </ul>
Social equality	Improve public transport quality to promote its use for all travelers in the city	<ul style="list-style-type: none"> <li>ST service improvement &gt;&gt; Considering factors tending to identify significant individuals to use ST which are Travel cost, Travel time, Image of ST, and Safety. (Chapter 6, 7, 8)</li> <li>Integrating ST as a feeder of LRT or city bus service in the plan &gt;&gt; Connecting the people to use LRT or city bus on the main route's service.</li> </ul>
Economy	Promote efficiency economy	<ul style="list-style-type: none"> <li>Utilizing the existing public transport mode; Songtaew by improving ST service &gt;&gt; Saving city money more than building the new mode.</li> </ul>

Source: Adapted and modified from Minken et al., 2003.

Moreover, how to make the quality of transportation service which is satisfactory to users and comparable to alternative modes of travel is necessary to support the city sustainability especially in the sustainable transportation context.

Besides the results of this study, the important factors towards the sustainable transportation are (Tumlin, 2012):

- 1) Speed: Reducing travel time (especially on the busiest routes in the city center) is important, not just to reduce travel times, but also to improve the reliability of the service and reduce operating costs.
- 2) Frequency: Operating more frequency will attract more choice riders.
- 3) Passengers Experience: In addition to time, people value their comfort, convenience, safety, and money.

In this case, public transportation must compete with the private vehicles by increasing safety, providing all-day, or evening service, providing secure waiting areas, providing the cleanness of stops and vehicles, providing more coverage service areas, providing service information

including clear signs and clear and widely schedule and map, especially for the city center with busiest routes, and providing real-time information for passengers especially on personal communication devices.

Therefore, the suggested actions and policy considerations for Songtaew service following the results of this dissertation are:

- 1) Implement a diverse route, and balanced coverage service areas that meet the transportation needs of everyone in the city.
- 2) Improve the coordination among Songtaew service operators to integrate the public transit system in terms of the physical, and operational system.
- 3) Build the necessary infrastructure and facilities such as Songtaew stops, Songtaew information signs, Songtaew schedule to extend the quality of service of Songtaew in the city.
- 4) Give priority to road-based public transit mode, Songtaew, to other modes especially cars to reduce the delay of Songtaew as well as the travel time such as Songtaew express lane in rush hour.
- 5) Improve the Image of Songtaew service by improving the quality of service to meet the expectation of the majority riders especially on the safety and image issues such as promoting ST driver education.
- 6) Provide incentives to Songtaew operators for operating a reliable service of choice to riders.
- 7) Penalize or disqualify the Songtaew operators from operating the service if they fail to provide a reliable and quality service on a regular basis.
- 8) Provide real-time information mainly on the busiest routes for passengers especially on personal communication devices to reduce the waiting time of Songtaew.
- 9) Reduce Greenhouse gas by encouraging the Songtaew drivers to use LPG or CNG.

### 9.3 SUMMARY

It is evident from the above mentioned in this chapter that reducing the private vehicle use in the city and enhancing the use of public transportation by reducing adverse impact on the environment is one of the dominant approaches towards the sustainable transportation. As transportation is related to everyone's daily life, transportation service is one of the variables on which the quality of life of residents in a city depends. A sustainable transportation system can ensure access to goods, people, opportunities and services in a safe, efficient and equitable manner without putting a burden on the environment. The main benefit of a sustainable transportation is that it is an aspect of livability and thus a sustainable transportation improves the quality of life in the city.

One of the major goals of sustainable transportation is to reduce the travel demand, especially reduce the trips made by private vehicles. To achieve this, the city should start diverting from designing private vehicle oriented cities to public transport friendly cities.

Thus, Songtaew in Khon Kaen City plays an important role to support the sustainable transportation in the city since Songtaew is the main mode of public transport in the city that has

consistently served the residents of Khon Kaen City. With regard to the reduction of private vehicle use and the encouragement of Songtaew use in Khon Kaen City, the results noted that the quality of public service is a very important aspect to attract people to shift their mode.

According to this research, the usage of public transportation which is Songtaew can be promoted by improving the service of Songtaew in Khon Kaen City especially focusing on the improvement of travel time, coverage service area, and the satisfaction of users experience especially the image and the safety issues of Songtaew. Moreover, it is also crucial for the city to integrate urban transportation planning and land use planning. Therefore, it should be studied more about the integration of Songtaew service planning and Khon Kaen City land use planning in the future.

## CHAPTER 10

### CONCLUSIONS AND RECOMMENDATIONS

This dissertation mainly aims to develop a comprehensive study in order to provide policy suggestions to improve the paratransit service in developing countries to support the sustainable transportation investigating the Songtaew system in Khon Kaen city, Thailand. This chapter concludes the findings derived from the examination of Songtaew service system, the cost analysis, the travel behavior pattern, and the travel choice model. The proper policy concerns of encouraging the more use of Songtaew and supporting the sustainable transportation in the city are then recommended. Lastly, the future prospects for further research are discussed.

#### 10.1 SUMMARY OF FINDINGS

##### 10.1.1 Songtaew analysis regarding the institutional side focusing on the regulation

Thai central government is responsible for public transportation in Bangkok and other provincial areas, which includes the Office of Transport and Traffic Policy and Planning, and Department of Land Transport. To regulate policy of fixed-route bus as well as Songtaew in Thailand is implemented under Land Transport Act 1979 (B.E. 2522) by having Land Transport Policy Committee, Central Land Transport Control Board (CLTCB) and Provincial Land Transport Control Board (PLTCB) that have the authority to fix the routes, the number of Songtaew operator, and the number of vehicles for fixed routes in Bangkok and other provincial areas. (Department of Land Transport, 2014)

There are two types of fixed-route bus as well as Songtaew in Thailand that operated by government agency and by private agency which is a) Government agency which is two agencies to operate bus transport: The Transport Company Limited and the Bangkok Mass Transit Authority (BMTA) are state enterprises that the government shareholder is 51%, and private shareholder is 49%. The Transport Company Limited is permitted to operate the route which links between Bangkok and other provinces. The Bangkok Mass Transit Authority (BMTA) is permitted to operate the routes which are in Bangkok Metropolitan area, and b) Private agency which is given the approval by the government to operate the bus and Songtaew in the bus route in Bangkok Metropolitan area, the municipalities and the village in the provincial areas. (Department of Land Transport, 2014)

The fare-setting process is defined in the acts. The CLTCB has the authority to fix the share rates of transportation and other service charges. Those charges are determined by referring to the discussion in the cabinet. The fare of the urban bus, as well as Songtaew, is calculated under the cost-plus pricing, which determines the fare on the basis of the estimated total cost. Section 23 of

the 1979 Local Transport Act presents the licenses by route and by vehicle size which related to Songtaew is the license of the fixed-route transportation is valid for seven years while the licenses of the non-fixed route and small-vehicle transportation are valid for five years. These licenses are given by the provincial board under the Ministerial regulation.

### 10.1.2 Songtaew analysis in terms of the supply side focusing on cost analysis

Depending on the availability of detailed data, the performance of Songtaew route number 8 which is the major route plying thoroughfare of Khon Kaen city has been selected for this study. It is useful to analyze operating costs by considering the important components of Songtaew operating costs, namely personnel, energy, and maintenance to figure out the influencing factors which affect the cost structure of Songtaew service. Unfortunately, no data relating to personnel component is available for Songtaew service at the time of this research. However, Songtaew drivers usually own Songtaew fleets and run their service. The payment for drivers is based on the number of passengers per day. For investigating the performance of Songtaew by the collected and secondary data, cost analysis in terms of operational performance is undertaken in the following sequences.

In order to obtain the Songtaew route number 8's density in terms of average values of Songtaew fleets per kilometer, route length was calculated, and its result shows that the current density of Songtaew route number 8 is 2.67 number of Songtaew per kilometer. Moreover, from the collected data, the waiting time per unit of songthaew route number 8 can be analyzed in terms of average values of travel time per kilometer route length, and its result shows that the current waiting time per unit of Songthaew is 4.17 minutes. However, the waiting time is one of the important factors for evaluating the performance of the Songtaew service, the performance of Songtaew is still poor, especially in the real situation the waiting time is unreliable depending on the drivers such as some drivers stop the vehicles at each stop taking too much time to wait for the more passengers.

**Table 10.1** The summarization of cost characteristics of Songtaew in Khon Kaen City.

Types	Characteristics
Operating costs	<ul style="list-style-type: none"> <li>- Driver's wage per day ranged from 300 Baht to 400 Baht</li> <li>- Fuel costs ranged from 200 to 500 Baht per day</li> </ul>
Maintenance costs	The average of Songtaew maintenance costs (such as tires, oil and repairs) ranged from 5,000 Baht to 9,600 Baht.
Fixed costs	Licensing fee, registration fee and other taxes which the average of paying the total fees is 1,500 Baht per unit.

Operational performance of Songtaew service based on cost analysis has been studied in Chapter 5 to investigate the factors that might be affecting on Songtaew performance. According to the limited of available data relating to detailed Songtaew's cost structure, the results show that not only energy prices that affect the cost of Songtaew providing in Khon Kaen City but drivers' driving practice is also the influencing cost elements of Songtaew costs. Also, the analysis of Songtaew costs points out that Songtaew using LPG is considerably providing lower cost than Songtaew using CNG and diesel. Therefore, changing the fuel consumption have a significant impact on the sustainability of the operation in the future. Furthermore, it is possible to introduce the Songtaew service as effective transportation which continues growing and still play a significant role in the city more than other public transportation vehicles such as motorcycle taxis, car taxis, and three-wheelers because of its advantages on accessibility and low-cost service.

As a result, we can consider that operating costs of Songtaew in Khon Kaen City has affected by not only energy costs and maintenance costs, but there are other exogenous variables which can affect costs of this mode such as drivers' salary, operating speed, road condition, maintenance standard, loading practices, vehicle capacity and vehicle age.

Furthermore, for contributing to the sustainable transportation in Khon Kaen City, the results in this chapter highlight that the operating cost using LPG and CNG is much lower than using diesel then towards the sustainable transportation in the city should encourage the Songtaew drivers to use LPG or CNG. Although, LPG releases CO<sub>2</sub> which is a greenhouse gas but is cleaner when compared to gasoline. Moreover, CNG releases lesser greenhouse gas. Therefore this encouragement would contribute to the sustainable transportation of Khon Kaen City.

Lastly, due to the difficulty encountered in collecting data for this research, the government should require Songtaew owners to submit basic financial reports for making Songtaew database available for conducting the research and developing the policy relating to improving Songtaew performance in the future.

### **10.1.3 Songtaew analysis regarding demand side focusing on travel behavior of Travelers in Khon Kaen City**

The study in Chapter 6 revealed that the highest share of transport mode in Khon Kaen City is Songtaew. However, considering about the intention to use Songtaew in the future from which are if there will be a new transport mode for users and if there will be the improvement of Songtaew revealed that the choice users (37%) and the choice non-users (42%) are the majority groups who intend to keep using and stop using Songtaew (the users) and who intend to shift their modes from private vehicles to Songtaew (the non-users). Moreover, the consideration about the loyalty users who want to keep using Songtaew in the future, it reveals that 78.6% of the Songtaew users expressing their attitude toward still using Songtaew in the future even there will be a new transport mode like Bus Rapid Transit (BRT) or Light Rail Transit (LRT).

Considering the result regarding the travel behavior pattern, it can be summarized as follows. The results showed that people with higher income mostly lived in CBD area and made more travel than people with low income. The most of the home-based trip in Khon Kaen City is work trip which most of the workers took Songtaew going to their destination more than other modes

The relationship between the travel behavior pattern and city structure also was examined in this study. The results show that people with higher income mostly lived in CBD area and made more travel than people with low income. The most of the home-based trip in Khon Kaen City is work trip which most of the workers took Songtaew going to their destination more than other modes.

Moreover, it is clear from the study that the city structure of Khon Kaen City which is the polycentric pattern of employment and education centers, along with the dispersal of many jobs and schools outside the CBD, creates more trips outside the CBD, especially for the people who live in the Outer CBD Fringe and Rural-Urban Fringe areas, with the shorter travel time than the people who travel for work trip and school trip in CBD area. Moreover, the accessibility by Songtaew is usually convenient for people who travel in the CBD because of the congestion and the lack of parking space in CBD area that alters some car users to drive cars in CBD. The results of this study could potentially aid in applying urban transportation policy in the future.

#### **10.1.4 Songtaew analysis in terms of demand side focusing on the perception of paratransit in Khon Kaen City**

According to journey to school in Khon Kaen City, the satisfaction of Songtaew service result indicated that the students who use Songtaew for going to school in Khon Kaen City have different satisfaction among the students who always use Songtaew and the others who usually use motorcycle but sometimes using Songtaew regarding the characteristics of them such as gender, age and the status of holding the driving license. The overall satisfaction reflects that generally all student users are satisfied with Songtaew service because of the cheap fare and the convenience of the service. Moreover, the reliability and the comfort have the strongly significant effect to the non-users on the decision for not using Songtaew.

Turning to summarize the journey to work in Khon Kaen City, the finding of the perception for the users indicated that the fare of Songtaew which is cheaper than other modes, and the convenient of the service had a significant effect on the Songtaew users' satisfaction. Turning to the perception for the non-users, the results also explained the factors which are the cost, the availability, the waiting time, the safety and the comfort are the important factors which had a significant influence on their perception for not using Songtaew.

Lastly, based on the examination regarding the perception of the drivers and users on factors related to the usage of Songtaew: safety, reliability, comfort, and flexibility. The results indicated that there is a significant difference perception between Songtaew drivers and users in

Khon Kaen City. Moreover, the result highlighted that reliability and flexibility had strongly a positive impact on the decision to commute by Songtaew for both drivers and users' perception. This result is very interesting. Although there is no Songtaew schedule, and sometimes they have to wait for Songtaew more than 5 mins, but they still perceive Songtaew service is reliable especially in CBD area because there is high frequency of Songtaew service in CBD area then the waiting time around 5 to 10 mins can be acceptable for them and they could predict their arrival time at their destination from their travel experience. For the safety issue, it is also interesting to find that it might be not only the safety issue relating to driver behavior but the waiting area at Songtaew stop also might affect their perception on the safety issue.

However, some of the respondents raised the safety issue that there are some Songtaew waiting area problems currently occurring such as missing route information and no properly design of Songtaew waiting area especially at the crowded area in CBD. These results in discomfort and discourages people to use Songtaew as well as to increase the risk of a safety issue.

#### **10.1.5 Songtaew analysis in terms of demand side focusing on the travel mode choice behavior in Khon Kaen City**

According to this analysis, travel cost, travel time, safety condition of the transport mode and individual characteristics have considerable effects on Khon Kaen City travelers' travel choice. Based on the estimated model, it can be concluded that travel cost, travel time, safety condition of the transport mode should be the policy variables which are influencing people in Khon Kaen City selecting their travel mode choice. Considering the encouragement of reducing private vehicles' dependency in the city to support the sustainable transportation in Khon Kaen City. The policy plan for Khon Kaen Transportation Development in order to encourage more Songtaew use is needed following the findings of this study.

Regarding model results, more travelers would shift to Songtaew if shortening the travel time, reducing the travel cost and increasing the satisfaction of safety issue. Thus the reduction of the travel time of Songtaew service which means all the waiting time and the in-vehicle time would significantly enhance the possibility of the Songtaew service chosen by people in Khon Kaen City. In conclusion, this chapter analyzed the travelers' choice behavior through discrete choices model in Khon Kaen City. The cost, travel time, safety and driving license possession were the essential variables that have a significant impact on the travel choice behavior in the city. Some recommendation were provided after identifying the influence of these factors on the selection model results. Such as improving the Songtaew service by shortening the travel time including the waiting and in-vehicle time, enlarging transit service coverage areas and increasing the safety issue primarily control the drivers' driving behavior. The fare of Songtaew is already acceptable since cheaper than another mode. However, it should not be set too high in the future. Because of the median and low-income people tend to choice Songtaew to make their trip.



Moreover, it is necessary to enhance the connection with the new public transport mode which will be proposed to the city in the future to form the role of Songtaew and integrate with the other modes such as feeding of the passengers. If all the recommendation policies can be carried out together, this can lead the car and motorcycle users to select public transportation which is Songtaew and improve the choice probability of public transit as well as to support the sustainable transportation and make Khon Kaen City is more sustainable in the future.

## **10.2 POLICY CONSIDERATION AND EXPECTED IMPLICATIONS FOR THE DEVELOPING COUNTRIES AND FUTURE RESEARCH**

It is apparent that the transport system of Khon Kaen City is highly unsustainable; it is highly dependent on car and motorcycle, which produce harmful emissions creating a health hazard and causing the traffic congestion, and the injuries and death from transport accidents.

Over recent years there have been several proposals for the implementation of various public transport systems in Khon Kaen City, ranging from introducing the BRT and the LRT services in and around the city following major arterial routes. There is no lack of understanding that the city needs to find a solution to its congested roads by understanding more about the existing urban public transport mode namely Songtaew. What seems to be lacking is the political will to actively improve the current transport system and pave the way toward a more sustainable future. Therefore, improving our ability to understand the realities of the existing urban transport system and find effective solutions to facing problems is needed for contributing to the sustainable transportation.

Thus, another aim of this dissertation is in essence, to contribute toward efforts to rid fallacies that cloud the true perception of the transport system. It seeks to increase the chances of successfully solving urban transport problems and to improve the sustainability of the system through the case study of Songtaew in Khon Kaen City.

The study regarding paratransit system in Khon Kaen City covered all institutional side, supply side and demand side which can develop possible policy implications, which serve as useful information for transportation planners in formulating an appropriate policy and regulation for the sustainable and efficient integrated public transport system in Asian developing countries. Furthermore, studies on paratransit should also be done in other Asian developing cities. Due to the differences in city characteristics, the operations of paratransit might not be the same and policy implications might follow.

According to the results of this study, the suggested actions and policy considerations for Songtaew service are:

- 1) Implement a diverse route, and balanced coverage service areas that meet the transportation needs of everyone in the city.
- 2) Improve the coordination among Songtaew service operators to integrate the public transit system in terms of physical, and operational system.

3) Build the necessary infrastructure and facilities such as Songtaew stops, Songtaew information signs, Songtaew schedule to extend the quality of service of Songtaew in the city.

4) Give priority to road-based public transit mode, Songtaew, to other modes especially cars to reduce the delay of Songtaew as well as the travel time such as Songtaew express lane in rush hour.

5) Improve the Image of Songtaew service by improving the quality of service to meet the expectation of the majority riders especially on the safety and image issues such as promoting ST driver education.

6) Provide incentives to Songtaew operators for operating a reliable service of choice to riders.

7) Penalize or disqualify the Songtaew operators from operating the service if they fail to provide a reliable and quality service on a regular basis.

8) Provide real-time information mainly on the busiest routes for passengers especially on personal communication devices to reduce the waiting time of Songtaew.

9) Reduce Greenhouse gas by encouraging the Songtaew drivers to use LPG or CNG.

Considering the policy development from this study, the proposed policy developments to support sustainable transportation in Khon Kaen City can be divided into two mainly policies.

#### (1) Land use development policy

- Ease of accessibility improvement policy

Enhancing the linkage between land use and the existing public transport service, ST, by implementing a diverse route, and balanced coverage service areas especially the house communities areas that meet the transportation needs of everyone in the city to encourage the car and motorcycle users shift their mode to Songtaew.

#### (2) Transport development policy

##### 2.1 Utilizing the existing public transport mode: Songtaew

##### Songtaew service improvement policy

- Reduce total travel time
- Improve safety of the service
- Improve the image of Songtaew

(a) Provide real-time information mainly on the busiest routes for passengers especially on personal communication devices to reduce the waiting time of ST.

(b) The enforcements and regulations of service license and good behavior driving training should be implemented.

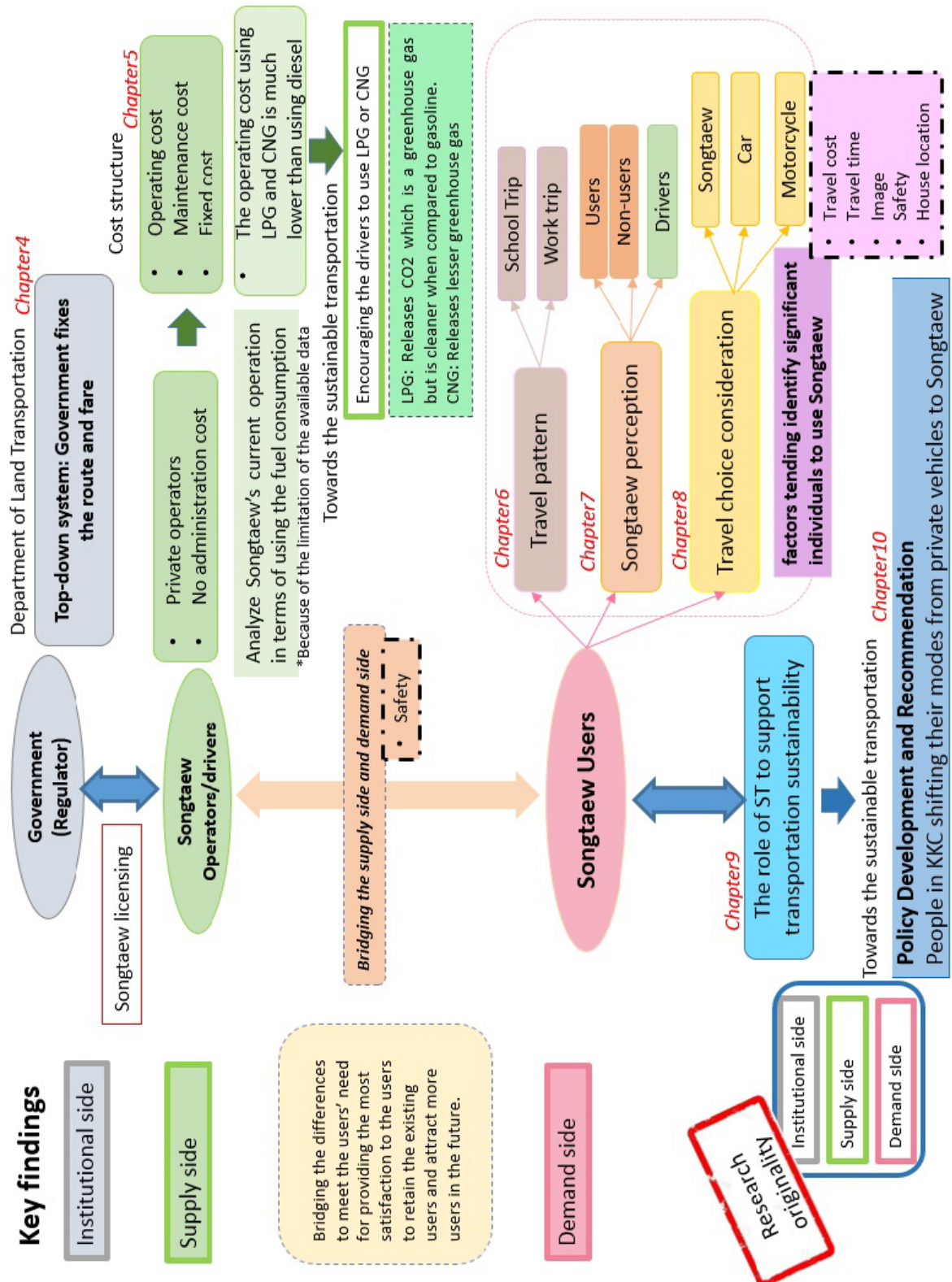
(c) Improving the good design and the cleanliness both inside and outside of the vehicle and facilities at the Songtaew stop.

##### 2.2 Integrating Songtaew with new public transport services

- Integrating ST as a feeder of LRT or city bus service in the future plan
  - (a) Songtaew rerouting that it can reach as close as possible to the LRT station or obtain well coordination with city bus network.
  - (b) Implementing coverage service areas especially on the narrow routes inside the city to connect the people to use LRT or city bus on the main routes service that meet the transportation needs of everyone in the city in the future.

Admittedly, Songtaew in Khon Kaen City plays an important role to support the sustainable transportation in the city. The usage of public transportation which is Songtaew can be promoted by improving the service of Songtaew in Khon Kaen City as mentioned previously. Especially it should be focused on the improvement of reducing travel time, increasing the frequency of service, increasing the coverage service area, and increasing the satisfaction of users experience especially safety issue. Moreover, it is also crucial for the city to integrate urban transportation planning and land use planning. Therefore, it should be studied more about the integration of Songtaew service planning and Khon Kaen City land use planning in the future.

Implications of this study would also be useful for the other researchers to understand more about the factors which affect the paratransit use in other cities. Furthermore, this study would also be useful for providing a data of developing countries' paratransit issues for the further study on paratransit in other developing countries in the future.



**Figure 10.1** The summary of dissertation findings.

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## **APPENDIX A**

### **QUESTIONNAIRE SHEET FOR THE FIRST FIELD SURVEY**

**A Questionnaire Survey about the Role of Songtaew based on Travel behavior and the Perception on Songtaew**

**Conducted by: Pattamaporn WONGWIRIYA, Doctoral Student, Yokohama National University**

**For Staff only**

Name (.....)

Sampling No. (.....)

Place (.....)

Date (.....)

Time (.....)

**Part 1: Socioeconomic information**

**Instructions: Please kindly mark √ in the appropriate box and fill in your best answer.**

Q1	Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female
Q2	Age (years)	<input type="checkbox"/> 15 or less <input type="checkbox"/> 15-20 <input type="checkbox"/> 21-30 <input type="checkbox"/> 31-40 <input type="checkbox"/> 41-50 <input type="checkbox"/> 51-60 <input type="checkbox"/> 60-70    ( ) More than 70
Q3	Education level	<input type="checkbox"/> Lower than undergraduate <input type="checkbox"/> Undergraduate <input type="checkbox"/> Graduate
Q4	Occupation	<input type="checkbox"/> Government officer <input type="checkbox"/> Private employee <input type="checkbox"/> Business owner <input type="checkbox"/> Labor/worker <input type="checkbox"/> Junior High Student <input type="checkbox"/> Senior High School <input type="checkbox"/> Others.....
Q5	Where do you live?	Street name..... Soi's name.....
Q6	Driving license	<input type="checkbox"/> None <input type="checkbox"/> Car <input type="checkbox"/> Motorcycle <input type="checkbox"/> Both
Q7	Household Motorcycle	<input type="checkbox"/> None (Go to Q9) <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> More than 2
Q8	Do you drive a motorcycle?	<input type="checkbox"/> Yes <input type="checkbox"/> No >> If you say "No" Why? <input type="checkbox"/> My family members drive <input type="checkbox"/> Unable to drive <input type="checkbox"/> Others.....
Q9	Household Car	<input type="checkbox"/> None (Go to Q12) <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> More than 2
Q10	Car brands in your family	<input type="checkbox"/> Toyota <input type="checkbox"/> Honda <input type="checkbox"/> Nissan <input type="checkbox"/> Mazda <input type="checkbox"/> Misubishi <input type="checkbox"/> Isuzu <input type="checkbox"/> Ford <input type="checkbox"/> Chevrolet <input type="checkbox"/> Volvo <input type="checkbox"/> BMW <input type="checkbox"/> Benz <input type="checkbox"/> Others.....
Q11	Do you drive a car?	<input type="checkbox"/> Yes <input type="checkbox"/> No >> If you say "No" Why? <input type="checkbox"/> My family members drive <input type="checkbox"/> Your family has a driver <input type="checkbox"/> Unable to drive <input type="checkbox"/> Others.....
Q12	Experiences with Songtaew	<input type="checkbox"/> Yes (Continue to Q13-14, Part 2, Part 3 and Part 4) <input type="checkbox"/> No (Go to Part 2 and then go to Part 5 and Part 6)
Q13	How often do you use Songtaew?	<input type="checkbox"/> >3 days/weekdays <input type="checkbox"/> 1-2 days/weekdays <input type="checkbox"/> weekend or holiday <input type="checkbox"/> few per month
Q14	What is your major purpose for riding Songtaew?	<input type="checkbox"/> Going to work <input type="checkbox"/> Going to school <input type="checkbox"/> Shopping <input type="checkbox"/> Leisure <input type="checkbox"/> Others.....

**Part 2: Work/School Trip pattern and Travel behavior**

**Instructions: Please kindly mark √ in the appropriate box and fill in your best answer.**

**The following question (Q15-Q16) aim to collect your regular work or school trip information that you usually go from home to workplace/school on weekdays**

*For example: In case of using Songtaew*

Q15	<b>How do you usually go to your destination for work or school trip?</b>		
	Please kindly mark √ in the appropriate box and fill in the details of your regular work/school trip data that you usually go from home to workplace/school on weekdays		
	From Home to <input type="checkbox"/> Workplace ..... <input checked="" type="checkbox"/> School...Khonkaenwittayayon School..... (Please specify the name of place or the name of road/soi )		
	<b>Mode</b>	<b>Time</b>	<b>Cost</b>

	<input type="checkbox"/> Private Vehicle <input type="checkbox"/> car as a driver <input type="checkbox"/> car as a passenger <input type="checkbox"/> motorcycle as a driver <input type="checkbox"/> motorcycle as a passenger	<input type="checkbox"/> In vehicle time ..... mins *Car....., *MC.....	<input type="checkbox"/> Fuel/Gasoline charge .....Baht *Car....., *MC.....
	<input checked="" type="checkbox"/> Public transport <input checked="" type="checkbox"/> Songtaew (Route No..8..)	<input checked="" type="checkbox"/> Walking time to Songtaew stop ...6... mins <input checked="" type="checkbox"/> Waiting time at Songtaew stop ...3... mins <input checked="" type="checkbox"/> In vehicle time ...10... mins	<input checked="" type="checkbox"/> Fare...8...Baht
After getting off the transport mode, Do you have to walk to the destination? <input checked="" type="checkbox"/> Yes ...3.... mins <input type="checkbox"/> No			
Q16	Who pay for your travel cost? <input type="checkbox"/> Yourself <input checked="" type="checkbox"/> Parent <input type="checkbox"/> Company <input type="checkbox"/> Others.....		

**Remark: In Khon Kaen Fuel charge = 4 Baht/ Km OR Gasoline= 2 Baht/ Km**

**Please explain your own data**

Q15	<b>How do you usually go to your destination for work or school trip?</b>  Please kindly mark √ in the appropriate box and fill in the details of your regular work/school trip data that you usually go from home to workplace/school on weekdays From Home to <input type="checkbox"/> Workplace ..... <input type="checkbox"/> School..... (Please specify the name of place or the name of road/soi )		
	<b>Mode</b> <input type="checkbox"/> Private Vehicle <input type="checkbox"/> car as a driver <input type="checkbox"/> car as a passenger <input type="checkbox"/> motorcycle as a driver <input type="checkbox"/> motorcycle as a passenger <input type="checkbox"/> Public transport <input type="checkbox"/> Songtaew (Route No.....)	<b>Time</b> <input type="checkbox"/> In vehicle time ..... mins *Car....., *MC..... <input type="checkbox"/> Walking time to Songtaew stop ..... mins <input type="checkbox"/> Waiting time at Songtaew stop ..... mins <input type="checkbox"/> In vehicle time ..... mins	<b>Cost</b> <input type="checkbox"/> Fuel/Gasoline charge .....Baht *Car....., *MC..... <input type="checkbox"/> Fare.....Baht
After getting off the transport mode, Do you have to walk to the destination? <input type="checkbox"/> Yes ..... mins <input type="checkbox"/> No			
Q16	Who pay for your travel cost? <input type="checkbox"/> Yourself <input type="checkbox"/> Parent <input type="checkbox"/> Company <input type="checkbox"/> Others.....		

**Remark: In Khon Kaen Fuel charge = 4 Baht/ Km OR Gasoline= 2 Baht/ Km**

**Part 3: For Songtaew User**

**Your satisfaction on using Songtaew in present service**

**Instructions: Please circle on the choice you think.**

	Please select your preferring number that relate to your perception of Songtaew	Very dissatisfy	Dissatisfy	Satisfy	Very satisfy
Example	Picking up the passengers more than the capacity	①	2	3	4
Q17	Picking up the passengers more than the capacity	1	2	3	4
Q18	Waiting time duration for using service	1	2	3	4
Q19	Travel time duration in the vehicle from origin to destination	1	2	3	4
Q20	Number and location of Songtaew stops to pick-up/drop-off users along the way	1	2	3	4
Q21	Songtaew fare				
Q22	Seating comfort and seat availability	1	2	3	4
Q23	Flexibility for changing route	1	2	3	4
Q24	The image of Songtaew	1	2	3	4
Q25	Service schedule and route information	1	2	3	4



**Part 4: *For Songtaew User*****Your opinion and attitude on selecting Songtaew as Travel mode to work/school trip****Instructions: Please circle on the choice you think.**

I use Songtaew because.... (Please select your preferring number that relate to your perception of the reason for using Songtaew)....		Strongly disagree	Disagree	Agree	Strongly agree
<i>Example</i>	<i>Songtaew fare is cheaper than other modes</i>	①	2	3	4
Q26	You know well about Songtaew service information such as the route number that you can ride to the destination	1	2	3	4
Q27	Songtaew fare is cheaper than other modes	1	2	3	4
Q28	Waiting time duration for using service is not too long	1	2	3	4
Q29	Travel time duration in the vehicle from origin to destination is not too long.	1	2	3	4
Q30	You can predict the waiting time for Songtaew and the total travel time taking from the origin to the destination	1	2	3	4
Q31	Songtaew has enough ride and off spots (Songtaew stops) where close to the origin and destination places	1	2	3	4
Q32	Seats are comfortable and you don't feel uncomfortable when sit close to the other users	1	2	3	4
Q33	Songtaew is flexible for changing route	1	2	3	4
Q34	It is ok for you that Songtaew is too overcrowding during peak hours and when the drivers pick up the passengers more than the capacity	1	2	3	4
Q35	You don't care about the Songtaew image which represents low income people's vehicle	1	2	3	4
Q36	Travelling by Songtaew is more convenient than private vehicle	1	2	3	4
Q37	You will continue using Songtaew as your main mode going to workplace/school in future even there will be a new transport mode such as Bus Rapid Transit (BRT)	1	2	3	4

**Part 5: *For Non-Songtaew User*****Your opinion and attitude on not selecting Songtaew as Travel mode to work/school trip****Instructions: Please circle on the choice you think.**

I do not use Songtaew because.... (Please select your preferring number that relate to your perception of the reason for not using Songtaew)....		Strongly disagree	Disagree	Agree	Strongly agree
<i>Example</i>	<i>Travelling by Songtaew represents low income status</i>	1	2	③	4
Q38	You don't know well about Songtaew service information such as the route number that you can ride to the destination.	1	2	3	4
Q39	Songtaew image discourages you to use (because travelling by Songtaew represents low income status)	1	2	3	4
Q40	Songtaew has not enough ride and off spots (Songtaew stops) where close to the origin and destination places	1	2	3	4

Q41	Songtaew waiting time is unreliable so you cannot predict the total travel time and it has much variation more than 10 mins	1	2	3	4
Q42	Songtaew waiting time is taking too long duration	1	2	3	4
Q43	The travel time in Songtaew is taking too long duration	1	2	3	4
Q44	Songtaew is unsafe because of picking up the passengers more than the capacity that they can hang onto the rails by which the roof is affixed and at the exit.	1	2	3	4
Q45	Songtaew seats are uncomfortable and you don't like to sit close to other users	1	2	3	4
Q46	Travelling by private vehicle is more convenient than Songtaew	1	2	3	4
Q47	Songtaew is not flexible for changing route	1	2	3	4
Q48	Your total transport cost per month is cheaper than using Songtaew (especially the person who use gasoline for car/motorcycle)	1	2	3	4
Q49	You will use Songtaew in future if there will be the improvement of Songtaew service	1	2	3	4

**Part 6: For Non-Songtaew User**

**Your satisfaction on Songtaew improvement in future**

**Instructions: Please circle on the choice you think.**

Please express your attitude level to each improvement of Songtaew		Very dissatisfy	Dissatisfy	Satisfy	Very satisfy
<i>Example</i>	<i>Driver will not pick up the passengers more than the capacity</i>	1	2	3	④
Q50	Driver drive safe and will not pick up the passengers more than the capacity controlled by regulation	1	2	3	4
Q51	Every vehicles are required to check its condition for good condition about the engine, the exterior and interior of the vehicle, and good maintenance	1	2	3	4
Q52	Songtaew seats are improved to be more comfortable and clean	1	2	3	4
Q53	Service time table and route map of each route number of Songtaew are provided at each stops	1	2	3	4
Q54	Improving service reliability by using regulation to control driver drive Songtaew following the service time table	1	2	3	4
Q55	Provide Songtaew service at night after 8 p.m.	1	2	3	4
Q56	Provide Express-Songtaew which has limited specific stops at main/important points (market, school, residential area, etc.)	1	2	3	4
Q57	Provide air-conditioned Songtaew and you prefer to pay more for this service.	1	2	3	4

*Thank you very much for your kind cooperation.*

## **APPENDIX B**

### **QUESTIONNAIRE SHEET FOR THE SECOND FIELD SURVEY**

**A Questionnaire Survey about the Role of Songtaew based on Travel behavior and the perception on Songtaew**  
**Conducted by: Pattamaporn WONGWIRIYA, Doctoral Student, Yokohama National University**

<b>For Staff only</b>	
Name (.....)	Sampling No. (.....)
Place (.....)	Date (.....)
	Time (.....)

**PART 1: Socioeconomic information**

**Instructions: Please kindly mark  $\checkmark$  in the appropriate box.**

Q1	Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female
Q2	Age (years)	<input type="checkbox"/> 15 or less <input type="checkbox"/> 15-20 <input type="checkbox"/> 21-30 <input type="checkbox"/> 31-40 <input type="checkbox"/> 41-50 <input type="checkbox"/> 51-60 <input type="checkbox"/> 60-70    ( ) More than 70
Q3	Education level	<input type="checkbox"/> Lower than undergraduate <input type="checkbox"/> Undergraduate <input type="checkbox"/> Graduate
Q4	Occupation	<input type="checkbox"/> Government officer <input type="checkbox"/> Private employee <input type="checkbox"/> Business owner <input type="checkbox"/> Labor/worker <input type="checkbox"/> Junior High Student <input type="checkbox"/> Senior High School <input type="checkbox"/> Others.....
Q5	Driving license	<input type="checkbox"/> None <input type="checkbox"/> Car <input type="checkbox"/> Motorcycle <input type="checkbox"/> Both
Q6	Do you have car or MC?	<input type="checkbox"/> Yes <input type="checkbox"/> No

**Part 2: Travel behavior**

**Instructions: Please kindly mark  $\checkmark$  in the appropriate box and fill in your best answer.**

Q7	How do you go to your destination for the regular trip? <input type="checkbox"/> To work <input type="checkbox"/> To school	<input type="checkbox"/> Car $\gg$ <input type="checkbox"/> Drive by yourself <input type="checkbox"/> Drive by the others <input type="checkbox"/> MC $\gg$ <input type="checkbox"/> Drive by yourself <input type="checkbox"/> Drive by the others <input type="checkbox"/> ST (Route number.....) <input type="checkbox"/> Others.....
Q8	How do you go to your destination for leisure or shopping trip in city center?	<input type="checkbox"/> Car $\gg$ <input type="checkbox"/> Drive by yourself <input type="checkbox"/> Drive by the others <input type="checkbox"/> MC $\gg$ <input type="checkbox"/> Drive by yourself <input type="checkbox"/> Drive by the others <input type="checkbox"/> ST (Route number.....) <input type="checkbox"/> Others.....
Q9	Total travel time from your home to your destination for the regular trip?	About.....mins
Q10	If you ride ST, How long do you waiting for ST at bus stop for the regular trip?	About.....mins
Q11	Total travel time from your home to your destination for leisure or shopping in city center?	About.....mins
Q12	If you ride ST, How long do you waiting for ST at bus stop for the leisure or shopping trip in city center?	About.....mins
Q13	If you ride ST, Are you usually getting on ST at the designated bus stop?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Q14	If you ride ST, Are you usually getting off ST at the designated bus stop?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Q15	How often do you ride ST?	<input type="checkbox"/> never <input type="checkbox"/> rarely <input type="checkbox"/> sometimes <input type="checkbox"/> often <input type="checkbox"/> almost always
Q16	How often do you drive car?	<input type="checkbox"/> never <input type="checkbox"/> rarely <input type="checkbox"/> sometimes <input type="checkbox"/> often <input type="checkbox"/> almost always
Q17	How often do you drive MC?	<input type="checkbox"/> never <input type="checkbox"/> rarely <input type="checkbox"/> sometimes <input type="checkbox"/> often <input type="checkbox"/> almost always
Q18	How much for your travel cost per month?	<input type="checkbox"/> Fuel cost for car (About.....Baht/Month) <input type="checkbox"/> Fuel cost for MC (About.....Baht/Month) <input type="checkbox"/> ST cost (About.....Baht/Month)
Q19	If now you don't have car or MC, Do you want to buy car or MC?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Q20	According to Q19 When you have car or MC, Do you quit using ST?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Q21	If now you have car or MC and never use ST, Do you want to shift your present mode to ST?	<input type="checkbox"/> Yes <input type="checkbox"/> No

### Part 3: Perceived Songtaew use

Instructions: Please circle on the scale from 1-5 which you prefer most.

		<i>Uncomfortable</i> _____ <i>Comfortable</i>				
Q22	How comfortable do you feel about riding ST?	1	2	3	4	5
		<i>Risky</i> _____ <i>Safe</i>				
Q23	How safe do you feel about riding ST?	1	2	3	4	5
		<i>Long time</i> _____ <i>Short time</i>				
Q24	How long of travel time do you feel about riding ST?	1	2	3	4	5
		<i>Expensive</i> _____ <i>Cheap</i>				
Q25	How cheap do you feel about paying for ST cost?	1	2	3	4	5
		<i>For poor people</i> _____ <i>For rich people</i>				
Q26	How do you feel about the image of ST service?	1	2	3	4	5
		<i>Inflexible</i> _____ <i>Flexible</i>				
Q27	How flexible do you feel about riding ST?	1	2	3	4	5
		<i>Unreliable</i> _____ <i>Reliable</i>				
Q28	How reliable do you feel about riding ST?	1	2	3	4	5
		<i>Bored</i> _____ <i>Enthusiastic</i>				
Q29	How do you feel when riding ST? (your emotion)	1	2	3	4	5
		<i>Very dissatisfied</i> _____ <i>Very satisfied</i>				
Q30	What is your overall satisfaction about riding ST?	1	2	3	4	5

Thank you for your kind cooperation.

**A Questionnaire Survey about the Role of Songtaew based on the perception on Songtaew from Driver**  
**Conducted by: Pattamaporn WONGWIRIYA, Doctoral Student, Yokohama National University**

<b>For Staff only</b>	
Name (.....)	Sampling No. (.....)
Place (.....)	Date (.....)
	Time (.....)

**PART 1: Socioeconomic information**

**Instructions: Please kindly mark √ in the appropriate box.**


Q1	Gender	<input type="checkbox"/> Male <input type="checkbox"/> Female
Q2	Age (years)	<input type="checkbox"/> 15 or less <input type="checkbox"/> 15-20 <input type="checkbox"/> 21-30 <input type="checkbox"/> 31-40 <input type="checkbox"/> 41-50 <input type="checkbox"/> 51-60 <input type="checkbox"/> 60-70    ( ) More than 70
Q3	Education level	<input type="checkbox"/> Lower than undergraduate <input type="checkbox"/> Undergraduate <input type="checkbox"/> Graduate
Q4	Driving license	<input type="checkbox"/> None <input type="checkbox"/> Car <input type="checkbox"/> Motorcycle <input type="checkbox"/> Both
Q5	Do you have car or MC?	<input type="checkbox"/> Yes <input type="checkbox"/> No

**Part 2: Perceived Songtaew use**


**Instructions: Please circle on the scale from 1-5 which you prefer most.**

		<i>Uncomfortable</i>		<i>Comfortable</i>		
Q6	How comfortable do you feel about riding ST?	1	2	3	4	5
		<i>Risky</i>				<i>Safe</i>
Q7	How safe do you feel about riding ST?	1	2	3	4	5
		<i>Long time</i>				<i>Short time</i>
Q8	How long of travel time do you feel about riding ST?	1	2	3	4	5
		<i>Expensive</i>				<i>Cheap</i>
Q9	How cheap do you feel about paying for ST cost?	1	2	3	4	5
		<i>For poor people</i>				<i>For rich people</i>
Q10	How do you feel about the image of ST service?	1	2	3	4	5
		<i>Inflexible</i>				<i>Flexible</i>
Q11	How flexible do you feel about riding ST?	1	2	3	4	5
		<i>Unreliable</i>				<i>Reliable</i>
Q12	How reliable do you feel about riding ST?	1	2	3	4	5
		<i>Bored</i>				<i>Enthusiastic</i>
Q13	How do you feel when riding ST? (your emotion)	1	2	3	4	5
		<i>Very dissatisfied</i>				<i>Very satisfied</i>
Q14	What is your overall satisfaction about riding ST?	1	2	3	4	5

**Thank you for your kind cooperation.**



**YNU** 横浜国立大学  
YOKOHAMA National University



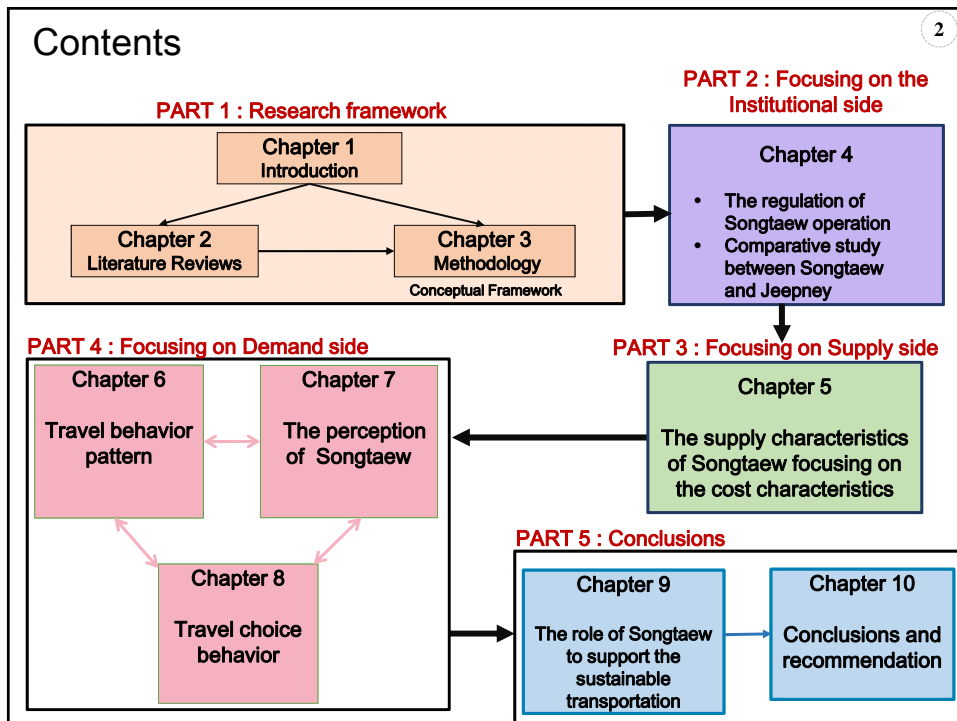
## A STUDY ON THE EVALUATION OF PARATRANSIT SYSTEM TO SUPPORT THE SUSTAINABLE TRANSPORTATION IN DEVELOPING COUNTRIES: A CASE STUDY OF SONGTAEW IN THAILAND

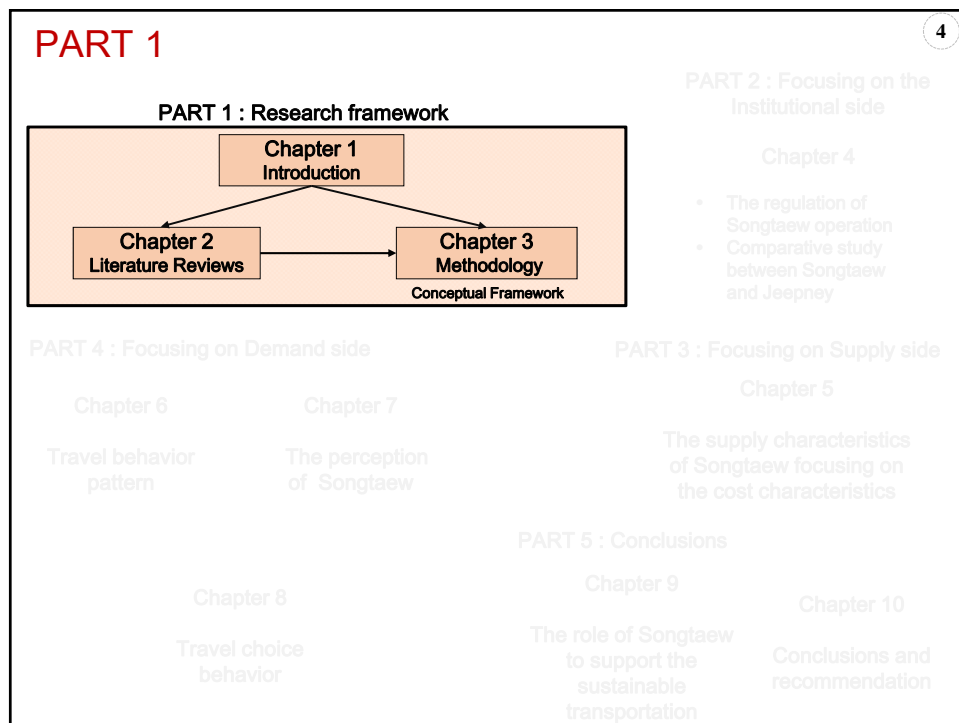
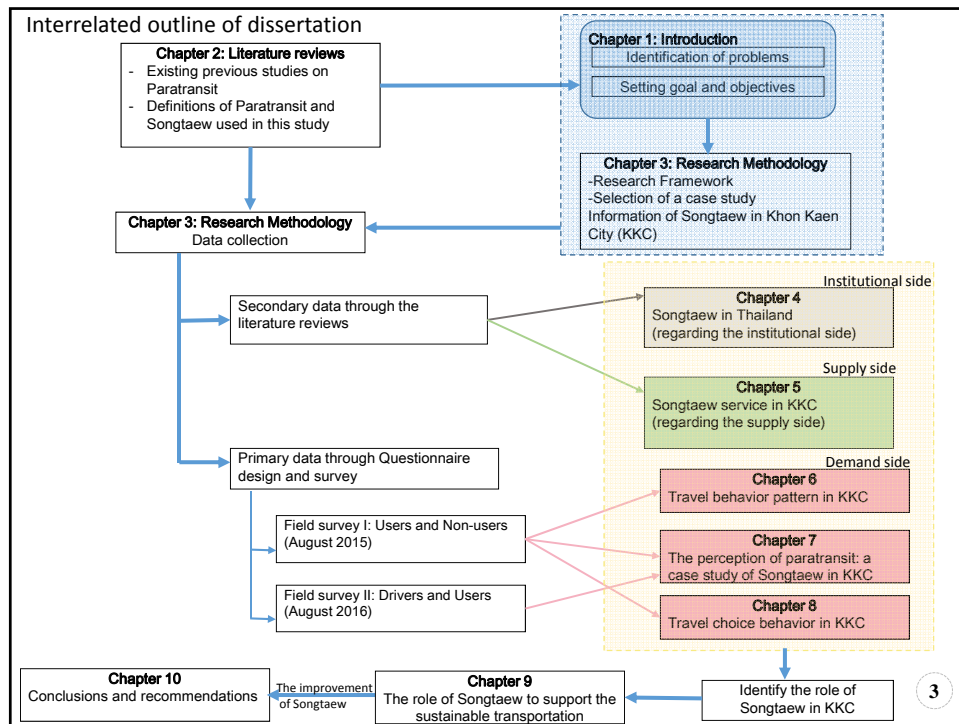
発展途上国における持続可能な交通に資するパラトランジットの評価に関する  
研究：タイのソンテウのケーススタディを通して

**Pattamaporn WONGWIRIYA**  
パッタマボン ウォンウィリヤ  
*Transportation and Urban Engineering Laboratory  
Graduate School of Urban Innovation*

**Academic Advisors**  
Executive Director, Vice Pres. Prof. Fumihiko NAKAMURA (Advisor)  
Associate Professor Shinji TANAKA (Co-advisor)

*Final Defense on August 4th, 2017*



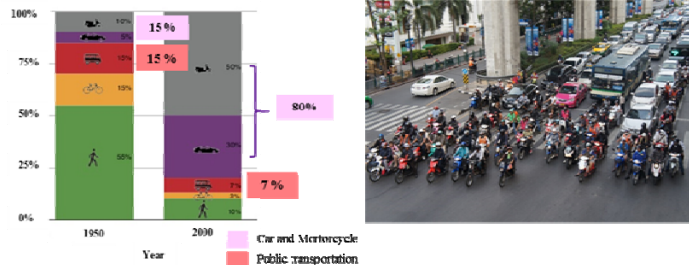




## Background and Motivation

Chapter 1

Thailand Modal Share within an urban area in 1950 and 2000



Source: Adapted from Challenges and Potential of e-mobility in Thailand's Transport Future, 2015.

- Transport situation in Thailand changes quite rapidly especially an increasing number of motorcycle and car.
- The use of public transport in Thailand tends to decrease, and automobile tends to increase.

Basic goals for policy and planning to support the sustainable transportation is the reduction of car use for daily mobility, strengthen non-motorized and efficient public transport (Prillwitz, 2011)

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## Background and Motivation

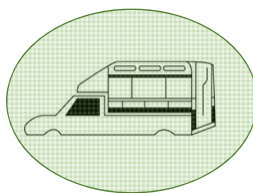
Chapter 1

### Challenges and Opportunities

- The problem with private vehicle-dependent societies lies with its large impact on the environment and the quality of life in many urban areas.
- This research addresses the challenge of planning and creating an urban transportation system to create a sustainable transport system that considers social, environmental, and economic development aspects.

- How do we attract more public transport users?

>> To motivate a modal shift towards the sustainable transport system.



**Sustainable Transport**

Less dependence on the private vehicle



Source: <http://xarxanet.org>

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## Research Objectives

1. To explore the current Songtaew (ST) service system in Khon Kaen City (KKC). (Chapter 4,5)
2. To examine travel behavior pattern in Khon Kaen City. (Chapter 6)
3. To investigate the influencing factors of traveler attitudes toward Songtaew service satisfaction. (Chapter 7)
4. To examine urban travelers' travel choice consideration. (Chapter 8)
5. To develop and recommend an appropriate policy and useful insights related to the improvements of operation and future management for Songtaew. (Chapter 9,10)



### Goal : Modal Shift

- Attract the people in KKC for shifting their modes from private vehicles to ST.
- Provide policy suggestions to improve the paratransit service which is Songtaew towards the sustainable transport system in Khon Kaen city.

**Sustainable Transport**



7

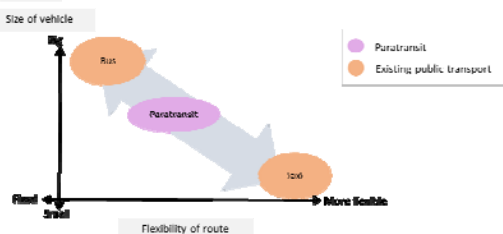
## Paratransit Definition

Although various descriptions have previously been provided, there is no common definition of "paratransit" that covers all modes and types of operation of paratransit services in Asian developing countries.



The various types of paratransit in Thailand

In this study, paratransit is defined follow the common definition which various describes public transport modes in developing countries that are operated on a small scale, a low-cost transport mode and its operation can be either legal or illegal as defined by local rules and regulations.



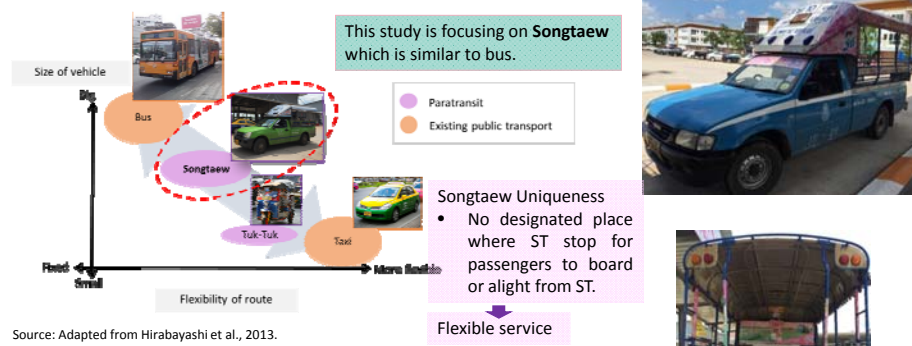
Paratransit definition in terms of the size of vehicle and flexibility of route.

Source: Hirabayashi et al., 2013.

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## Songtaew (ST) Definition

**Songtaew in Thailand** : a modified Pick Up truck with 2 rows of seats in the back



### The Role of Songtaew in Thailand

Bangkok	Other cities
A feeder of mass transit system.	A main public transport mode in the city.
	

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## Previous paratransit studies

No.	Author/ Year	Location	focusing on		
			Demand side	Supply side	Institutional side
1	Cervero (1990)	Indonesia, Thailand, Philippines, Malaysia and Singapore	-	vehicles, services, operation	-
2	Shimazaki and Rahman (1996)	Developing Countries of Asia	-	vehicles, services, operation	-
3	A. D. Golub (2003)	Brazil	people's modal choice	-	-
4	D. Diaz, C. Cal (2005)	Philippines	-	services and operation	-
5	A.K. Somasundaraswaran (2006)	Sri Lanka	-	drivers	-
6	Luthra (2006)	India	-	drivers, services, operation	-
7	Becky P.Y. Loo (2007)	Hong kong	people's modal choice, residential location, user perception	-	the policy
8	Joewono (2007)	Indonesia	user perception	-	the policy

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Chapter 2					
No.	Author/ Year	Location	focusing on		
			Demand side	Supply side	Institutional side
9	Shimomura, Ogita, Colette, Nakagawa, Kuranami and Kato (2007)	Thailand, Indonesia and Cambodia	-	the management and operation	the transport plan
10	A O. Owolabi (2009)	Nigeria	user perception/people's modal choice	-	the policy
11	Joewono (2009)	Indonesia	user perception	-	-
12	A. Tangphaisankun (2010)	Bangkok, Thailand	users' travel choice consideration, user satisfaction	the operation	the policy
13	H. Schalekamp, R. Behrens (2010)	South Africa	-	services and operation	-
14	M. S. OMMEH (2012)	Nairobi, Kenya	user perception	-	-
15	R. Nwaogbe (2012)	Nigeria	user perception	services and operation	the policy
16	A. Verseckiene (2013)		-	services and operation	-
17	Vu Anh TUAN (2013)	Hochiminh, Vietnam	usage characteristics, user perception	operational characteristics	the policy
18	Kanalli and Hublikar (2014)	India	people's modal choice	-	-

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Chapter 2	
Summary of previous paratransit studies	
<ul style="list-style-type: none"> <li>The most of Paratransit studies in developing countries focused on the supply side to understand various aspects of it. <ul style="list-style-type: none"> <li>Drivers and vehicles</li> <li>Service characteristics</li> <li>Service quality</li> <li>The operation and operators</li> </ul> </li> <li>In Thailand, the study of Paratransit on the demand and supply sides have been studied only in Bangkok where Songtaew operates as a feeder of mass transit system.</li> <li>Thus, the originality of the methodological approach adopted for this research is given by the integrated evaluation of three main aspects in paratransit system; institutional, supply and demand sides in Khon Kaen City where Songtaew operates as a main public transport mode.</li> </ul>	

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## Study Area : Why Khon Kaen City?

Khon Kaen is one of the four major cities of the northeastern part, Thailand which known as the regional capital.



Thailand



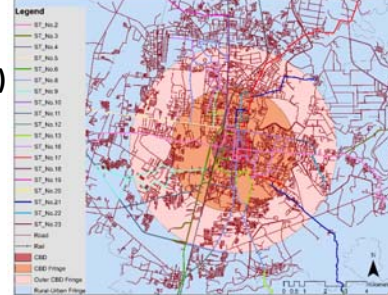
Khon Kaen City (KCC)

The city is home to 326,643 people  
(in 2014)  
Area = 46 km<sup>2</sup>

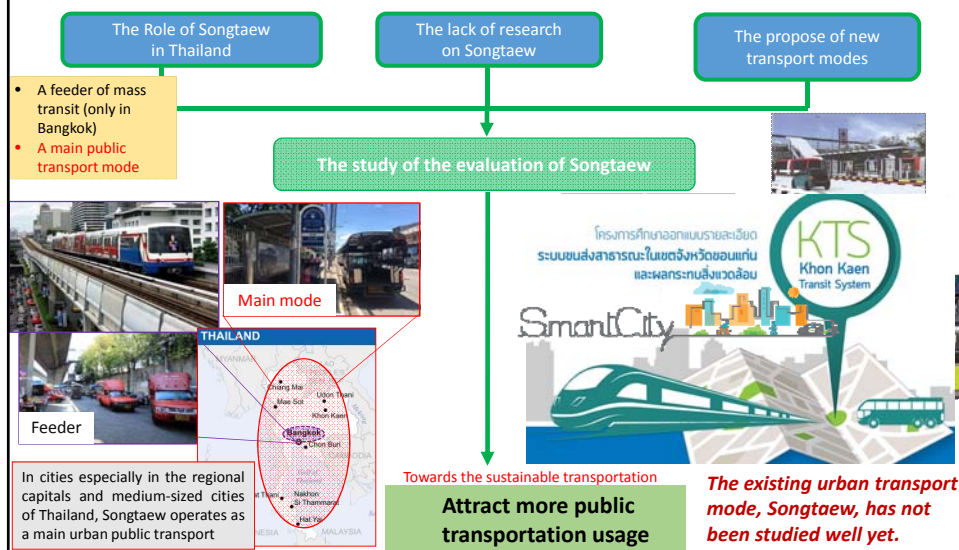
In Khon Kaen City, public transport option is limited to Songtaew.



Route map of Songtaew (ST) in Khon Kaen City



## Research Motivation of a case study: Songtaew (ST) in Khon Kaen City (KCC)



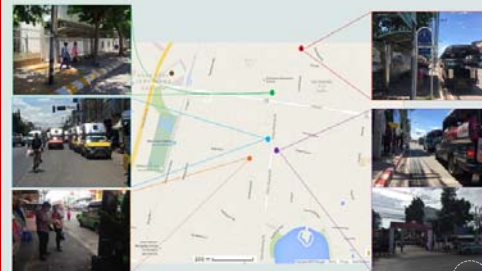
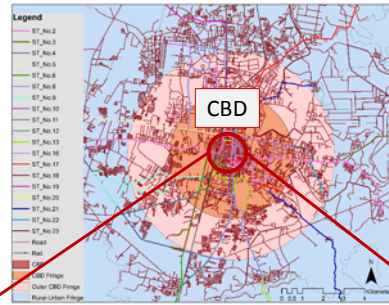
## Main Public Transport



Songtaew

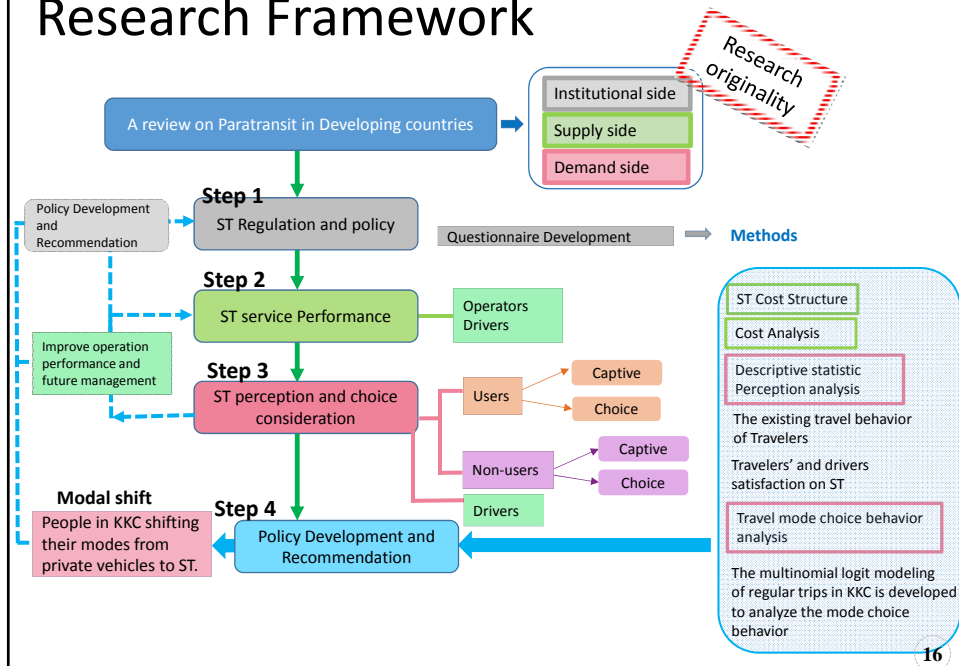
Elements	Songtaew
Number of Route	19
Vehicle capacity (person/vehicle)	20
Average travel time (one way) (h)	0.50
Average route Length (km)	18
Fare (per person per trip)	26 JPY ( 9 THB : Adults) 15 JPY ( 5 THB : Students)
Operation time	6:00 – 18:00

Source: Field survey conducted in September 2015



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## Research Framework





## Scope and Limitation

- The research scope of this study is limited to Songtaew service within the city of Khon Kaen.
- There is the lack of Songtaew data collection by government official
- This study has limited sample size of field surveys from all the study of institutional, supply, demand sides.

Institutional side: The government officials and university professor

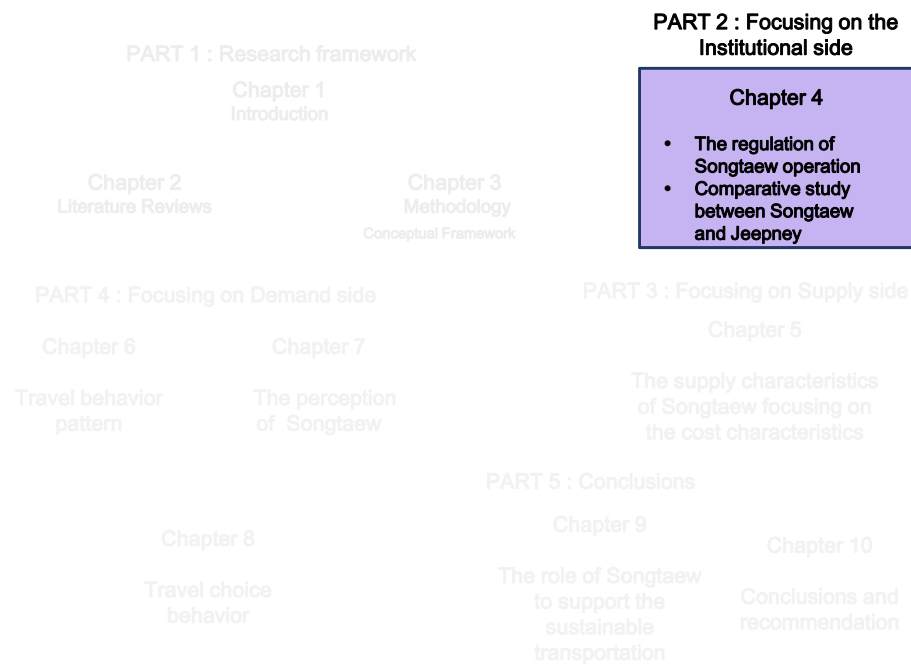
Supply side: 150 samplings (Drivers)

Demand side: 602 Samplings (Urban travelers in Khon Kaen City)

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## PART 2

18





Institutional side

Chapter 4

Objective: To review the role of paratransit namely Songtaew in Thailand regarding the institutional side in terms of the regulation compared with Jeepney in the Philippines. (Chapter 4)

Research methodology: Comparative study by collecting the data through

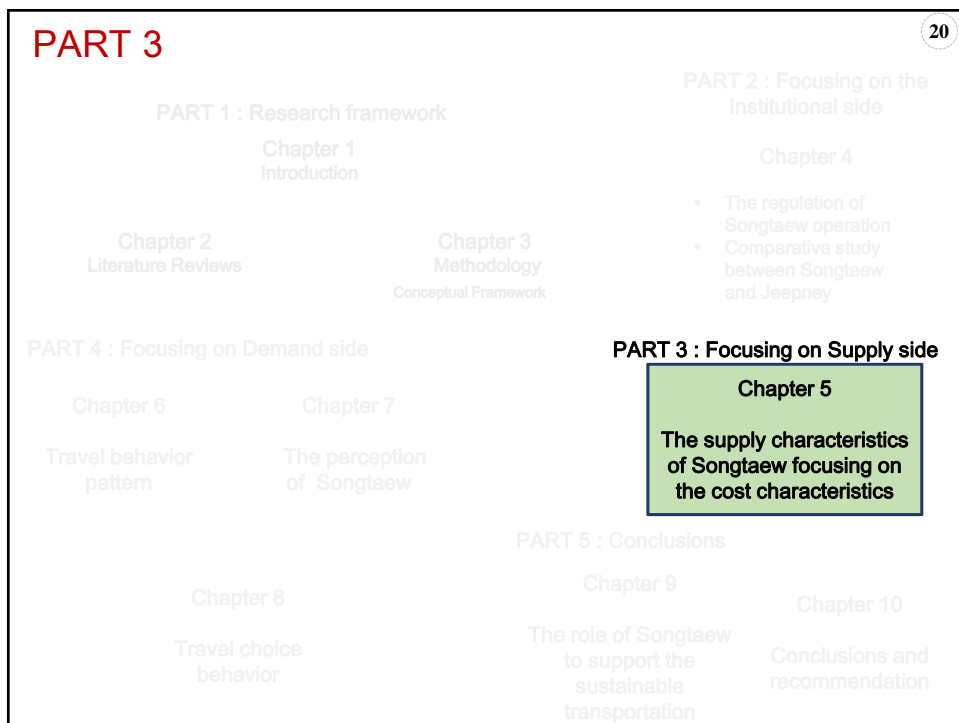
- The interview with government officials and university professor in Thailand and the Philippines
- The literature review related to Songtaew and Jeepney

Route Regulation	Fare Regulation
 <p>a) The Transport Company Limited and the Bangkok Mass Transit Authority (BMTA) <b>fix the route</b> in Bangkok.</p> <p>b) The private agency given the approval by government <b>fixes the route</b> in Bangkok and other provinces.</p>	<p>a) The Central Land Transport Control Board (CLTCB) <b>fixes the fare</b> in Bangkok.</p> <p>b) The Provincial Land Transport Control Board (PLTCB) <b>fixes the fare</b> in other provinces.</p> <div style="border: 2px dashed green; background-color: #90ee90; padding: 10px; text-align: center; margin: 10px 0;">Top-down approach</div>
 <p>The Jeepney operators <b>propose the route</b> and the Department of Transportation and Communications (DOTC) Road Transport Planning Division (RTPD) evaluates and approves the route.</p>	<p><b>Public hearings and approving the fare</b> by the Land Transportation Franchising and Regulatory Board (LTFRB)</p> <div style="border: 2px dashed green; background-color: #90ee90; padding: 10px; text-align: center; margin: 10px 0;">Bottom-up approach</div>

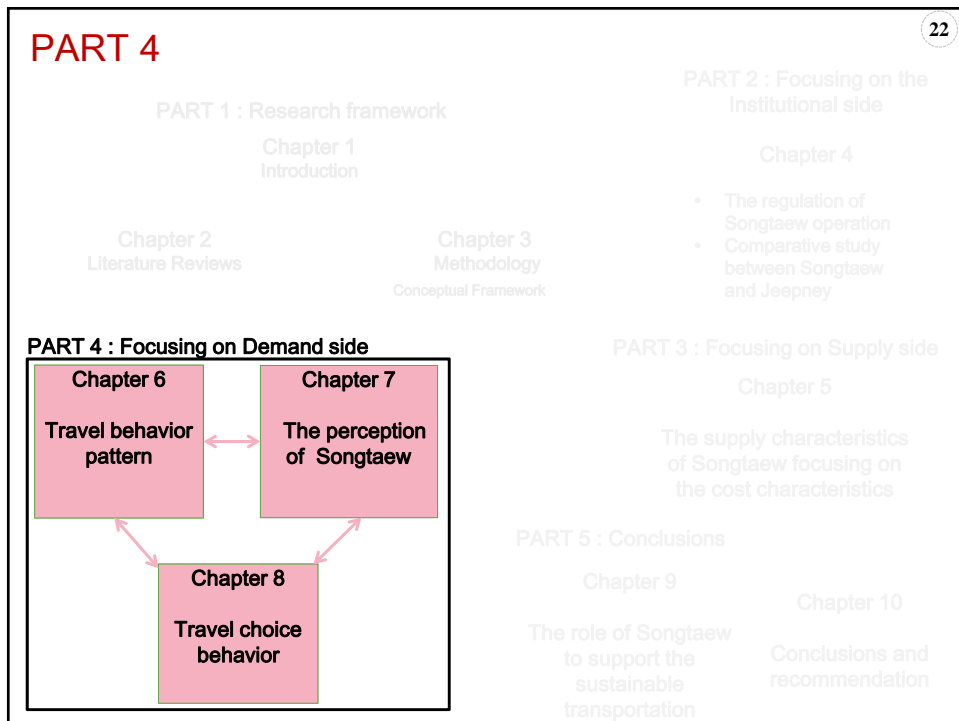
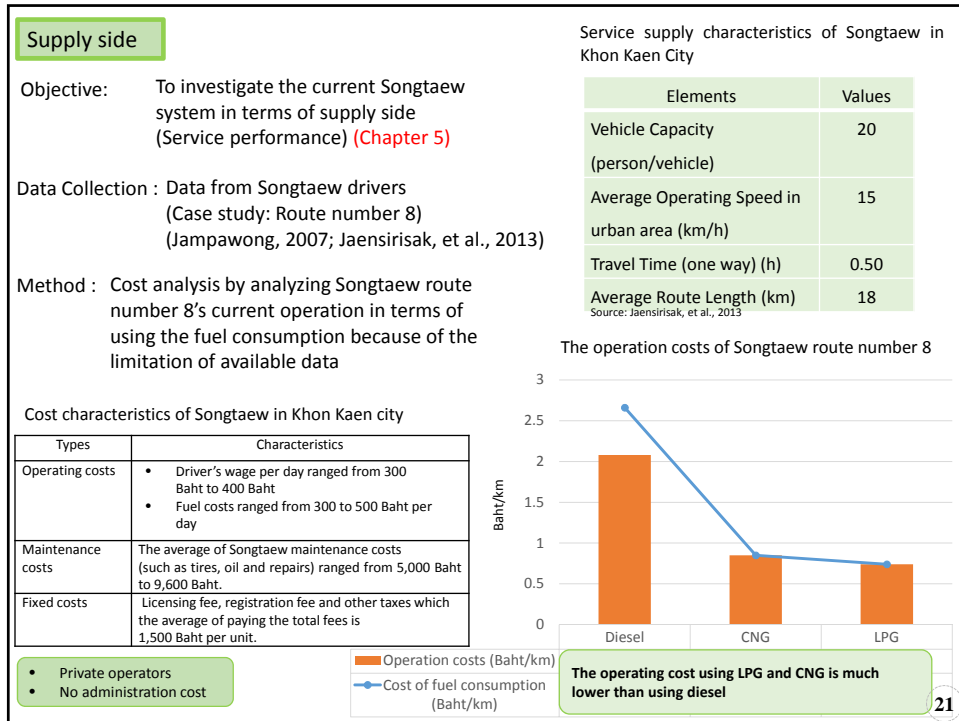
Why compared with Jeepney ?

- The characteristics of the vehicle
- Capacity ~20
- Operate as a fixed route bus
- Play a role as the main public transport mode in an urban area.

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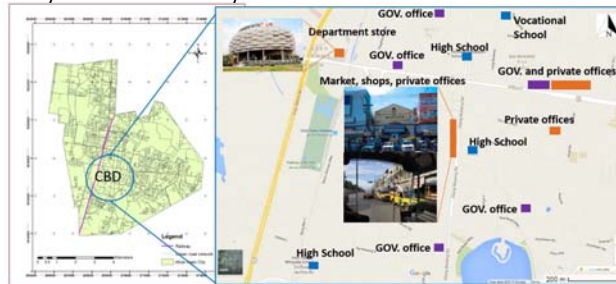


## Demand side

- Objective:
- To examine travel behavior pattern in Khon Kaen City. (Chapter 6)
  - To investigate the influencing factors of traveler attitudes toward ST service satisfaction. (Chapter 7)
  - To examine urban travelers' travel choice consideration. (Chapter 8)

- Research Methods:
- A comprehensive field survey was carried out on interviewing randomly selected the travelers in Khon Kaen City considering the regular trips; school and work trip.
  - Data were analyzed through descriptive statistics and especially regression analysis (identify the important factors influencing the overall trip satisfaction), and multinomial logit model (identify significant factors tending individuals to travel in the city)

Study area: Khon Kaen City



Study area: the CBD of KKC

602 travelers\* were the respondents in this study conducted in August 2015. *Choice Set alternatives for this study were defined as 1 for Car, 2 for Motorcycle (MC), and 3 for Songtaew (ST).*

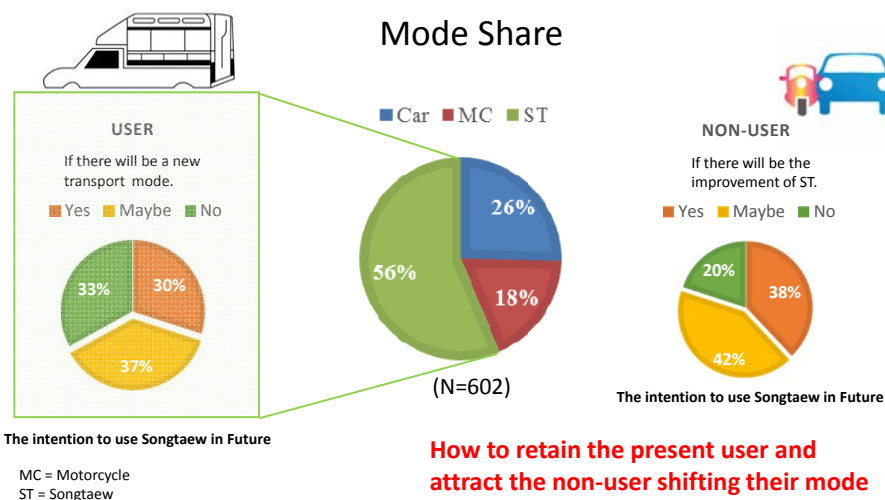
(\*Worker 392; High school student 210)

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## Demand side (Continued)

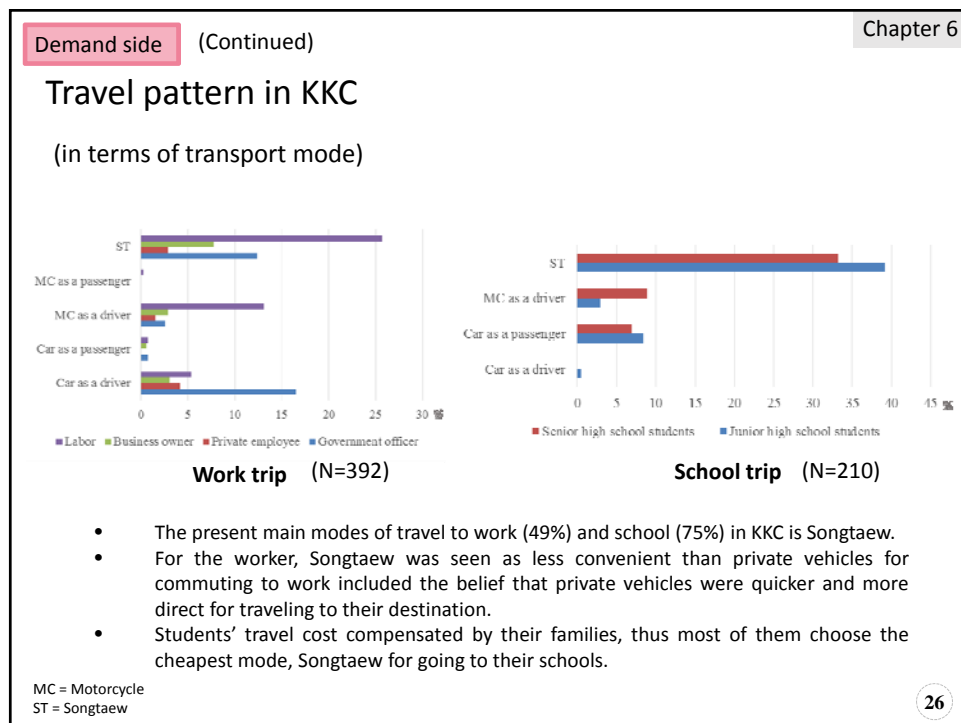
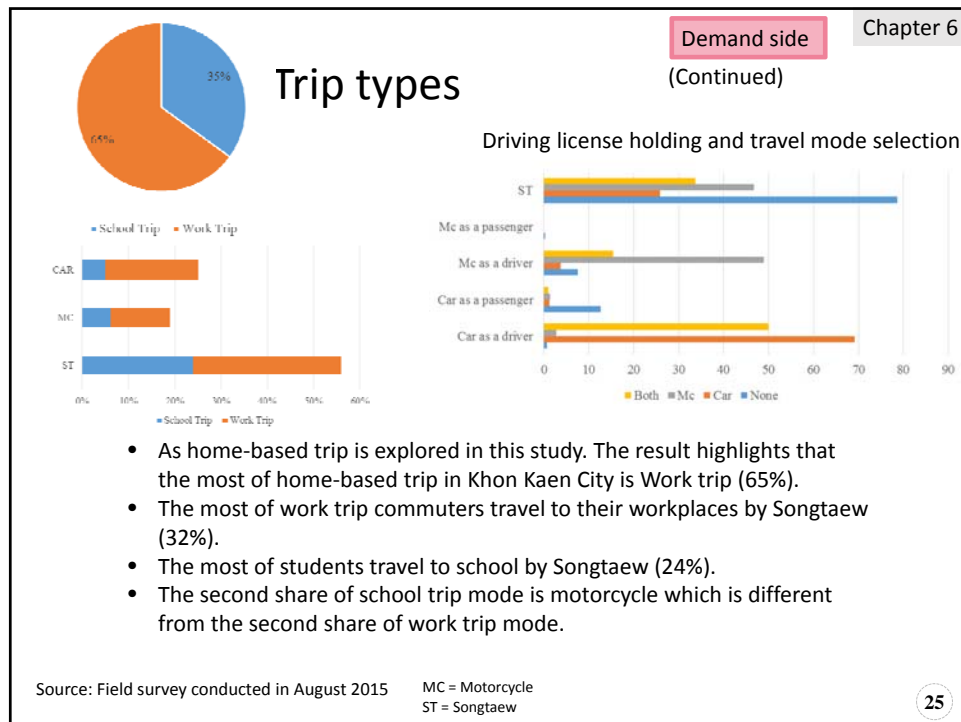
Chapter 6

### Existing travel behavior in Khon Kaen City (KKC)



Source: Field survey conducted in August 2015

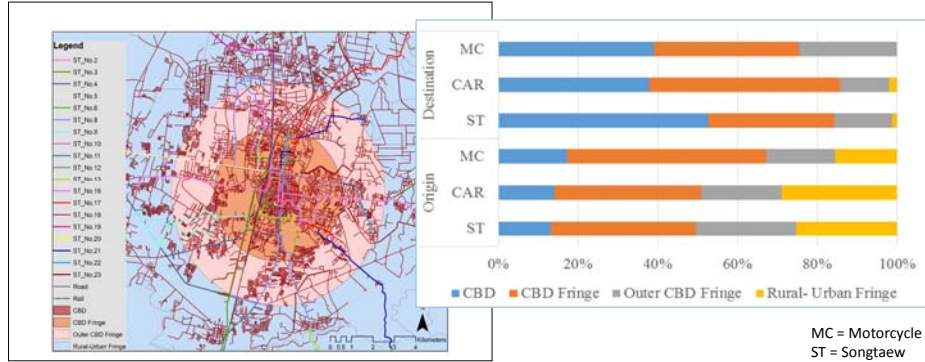
24



Demand side (Continued)

Chapter 7

The relationships between city structure and travel behavior pattern



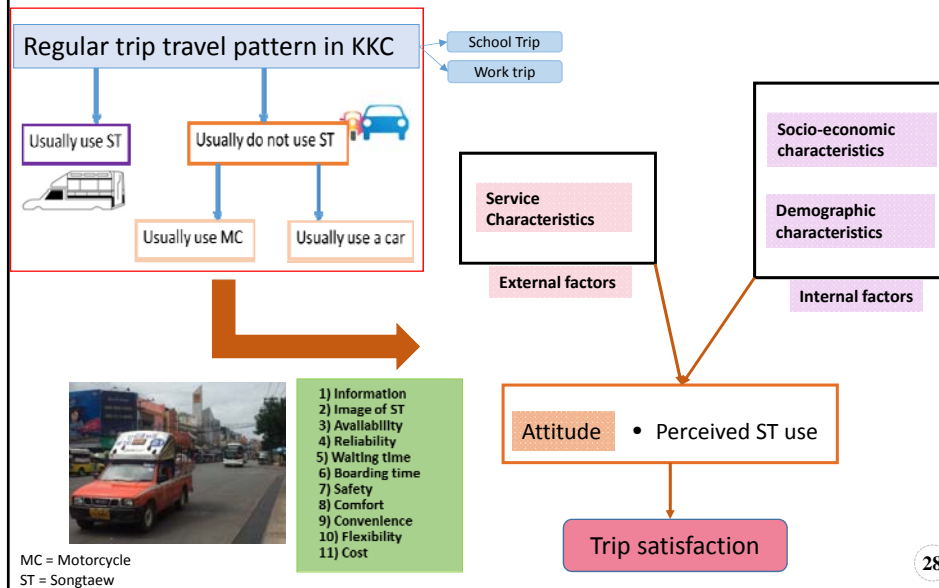
- Lot of trips were generated and attracted most in CBD and CBD fringe. One of reasons to this might because of the distance between different land use facilities between these zones were not so far.
- Most of the origin locations among Songtaew user, car user and motorcycle user is the same which is CBD fringe area.
- Most destination locations for all transport mode users is CBD.

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Demand side (Continued)

Chapter 7

Research Framework of perception study



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## Satisfaction Results: School Trip

Regression results: Songtaew trip satisfaction  
for the users and non-users

Significant Variables	Users	
	B	t
Cost	0.369***	4.426
Convenience	0.169**	2.271

The cost and the convenience have strongly a positive impact on the decision to commute by Songtaew for the users because most of them is the junior high school students who have no driving license especially motorcycle driving license.

Significant Variables	Non-users	
	B	t
Reliability	0.257**	2.034
Comfort	0.229*	1.346

\*\*\* Significant at 99% (p-value < 0.01),

\*\* Significant at 95% (p-value < 0.05),

\* Significant at 90% (p-value < 0.1)

## Satisfaction Results: Work Trip

Regression results: Songtaew trip satisfaction  
for the users and non-users

Significant Variables	Users	
	B	t
Cost	0.194**	2.281
Convenience	0.360***	5.650

The perception on Songtaew service about the cost and the convenience have strongly a positive impact on the decision to commute by Songtaew for the users because most of them is low income people with no driving license.

Significant Variables	Non-users	
	B	t
Cost	0.181**	2.508
Availability	0.153*	1.779

\*\*\* Significant at 99% (p-value < 0.01),

\*\* Significant at 95% (p-value < 0.05),

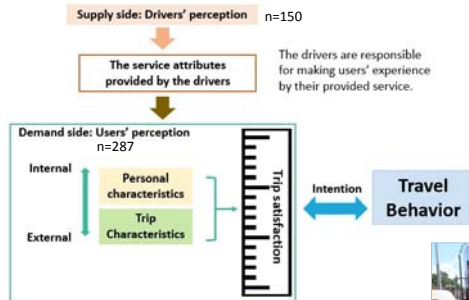
\* Significant at 90% (p-value < 0.1)

## Demand side (Continued)

Chapter 7

## Perception analysis: differences between driver and users

## Research Framework



Field survey conducted in August 2016

To examine the perception of Songtaew service in KKC in identifying factors that influence a use of Songtaew through the drivers and the users' point of view.

The improvement by bridging these differences to meet the users' need for providing the most satisfaction to retain the existing users in the future.

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## Demand side (Continued)

Chapter 7

## The perception differences between driver and users

Significant Variables	Users	
	B	t
Reliability	0.308**	4.694
Safety	0.160**	2.945
Flexibility	0.116*	2.251

Significant Variables	Drivers	
	B	t
Reliability	0.536**	3.455
Flexibility	0.475**	6.481

\*\* Significant at 99% (p-value &lt; 0.01)

\* Significant at 95% (p-value &lt; 0.05)

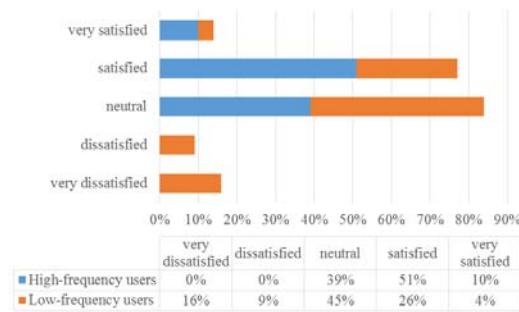
- The majority of Songtaew users (n=287) is female (71.8%) and most of Songtaew drivers (n=150) is male (95.3%).
- The **reliability and flexibility** of Songtaew service had a significant effect on both Songtaew drivers and users' perception.
- There is the difference that for the users' perception not only the reliability and flexibility had a significant effect on their perception but also **the safety of the service**.
- Songtaew users perceive the quality of Songtaew service in terms of reliability, safety and flexibility in positive way which allure them to use Songtaew.

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Demand side (Continued)

Chapter 7

**Safety issue** is very interesting to study more deeply since some users claimed that they thought Songtaew is unsafe then it should be not overlooked.



The different responses between high-frequency users and low-frequency users on safety.

- The high-frequency users never perceive Songtaew service unsafe. On the other hand, low-frequency users perceive Songtaew service unsafe 25% (very dissatisfied and dissatisfied)
- Low-frequency users' bad experiences regarding the safety issue of Songtaew service especially the bad driver behavior affected to their perception on safety in the negative way.
- For the future work it should be studied more in detail on the users' experience regarding Songtaew safety issue in order to find the best solution to improve the service in the future.

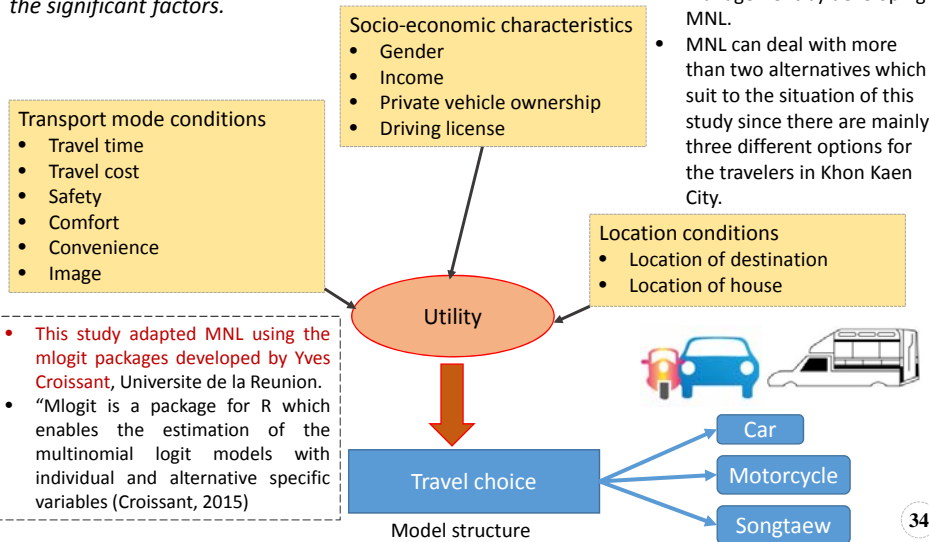
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Demand side (Continued)

Chapter 8

## Travel choice behavior in KKC

*The framework of travel choice study in KKC before looking into the significant factors.*



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## Mode Choice Estimation Results by MNL

Demand side (Continued)

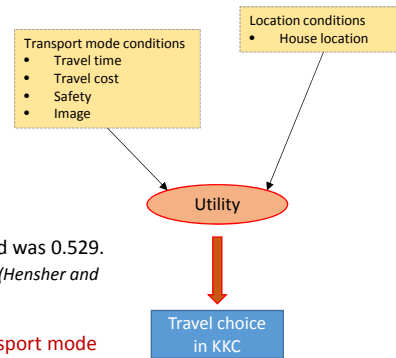
Variables	Std. Error	t-value	p-value
Travel Cost	0.03	-2.40	0.04*
Travel Time	0.05	-2.19	0.02*
Image of transport mode	0.24	2.81	0.00**
Safety of transport mode	0.10	1.98	0.00**
House location	0.18	3.01	0.05*
Log-Likelihood	-275.65		
McFadden R <sup>2</sup>	0.529		
No. of Observation	602		

\*\* Significant at 99% ,

\* Significant at 95%

- **The model performs rather well**; McFadden's R squared was 0.529. (Values of 0.2 to 0.4 for rho-squared represent EXCELLENT fit, (Hensher and Stopher, 1979))
- **Travel cost, travel time, Image, safety condition of transport mode and house location** are playing an important role in traveler's choice behavior for regular trips in Khon Kaen City.
- This study excluded gender, income, the status of private vehicle ownership, driving license possession, comfort, convenience and destination location factors since the t-value were not significant.

## Factors influencing travel choice in KKC



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Demand side (Continued)

Chapter 8

## Conclusions

1) The model results identified significant factors tending individuals to decide travel mode choice for regular trips in Khon Kaen City.

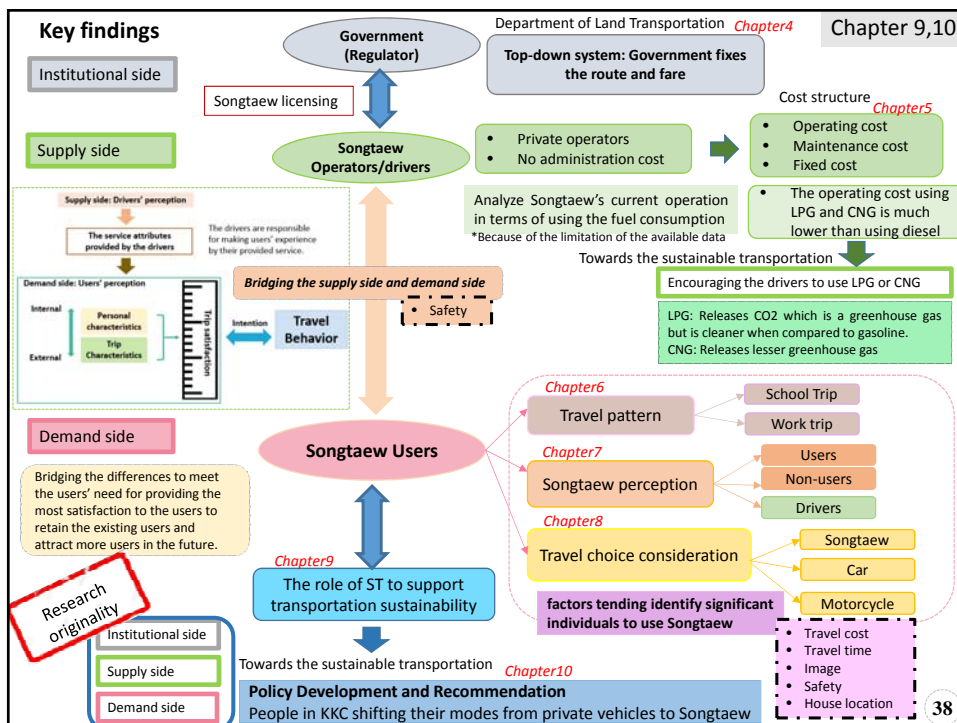
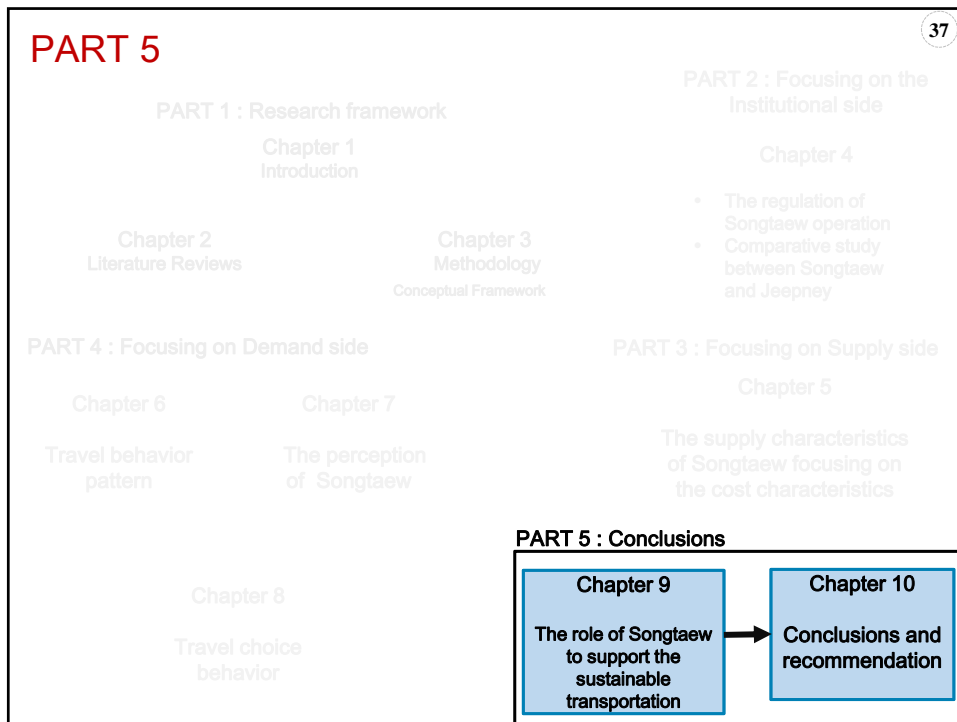
- House location, image, travel cost, travel time, and safety.

2) The study revealed the interesting travel behavior in KKC where is the case study of the travel behavior in developing countries that **Image of the transport mode is the important determinant of mode choice**.

3) Their present traveling mode will shift to Songtaew if the Songtaew improvement is considered these finding factors which affect their choice consideration.

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### The role of Songtaew to support transportation sustainability

- Songtaew is the main mode of public transport in the city that has consistently served the residents of Khon Kaen City.
- In Khon Kaen City in particular, the lack of quality public transport resulted in phenomenal increases to the number of private vehicles on the road.
- With regard to the reduction of private vehicle use and the encouragement of Songtaew use in Khon Kaen City, the results noted that **the quality of public service is very important aspect to attract people to shift their mode.**
- Thus it is essential to **improve the service of Songtaew to support the sustainable transportation in Khon Kaen City by considering the findings of this dissertation.**

### The role of Songtaew to support transportation sustainability (Continued)

Khon Kaen City sustainable transport planning supported by Songtaew.

Aspect	Objective
Environmental	<ul style="list-style-type: none"> <li>• Environment protection               <ul style="list-style-type: none"> <li>• Promote the use of Songtaew (ST)                   <ul style="list-style-type: none"> <li>&gt;&gt; Less dependence on the private vehicle</li> </ul> </li> <li>• Reduce Greenhouse gas                   <ul style="list-style-type: none"> <li>&gt;&gt; Encouraging the ST drivers to use LPG or CNG (Chapter 5)</li> </ul> </li> </ul> </li> </ul>
Social equality	<ul style="list-style-type: none"> <li>• Improve public transport quality to promote its use for all travelers in the city               <ul style="list-style-type: none"> <li>• ST service improvement                   <ul style="list-style-type: none"> <li>&gt;&gt; Considering factors tending identify significant individuals to use ST (Chapter 6, 7, 8)</li> </ul> </li> <li>• Integrating ST as a feeder of LRT or city bus service in the future plan                   <ul style="list-style-type: none"> <li>&gt;&gt; Connecting the people to use LRT or city bus on the main routes service</li> </ul> </li> </ul> </li> </ul>
Economy	<ul style="list-style-type: none"> <li>• Promote efficiency economy               <ul style="list-style-type: none"> <li>• Utilizing the existing public transport mode; Songtaew (ST) by improving ST service                   <ul style="list-style-type: none"> <li>&gt;&gt; Saving city money more than building the new mode</li> </ul> </li> </ul> </li> </ul>



- Travel cost
- Travel time
- Image of ST
- Safety
- House location

## The role of Songtaew to support transportation sustainability (Continued)

Chapter 9

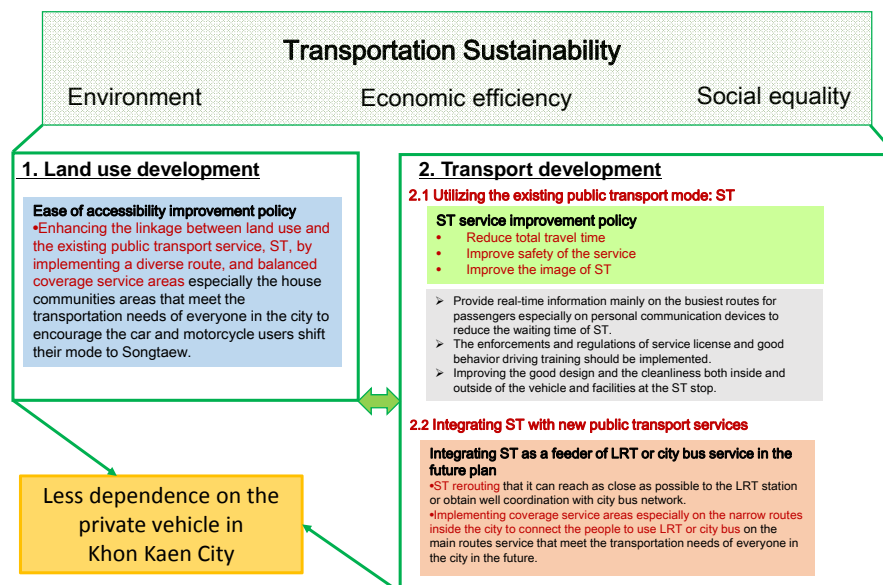
According to the results of this study, the suggested actions for Songtaew service improvement are such as:

- 1) **Implement a diverse route, and balanced coverage service areas** especially the house communities areas that meet the transportation needs of everyone in the city (Bottom-up system).
- 2) **Give priority to Songtaew** to other modes especially cars to reduce the in-vehicle travel time such as Songtaew express lane in rush hour.
- 3) **Improve the Image of Songtaew service** by improving the quality of service to meet the expectation of the majority riders especially on the safety and image issues such as promoting ST driver education.
- 4) **Provide real-time information** mainly on the busiest routes for passengers especially on personal communication devices to reduce the waiting time of Songtaew.

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## Policy development

Chapter 10



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## Implications for the developing countries

- The study regarding paratransit system in Khon Kaen City covered all institutional supply and demand sides which can develop possible policy implications, which serve as **useful information for transportation planners in formulating an appropriate policy and regulation for the sustainable and efficient integrated public transport system in Asian developing countries.**
- Furthermore, **studies on paratransit should also be done in other Asian developing cities.** Due to the differences in city characteristics, the operations of paratransit might not be the same and policy implications might follow.
- Although this study is specific to Khon Kaen City, **its result should be beneficial to other medium sized cities in developing countries.**
- Implications of this study would also be useful for the other researchers **to understand more about the factors which affect the paratransit use in other cities and to develop the policy from bridging the different perceptions with the drivers and users to improve paratransit performance.**
- Moreover, this study would also be useful for **providing a data of developing countries' paratransit issues for the further study on paratransit in other developing countries in the future.**

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## Conclusions and Future research

- Developing countries – highly striving for public transport development, however **paratransit mode should not overlooked.**
- Transport planners in developing countries require **innovative solution** such as providing real-time information to increase the number of public transport users.
- It should be studied more about **the integration of Songtaew service planning and Khon Kaen City land use planning** in the future such as rearrange ST route network, feeder analysis.

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## Research Publications :

6 published reviewed paper (3 Journal Papers)  
3 full papers are under peer review process  
2 abstracts are under the screening

- 1) Wongwiriya, P., Nakamura, F., Tanaka, S., Sanit, P., Ariyoshi, R.: Paratransit in Developing Countries: Songtaew in Thailand, *Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.10, 2015. [Chapter4](#)
- 2) Wongwiriya, P., Nakamura, F., Tanaka, S., Ariyoshi, R.: The Role of Paratransit in Thailand Considering the Cost of Songtaew in Khon Kaen City, *Proceedings of the International Symposium on Urban Planning*, 2015. [Chapter5](#)
- 3) Wongwiriya, P., Nakamura, F., Tanaka, S., Miura, S., Ariyoshi, R.: User Perception of Paratransit in Developing Countries: A Case Study of Songtaew in Khon Kaen City, Thailand, *Proceedings of the International Conference of Asian-Pacific Planning Societies*, 2016. [Chapter7](#)
- 4) Wongwiriya, P., Nakamura, F., Tanaka, S., Ariyoshi, R.: User Satisfaction of Songtaew in Thailand: Case Study of Khon Kaen City, *Transportation Research Procedia*, Elsevier, 2017. [Chapter7](#)
- 5) Wongwiriya, P., Nakamura, F., Tanaka, S., Miura, S., Ariyoshi, R.: User Perception of Paratransit in Thailand: Case study of Journey to School in Khon Kaen City, *Journal of Japan Society of Civil Engineers, Ser. D3 (Infrastructure Planning and Management)*, Vol. 72, No. 5, pp. I\_801-I\_807, 2016. [Chapter7](#)
- 6) Wongwiriya, P., Nakamura, F., Tanaka, S., Miura, S., Ariyoshi, R.: User Perception of Paratransit in Thailand: Case study of Journey to Work in Khon Kaen City, *Asia-Pacific Journal of Science and Technology: Volume: 22, Issue: 02, 2017*. [Chapter7](#)
- 7) Wongwiriya, P., Nakamura, F., Tanaka, S., Miura S.: The Pattern of Travel Behavior in Khon Kaen City, *Proceedings of the Eastern Asia Society for Transportation Studies*, 2017. [Chapter6](#)
- 8) Wongwiriya, P., Nakamura, F., Tanaka, S., Miura S.: Paratransit Service Perception Differences between Drivers and Users: Case Study of Khon Kaen City, Thailand, *Proceedings of Japan Society of Civil Engineers, Ser. D3 (Infrastructure Planning and Management)*. [Chapter7](#)
- 9) Wongwiriya, P., Nakamura, F., Tanaka, S., Ariyoshi, R., Miura S.: Relationship between Urban Form and Paratransit User's Travel Behavior in Thailand, *Proceedings of the International Conference of Asian-Pacific Planning Societies*, 2017. (The abstract is under the screening) [Chapter6](#)
- 10) Wongwiriya, P., Nakamura, F., Tanaka, S., Ariyoshi, R., Miura S.: Evaluation of Paratransit in Asian Medium-Sized Cities: A Case Study of Khon Kaen City, Thailand, *Proceedings of the 22nd International Conference of Hong Kong Society for Transportation Studies*, 2017. (The abstract is under the screening) [Chapter8](#)
- 11) Wongwiriya, P., Nakamura, F., Tanaka, S., Ariyoshi, R., Miura S.: Urban Travel Behavior in Developing Countries: A Case study of Khon Kaen City, Thailand, *Proceedings of Japan Society of Civil Engineers, Ser. D3 (Infrastructure Planning and Management)*. (The abstract is under the screening) [Chapter8,9](#)

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Thank you for your attention.