Policy for Sustainable Informal Transport - A Case Study of Feeder Services in Bangkok, Thailand

Miss Chutaporn Amrapala

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Environment, Development and Sustainability
Inter-Department of Environment,Development and Sustainability
Graduate School
Chulalongkorn University
Academic Year 2019

นโยบายเพื่อความยั่งยืนของระบบขนส่งอย่างไม่เป็นทางการ กรณีศึกษาการให้บริการเชื่อมต่อในกรุงเทพมหานคร ประเทศไทย

น.ส.จุฑาภรณ์ อัมระปาล

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาศิลปศาสตรดุษฎีบัณฑิต
สาขาวิชาสิ่งแวดล้อม การพัฒนา และความยั่งยืน สหสาขาวิชาสิ่งแวดล้อม การพัฒนาและความยั่งยืน
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ปีการศึกษา 2562

Thesis Title	Policy for Sustainable Informal Transport - A Case Study of Feeder Services in Bangkok, Thailand
By	Miss Chutaporn Amrapala
Field of Study	Environment, Development and Sustainability
Thesis Advisor	Professor Kasem Choocharukul, Ph.D.

Accepted by the Graduate School, Chulalongkorn University in Partial Fulfillment of the Requirement for the Doctor of Philosophy

..... Dean of the Graduate School
(Associate Professor THUMNOON NHUJAK, Ph.D.)

DISSERTATION COMMITTEE

..... Chairman
(Associate Professor DAWAN WIWATTANADATE, Ph.D.)
..... Thesis Advisor
(Professor Kasem Choocharukul, Ph.D.)
..... Examiner
(Assistant Professor SINEENAT SERMCHEEP, Ph.D.)
..... Examiner
(Pongsun Bunditsakulchai, Ph.D.)
..... External Examiner
(Bharat Dahiya, Ph.D.)

จุฑาภรณ์ อัมระปาล : นโยบายเพื่อความยั่งยืนของระบบขนส่งอย่างไม่เป็นทางการ กรณีศึกษาการให้บริการเชื่อมต่อในกรุงเทพมหานคร ประเทศไทย. (Policy for Sustainable Informal Transport - A Case Study of Feeder Services in Bangkok, Thailand) อ.ที่ปรึกษาหลัก : ศ. ดร.เกษม ชูจารุกุล

รถสี่ล้อเล็กเป็นบริการรูปแบบหนึ่งของระบบขนส่งอย่างไม่เป็นทางการในกรุงเทพมหานคร อำนวยความสะดวกทั้งในการเดินทางหลักและการเดินทางสำหรับเชื่อมกับระบบขนส่งอื่น เช่น รถเมล์และระบบขนส่งมวลชน งานวิจัยนี้มีวัตถุประสงค์เพื่อสำรวจลักษณะรูปแบบการให้บริการรถสี่ล้อเล็ก ปัญหา ความท้าทายในการให้บริการ ระบุปัจจัยที่มีผลต่อการใช้บริการและไม่ใช้บริการรถสี่ล้อเล็ก ศึกษาพฤติกรรมการเดินทางและทัศนคติเพื่อทราบปัจจัยที่สามารถนำไปปรับปรุงการให้บริการ และเสนอแนะแนวทางสำหรับจัดทำนโยบายการพัฒนาการให้บริการรถสี่ล้อเล็กต่อไป

งานวิจัยดำเนินการเก็บข้อมูลโดยการสัมภาษณ์โดยใช้แบบสอบถามจากผู้ให้บริการรถสี่ล้อเล็ก ผู้ใช้บริการรถสี่ล้อเล็ก และผู้ที่ไม่ใช้บริการ รวมทั้งสัมภาษณ์กึ่งโครงสร้าง (Semi-structured interview) จากหน่วยงานที่กำกับดูแลสี่ล้อเล็ก การศึกษาครอบคลุมการให้บริการรถสี่ล้อเล็ก จำนวน 5 เส้นทาง ได้แก่ บางบอน-ตลาดพลู ศิริราช-ตลาดพลู จรัญสนิทวงศ์-คลองสาน วิภาวดี-รัชดาภิเษก และ สุขุมวิท ซอย 39 พบว่าประเด็นที่น่าสนใจจากผู้ให้บริการรถสี่ล้อเล็ก ประกอบด้วย ระยะเวลาในการทำงาน สภาพแวดล้อมในการทำงาน การขึ้นทะเบียนรถและผู้ให้บริการ ประสบการณ์ตำรวจเรียกจับ และการทับซ้อนเส้นทางกับรูปแบบการให้บริการขนส่งสาธารณะอื่นๆ ผู้ใช้บริการเลือกใช้บริการรถสี่ล้อเล็กเนื่องด้วยเหตุผลอันดับแรก คือ ความสะดวกสบาย การเข้าถึงได้ง่าย และราคาถูก ตามลำดับ สำหรับผู้ที่ไม่ใช้บริการรถสี่ล้อเล็กมีเหตุผลอันดับแรก คือ การต่อรถ การเปลี่ยนรูปแบบการเดินทาง และผู้โดยสารหนาแน่น ตามลำดับ

จากการวิเคราะห์ความสำคัญ-ผลการดำเนินงาน (Importance-Performance Analysis) จากทัศนคติของผู้ใช้บริการรถสี่ล้อเล็ก พบว่าปัจจัยความน่าเชื่อถือของการบริการ การเชื่อมต่อ การได้ที่นั่ง และค่าโดยสาร เป็นปัจจัยที่ผู้ใช้บริการให้ความสำคัญและมีความพึงพอใจ ส่วนปัจจัยด้านความปลอดภัยต่อชีวิตและทรัพย์สินเป็นปัจจัยที่ผู้ใช้บริการเห็นว่ามีความสำคัญแต่พึงพอใจระดับต่ำ การวิเคราะห์องค์ประกอบเชิงสำรวจ (Exploratory Factor Analysis) และโมเดลการถดถอยโลจิสติก (Logistic regression model) พบว่าปัจจัยที่มีผลอย่างมีนัยสำคัญต่อความพึงพอใจในการให้บริการโดยรวม ประกอบด้วย ความน่าเชื่อถือของการให้บริการ สภาพแวดล้อมภายในรถ ความสะดวกสบาย และผลกระทบที่มีต่อสิ่งแวดล้อม ต่อจากนั้น ได้วิเคราะห์จัดกลุ่ม (Cluster Analysis) ผู้ใช้บริการ ได้จำนวน 4 กลุ่ม โดยใช้ตัวแปรที่ได้จากการวิเคราะห์องค์ประกอบ พบว่าผู้ใช้บริการแต่ละกลุ่มมีข้อมูลการเดินทางและความคาดหวังที่แตกต่างกัน นอกจากนี้ ได้ทำการศึกษาเปรียบเทียบพฤติกรรมการเดินทางและทัศนคติต่อการให้บริการระหว่างผู้ใช้บริการรถสี่ล้อเล็กชาวไทยและชาวญี่ปุ่น พบว่าผู้ใช้บริการทั้งสองกลุ่มมีความแตกต่างในปัจจัยต่าง ๆ

จากการวิเคราะห์ด้านความยั่งยืนของการให้บริการ เมื่อเปรียบเทียบกับรูปแบบทางเลือกอื่นพบว่าการเดินทางโดยรถสี่ล้อเล็กใช้เวลาในการเดินทางน้อยกว่า ค่าโดยสารอยู่ในระดับที่สามารถจ่ายได้มากกว่า การสิ้นเปลืองน้ำมันเชื้อเพลิงและการปล่อยมลพิษน้อยกว่า อย่างไรก็ตาม ควรพิจารณาปัจจัยการให้บริการรถสี่ล้อเล็กเพื่อเป็นประโยชน์ต่อผู้ใช้บริการทุกกลุ่มอย่างเท่าเทียมกัน ในด้านความสามารถในการจ่ายค่าโดยสาร ความน่าเชื่อถือของการให้บริการ และความสะดวกสบาย ทั้งนี้ ได้เสนอแนะแนวทางสำหรับหน่วยงานที่เกี่ยวข้องวางแผนนโยบายในอนาคตเพื่อจัดระเบียบและรวมประสานรถสี่ล้อเล็กเข้ากับระบบโครงข่ายการเดินทางในเมือง เพื่อให้สังคมมีทางเลือกการเดินทางที่มีประสิทธิภาพอย่างยั่งยืนต่อไป

สาขาวิชา	สิ่งแวดล้อม การพัฒนา และความยั่งยืน	ลายมือชื่อนิสิต .....
ปีการศึกษา	2562	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....

5987760920 : MAJOR ENVIRONMENT, DEVELOPMENT AND SUSTAINABILITY
KEYWORD: Silor, Travel behavior, Attitude, Exploratory factor analysis, Cluster analysis

Chutaporn Amrapala : Policy for Sustainable Informal Transport - A Case Study of Feeder Services in Bangkok, Thailand. Advisor: Prof. Kasem Choocharukul, Ph.D.

One informal public transport service in Bangkok is Silor (SR), given the meaning in Thai as four-wheeler. SR facilitates urban mobility both in terms of major travel mode and feeder bus and mass transit lines in the city. This research aims to investigate service characteristics and challenges of SR service, identify factors affecting the use and non-use of SR, explore travel behavior and attitudes to determine service delivery gaps in order to propose policy recommendations for the better functioning of SR service. Interviews are conducted through questionnaire survey to collect data from supply side, including drivers and regulators, and demand sides, which involves both users and non-users. Five SR routes are selected for study namely, Bangbon-Taladplu, Siriraj-Taladplu, Charansanitwong-Klongsan, Vibhavadi-Rachadapisek, and Sukhumvit Soi 39. Findings from supply side reveal challenges in terms of work hour, working condition, registration of vehicles and drivers, experiences when called by polices as well as competitions among transport modes. For demand side, reasons for using SR are convenience, accessibility, and cheap fare whereas difficulties for non-users seem to associate with connection, transfer and crowdedness. Importance-performance analysis are performed with users' attitudes on service quality and found that reliability, connection and transfer, seat availability and fare are the aspects of high importance and highly satisfied while safety and security seem to be of high importance but low satisfaction. In addition, exploratory factor analysis and logistic regression model illustrate the four service factors that significantly affect the overall satisfaction of users, including reliability, in-vehicle environment, comfort and convenience, and environmental impact. Further, the study applies user segmentation through cluster analysis based on the obtained factors which results in four user subgroups having diverse profiles and expectations. Moreover, travel behavior and perceptions of Thai and Japanese SR users are comparatively analyzed and considerable variations among them are found. For sustainability aspects, travelling by SR is more desirable than alternative modes in terms of less commute time, more affordable, less energy consumption and emissions; however, there still need more attention on provision of affordable, reliable, comfort and convenient services to users of all socioeconomic groups. Most feasible options for future policy suggest transport authorities and relevant sectors in formalizing and integrating SR into urban transportation network in order to provide society with efficient alternative mode for a sustainable means of travelling.

Field of Study:	Environment, Development and Sustainability	Student's Signature .....
Academic Year:	2019	Advisor's Signature .....

ACKNOWLEDGEMENTS

I gratefully acknowledge the financial support from the 100th Anniversary Chulalongkorn University Fund for Doctoral Scholarship and the 90th Anniversary of Chulalongkorn University Fund (Ratchadaphiseksomphot Endowment Fund) both from Graduate School, Chulalongkorn University.

I would like to express my appreciation to my advisor, Professor Dr. Kasem Choocharukul, for his guidance and encouragement through each stage to completion of this dissertation. I would like to extend my sincere gratitude to committee members, Associate Professor Dr. Dawan Wiwattanadate, Associate Professor Viroat Srisurapanon, Assistant Professor Dr. Sineenat Sermcheep, Dr. Bharat Dahiya, and Dr. Pongsun Bunditsakulchai, for their valuable comments and discussion.

Also, I would like to give special thanks to survey team at Transportation Division of Civil Engineering Department for assistance in data collection. I would like to thank lecturers, staff members and friends in Environment Development and Sustainability Program, Graduate School for their knowledge and support. I wish to send my appreciation to all research participants. Without their valuable opinions on questionnaires and interviews, the research would not have been accomplished.

Finally, I am deeply thankful to my family for their never ending support and love.

Chutaporn Amrapala

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURE

Page

LIST OF ABBREVIATIONS

ALT	Alternative
BKK	Bangkok
BMA	Bangkok Metropolitan Administration
BT	Bangbon-Taladplu
CA	Cluster Analysis
CK	Charansanitwong Soi 13-Klongsan
CO_2	Carbon dioxide
DLT	Department of Land Transport
EFA	Exploratory Factor Analysis
FA	Factor analysis
IPA	Importance-Performance Analysis
MC	Motorcycle
MRT	Mass Rapid Transit
NESDB	Office of the National Economic and Social Development
NSO	National Statistical Office
OTP	Office of Transport and Traffic Policy and Planning
PC	Private Car
PCD	Pollution Control Department
PT	Public Transport
SDG	Sustainable Development Goals
SR	Silor
ST	Siriraj-Taladplu
SV	Sukhumvit Soi 39
SWU	Srinakharinwirot University
VR	Vibhavadi Rangsit Soi 16-Ratchadapisek Soi 19

CHAPTER I
INTRODUCTION

1.1 Background

The intensification of development brings about the growth in urban population. People move into cities to find jobs, earn their livings, set up business, get access to high-efficiency social welfare, improve their well-beings and so on. Transportation has become the central part of people's daily lives by providing access to employment, education, markets, recreation and healthcare as well as other key services. Whilst urban transportation system is the driving force for economic development and improving quality of life for their citizens, their frequently mentioned problems of traffic congestion create significant impact on local and nation GDP. Moreover, the growing transport demand, particularly in the form of car-dependency, from rapid urbanization in many cities, poses negative impacts to the environment. For instance, the depletion of resources and air pollution from transportation lead to issues of resource insufficiency and public health, signifying a state of unsustainability.

Now is the time of challenges to sustainable development which is defined as "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (UN, 1987). It is important that three interrelated pillars of sustainable development, social, economic, and environment, should be managed to be in balance. That is, the nation's economic growth and social well-beings should occur in harmony with the resource use efficiency. Therefore, in urban transport sectors, firstly, activities should be cost-effective and respond to changing demands for economic performance. Second, for social performance, transport activities should provide people with better physical access to employment, education, and health services, ensuring social equity. Lastly, transport strategies should focus on reducing resource use and fuel consumption so as to mitigate air pollution, ensuring sustainability in the pillar of environmental performance.

With regard to the Sustainable Development Goals (SDGs) in the 2030 Development Agenda, transport activities are important for achieving many of the goals, especially SDG 11 in the concept of sustainable cities and communities by making cities inclusive, safe, resilient and sustainable. As urban population continues to rise, in order to achieve this goal, urban transportation planning should focus on service provision with safety and ease of access for all groups of people. Additionally, one strategy in the National Transportation Development Plan (OTP, 2016) aim to improve transportation services as to provide public with efficient and high quality alternative modes. The high quality of public transport service not only facilitates

mobility in urban areas, but also ensures quality of people's life in cities by providing accessibility to places and activities. Government policies on Thailand 4.0 goals in environmental dimension also enhance the economy with climate change adaptation strategies towards low-carbon society.

Bangkok, the capital city, occupies 1,569 square kilometer in the central part of Thailand with the population of 5.7 million or 9 percent of the country's population and the population density of 3,600 per square kilometer (BMA, 2018; DOPA, 2018). The expansion of Bangkok proceeded mainly along the main arteries, creating soi or small street network branching off the main roads. Some are short sois while some are several kilometers long. Some sois are through sois that connect between major arteries and are attractive in terms of accessibility. Therefore, residential, commercial and service areas are developed and, consequently, access modes emerge in these communities such as Silor, songtaew, tuktuk, and motorcycle in respond to the mobility demand to access the main transport modes in major arteries.

The total trips in the Greater Bangkok area are 32.65 million trips per day with the increase 15% and 20% by 2027 and 2037, respectively (OTP, 2018b). The distributions of trips by different travel modes in 2017 are illustrated in Figure 1 (OTP, 2018b). Private car displays the highest share (43.2%), followed by motorcycle (25.5%) and public transport (20.2%), respectively. Within the public transport category, bus shows the highest proportion (15.96%), followed by mass transit (2.53%), and public van (1.28%), respectively.

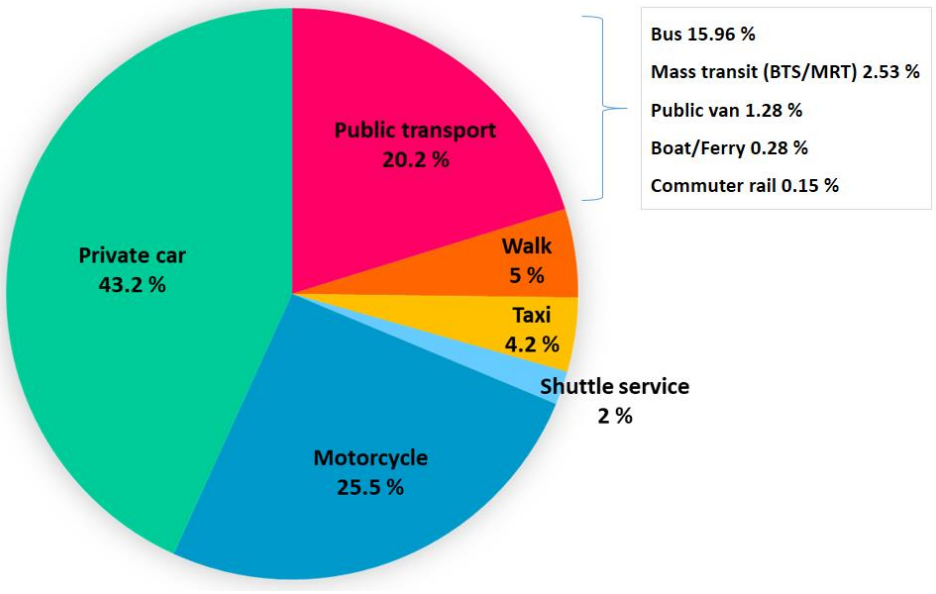


Figure 1 Trips of travel modes in the Greater Bangkok area (OTP, 2018b)

At present, various forms of public transport are seen in Bangkok, including both formal and informal services. Among them is Silor (SR), given the meaning in Thai as “four-wheeler”. The vehicle is a small converted Daihatsu or Suzuki pickup with 6-11 passenger seats, as shown in Figure 2. The seating structures were locally adapted and the seating capacity varies among each route. Based on the Department of Land Transport (DLT) database in 2018, 1,964 of SR are registered and 143 service routes have been operating in Bangkok (DLT, 2018). Such transport mode is classified as informal because not all vehicles and drivers are properly registered in accordance with public transport service regulation. The operational issues concerning vehicle capacity, fare structure, and station area are poorly regulated. Many service routes are not conformed to those recorded by DLT, illegal route operations are observed, such as route extension and unauthorized routes (Choocharukul & Sriroongvikrai, 2011); nonetheless, SR service gains popularity from people in the neighborhood both as the main travel mode and as feeders to access a more formal mode, such as bus and mass transit lines in Bangkok. Although SR is known to cause pollution, congestion and accidents in the area, its provision of mobility for users are of high interest among transport researchers.

Figure 2 Silor in Thailand

In previous studies, a report by DLT and TRI (2009) investigated SR demand, supply, and analysis in safety, route alignment, laws and regulation aspects. Another research was on attitudes of SR passengers (Choocharukul & Sriroongvikrai, 2011). Former studies on SR in Bangkok are very limited; however; various literatures on informal transport in Asian developing countries particularly the similar functioning modes as SR are available, for instance, Angkot, Motodup and Remork, Songtaew and Jeepney (Eung & Choocharukul, 2018; Joewono *et al.*, 2015; Okamura *et al.*, 2013; Tangphaisankun *et al.*, 2009). Therefore, it is important to examine the role of SR in Bangkok transportation system as well as to investigate the supply and demand

characteristics in order to assess their social, economic, and environmental performance. Thus, the result would shade some lights into the informal operation system and assist transport policymakers and regulators in improving the performance towards sustainable urban transportation system.

1.2 Research Questions

The main research question is "What policy options can be applied for a better functioning of Silor services in Bangkok, and how?"

In responding to the main research question, six sub-questions are needed to be answered, as follows:

Sub-question 1: What are the main factors that influence the use and non-use of Silor services?

Sub-question 2: What are the service quality factors affecting the overall satisfaction of Silor service?

Sub-question 3: What are the attitudes of users and non-users on service quality aspects of public transport?

Sub-question 4: What are different attitudes perceived by different user segments and nationality?

Sub-question 5: What are the sustainability of current Silor services in social, economic and environmental dimensions?

Sub-question 6: What are the policy bottlenecks for integrating informal transport provider into urban transport?

1.3 Research Objectives

The aims of this research are:

1. To investigate service characteristics of Silor services
2. To identify factors affecting the use and non-use of Silor services
3. To explore users' travel behavior and determine service delivery gaps of Silor services
4. To propose policy recommendations to enhance Silor performance improvement towards sustainable urban transport system in Bangkok

1.4 Scope of Study

This study focuses on both supply and demand sides of Silor services in Bangkok. Firstly, the study investigates driver personal and occupation information as well as challenges and opinions from regulators. Second, the study examines travel behavior of Silor users and non-users along five Silor service routes which cover ten districts of Bangkok: Bang Bon, Chom Thong, Bangkoknoi, Bangkokyai, Thonburi, Klong San, Chatuchak, Din Daeng, Klong Toei and Wattana. Factors which encourage and discourage Silor usage as well as user satisfaction on service quality will also be examined to determine areas where improvements are possible. Moreover, user and non-user perceptions towards various service attributes of

different travel modes will be explored. The study then identifies sustainability of SR services in social, economic and environmental dimensions.

Both primary and secondary data are collected in this study. Primary data are collected from questionnaire survey and interviews while secondary data are collected from DLT database. Data from questionnaire survey will be analyzed using multivariate analysis techniques and Importance-Performance Analysis (IPA). For sustainable development of Silor service, social, economic, and environmental dimensions of the system are also analyzed.

1.5 Organization of dissertation

Following this, Chapter 2 will present literatures on public transport with the development of informal transport and policy agendas in Thailand context as well as service quality reviews and sustainability indicators. Chapter 3 will describe research methodology with research design including data collection and data analysis. Chapter 4, 5, and 6 will present the results of fieldwork conducted associated to supply, demand of SR services, and sustainability of the services, respectively. Chapter 7 will discuss the findings with references to previous studies in the field. Finally, Chapter 8 will conclude the research by considering the policy context of the finding and noting the contributions of this work to transport studies as a whole. The organization of chapters in this dissertation is illustrated in Figure 3.

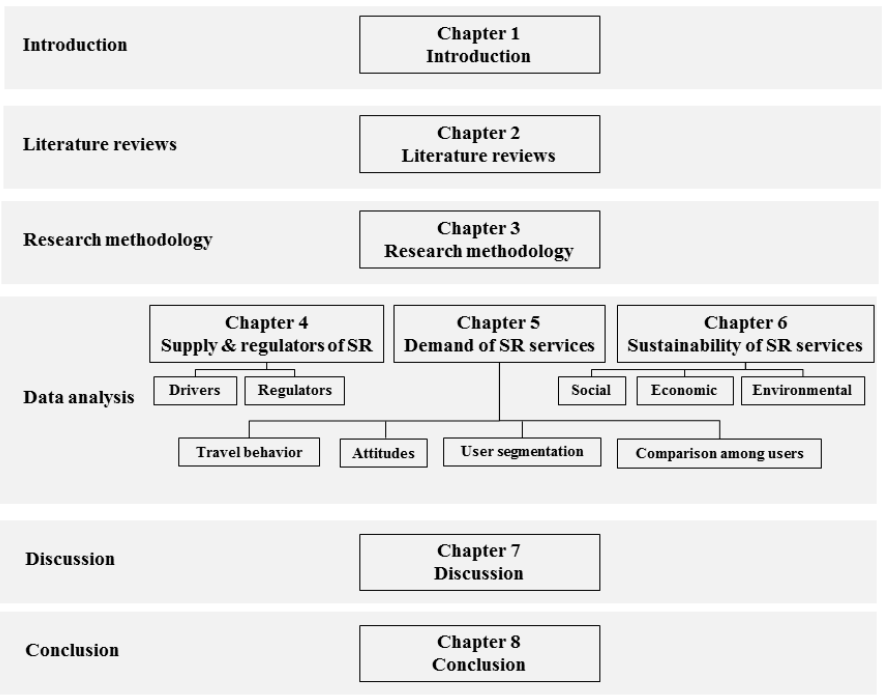


Figure 3 Organization of dissertation

CHAPTER II
LITERATURE REVIEWS

This chapter first reviews literatures on roles of public transport and introduces the terminology of paratransit, followed by the concept of complementarity between formal and paratransit modes, and paratransit modes in Asian developing countries. Following this, Thailand's transport policy framework and regulations are discussed and the literatures on operational characteristics of Silor in Bangkok are summarized. Then, factors affecting commuter choices in terms of service quality framework and measurements are described. Finally, the concept of sustainable transportation system and indicators related to sustainable transport are presented.

2.1 Public Transportation

Public transport, also called public transit, mass transit, is a collective form of transport other than private car or taxi which comprises all transport system in which passengers do not travel in their own vehicles (Cihat, 2012). When looking at its effects, public transport is the very basic instrument of mobility for big percentage of population in almost all countries, which become driving forces for economic and social life. Cihat (2012) further explained the nature of public transport services in three aspects. Firstly, public transport environment is dynamic and interactive with the combination of alternative modes, various types of passengers, different travel purposes, travel frequency, and travel time. Second, the demand is time-dependent, for instance, higher density in the morning and evening from worker and students while the remaining time demand comes from shoppers, leisure trips and others. Lastly, different types of commuters have different expectations from services depending on their travel time and travel purpose.

2.1.1 Demand-Responsive Transit

Demand-responsive transit (DRT) refers to a form of public transportation characterized by flexible routing and scheduling of smaller to medium-size vehicles, operating in shared-ride mode between pick-up and drop-off locations according to passengers' needs (Kittelson and Assoc *et al.*, 2013). The defining attribute of DRT is their "flexibility". While variants of DRT share common attribute which is not fixed-route and not fixed schedule, including individual trip request, the service differ in their degree of flexibility, rider groups, operational and performance attributes.

DRT operate by using various trip patterns, depending on numbers of origins and destinations, as illustrated in Figure 4. Their routing may be "many-to-many", providing trips from many different origins to many destinations within the defined service area.

Besides, routing are found in pattern of "many-to-few" by providing trips from many origins to a smaller number of frequent destination (Kittelson and Assoc *et al.*, 2013).

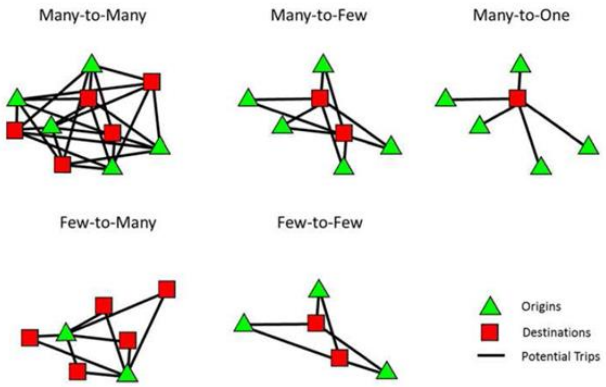


Figure 4 Examples of DRT trip patterns (Kittelson and Assoc *et al.*, 2013)

Sometimes, DRT connector, also referred to as "feeder" service, provides demand-response service within a defined zone that has one or more scheduled transfer points to fixed-route transit. Transfer points may be bus stop of peak-period or rail station. Generally, large percentage of DRT connecting trips begin or end at the designated transfer points (Kittelson and Assoc *et al.*, 2013). The service is designed primarily, not only, to offer connections to the fixed-route network, but also provide local transportation within the defined zone. The performance of DRT varies depending on its productivity, size of service areas, locations of trip generators, and nature of trip demands (Kittelson and Assoc *et al.*, 2013).

2.1.2 Terminology of Paratransit

The term "Paratransit" means "alongside transit" (Lave & Mathias, 2000). It was first used in the mid-1960s to describe transportation services that would approximate the convenience and ubiquity of vehicle, which ensure the efficiency and economy of public transport (Orski, 1975). Although this term has been used worldwide, its concept differs among the developed and developing countries (Phun & Yai, 2016). Table 1 below highlights various definitions given in literatures.

Table 1 Terminology of "Paratransit"

Terminology	References
North America	
- Flexible door-to-door transport services (complementary mode) specifically provided to elderly or physically handicap people - demand-responsive services	Lave and Mathias (2000)
Europe	
- Particular public transport services, including dial-a-ride, ride-sharing, jitneys, and shuttles	Orski (1975);Mulley and Nelson (2009)
Asian and developing countries	
- A group of mainly urban transport services somewhere between private passengers transport and conventional public transport in terms of costs and quality of services	Etherington and Simon (1996)
- Public transport modes that are privately operated with small-scale services, also termed as "low-cost transport", "intermediate technologies", and "third-world transport"	Cervero (2000)
- Public mode that is available for passengers and operated in mixed traffic with fixed route, but without fixed schedule in urban streets	Joewono and Kubota (2007)
- "Informal public transport mode" that has been developed to fill the service void left by the private vehicles and conventional mass transit systems and when there is no official authorization for the transport services	Cervero and Golub (2007)
- Transport mode that is not quite full public transit, utilizing smaller vehicles - Either legal or illegal operation as defined by local rules and regulations	Weningtyas (2013)
- User-demand-oriented transport mode mainly used in the cities of developing world	Neumann (2014)
- Transport mode combining advantages of bus mode and taxi mode of low cost demand-responsive mode with non-fixed routes and non-fixed schedules	Wicaksono *et al.* (2015)

The term "paratransit" conventionally describes a flexible mode of passenger public transportation that does not necessarily follow fixed routes or schedules, typically in the form of small-to-medium sized buses. In the Global South, paratransit services are usually provided for the general population, often by unregulated or illegal operators within informal sector. For this reason, paratransit in the Global South is sometimes also referred to in the literature as "informal" transport (Ferro & Behrens, 2015).

2.1.2.1 Informal Transport

Informal transport services–paratransit-type services provided without official sanction–can often be difficult to rationalize from a public policy perspective. While these systems provide benefits including on-demand mobility for the transit-dependent, jobs for low-skilled workers and service coverage in areas devoid of formal transit supply, they further have costs, such as increased traffic congestion, air and noise pollution, and traffic accidents (Cervero & Golub, 2007). Informal transport succeed from its ability to adapt to the urban environment, the regulatory framework and the economic conditions by lowering or raising the fare, its ability to change routes and

service points, and its ability to vary its service times. However, the goal of maximizing daily revenue lead operators to concentrate supply on the most profitable links, provide poor quality of service in terms of comfort and safety, and picking up and dropping off passengers outside the designated areas leading to congestion of radial routes during peak periods (Diaz Olvera *et al.*, 2012).

As cities have grown and developed, so has the paratransit network. Based largely on discrete and direct service route implementation, they connect different areas of cities, displaying demand responsiveness and flexibility. Most paratransit business sectors in the Global South are highly fragmented, and thus are difficult to regulate by transport or local planning authorities. Absent or weak regulations are then reflected in paratransit operations; they contribute to congestion and pollution problems, and they display dangerous behaviors on the road (Ferro & Behrens, 2015).

2.1.2.2 Complementarity between Formal and Paratransit Services

Ferro and Behrens (2015) applied case study method in two cities: Bogota (Columbia) and Santiago (Chile) to investigate effects of the changing relationships between paratransit operations and recently implemented BRT systems in an urban setting. By focusing on implementing feeder-trunk-distributor BRT model, it is argued that the inclusion of existing paratransit operations can lead to operational complementarity. Operation complementarity, as an element of integration, is vital when attempting to implement a sustainable public transport restructuring project.

Successful complementarity between formal and paratransit modes is possible as has been observed in Southeast Asian cities by Cervero (1991). The author argues that due to poor state of roads (i.e., narrow roads, faulty pavement and/or lack of road hierarchy), paratransit services in the form of small vehicles have flourished (Cervero, 1991). They operate specialized local area services that complement the existing high-capacity modes with relative success and acceptability from inhabitants.

Existing direct service networks express a multitude of individual links that are operated independently. Established paratransit operators have built a dense network that fits the wishes of inhabitants to travel without transfer between various points in the city (Ferro & Behrens, 2015). This type of network is similar to what Dupuy (1992) describes as a network built out of “desire line”, as opposed to a “simplified network” (as shown in Figure 5).

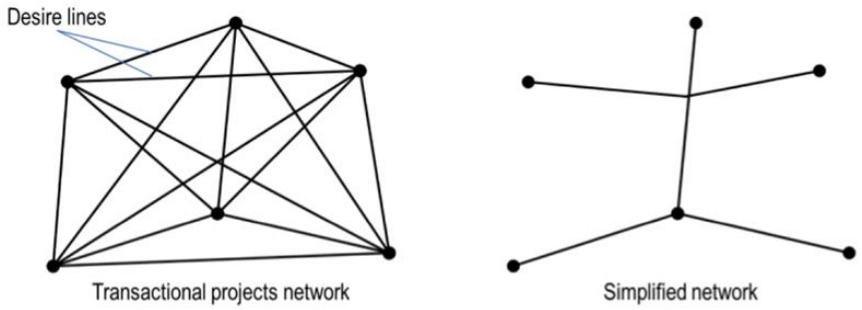


Figure 5 Conceptual model of direct service network and feeder-trunk-distributor network (Dupuy, 1992)

2.1.2.3 Paratransit in Asian Developing Countries

The study on state of the art of paratransit literatures in Asian developing countries (Phun & Yai, 2016) proposed the common definition for paratransit as "indigenous public transport modes that are locally adapted, modified, and advanced for certain transport service in a particular city or region." The term "LAMAT: Locally Adapted, Modified, and Advanced Transport" is given when referring to the paratransit modes in Asian developing countries.

LAMAT mode may be first adapted in its original form (e.g., a vehicle imported without physical alternation) for domestic operation and service (e.g., Motorcycle Taxi, Taxi, or Minibus). The mode may be then modified (e.g., a vehicle with physical conversion) in correspondence to the transport needs required by local people (e.g., Remork, Jeepney, or Songtaew). Later, the mode may be advanced with affordable technology in order to improve its service quality (e.g., comfort, safety, and environment) as well as to sustain its passenger demand (e.g., Comet, E-Jeepney, or E-Tuktuk). Some typical examples of LAMAT modes in Asian developing countries are shown in Figure 6. Most of LAMAT are privately operated as either a fleet of vehicles or an individual vehicle that are often in low performance status because they are in the modified forms of used vehicles to fit with intended services (Phun & Yai, 2016).

a) Sidecar in Myanmar b) Remork in Cambodia c) Multicap Jeepney & Tricycle in the Philippines
Figure 6 Example of typical LAMAT modes in Asian developing countries (Phun & Yai, 2016)

Although characteristics of LAMAT modes vary across cities in Asian developing countries, they principally share common attributes such as low energy consumption, low travel fare, higher labor intensity, and small area of service coverage (Shimazaki & Rahman, 1995). The significant features of paratransit system in developing countries are their flexibility and door to door service. Paratransit can be operated as a feeder service, e.g. a door to conventional public transport service, and sometimes may provide alternate services where public transport services are not available (Shimazaki & Rahman, 1995). Moreover, most governments will have to introduce more urban rail system to promote urban mobility, as well as to relieve traffic congestion problems in the cities. Paratransit modes will continue its dominant role in urban transport system either as independent mode of transport or feeder transport regarding mass transit system.

Paratransit system can be classified into three groups based on their seating capacity (ESCAP/UNCHS, 1987). They are individual type (seating capacity less than 4), shared type (seating capacity 5-10), and collective type (seating capacity 11-20), as shown in Table 2. The classification system of paratransit modes in Thailand is shown in Table 3.

Table 2 Example of classification of paratransit modes in developing countries

	Non-motorized	Motorized		
Country	Individual	Individual	Shared	Collective
Bangladesh	R (2)	Auto R (2-3) Misuk (2)	Auto tempo (6-10)	-
India	Tonga (2) CR (2) Hand R (1)	T scooter R (2) MCR (4)	Trekker (9)	Tempo (14)
Indonesia	Dokar (2) Delman (2) Becak (2)	Bajaj (2-3) Ojek (2) Helicak (2)	Bemo(3 wheel) (7) Bemo(4 wheel) (10) Opelet (7-9)	Opelet(Large) (17)
Malaysia	Trishaw (2)	-	-	Bus mini (16)
Nepal	CR (2)	Meter tempo (2)	Tempo (6-7)	-
Pakistan	Tonga (2-4)	Auto R (2)	-	-
Philippine	Calesa (2) Pedal T (2)	T (2)	-	Jeepney (14-18)
Sri Lanka	-	Auto/3 Wheeler (2-3)	-	-
Thailand	R (2)	Samlor (2-3) T (2) MC (1)	Silor (6-8)	Song-Thaew (14)
Vietnam	Xiclos (2)	-	Xelam (6-10)	-

Notes: The values in the parenthesis indicate the capacity (person) of each paratransit modes
R = Rickshaw, M = Motor,T = Tricycle,C = Cycle
- = Not exist

Source: ESCAP/UNCHS (1987)

Table 3 Classification system of paratransit modes in Thailand

Non-motorized	Motorized		
Individual	Individual	Shared	Collective
Rickshaw (2)	Samlor (2-3) Tricycle (2) Motorcycle (1)	Silor (6-8)	Song-taew (14)

Note: The number in the parenthesis indicate the capacity (person) of each paratransit mode
Source: ESCAP/UNCHS (1987)

Bangkok's paratransit sector has helped compensate for the lack of good road hierarchy and substandard bus services, providing supplemental capacity while also diversifying the service-price options available to the travelling (Cervero & Golub, 2007). Respecting a study on informal transport from the case study of vans, motorcycles, and pedicabs in Bangkok, all services are territorially defined, most sois have their own co-op or "win" (Cervero & Golub, 2007). For Van and MC cooperatives, head determines the supply of operator, sets work schedules, manages queues, and sets general policy. All wins have rules that govern who get customer, where driver can deliver someone, how far from stations they can travel, pricing policies, maximum speed, and driving behavior. What is unspoken is that the responsibility of Head is to register specify routes and numbers of operators with the police. This is to pay off law enforcement so as to keep them at bay. The system of payoff-for-protection sustains itself accordingly.

2.2 Policies and Regulations in Thailand

2.2.1 Transport Policy

The National Transport Development Strategic 20-year Plan (2017-2036) (OTP, 2016) illustrated Thailand Strategic Transportation Framework, consisting of green transport, inclusive transport, and transport efficiency (Figure 7). Firstly, green transport refers to the use of clean energy or alternative energy to encourage transportation system of environmental-friendliness and safety. Secondly, making transportation system inclusive needs considerations on universal design and transportation for all. This is to ensure the accessibility and equity in all transport modes. Lastly, to increase transport efficiency through network connectivity at both nation and regional levels can be done by a number of management strategies; for instance, promoting feeder transport and door-to-door services, and application of intelligent transport system in traffic control and safety management system. Finally, all the three components require new innovation as a tool for the development of national transportation system.

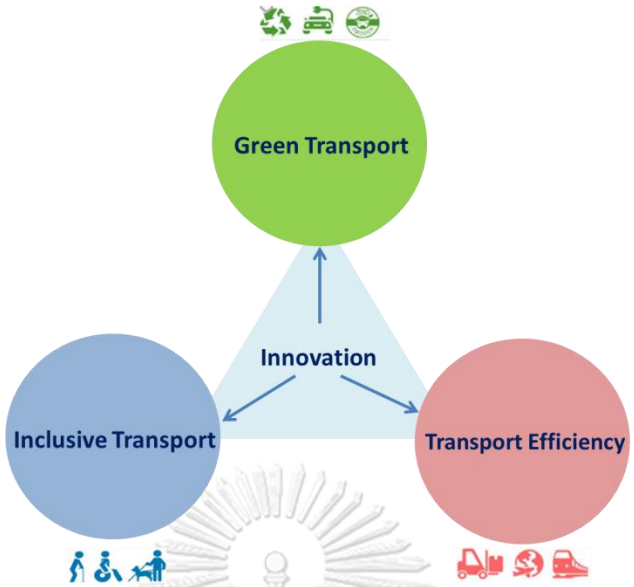


Figure 7 Thailand Strategic Transportation Framework (OTP, 2016)

In addition to Thailand Strategic Transportation Framework, five transportation development strategies are included in the 20-year Transportation Development Strategies (OTP, 2016), as illustrated in Figure 8.

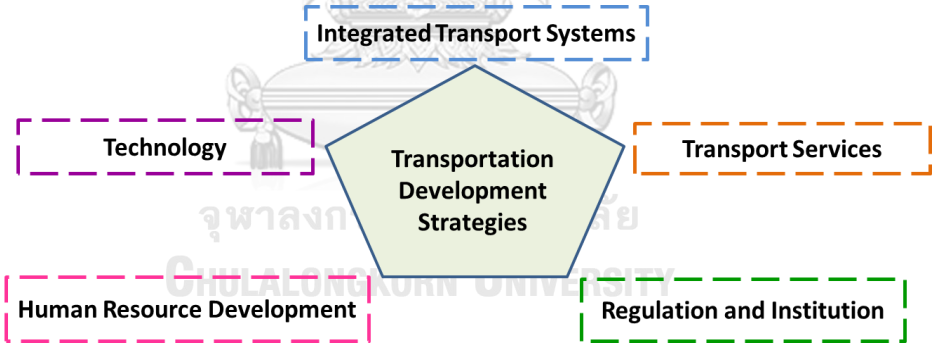


Figure 8 20-Year Transportation Development Strategies (2017-2036) (OTP, 2016)

Firstly, integrated transport system relates to both infrastructures and services in terms of planning and development. This aims to build transport network connectivity within cities and countries, as well as at regional level. Secondly, in transport services, the strategy is to improve the efficiency of services and supply chain management. All transport services should be on-time, reliable, comfortable, clean, and safe. In addition, services should be inclusive to all groups of people with affordable travel cost. Third, in regulation and institution dimensions, the revise of laws and regulation is needed as to be compliance with the global infrastructure and service standards. Moreover, strategies should focus on restructuring transport institutions and their responsibilities in order to determine their roles on transport policy, operation, and

control. Fourth, because the role of transport-related human resources is to establish transport plan and policy as well as implement transportation projects, setting up training institutes is one important strategy to development human resources in transport sectors. Lastly, transport technology and advance innovations should be applied to increase the efficiency of transportation infrastructure and services by promoting research and development programs as well as transport intelligent system.

2.2.2 Law and Regulation

In Thailand, bus and minibus modes are regulated by Land Transport Act (1979) while taxi, motorcycle taxi and tuk-tuk are regulated by Motor Vehicle Act (1979). According to the current framework, the Land Transport Act cannot adequately address changes in transport system of the country. It neither promotes the development of integrated transport networks nor deals with urban growth in regional cities (Wicaksono *et al.*, 2015).

Details and regulations of Land Transport Act and Motor Vehicle Act are presented as followed.

1) Land Transport Act, B.E. 2522 (1979)

Category 2: Land Transport Control Board

Section 16: Central Land Transport Control Board (CLTCB) was set up, having Permanent Secretary of Ministry of Transport as a chairman and Director General of DLT as a secretary general. CLTCB was authorized for regulating the number of operators, service routes, fares, etc. But in Section 5, it was stated that vehicles in Land Transport Act do not include vehicles less than 7 passengers, vehicles with 8-12 passengers, tuk-tuk, motorcycle, and tractor.

2) Motor Vehicle Act, B.E. 2522 (1979)

Category 3: Driving License

Section 43: Types of driving licenses different types of driving licenses and their validity periods are shown in Table 4. For temporary license, the validity period is two years while validity period of regular license for private and public vehicles are five and three years, respectively. For vehicles apart from all mentioned, the validity period is five years. The detail is noted that the driving license for Silor is not specifically stated.

Table 4 Types of driving license and validity period

Types of Driving License	*Validity Period (Year)*
Temporary license for private vehicle, tuk-tuk, and motorcycle	2
Private vehicle Private tuk-tuk Private motorcycle Road roller Tractor	5
Public vehicle Public tuk-tuk Motorcycle taxi	3
Other vehicles apart from all above	5

Source: Motor Vehicle Act, B.E. 2522 (1979)

(1) Ministerial Regulation on Characteristic, Engine Size or Capacity of Different Types of Registering Vehicles, B.E. 2548 (2005)

The Ministerial Regulation on Characteristic, Engine Size or Capacity of Different Types of Registering Vehicles (2005) under the Motor Vehicle Act states that both Tuk-tuk and Silor are included in the group of public vehicles. Details of physical characteristics and engine size/capacity for various types of vehicles to be registered are indicated in the regulation, as illustrated in Table 5.

Table 5 Physical characteristics and engine size/capacity of tuk-tuk and Silor

Vehicle Type	General Characteristic	Vehicle Width (m)	Vehicle Length m)	Vehicle Height (m)	Height of Internal Space (m)	Maximum Engine Capacity (cc)
Tuk-tuk or Samlor	Two seat-partitions or two seat-rows	1.5	4	2	1.2	660
Silor	Two-partitioned with at least two doors	1.5	4	2	1.2	800

Source: Ministerial Regulation on Characteristic, Engine Size or Capacity of Different Types of Registering Vehicles, B.E. 2548 (2005) under the Motor Vehicle Act, B.E. 2522 (1979)

(2) Ministerial Regulation on Size, Characteristic, and Color of Vehicle License Plate and Declaration of License Plate Annual Vehicle Tax (2011) under the Motor Vehicle Act (1979)

Concerning the Ministerial Regulation on Size, Characteristic, and Color of Vehicle License Plate and Declaration of License Plate Annual Vehicle Tax (2011) under the Motor Vehicle Act (1979), the license plate colors are indicated for different types of vehicles. Table 6 highlights some examples of license plate color regulation.

Table 6 License plate colors for different types of vehicle

License Plate	Color		Vehicle Types
	Background	Text	
Private			
	White	Black	Sedan (not more than 7 passenger seats)
	White	Blue	Microbus, passenger van (over 7 passenger seats)
	White	Green	Pickup
Public/Hired			
	Yellow	Black	Taxi (not more than 7 passenger seats)
	Yellow	Blue	Silor
	Yellow	Green	Tuk-tuk, Sam-lor

Source: Ministerial Regulation on Size, Characteristic, and Color of Vehicle License Plate and Declaration of License Plate Annual Vehicle Tax (2011) under the Motor Vehicle Act, B.E. 2522 (1979)

2.3 SR service in Bangkok

Silor is one of public transport modes found in Bangkok. The vehicles are small-sized converted pickup trucks with seat capacity for 7-14 passengers (DLT & TRI, 2009). There exist different types of Silor with rear entrance, side entrance, and both rear and side entrance, as illustrated in Figure 9.

a) Rear entrance b) Side entrance c) Rear and side entrances

Figure 9 Different location of Silor entrance (DLT & TRI, 2009)

The study on current situation of Silor transport mode in Bangkok (DLT & TRI, 2009) collected data on existing service routes through secondary data from 8 Silor

cooperatives in addition with field survey. Results found that 172 routes are authorized by DLT whereas 42 routes were found unauthorized, as detailed in Figure 10. Among 172 authorized routes, 25 were found operating correctly in the route as registered, while 15 have extended their routes, 24 have changed routes to operate in area-based for-hired pattern, and 108 routes were not found. For 42 unauthorized routes, all of them are found operating as route-based pattern by collecting fare individually, except one route which are found operating in area-based for-hired pattern.

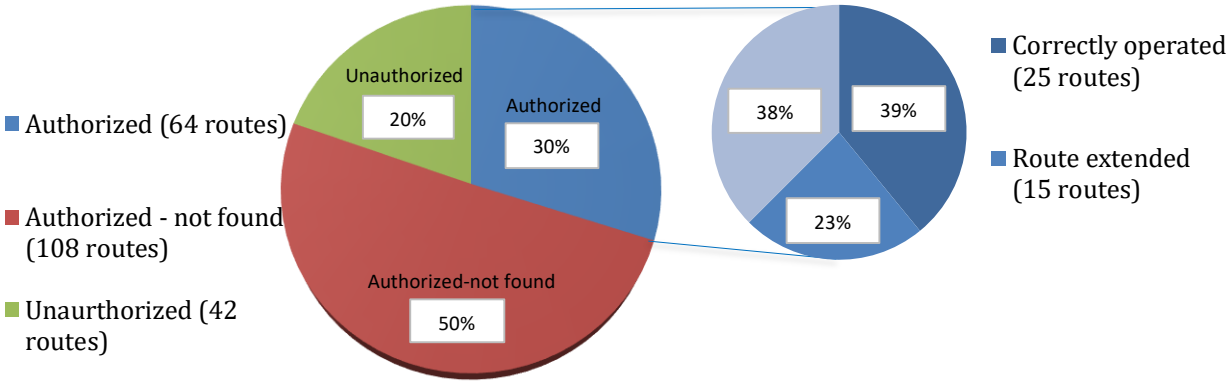
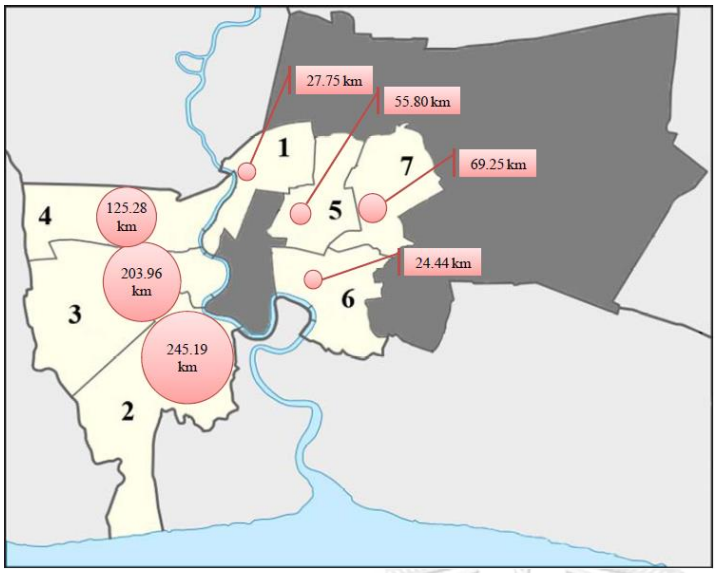


Figure 10 Survey of Silor routes (DLT & TRI, 2009)

The service coverage of Silor service mostly scattered on the west side of Bangkok, the main residential area of the city, as shown in Figure 11. This area, including Zone 2, 3, and 4, accounts for more than three quarters of the total service length (Choocharukul & Sriroongvikrai, 2011). On the other hand, Bangkok CBD area on the east side does not have much service running. Thus, it can be implied that the current public transportation system may not be sufficient for the current needs of passengers, especially in commuting trips from home to work and vice versa.

When comparing service length in seven target zones of Bangkok, Zone 2 possessed the longest service length of Silor. This zone comprises of four Bangkok's main residential districts, i.e. Chom Thong, Bang Khun Tien, Thung Kru, and Rat Burana. From land use planning perspective, these districts have limited number of major arterials, which generally form into the so-called superblock, and thus making it difficult for residents to access to main arterials. Therefore, Silor served as a feeder mode, carry passengers from homes to main arterial in order to access to a more formal mode of transport (Choocharukul & Sriroongvikrai, 2011).

Zone	District



1	Pra Nakorn, Bangsue, Chatuchak
2	Chom Thong, Bang Khun Tien, Thung Kru, Rat Burana
3	Nong Khaem, Bang Khae, Bang Bon, Phasi Charoen, Bangkok Yai, Thon Buri, Khlong San
4	Thawi Wattana, Taling Chan, Bang Phlat, Bangkok Noi
5	Din Daeng, Huai Khwang, Lat Phrao
6	Watthana, Khlong Toei, Suan Luang, Phra Khanong, Bang Na
7	Bang Kapi, Bueng Kum, Wang Thonglang

Figure 11 Coverage areas of Silor in Bangkok (Choocharukul & Sriroongvikrai, 2011)

The field survey of 130 Silor service routes found that most routes are short in distance, with an average of 5.78 kilometers, as illustrated in Figure 11. The majority of service routes range between 2-8 kilometers. It was noted that many run along small streets and provide access from home to major arterials, while some routes are extended from small streets and compete directly with other public transport modes on major arterials (Choocharukul & Sriroongvikrai, 2011).

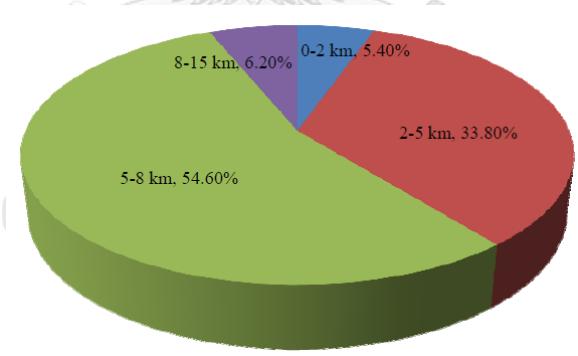


Figure 12 Distribution of service length of Silor (Choocharukul & Sriroongvikrai, 2011)

Although, operators of Silor service system consists of DLT, cooperatives and drivers, the existing situation revealed that there are heads of Win who set up the work schedules and manage queues for the service (DLT & TRI, 2009). The roles of Silor operators are presented in Figure 13.

As one of the major informal transport modes in the city, Silor was introduced mainly because of the fact that existing transport mode could not accommodate the increasing demand for travel. In terms of supply side, it found that Silor are competing directly with motorcycle taxi, bus, and songtaew. Several illegal

operations such as illegal route extension and unauthorized routes are observed. Risky driving behavior also aggravates the problems and many times leads to traffic accident and congestion (Choocharukul & Sriroongvikrai, 2011).

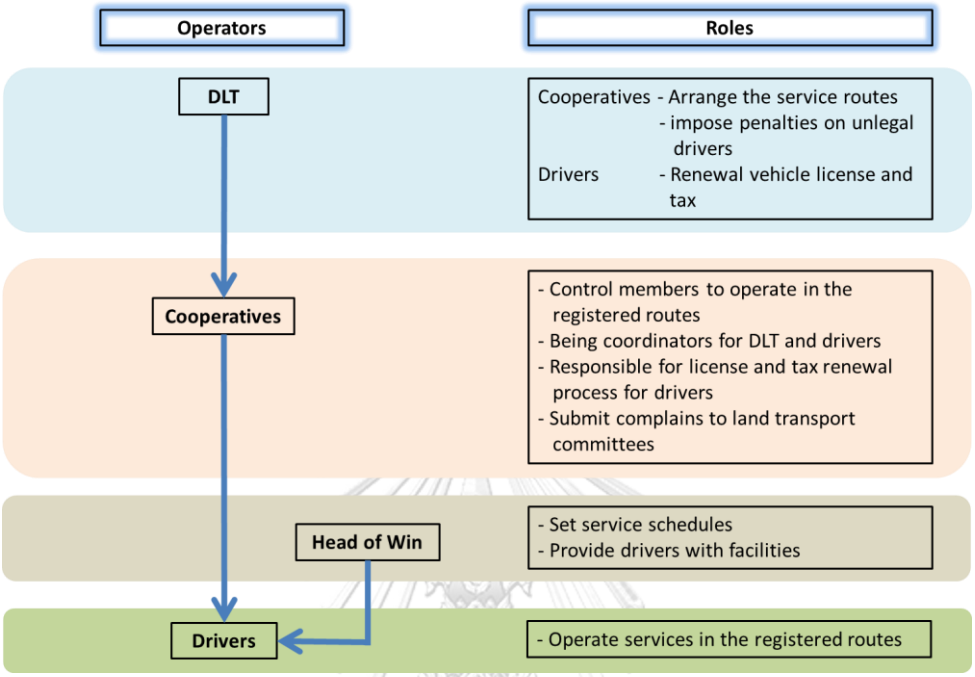


Figure 13 Roles of Silor operators (DLT & TRI, 2009)

Based on the survey of passengers whose feasible modes include Silor, when compare to motorcycle taxi, Silor is more advantageous in terms of fare and safety whereas motorcycle is more advantageous for its speed and stop locations. For Silor and bus, the preference towards Silor is because of its fare and higher speed; however, bus is preferred for some passengers due to the higher perception of safety. For Silor and songtaew, their operations are quite similar. The preference towards Silor is its faster speed while those who choose songtaew seems to have cheaper trip cost (Choocharukul & Sriroongvikrai, 2011).

Evidence indicated that there is available market for informal transport service in Bangkok. Nonetheless, these modes should operate as complementarity with the formal public transport modes, such as bus and urban rail system. Importantly, a proper and stringent regulatory framework is necessary (Choocharukul & Sriroongvikrai, 2011).

2.4 Factors Affecting Commuter Choices

Previous transport studies investigated relationship among characteristics of travelers, trips and transport facilities, with individual's transport mode choice behavior. They found that, in general, there are three core characteristics influencing mode choice of individual (Chiu Chuen *et al.*, 2014):

(1) Traveler characteristics (e.g., background, household structure and income, vehicle ownership, and availability of vehicle choice);
(2) Trip characteristics (e.g., trip purpose, time of the trip, and trip distance);
(3) Transport facility characteristics (e.g., travel duration, costs, quality of service, and parking space availability).

Many studies examine the correlation between the individual choices of transport mode and these characteristics. However, these characteristics could be interrelated with each other and directly or indirectly affect the demand for public transport services in practice (Balcombe *et al.*, 2004). A study conducted by Wener *et al.* (2003) on public transport system in New York suggests that the major reason for private vehicle users not shifting to public transport is the quality of service and the stress associated with frequent transfers among different modes. However, satisfaction is an important aspect which may attract more commuters to shift from private vehicle to public transport. Hence, it is very important to understand the commuter perceptions as well as their behavior towards public transport characteristics (Jain *et al.*, 2014).

The study on identifying public preferences using multi-criteria decision making for assessing the shift of urban commuters from private to public transport in Delhi (Jain *et al.*, 2014) considered the factors affecting commuter choices for public transport based on existing literatures before categorizing sub-factors into four parent criteria i.e. reliability, comfort, safety, and cost, based on experts opinion as presented in Table 7. The results suggest safety as the most important criteria (36%) for encouraging urban commuters to shift from private vehicles to public transport and then reliability (27%), cost (21%), and comfort (16%). Based on four criteria, commuters are willing to pay more for better public transport service since the travel cost was not considered to be one of the important criteria (Jain *et al.*, 2014).

Table 7 Factors affecting choice of commuters for public transport modes

Factors affecting public transport system	Sub-factors	References
Comfort	Cleanliness Air-conditioning Seating Availability Low floor Non crowded Accessibility Less travel time	Sherestha (2013), Redman *et al.* (2013), Tirachini and Hensher (2011), Fellesson and Friman (2008), Gatersleben and Uzzell (2007), Stradling *et al.* (2007), Bhat and Sardesai (2006), Stradling *et al.* (2005), Hensher *et al.* (2003), and Friman and Garling (2001)
Safety	Lesser accident Personal safety Staff behavior and attitude	Fellesson and Friman (2008), Nolan (2007), Eboli and Mazzulla (2007), Stradling *et al.* (2005), Hensher *et al.* (2003), and Friman *et al.* (2001)
Reliability	Good frequency Adherence to schedule	Redman *et al.* (2013), Tirachini and Hensher (2011), Abou-Zeid *et al.* (2012), Fellesson and Friman (2008), Eboli and Mazzulla (2007), Gatersleben and Uzzell (2007), Stradling *et al.* (2007), Bhat and Sardesai (2006), Stradling *et al.* (2005), Hensher *et al.* (2003), Rietveld *et al.* (2001), and Friman *et al.* (2001)
Cost	Cost of travel	Sherestha (2013), Eboli and Mazzulla (2007), Stradling *et al.* (2005), and Friman and Garling (2001)

Source: Jain *et al.* (2014)

It is impossible to deny against the fact that public transport, in terms of the way they are delivered and the service quality, influence users' attitudes, behaviors and demand for service. Cihat (2012) reviewed current literatures with respect to factors that affect the demand for urban public transport. Not only, it is important to know which factors, but also in what way and in which importance they affect the demand. In the findings, factors affecting demand for public transport include cost of travel (sum of fares charged and valuation of time), fares, travel time (i.e., walking time, waiting time, in-vehicle time, interchange time), service quality, reliability, comfort, travel distance, availability and costs of alternative travel modes, time of travel, purpose of travel, level of transport supply, level of public transit dependency, economic factors (e.g., household income, employment rate, level of wealth), population density, demographic and social factor (e.g., age, gender, car ownership, household income, household size, social-orientation, presence of child), land use and city built environment, government policies and approach to public transport, and other factors (e.g., behavioral factors, marketing).

Moreover, the investigation result separated factors into two main groups (Cihat, 2012). First, structural factors, for example, cost of travel, service quality, travel

time, distance, alternative modes, purpose of travel, and level of supply. Another group is external factors, for instance, public transport dependency, demographic, economic and social factors, built environment, government policies, and behavioral factors.

2.4.1 Role of Quality of Service

Quality of service is still an important consideration for both riders and service providers. For riders, a poor quality of service can limit options available for finding and holding a job, taking classes, or taking care of basic living needs. For transit providers, providing good quality of service help retain riders (Kittelson and Assoc *et al.*, 2013).

Transit service affects many aspects of a community, both directly and indirectly (Kittelson and Assoc *et al.*, 2013). There are a number of different stakeholders related with transit performance, including:

(1) Transit passengers who have to decide which travel mode to use (when they have a choice of modes), or whose travel options may be constrained by the quality of service (when they do not have a choice);
(2) Transit agency staff and decision makers who have to make choices about how to allocate a finite amount of resources to best meet the agency's goals and objective, and additionally, have to report on transit performance to other agencies providing funding support;
(3) Motorists who interact with transit vehicles on the road and who may benefit when other motorists decide to use transit;
(4) Community members and decision makers who may directly support transit service through taxes and who may indirectly benefit from the role that transit play in the community (e.g., congestion relief, air quality, mobility, source of employment).

Each of these major stakeholders has its own sets of interests and priorities–a point of view (Kittelson and Assoc *et al.*, 2013). Figure 14 illustrated some of the primary interest area of major stakeholder groups, along with potential performance measures for those interests.

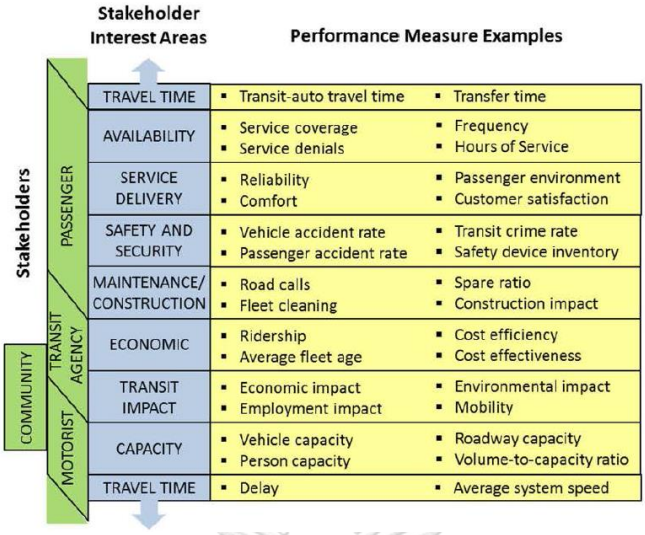


Figure 14 Transit performance: Stakeholders, Interest areas, and Performance measure examples (Kittelson and Assoc *et al.*, 2013)

2.4.2 Quality of Service Framework

Urban transport involves millions of individual travel decisions. Some are made infrequently, whereas other decisions are made for every trip. The quality of service determining whether or not transit service is an option for a particular trip include transit availability and transit comfort and convenience (Kittelson and Assoc *et al.*, 2013). Each comprise of sub-factors, in Figure 15, which influence the decision of using transit.

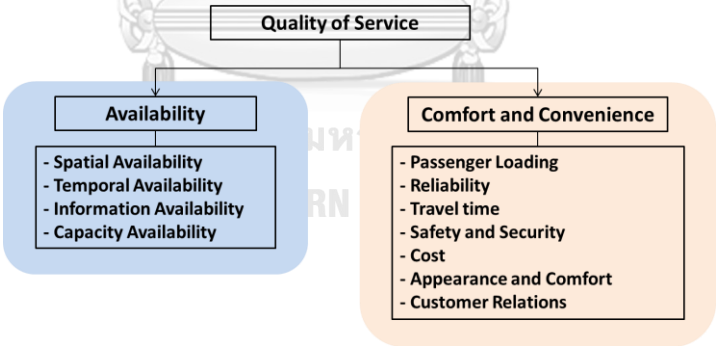


Figure 15 Quality of service for transit trip decision-making process (Kittelson and Assoc *et al.*, 2013)

Aspects of transit availability and transit comfort and convenience that are important to passengers and relatively easy to quantify and forecast are presented in the form of quality of service framework, in Table 8 (Kittelson and Assoc *et al.*, 2013). These frameworks focus on key performance measures that transit agencies can use to set service standards and to evaluate the quality of service they provide to their passengers.

Table 8 Quality of service framework: Fixed-route transit

Availability	Comfort and Convenience
Frequency	Passenger Load
Service Span	Reliability
Access	Travel Time

Source: Kittelson and Assoc *et al.* (2013)

2.4.2.1 Measures of Availability

1) Service frequency

Service frequency reflects how often service is provided. From users' perspective, service frequency determines how often a potential user has access to transit service (Kittelson and Assoc *et al.*, 2013). If transit service is only offered hourly, there is very limited window of time during the hour when a transit trip can be started immediately. More frequent service provides more opportunities for immediate travel, and allows transit service to more closely resemble competing modes in terms of departure time convenience.

From transit operators' perspective, frequency is a key driver of operating costs (Kittelson and Assoc *et al.*, 2013). All other things being equal (in particular, average travel speeds), doubling the frequency doubles operating costs and increases capital costs to the degree that additional vehicles are used and infrastructure improvements are needed to allow the increased frequency.

Different system headways determined various quality of service. To obtain system peak-period headway, firstly, divide directional route miles by the average system speed (revenue miles per revenue hour) to give the average round-trip time for all vehicles on all route. Then, divide this result by the number of vehicles operated in peak service to give average peak headway in hours, and multiply by 60 to give a result in minutes (Kittelson and Assoc *et al.*, 2013).

2) Service span

Service span reflects how long service is provided. Hours of service represents the number of hours during the day when transit service is provided along a route, is available at a specific location, or is available between two locations (Kittelson and Assoc *et al.*, 2013). The longer the hours of service, the greater the variety of trip purposes that can be served. Longer hours of service than needed to serve a particular market (e.g., office workers) gives those customers travel flexibility; particularly for their return trip.

3) Access

Access reflects where the service is provided. The main transit access modes are walking (dominant access mode to local bus service and to transit stations in higher-density locations and at university campuses), bicycling, auto drop-off, and auto park-and-ride (Coffel *et al.*, 2012).

Service coverage is the area located within walking distance of transit service (Kittelson and Assoc *et al.*, 2013). As with the other availability measures, it does not provide a complete picture of transit availability itself, but when combined with frequency and hours of service, it helps identify the number of opportunities people have to access transit from different locations. Service coverage can be measured in a number of ways. For instance, route density (route miles per square mile) and geographic or population coverage (percentage of system area served or percentage of the population served) (Kittelson and Assoc *et al.*, 2013).

2.4.2.2 Measures of Comfort and Convenience

1) Passenger load

Passenger load reflects crowdedness of the service. For transit vehicles designed for mostly seated passengers, passenger load can be defined by load factor (passengers per seat) (Kittelson and Assoc *et al.*, 2013). From passenger perspective, passenger load affects comfort of the on-board vehicle portion of transit trip, both in terms of being able to find a seat and in overall crowding levels within the vehicle. From transit operator's perspective, a poor quality of service may indicate the need to increase service frequency or vehicle size to reduce crowding and increase passenger comfort (Kittelson and Assoc *et al.*, 2013).

2) Reliability

Reliability reflects the schedule adherence of the service. There are different measures of reliability used by transit operators. Most common of these are on-time performance ("on-time" defined as departure from a time point as 1 min early to 5 min late or arrival at route terminal up to 5 min late), headway adherence (the consistency or "evenness" of the interval between transit vehicles), excess wait time (the average departure time after the scheduled time), missed trips (i.e., scheduled trips not made), percent of scheduled time in operation (for automated systems), and distance traveled between mechanical breakdowns (Kittelson and Assoc *et al.*, 2013).

3) Travel time

Travel time reflects the time competitiveness of transit service with respect to the auto mode. The important factor in potential user's decision to use transit on a regular basis is how much long the trip will take in comparison with the automobile. For transit agencies to assess and forecast the performance, useful metrics are travel time, average speed (distance divided by time), and travel time rate (time divided by distance). From passenger point of view, quality of service is measured by transit-auto travel time ratio which is the in-vehicle transit travel time divided by in-vehicle single-occupant auto travel time for a given trip (Kittelson and Assoc *et al.*, 2013). This measure can be applied to the evaluation of route segments, or a route as a whole, or for origin-destination trips.

2.4.2.3 Other Comfort and Convenience Measures

1) Safety and security

Safety relates to being injured in an accident, whereas security is relates to becoming the victim of a crime. Both are highly important to transit passengers and employees (Kittelson and Assoc *et al.*, 2013). The customer-focused measures related to safety and security as presented in Table 9.

Table 9 Customer-focused measures on safety and security

Measures	**Comments**
Accident rate	The number of vehicle accident per specified distance (e.g., 100,000 mi) or time (e.g., year).
Passenger safety	Passenger injuries or fatalities per specified number of boarding or time period.
Percent positive drug and alcohol tests	An example of a leading indicator, as an increase in the measured value indicates a greater likelihood of safety problems in the future.
Number of traffic tickets issued to operators, percent of buses exceeding the speed limit	These measures identify potential safety problems with bus operators.
Number of station overruns	On manually operated rail system, this measure can indicated a lack of operator attentiveness or driving skill; on automated systems, it can indicate that the system design parameters are not being met.
Number of fires	Fires are a serious safety issues, particularly underground.
Number of crimes (crime rate)	Measures number of reported crimes on transit property; these can be categorized by type and severity.
Ratio of police officers to transit vehicles	A measure of the visibility of police officers; however, it may be difficult to track how often officers are deployed on vehicles.
Number or percent of vehicles (or stops or stations) with specified safety devices	These can include security cameras, intercom systems, emergency alarms, lighting, and vehicle tracking capabilities.

Source: Kittelson and Assoc *et al.* (2003)

2) Customer services

Public transit is a customer service industry, and maintaining high levels of customer satisfactions helps retain customers who have or obtain other travel choices. It also helps attract new customers through reputation of satisfied existing customers. Therefore quantifying service performance is essential for transit agencies to continue on their strength and identify area of weakness. There are many techniques for measuring customer service such as customer satisfaction survey and passenger environment surveys.

(1) Customer satisfaction survey

Two important ways of identifying quality of service factors that are most important to existing and potential passengers are (1) to ask them directly through customer satisfaction surveys and (2) to observe how they react when given actual or hypothetical choices between transit service or travel modes with different characteristics (Kittelson and Assoc *et al.*, 2013).

TCRP (Transit Cooperative Research Program) Project on Customer-Defined Service Quality developed guidance for transit agencies on conducting customer satisfaction surveys to allow agencies to identify the most important customer-service issues that affect, or could potentially affect, their system. Survey techniques were pilot tested at three transit agencies–an urban rail system, suburban bus system, and small city bus system. These survey asked passengers to rate 46 transit system attributes on a scale of 1 to 10 and identify whether they had experience a problem with that attribute within the last 30 days (MORPACE International & Cambridge Systematics, 1999).

For ease of comparison, 46 attributes were grouped into following nine categories: comfort, nuisances, scheduling, fares, cleanliness, in-person information, passive information, safety and transfers. Findings showed that attributes relating to scheduling were top area of existing concern, followed by comfort and nuisances (e.g., rowdy passengers). For potential problems, fare and scheduling were the top concerns, followed by comfort and safety (MORPACE International & Cambridge Systematics, 1999).

The Florida Department of Transportation commissioned a customer satisfaction survey for six larger Florida transit systems (Cleland & Thompson, 2000). The surveys covered 22 factors, including hours of service, frequency of service convenience of routes, on-time performance, travel time, transferring cost, information availability, vehicle cleanliness, rider comfort, employee courtesy, perception of safety, bus stop locations, and overall satisfaction. The existing problems of greatest significance to Florida customers were hours of service, routes

and headways. Potential problems of greatest significance were routes and headways, hours of service, bus ride comfort, printed schedules, safety and cleanliness (Cleland & Thompson, 2000).

Onboard survey were conducted on bus routes with varying service characteristics (e.g., frequency, loading, reliability, amenity provision) operated by five transit agencies around the US (Dowling *et al.*, 2008). Customers were asked to rate their overall satisfaction with their trip, along with their satisfaction about specific aspects of their trip (e.g., frequency reliability) and to select the service quality factors contributing most to their overall satisfaction. It was found that frequency is the most important factor for passengers, while reliability, wait time (which relates to frequency and reliability), access (close to home and destination), and service span were also consistently stated as being contributors to passengers satisfaction (Dowling *et al.*, 2008), as shown in Table 10.

Table 10 Factors contributing most to stated overall satisfaction with a transit trip

	Route				
Rank	A	B	C	D	E
1	*frequency*	*frequency*	*frequency*	*frequency*	frequency
2	*wait time*	*reliability*	*close to home*	*reliability*	wait time
3	*reliability**	*wait time*	*reliability*	*close to home*	close to home
4	*close to home**	close to dest.	*wait time*	close to dest.	reliability
5	service span	close to home	close to dest.	wait time	service span
6	close to dest.	service span		service span	
7	friendly drivers				

Source: Dowling *et al.* (2008)

Note: * tie

Italics indicate factors mentioned by 50% or more of surveyed passengers. Other listed factors were mentioned by at least 33% of survey passengers

Dest. = destination

Examples of service attributes that could be rate as part of a customer survey, with each attribute rated on 1 to 5 or 1 to 10 scales, for instance, are shown in Figure 16.

(2) Passenger Environment survey

Passenger environment surveys are rated through a variety of trip attribute which can be separated into factors that could be evaluated for (1) transit vehicles and (2) transit stations, as details in Table 11.

Absence of graffiti	Frequency of service on Saturdays/Sundays
Absence of offensive odors	Frequent service so that wait times are short
Accessibility to persons with disabilities	Friendly, courteous, quick service from personnel
Availability of handrails or grab bars	Having station/stop near one's destination
Availability of monthly discount passes	Having station/stop near one's home
Availability of schedule information	Hours of service during weekdays
Availability of schedules/maps at stops	Number of transfer points outside downtown
Availability of seats on train/bus	Physical condition of stations/stops
Availability of shelter and benches at stops	Physical condition of vehicles and infrastructure
Cleanliness of interior, seats, windows	Posted minutes to next train/bus at stations/stops
Cleanliness of stations/stops	Quietness of the vehicles and system
Cleanliness of train/bus exterior	Reliable trains/buses that come on schedule
Clear and timely announcements of stops	Route/direction information visible on trains/buses
Comfort of seats on train/bus	Safe and competent drivers/conductors
Connecting bus service to main bus stops	Safety from crime at stations/stops
Cost effectiveness, affordability, and value	Safety from crime on trains/buses
Cost of making transfers	Short wait time for transfers
Display of customer service number	Signs/information in Spanish as well as English
Ease of opening doors when getting on/off	Smoothness of ride and stops
Ease of paying fare, purchasing tokens	Station/stop names visible from train/bus
Explanations and announcements of delays	Temperature on train/bus—not hot/cold
Fairness/consistency of fare structure	The train/bus traveling at a safe speed
Freedom from nuisance behaviors of riders	Trains/buses that are not overcrowded
Frequency of delays from breakdowns/emergencies	Transit personnel who know system

Figure 16 Examples of transit service attributes (MORPACE International & Cambridge Systematics, 1999)

Table 11 Factors that could be evaluated for transit vehicles and transit stations

Factors	**Indicators**
	Transit vehicles
Cleanliness and appearance	Amount of litter; exterior dirt conditions; floor and seat cleanliness; graffiti; and window condition
Customer information	Readable and correct vehicle signage; presence of priority seating stickers (bus); correct and legible maps; correct and adequate bus stop signage; and audible, understandable, and accurate public address announcements
Equipment	Climate control conditions; operative kneeling feature, wheelchair lift, window, and rear door (bus); or door panel condition and lighting (rail)
Operators	Proper uniforming; proper display of badges and proper use of kneeling feature (bus)
	Transit stations
Cleanliness and appearance	Amount of litter; station floor and seat cleanliness; and graffiti
Customer information	Readable and correct signage; correct and legible maps; and audible, understandable, and accurate public address announcements
Equipment	Functional speakers in stations; escalators/elevators in operation; public telephones in working order; station control areas that have a working booth microphone; trash receptacles usable in stations; functional toke/metrocard vending machines; and functional turnstiles
Station agents	Proper uniforming and proper display of badges

Source: Kittelson and Assoc *et al.* (2003)

2.4.3 Service Quality Model

A model of service quality of public land transport services, namely P-TRANSQUAL, consist of four dimensions, which as comfort, tangible, personnel, and reliability (Bakti & Sumaedi, 2015). In respect to the questionnaire survey from passengers of paratransit services, this model was tested and has been proved to have good validity, reliability and stability for measuring service quality of paratransit services in Indonesia.

The respondents were asked to express their perception on 23 positive statements regarding service quality indicator of public land transport service. The indicators were obtained from the literature that discusses service quality, especially service quality of public land transport service. The items can be seen in Table 12. The scale of questionnaire was seven points Likert scale where 1 represents "totally disagree" and 7 represents "totally agree" (Bakti & Sumaedi, 2015).

Table 12 Service quality indicators of the public land transport services

	Indicators	References
IK1	Facilities and equipments of public transport	Wen *et al.* (2005); Caro and Garcia (2008); Suman (2007)
IK2	Condition of public transport seats	Wen *et al.* (2005); Sezhian *et al.* (2011); Transportation Research Board (1999)
IK3	Ride smoothness of public transport	Lai and Chen (2011); Wen *et al.* (2005); Transportation Research Board (1999)
IK4	Passengers capacity in public transport	Transportation Research Board (1999)
IK5	Cleanliness of the interior, seats, and windows of public transport	Lai and Chen (2011); Eboli and Mazzulla (2007); Wen *et al.* (2005); Sezhian *et al.* (2011); Suman (2007); Transportation Research Board (1999)
IK6	Cleanliness of public transport exterior	Lai and Chen (2011); Sezhian *et al.* (2011); Suman (2007)
IK7	Condition of public transport machine	Suman (2007)
IK8	Adequacy of public transport	Transportation Research Board (1999); Lai and Chen (2011)
IK9	Neatness of personnel	Wen *et al.* (2005); Caro and Garcia (2008); Suman (2007)
IK10	Waiting time of public transport	Wen *et al.* (2005); Caro and Garcia (2008); Transportation Research Board (1999)
IK11	Travel time of public transport	Wen *et al.* (2005); Sezhian *et al.* (2011); Caro and Gracia (2007); Transportation Research Board (1999)
IK12	Helpfulness of personnel	Eboli and Mazzulla (2007); Caro and Gracia (2007); Suman (2007)
IK13	Responsiveness of personnel	Eboli and Mazzulla (2007); Caro and Garcia (2008); Suman (2007)
IK14	Understanding of passengers' need	Eboli and Mazzulla (2007); Caro and Garcia (2008)
IK15	Courtesy of personnel	Wen *et al.* (2005); Sezhian *et al.* (2011); Caro and Garcia (2008); Suman (2007); Transportation Research Board (1999)
IK16	Expertise of driver	Caro and Garcia (2008); Suman (2007); Transportation Research Board (1999)
IK17	Safety while using public transport services	Eboli and Mazzulla (2007); Suman (2007); Transportation Research Board (1999)
IK18	Security from crime while using public transport services	Lai and Chen (2011); Eboli and Mazzulla (2007); Suman (2007); Transportation Research Board (1999)
IK19	Obedience to traffic	Caro and Garcia (2008); Suman (2007)
IK20	Delivery to the destination	Caro and Garcia (2008); Suman (2007)
IK21	Public transport cleanliness of the graffiti	Transportation Research Board (1999)
IK22	Comfortable temperature on public transport	Wen *et al.* (2005); Transportation Research Board (1999)
IK23	Safety related to the behavior of other passengers	Transportation Research Board (1999)

Source: Bakti and Sumaedi (2015)

The result indicated that P-TRANSQUAL consists of four dimensions with 18 indicators, as illustrated in Table 13.

Table 13 P-TRANSQUAL dimensions and indicators

Dimensions	Indicators
Comfort	Passengers capacity in public transport
	Safety while using public transport services
	Obedience to traffic
	Comfortable temperature in public transport
	Security from crime while using public transport services
	Safety related to the behavior of other passengers in public transport
Tangible	Cleanliness of interior, seating and window
	Cleanliness of public transport exterior
	Condition of public transport machine
	Condition of public transport seats
Personnel	Helpfulness of personnel
	Responsiveness of personnel
	Understanding of passengers need
	Courtesy of personnel
Reliability	Waiting time of public transport
	Travel time of public transport
	Adequacy of public transport
	Delivery to the destination

Source: Derived from Bakti and Sumaedi (2015)

2.5 Sustainable Transportation

Due to the complex conditioned character of "sustainable transport", there is not one dedicated SDG for transport in the 2030 Development Agenda (Gudmundsson & Regmi, 2017). However, transport is important for achieving many of the SDG's, and several of the 169 specific SDG targets do address transport more directly.

Table 14 below highlights the SDG goals and targets that are most directly related to transport. Of these, some address urban transport directly (3.6, 9.1 and 11.2), while others refer to impacts such as energy and emissions where urban transport play important roles (especially 7.3, 11.6 and 13.2).

Table 14 SDGs and targets of directly relevance for transport

Goal	Targets
3. Ensure healthy lives and promote well-being for all at all ages	3.6 By 2020, halve the number of global deaths and injuries from **road traffic accidents**
7. Ensure access to affordable, reliable, sustainable and modern energy for all	7.3 By 2030, double the global rate of improvement in energy efficiency (*)
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	9.1 Develop quality, reliable, sustainable and resilient **Infrastructure**, including regional and trans-border infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all
11. Make cities and human settlements inclusive, safe, resilient and sustainable	11.2 By 2030, provide access to safe, affordable, accessible and sustainable **transport system** for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, person and disabilities and older persons
	11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management (*)
12. Ensure sustainable consumption and production patterns	12c. Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances (*)
13. Take urgent action to combat climate change and its impact	13.2 Integrate climate change measure into national policies, strategies and planning (*)

Source: Gudmundsson and Regmi (2017)

Note: (*) These targets do no explicitly mention transport system, but transport actions are implied or will be instrumental for achieving them

2.5.1 Indicators for Sustainable Transportation System

2.5.1.1 Sustainable and Livable Transport Indicators

There is a growing interest in the concepts of sustainability, livability, sustainable development and sustainable transport (Litman, 2016). Sustainability includes economic, social, and environmental goals, which are often called “triple bottom line”, as illustrated in Figure 17.

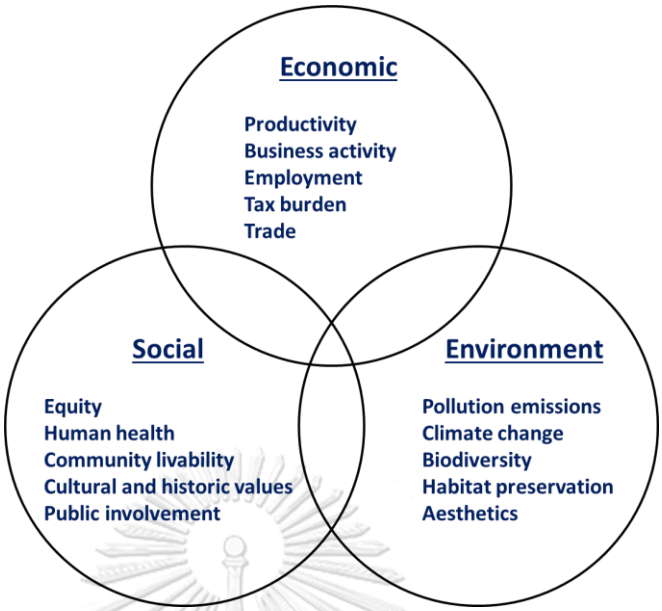


Figure 17 Sustainability Goals (Litman, 2016)

Sustainability emphasizes the integrated nature of human activities and, therefore, the need for coordinated planning among different sectors, groups and jurisdictions. It expands the objectives, impacts, and options considered in a planning process. This helps insure that individual, short-term decisions and consistent with strategic, long-term goals (Litman, 2016). Sustainability includes goals that involve indirect and long-term impacts, as indicated in Table 15.

Table 15 Sustainability Goals

Economic	Social	Environmental
- Economic productivity	- Equity/Fairness*	- Climate change prevention and mitigation*
- Local economic development*	- Safety and security*	- Air, noise and water pollution prevention*
- Resource efficiency	- Community development*	- Non-renewable resource conservation
- Affordability*	- Cultural heritage preservation*	- Open space preservation*
- Operational efficiency	- Public fitness and health*	- Biodiversity protection
Good Governance and Planning		
Integrated, comprehensive and inclusive planning*		
Efficient pricing		

* Goals affect livability of residents

Source: Litman (2016)

Livability refers to the subset of sustainability goals and impacts that directly affect community members, including local economic development and environmental quality, equity, affordability, basic mobility for non-drivers, public safety and health, and community cohesion. Most of them fall into social impacts dimensions of sustainability (Litman, 2016).

Sustainable transport must balance triple bottom line, as indicated in Figure 18. Although these imply that each goal fits into a specific category, they often overlap (Litman, 2016). For example, pollution is generally considered an environmental issue, but it also affects human health (a social issue), and tourism industries (economic issues).

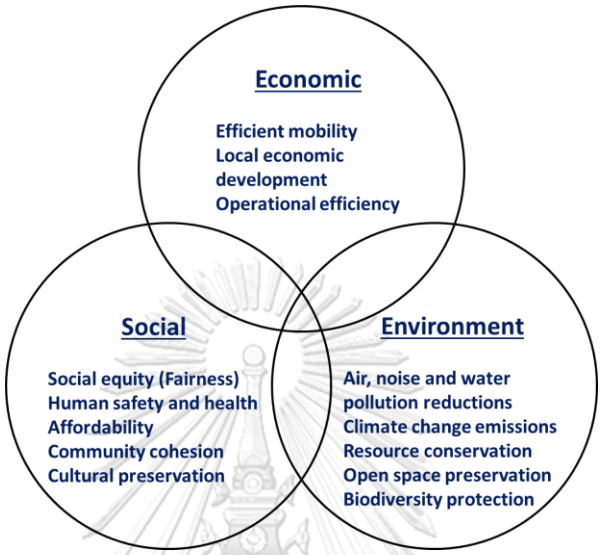


Figure 18 Sustainable Transport Goals (Litman, 2016)

The report on developing indicators for sustainable and livable transport planning (Litman, 2016) provides guidance on the use of indicators for sustainable and livable transportation planning. The summarized sustainable transport goals, objectives, and performance indicators are presented in Table 16.

Table 16 Key sustainable transport goals, objectives and indicators

Sustainability Goals	Objectives	Performance Indicators
1. Economic		
Economic productivity	- Transport system efficiency - Transport system integration - Maximize accessibility - Efficient pricing and incentives	- Per capita GDP - Portion of budgets devoted to transport - Per capita congestion delay - Efficient pricing (road, parking, insurance, fuel, etc) - Efficient prioritization of facilities
Economic development	- Economic and business development	- Access to education and employment opportunities - Support for local industries
Energy efficiency	- Minimize energy costs, particularly petroleum imports	- Per capita transport energy consumption - Per capita use of imported fuels
Affordability	- All residents can afford access to basic (essential services and activities)	- Availability and quality of affordable modes (walking, cycling, ridesharing and public transport) - Portion of low-income households that spend more than 20% of budgets on transport
Efficient transport operations	- Efficient operations and asset management maximizes cost efficiency	- Performance audit result - Service delivery unit costs compared with peers - Service quality

Sustainability Goals	Objectives	Performance Indicators
2. Social		
Equity/fairness	- Transport system accommodates all users, including those with disabilities, low incomes, and other constraints	- Transport system diversity - Portion of destinations accessible by people with disabilities and low incomes
Safety, security and health	- Minimize risk of crashes and assaults, and support physical fitness	- Per capita traffic casualty (injury and death) rates - Traveler assault (crime) rates - Human exposure to harmful pollutants - Portion of travel by walking and cycling
Community development	- Help create inclusive and attractive communities	- Land use mix - Walkability and bikability - Quality of road and street environments
Cultural heritage preservation	- Respect and protect cultural heritage - Support cultural activities	- Preservation of cultural resources and traditions - Responsiveness to traditional communities
3. Environmental		
Climate stability	- Reduce global warming emissions - Mitigate climate change impacts	- Per capita emissions of greenhouse gases (CO_2, CFCs, CH_4, etc)
Prevent air pollution	- Reduce air pollution emissions - Reduce harmful pollutant exposure	- Per capita emissions (PM, VOCs, NOx, CO, etc) - Air quality standards and management plans
Minimize noise	- Minimize traffic noise exposure	- Traffic noise levels
Protect water quality & hydrologic functions	- Minimize water pollution - Minimize impervious surface area	- Per capita fuel consumption - Management of used oil, leaks and stormwater - Per capita impervious surface area
Open space and biodiversity protection	- Minimize transport facility land use - Encourage compact development - Preserve high quality habitat	- Per capita land devoted to transport facilities - Support for smart growth development - Policies to protect high value farmlands and habitat
4. Good Governance and Planning		
Integrated, comprehensive and inclusive planning	- Clearly defined planning process - Integrated and comprehensive analysis - Strong citizen engagement - Lease-cost planning	- Clearly defined goals, objectives and indicators - Availability of planning information and documents - Portion of population engaged in planning decisions - Range of objectives, impacts, and options considered - Efficient and equitable funding allocation

Source: Litman (2016)

A study on issues in sustainable transportation (Litman and Burwell, 2006) listed impacts of transport facilities and activities on sustainability, as indicated in Table 17.

Table 17 Transportation impacts on sustainability

Economic	Social	Environmental
Traffic congestion	Inequity of impacts	Air and water pollution
Mobility barriers	Mobility disadvantaged	Habitat loss
Accident damages	Human health impacts	Hydrologic impact
Facility costs	Community interaction	Depletion of non-renewable resources
Consumer costs	Community livability	
Depletion of non-renewable resources	Aesthetics	

Source: Litman and Burwell (2006)

Indicators for sustainable transports that reflect sustainability goals are indicated in Table 18.

Table 18 Sustainable transport indicators

Objectives	Indicators	Direction
1. Economic		
Accessibility–commuting	Average commute travel time	Less is better
Accessibility–land use mix	Number of job opportunities and commercial services within 30-minute travel distance of residents	More is better
Accessibility–smart growth	Implementation of policy and planning practices that lead to more accessible, clustered, mixed, multi-modal development	More is better
Transport diversity	Mode split: portion of travel made by walking, cycling, rideshare, public transit and telework	More is better
Affordability	Portion of household expenditures devoted to transport by 20% (lowest-income household)	Less is better
Facility costs	Per capita expenditures on roads, traffic services and parking facilities	Less is better
Freight efficiency	Speed and affordability of freight and commercial transport	More is better
Planning	Degree to which transport institutions reflect least-cost planning and investment practices	More is better
2. Social		
Safety	Per capita crash disabilities and fatalities	Less is better
Health and fitness	Percentage of population that regularly walks and cycles	More is better
Community livability	Degree to which transport activities increase community livability (local environment quality)	More is better
Equity–fairness	Degree to which prices reflect full costs unless a subsidy is specifically justified	More is better
Equity–non-drivers	Quality of accessibility and transport services for non-drivers	More is better
Equity–disabilities	Quality of transport facilities and services for people with disabilities (e.g., wheelchair users, people with visual impairments)	More is better
Non-motorized transport planning	Degree to which impact on non-motorized transport are considered in transportation modeling and planning	More is better
Citizen involvement	Public involvement in transport planning process	More is better

Objectives	Indicators	Direction
3. Environmental		
Climate change emissions	Per capita fossil fuel consumption, and emissions of CO_2 and other climate change emissions	Less is better
Other air pollution	Per capita emissions of "conventional" air pollutants (CO, VOC, NOx, particulates, etc.)	Less is better
Noise pollution	Portion of population exposed to high levels of traffic noise	Less is better
Water pollution	Per capita vehicle fluid losses	Less is better
Land use impacts	Per capita land devoted to transportation facilities	Less is better
Habitat protection	Preservation of wildlife habitat (wetlands, forests, etc.)	More is better
Resource efficiency	Non-renewable resource consumption in the production and use of vehicles and transport facilities	Less is better

Source: Litman and Burwell (2006)

2.5.1.2 Social dimension

Social sustainability consists of elements and indicators regarding access, safety, health, information availability, attractiveness, commitment to plans, and coordinated management, thus also include aspects of governance (Karjalainen & Juhola, 2019). Accessibility is understood as equitable transportation that provides access to opportunities, reduce exclusion and aim to increase quality of life. It can be measured either spatially or on the basis of individual socioeconomic traits. This means access and accessibility refer to physical proximity to transport services as well as the ability to access them based on, for instance, physical disabilities or affordability issues. Special attention is to be paid for vulnerable groups, i.e., the elderly, the disabled, the young and people with low income. (Boschmann & Kwan, 2008; Dobranskyte-Niskota *et al.*, 2007; Litman, 2017). Element of safety, health, equity and social cohesion, passenger perception, as well as livable communities are parts of socially sustainable public transport (Hertel *et al.*, 2016; Hull, 2008; Kennedy *et al.*, 2005; Prado *et al.*, 2012; Richardson, 2005; Schiller *et al.*, 2010; Walker *et al.*, 2007). Public transportation satisfaction survey conducted in Europe suggested that safety and security, system reliability, accessibility, comfort, and staff behavior are key elements affecting public transportation use (Fellesson & Friman, 2008).

Regarding to the (UN, 2015), accessibility in transport refers to people's ability to reach activities and destinations from a given location, using available transportation system. Many factors affect accessibility, including transport needs and ability of individuals, quality of transport options, connectivity of the various links and modes, land-use patterns, and the quality/costs of alternative solutions. Fast urbanization, increasing congestion and insufficient access to public transportation in many areas call for redesigning of urban mobility conditions, with an emphasis on

facilitating infrastructure for more environmentally friendly modes, as well as vulnerable groups, such as children, persons with reduced mobility and the growing global elderly population.

Accessibility involves the ability to move from one bus stop to another, within a specific timeframe, particularly if a person is interchanging from one mode to another. In fact, the distance to bus stop, wait time and ease to transfers are major factors that attract elderly persons to use public transport (Wardman, 2001). People should find it easy to board on and off the vehicle (Beimborn *et al.*, 2003).

2.5.1.3 Economic dimension

Transport affordability refers to the financial ability of people and societies to access adequate transport services without compromising their ability to purchase other basic goods and services, such as food, housing, education and health (UN, 2015). It can be assessed from several perspectives and one is the quality and cost of alternative transport modes such as public transport. Affordability can be studied through the share of income used to access transportation services (EPA, 2011; Murrey & Davis, 2001; Murrey *et al.*, 1998). Income inequalities are an issue present in all regions, and low income groups, which spend a high proportion of their income on transport, are specifically dependent on the availability of affordable public transport (UN, 2015).

The study of economic crisis gave insights into the trade-offs households made between income reduction and transport expenditure (Cascajo *et al.*, 2018). The situation differs considerably in accordance with economic position. The poorest households were unable to reduce their transport expense possibly since their budgets were already tight and were dedicated mainly to public transport, which suffered from the higher fares. Transport expenditure of poor households rose from 8.3% of their expenditure (2007) to 9.6% (2013). The effect of economic crisis was opposite for the wealthiest group, which their expenditure dropped from 21% of their total expenditure (2007) to 15.7% (2013). This could mean that the latter group has more options to adapt to the crisis since they can more generally modify their mobility patterns.

2.5.1.4 Environmental dimension

According to (UNDESA, 2007), energy intensity and CO_2 emission are elements of environmental sustainability in transport activities. Transport serves economic and development through distributions of goods and services and personal mobility. At the same time, transport is a major user of energy. Energy use in transport therefore contributes to depletion of natural resources, to air pollution and to climate change. Reducing energy use intensity in transport can reduce environmental impacts of this sector while maintaining its economic and social benefits.

2.5.2 Sustainable Transport Policy

The study on sustainable urban transport in developing world (Pojani & Stead, 2015) reviewed the potential role and impact of nine commonly considered options for sustainable urban transport in medium-sized cities located in developing countries: (1) road infrastructure; (2) rail-based public transport; (3) road-based public transport; (4) support for non-motorized travel modes; (5) technological solutions; (6) awareness-raising campaigns; (7) pricing mechanisms; (8) vehicle access restrictions; and (9) control of land uses. These options for actions are overlapping and interconnected. They cover both the demand and supply side of urban transport with a focus on the latter.

Pojani and Stead (2015) concluded that no single type of strategy or policy is effective or sufficient to promote more sustainable urban transport. Moreover, different types of measures may be more appropriate for smaller and medium-sized developing cities than megacities. Some key strategies to be considered in these developing cities include: (1) street conditions conducive to green modes via low-cost interventions such as sidewalk maintenance and speed restraint; (2) pedestrian-only zones in area with heavy pedestrian traffic; (3) exclusive lanes for buses and bicycles, which are adequately protected from car traffic; (4) reasonable parking fees; (5) more attention to road infrastructure maintenance rather than the construction of new infrastructure; and (6) awareness-raising and education campaigns.

Applying combination of policies can work together and give rise to synergies, leading to impacts greater than the sum of their individual parts. The identification of policy packages is a crucial issue for promoting more sustainable urban transport: packages should maximize potential synergies (Pojani & Stead, 2015). Importantly, local factors, such as costs, feasibility, and barriers should be considered. Finally, caution is advised in both appropriateness and effectiveness of policy solutions being transferred to smaller and medium-sized cities in developing countries from larger cities and/or from more developed countries.

CHAPTER III
RESEARCH METHODOLOGY

In this chapter, framework of the research is presented. Research design section illustrates the study area of five SR routes including operational characteristics and pictures from field survey. Sample designs are described, followed by data collection and pilot survey. Then questionnaire design and analytical techniques applied in this study are explained.

3.1 Research framework

3.1.1 Conceptual framework

Transportation systems evolve within relationship between transport supply, mainly the operational capacity of the network, and transport demand, the mobility requirements of a territory (Rodrigue *et al.*, 2006). Transport supply expresses in terms of service capacity and frequency. In this study, the supply-side relates to Silor vehicle and trip information drawn from the drivers. For the demand-side, transport demand expresses the transport needs, even if those needs are satisfied fully, partially, or not at all (Rodrigue *et al.*, 2006). In this study, transport demand will focus on both users and non-users of Silor. In addition, infrastructures facilitate interactions between transport supply and demand, supporting movements. Mobility must occur over transport infrastructures, providing transport supply. Without movements, infrastructures would be useless and without infrastructures, movements could not occur (Rodrigue *et al.*, 2006).

The three components of transport system, supply, demand and infrastructure, form the Silor service system. Based on the assessment of service performance, policy recommendations will then be proposed to improve Silor service performance towards sustainable transportation system. Therefore, the conceptual framework of the study is illustrated in Figure 19.

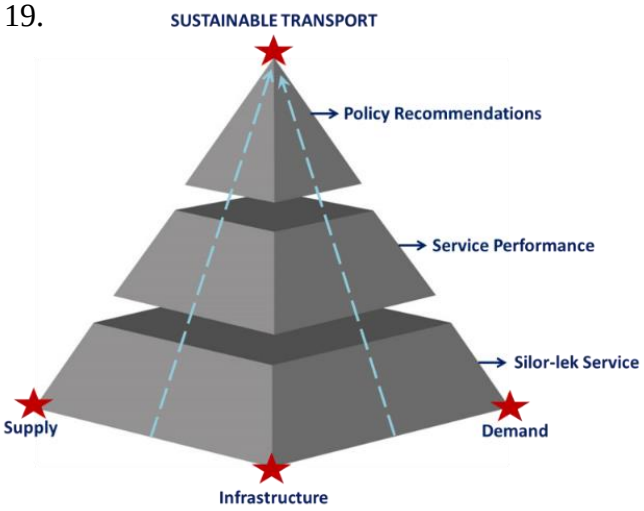


Figure 19 Conceptual framework of the study

3.1.2 Methodology diagram

The diagrammatic methodology in Figure 20 illustrates variables and analytical techniques to investigate regulators, supply and demand sides of SR services in Bangkok. The key components of the research comprise supply, regulators and demand, including both users and non-users of SR. Attitudes on satisfaction and importance on service quality are also investigated in various attributes, followed by two case studies and assessment of sustainability in social, economic and environmental dimensions.

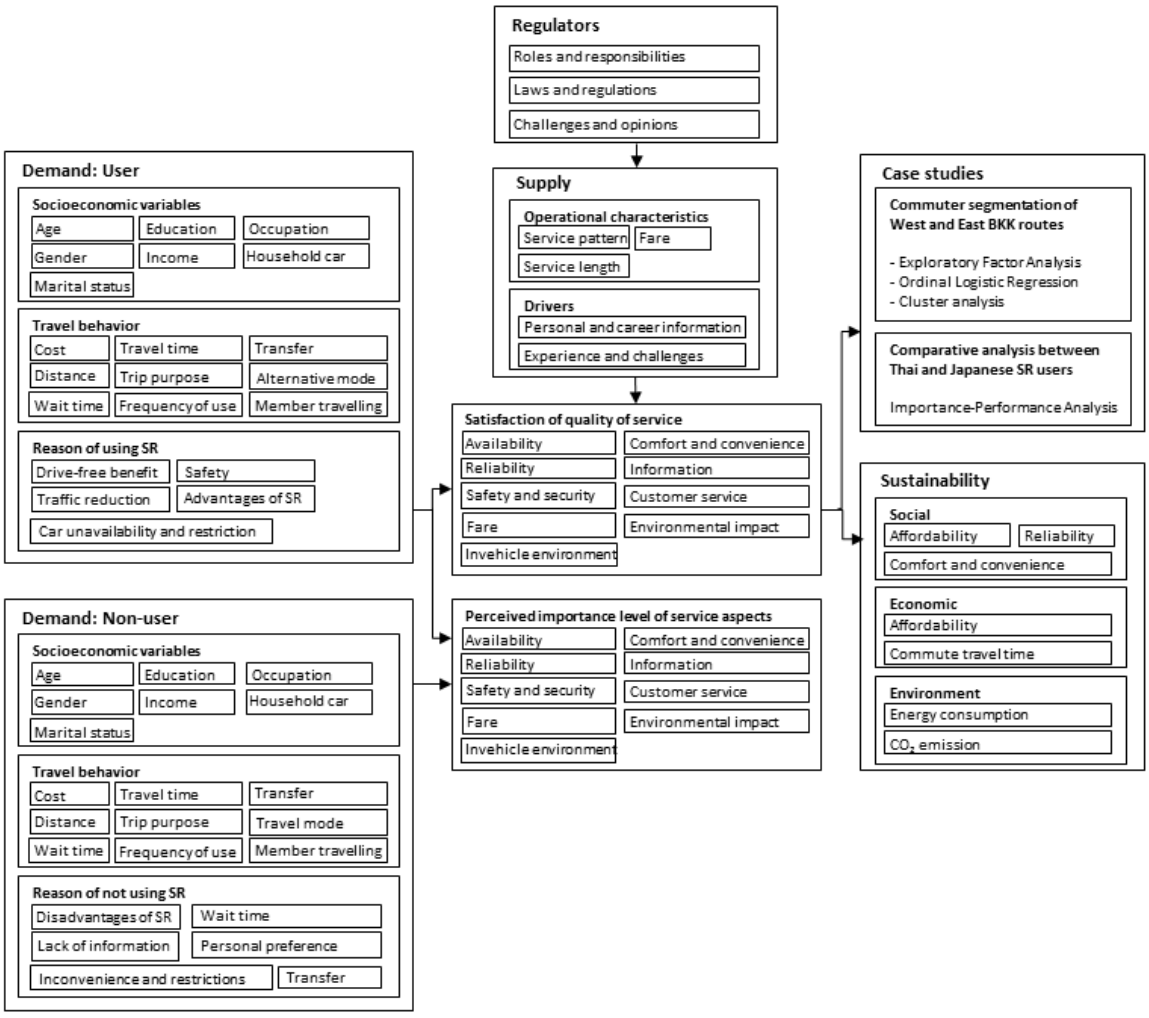


Figure 20 Diagrammatic methodology of the study

3.2 Research design

3.2.1 Study area

The study explores five Silor routes in the high-density residential areas on both the eastern and western part of Bangkok. The route service areas cover ten districts in Bangkok, comprising Bang Bon, Chom Thong, Bangkoknoi, Bangkokyai, Thonburi, Klong San, Chatuchak, Din Daeng, Klong Toei and Wattana, as illustrated in Figure 21.

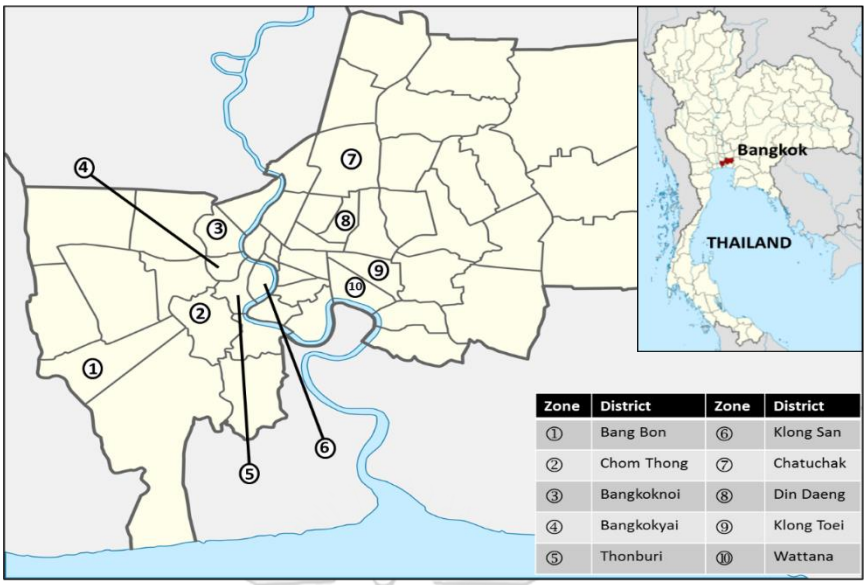


Figure 21 Map of Bangkok Districts: Districts of the study area

The basis of selecting five SR routes is to examine a diverse sample of different demands and service characteristics to understand underlying social and cultural context. The west and east Bangkok areas cover communities of different socioeconomic profiles; therefore, the study can explore the way demographic features influence travel behavior and attitudes. Also, the heterogeneity of the study population are found in Sukhumvit area which are dominated by foreign users so this research can determine the characteristics of respondents from different culture. In selecting the study sites, the study consider time, financial and personal costs involved in conducting fieldwork, and these routes are appropriate in terms of distance and convenience of fieldwork locations. They are located in the high-density residential area and provide adequate sample size of operators, users and non-users for the analysis to obtain the meaningful results.

The characteristics of the route locations are presented in Table 19. The first three routes are located on the West side of Bangkok which include Bang Bon – Taladplu, Siriraj – Taladplu, and Klong San – Charansanitwong Soi 13 routes. The other two routes are on the East side of Bangkok, Vibhavadi Rangsit Soi 16 – Ratchadapisek Soi 19 and Sukhumvit Soi 39 namely.

Table 19 Characteristics of Silor route locations

Route	District	Land use type	Connecting to other transport modes
Bang Bon – Taladplu	① Bang Bon ② Chom Thong ⑤ Thonburi	-Medium to high- density residential area - Commercial area - Industrial area	BTS Silom Line (Wuttakart Station)
Siriraj – Taladplu	③ Bangkoknoi ④ Bangkokyai ⑤ Thonburi	-High-density residential area	Ferry(Siriraj Pier)
Klong San – Charansanitwong Soi 13	④ Bangkokyai ⑤ Thonburi ⑥ Klong San	-High-density residential area - Commercial area - Government office	- Ferry(Klong San Pier) - BTS Silom Line (Wongwianyai Station and Krungthonburi Station)
Vibhavadi Rangsit Soi 16 – Ratchadapisek Soi 19	⑦ Chatuchak ⑧ DinDaeng	-High-density residential area	MRT Blue Line (Ratchadapisek Station)
Sukhumvit Soi 39	⑨ Klong Toei ⑩ Wattana	-High-density residential area	BTS Sukhumvit Line (Phrom Phong Station)

First, Bang Bon – Taladplu (BT) route runs pass Ekkachai Road, Wuttakart Road and BTS Wuttakart station. Second, Siriraj – Taladplu (ST) route operate on Phetkasem Road, Isaraphap Road and also sending passengers at Siriraj Pier. The third route, Klong San – Charansanitwong Soi 13 (CK) route runs on Charansanitwong Road, passing Phetkasem Road, BTS Wongwianyai station and Krungthonburi station, also sending users at Klongsan Pier. Fourth, Vibhavadi Rangsit Soi 16 – Ratchadapisek Soi 19 (VR) route operates in connect soi between Vibhavadi and Ratchadapisek, with terminal near MRT Ratchadapisek station. The fifth route is Sukhumvit Soi 39 (SV) route which operate in Sukhumvit Soi 39 and its neighborhood area, serving users mostly from BTS Phrom Phong station. The location of five routes with their physical and operational characteristics are depicted in Figure 22 to Figure 26.

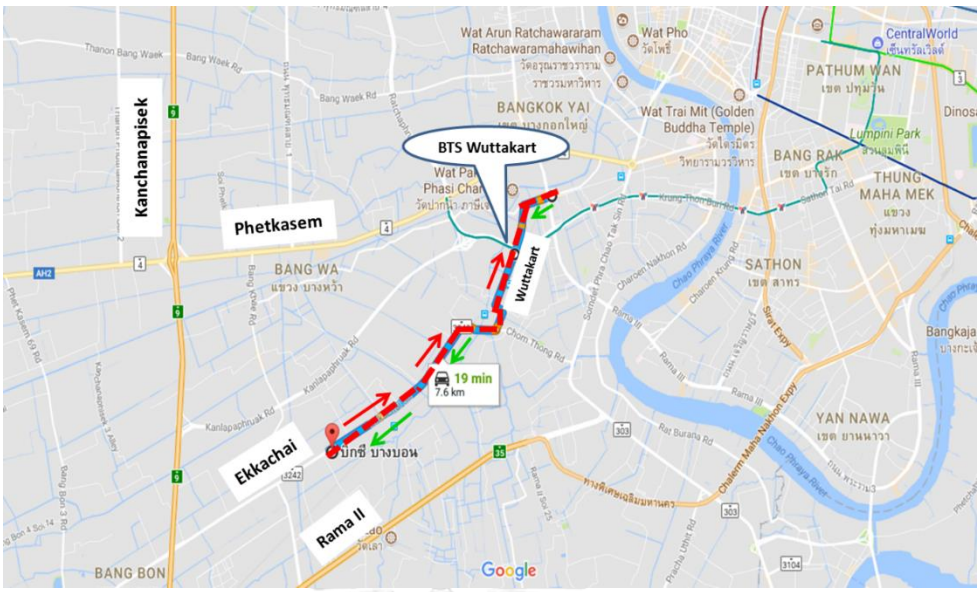
The operational characteristics in terms of service pattern, service length, and fare are summarized in Table 20. It is noted that in the West Bangkok (BT, ST and CK routes) operate for longer distance of 10 to 13 km whereas the East Bangkok route (VR and SV) operate with shorter service length of approximately 2 to 4 km. All routes apply fixed fare of 7-8 Baht and 10 Baht when using after 9 pm. The exception is noted for SV route which operate as for hire pattern with distance-based fare upon negotiations.

Table 20 Operational characteristics of SR routes

Route	Service pattern	Approximate service length (km)	Fare pattern	Fare (After 9 pm) Baht per trip
BT	Fixed route/collective	13	Fixed	7 (10) as of 28 Jul 2018
ST	Fixed route/collective	13	Fixed	7 (10) as of 28 Jul 2018
CK	Fixed route/collective	10	Fixed	7 (10) as of 5 Aug 2018
VR	Fixed route/collective	1.7	Fixed	8 (10) as of 7 Aug 2018
SV	Non-fixed/for hire	0.3-4.4	Distance-based upon negotiation	10-120 as of 20 Sept 2018

Fare noted are standard price, however, several exceptions are revealed from observations and interviews. For instances, for cases of traveling with child and both of them sit in the front seat, some vendors hire SR to move things and/or travelling beyond the service route. For VR route, some passengers request drivers to send them deep in the Soi at their doorsteps so the fares are added up from 8 to 30 Baht/trip.

From observations some routes apply rules when passengers need to get off as the announcement in the vehicle noted that ringing the bell one time means getting off at bus stop while ring twice means passengers need to get off immediately at any specific point at that time.



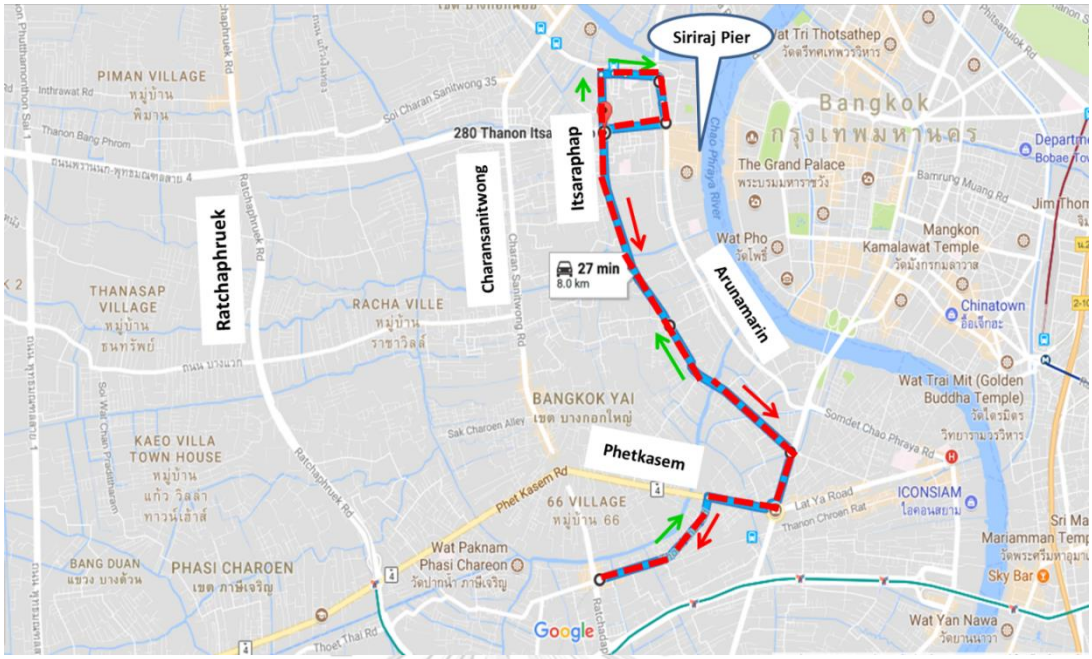
(a) Location of Bangbon-Taladplu (BT) route

(b) Passenger getting off at bus stop

(c) Vehicle seat

(d) Fare list

Figure 22 Characteristics of Bangbon-Taladplu (BT) route



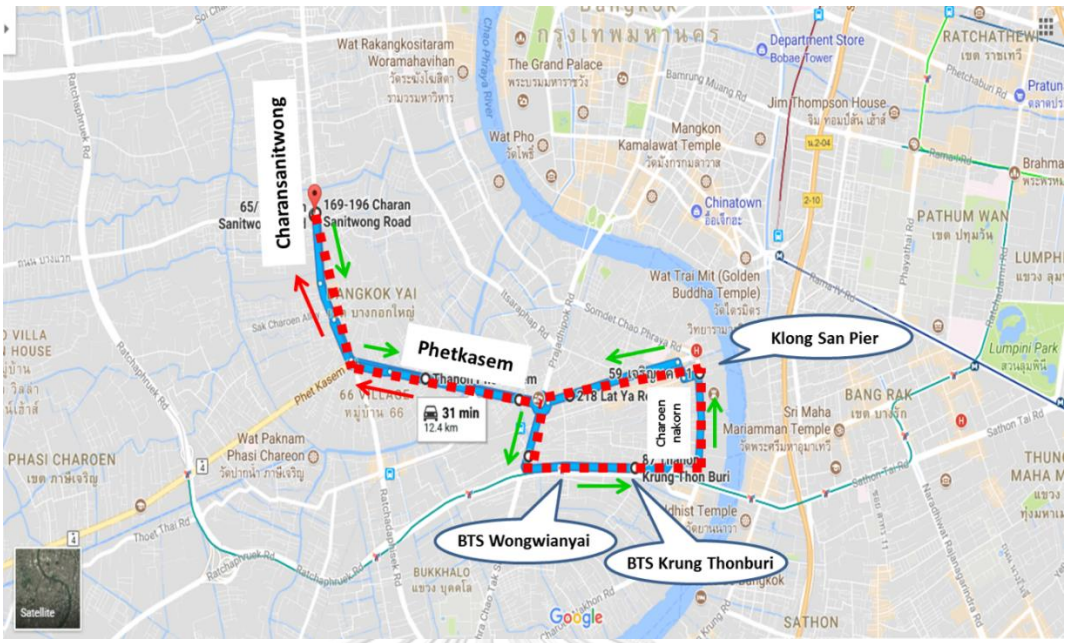
(a) Location of Siriraj-Taladplu (ST) route

(b) Operating route condition

(c) Stopping at bus stops

(d) Parking teminal

Figure 23 Characteristics of Siriraj-Taladplu (ST) route

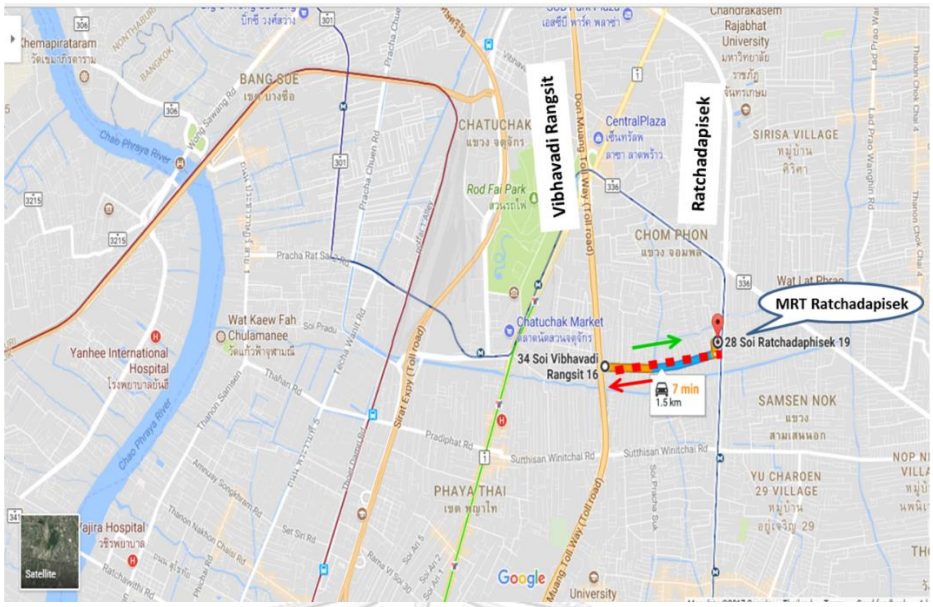


(a) Location of Charan-Klongsan (CK) route

(b) Cabin condition

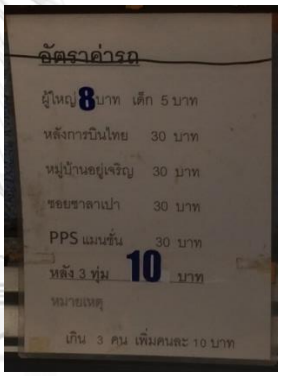
(c) Parking terminal

Figure 24 Characteristics of Charan-Klongsan (CK) route



(a) Location of Vibha-Rachada (VR) route

(b) Operating route in soi

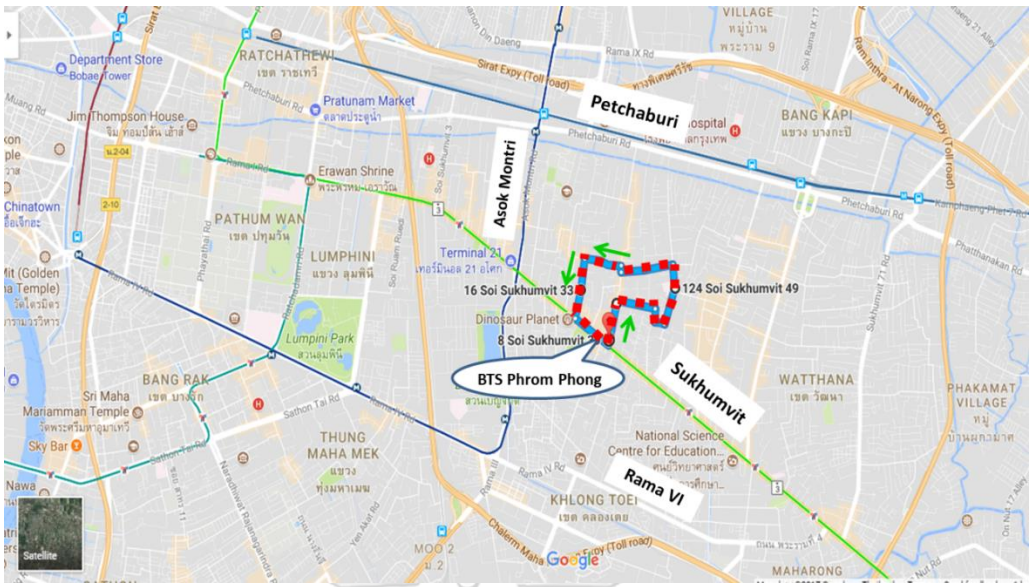


(c) Fare

(d) Parking terminal on Vibhavadi side

(e) parking terminal on Rachada side

Figure 25 Characteristics of Vibha-Rachada (VR) route



(a) Location of Sukhumvit Soi 39 (SV) route

(b) Parking at entrance of Sukhumvit Soi 39

(c) In-vehicle condition

สถานที่	ราคา/บาท
1. รพ. บ้านแพ้ว	20
2. พร้อมมิตรวิลล่า	20
3. Soi พร้อมมิตร 1-2	30
4. Soi พร้อมใจ	30
5. U.F.M 3-4	30
6. DH GRAND	30
7. BIO. Soi พร้อมศรี	30-40
8. สมิติเวช, 49/18 วินรก	30
9. Soi 49/14 แยก 1-2	40
10. Soi 49/19-18	40
11. D.S 1-2	40-50
12. U.F.M 1-2	40-50
13. Soi 31-33-51	40
14. อิตัลไทย, BOULEVARD	50
15. โอโซโน	50
16. Soi พร้อมพรรค, 49/6	50
17. Soi 53-55	50
18. Soi 24-26	60
19. Soi 20-22	70
20. ทองหล่อ Soi 20-10	60
21. Soi 23	50
22.	
23.	
24.	
25.	

(d) Fare list

Figure 26 Characteristics of Sukhumvit Soi 39 (SV) route

3.2.2 Sample design

To examine the functioning of Silor service under the current situation, data are collected from various stakeholders of the service, covering both supply sides (operators and regulators) and demand (users and non-users) side.

1) Supply side

The supply groups in this study include both operator and the government agency which control the operation of Silor service.

(1) Operators

Operators of this study are those drivers who provide services to passengers. Their socio-demographic profile, career and vehicle information should be collected to examine the operational characteristics of Silor service.

(2) Regulators

Service provider of this study is the Department of Land Transport (DLT), the government institution which controls Silor services. The Department plays an important role in proposing regulation and formulating policy to manage the service. Thus, policy and regulation related to Silor service should be investigated in order to identify the potential to improve the effectiveness in controlling the service.

2) Demand side

In this study, the demand groups cover all passengers who make their journey along Silor routes and have possibilities to use the service. They may either use or not use Silor. The demand groups are classified into users and non-users, based on Silor usage, as followed:

(1) Users

It is of great importance to understand who are existing Silor customers in order to retain the ridership. Users in this study are those who use Silor for their journey. Their socio-demographic profile, travel behavior as well as attitudes should be investigated. Also, the Silor service quality should be assessed from the perspective of the users as to realize the strength and weakness for the performance improvement of the service.

(2) Non-users

Apart from users, it is essential to understand who potential customers are in order to attract riders to use the service. In this study, non-users are those who have never used Silor but they might use private vehicles, other public transport modes, bicycle or walk for their usual journey. Their socio-demographic profile, travel behavior as well as attitudes should be investigated.

3.2.3 Data collection method

Regarding the varieties of social research, some social scientific research uses quantitative data (in form of numbers) while other research involve qualitative data (non-numerical) without statistics (Neuman, 2014). Both approaches are involved in this study using multiple research techniques, questionnaire survey, interview, and secondary analysis, to gather and analyze empirical data. The research design flowchart is presented in Figure 27.

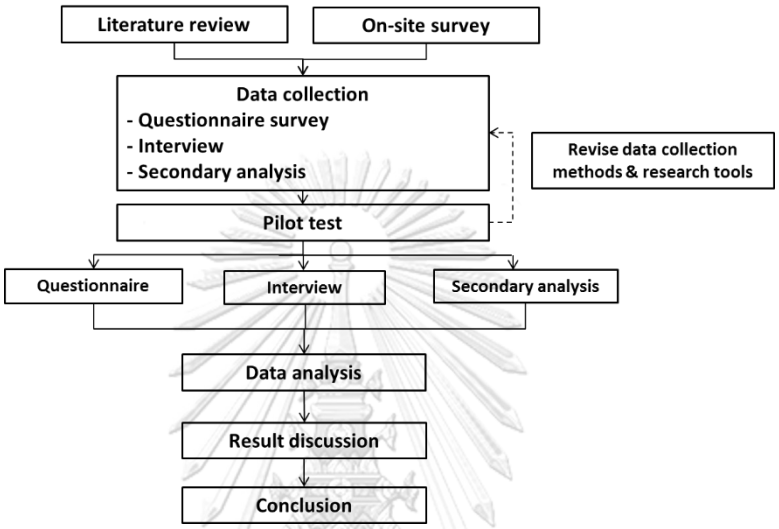


Figure 27 Research design flowchart

1) Questionnaire survey

Survey is the most widely used social science data-gathering technique which can be conducted in many forms—interview, polls, and various types of questionnaires (Neuman, 2014). Most surveys ask a large number of respondents the questions about their characteristics, opinions, and past or present behaviors. Regarding this, surveys are appropriate for gathering descriptive information and test multiple hypotheses in order to learn about behaviors.

In this study, questionnaire survey was constructed applying various types of questions: closed-ended question, open-ended question, and Likert scale. Firstly, in closed-ended question, respondent can choose their answer from a fixed set of responses provided. This type of questions is usually applied in large-scale survey as the reason that it is faster and easier for both respondents and researchers. Moreover, it is also easily coded and statistically analyzed (Neuman, 2014). Secondly, open-ended question, which need an unstructured and free response, respondents can give any answer. On the one hand, this permits unlimited number of possible answers. On the other hand, this requires interviewers to write word-by-word answers followed by the time-consuming coding (Neuman, 2014). Lastly, the Likert scale is used in this research to capture people's attitudes. Likert scales usually ask people to indicate whether they agree or disagree with the statement.

In this study, the questionnaires are constructed to investigate the operational characteristics of Silor services by asking Silor drivers, and also to examine travel behavior as well as attitudes of Silor users and non-users. Three types of surveys were conducted in this study: “Driver Survey”, “User Survey”, and “Non-user Survey”.

(1) Driver Survey

Driver Survey was carried out to gather information related to the operational characteristics of Silor services. Questions for Silor drivers were constructed in four sections. The sections on socio-demographic characteristics, career information, and vehicle information use closed-ended questions, while a section on challenges and opinions on Silor service apply open-ended questions. Mixing open-ended and closed-ended questions in a questionnaire offers a change of pace and help interviewers establish rapport (Neuman, 2014).

(2) User Survey

Questionnaire surveys for Silor users are set up to examine their travel behavior and identify their attitudes towards the current Silor service. Five sections of questionnaire include socio-demographic characteristics, Silor trip characteristics, alternative mode trip characteristics, reason for using Silor, and attitudes towards Silor service quality. Closed-ended questions are used for the first three sections, whereas a five-point Likert scale is applied to measure the reason of use and traveller attitudes.

(3) Non-user Survey

For non-users, questions are constructed to explore their travel behavior and also identify their attitude towards Silor and other modes they use. Questionnaires are separated into four sections, consisting of socio-demographic and trip characteristic sections, using closed-ended questions, and sections on reason of not using Silor and attitude which use a five-point Likert scale.

2) Semi-structured interview

The interview is short-term, secondary social interaction between two strangers with the explicit purpose of one person obtaining specific information from the other. Interactions take the form of a structured conversation in which the interviewer asks prearranged questions and the respondents gives answers, which the interviewer records (Neuman, 2014). The data were obtained from the answers and then coded into concepts and ideas.

In this study, the interviews were conducted with the DLT officers to gain insight into the policy making process as well as challenges and opinions relating to Silor services from policymaker points of view. Through the interview, the participants were asked to talk about roles responsibilities and policies for Silor service. Additionally, the issues on laws and regulations relating to Silor registration were discussed. To investigate further, participants were also asked to state challenges and opinions on regulating Silor service.

3) Secondary analysis

Secondary analysis analyzes survey data originally gathered by someone else. It is relatively inexpensive and permits comparisons across groups, nations, or time (Neuman, 2014). Information is available in the form of existing statistical documents, such as books and reports. It also includes data that organization collected over long time periods. In this study, secondary data on the record of Silor registration are collected from the official reports of DLT.

3.2.4 Pilot survey

When questionnaire had been constructed, they went for pilot testing to check if the language are easy to understand and also if the questions are answerable and related to the purpose of the survey. The pilot surveys were conducted with VR and BT routes on the 16th and 24th February 2018, respectively. The survey involved 41 respondents, which comprise 16 drivers, 19 users, and 6 non-users.

3.2.4.1 Questionnaire design

Regarding the test with respondents, some changes in questionnaire were made based on the feedback and necessity of the questions.

1) Driver Survey

The questionnaire tested with Silor drivers revealed that some questions were too complicate to answer. Consequently, some questions were decided not to include in the questionnaire. For example, questions relating to number of trips per day and service distance per trip; instead, the question on fuel cost per day will be applied to estimate the distance they operate in one day. Likewise, the questions on maintenance cost, age of vehicle, and engine capacity were excluded from the questionnaire.

Questionnaires were also evaluated regarding the necessity of the questions. For instance, questions about time spent on other jobs and additional income from other jobs were decided not to include in the question as they did not make much of a contribution to the study. Moreover, changes were made to the question that asked on the presence of child. The question was replaced by question on how many members are supported by their monthly income. This would provide a more significant household income data.

2) User Survey

After pilot testing with users of Silor, feedbacks from the survey brought about changes in the constructed questionnaire. In measuring satisfaction of Silor services, it is realized that some respondents were confused with wording applied in attitudinal statements. This might be due to the fact that some service factors in the questions are not applicable to Silor. Originally, the statements are constructed in form of noun phrase; thus, they were modified into simple sentences to make them easier to understand. Also, it is found that some service factors are not suitable for the performance assessment

of Silor and were removed correspondingly. However, questions relating to these factors still remain in the section asking importance level of public transport mode so as to capture attitudes on service quality of public transport modes.

Furthermore, when asked about the trip travelled by Silor, respondents had difficulty in responding to question on their trip distance. To cope with this, the question was added, following the trip purpose question in the trip characteristics section, for respondents to identify their specific location for, both, origin and destination. Thus, the trip distance will be estimated in the Google map afterwards.

Regarding the alternative mode section, two modes, private motorcycle and taxi, were added in the questionnaire since respondents had mentioned them as the travel choices and were not included in the original questionnaire. Additionally, question on origin and destination of alternative modes were also asked to respondents although it should be implied that origin and destination of trips by Silor and any alternative mode are, both, similar. As a consequence, this question in alternative mode section was removed because the data have already been obtained from the previous Silor mode section.

A question relating to weekly travel cost of all transport modes was also removed from the original questionnaire as they are information that do not need in the study. Besides, it is found that question asking whether respondents are travelling alone, accompanying children, or other people, should be changed. Therefore, a new question was developed by asking amount of members travelling altogether which would reveal the household travel pattern.

3) Non-user Survey

Thereafter, the feedbacks from the pilot test on non-users have resulted in some alteration in the questionnaire, most of which are similar to the user questions. Firstly, due to the fact that most respondent were not able to give the data on trip distance, a question was added asking origin and destination location. Besides, the question on weekly travel cost of all transport modes was removed and the question on household travel pattern was altered.

Moreover, one question was added in the beginning of the section on importance level rating for the public transport mode. In prior to rating the importance level of public transport attributes, respondents were asked to select on public transport mode they used from a category of different public transport mode. This is mainly because respondents may have chosen either private or public modes as their main transport mode in the previous question relating to trip characteristics. This new question is then constructed for them to specify only one mode of public transport before evaluating the importance score for its attributes.

For the section asking reason of not using Silor, few statements are decided not to be included in the question for the reason that information obtained would not make much a contribution to the study and the attributes are not applicable for Silor.

After the pilot test was conducted, three sets of questionnaires were revised before going for the survey along five Silor routes (See Questionnaire Design in Appendix A). The final set of questionnaire for Driver, User and Non-users include sections, aspects and questions as summarized in Table 21. The data collection are conducted from July to September 2018.

Table 21 Final questionnaire sections, aspects, and survey questions

Section	**Aspect**	**Survey question**		
		Closed-ended	Open-ended	Five-point Likert scale
Driver Survey (Three sections)				
I Career information	Years in career, time and days of work, income, other jobs, vehicle ownership, price, rental fee, fuel type, fuel cost, vehicle registration	✓		
II Challenges and opinion on the service	Challenges of services among competing modes, experiences with the police, opinions on policy for setting proper stops and to integrate SR as feeders	✓	✓	
III Personal information	Age, gender, hometown, marital status, education, driving license, cooperative membership, amount of members that income have to support	✓		
User Survey (Five sections)				
I Silor trip characteristic	Frequency, time period, origin-destination, travel cost, travel distance, waiting time, travel time, transfer mode, overall satifaction	✓		
II Reason of use	Level of agreement on statements relating to reason for using Silor			✓
III Attitudes towards public transport service	Importance score on service quality of public transport mode, satisfaction score on service quality of Silor			✓
IV Alternative mode	Alternative mode, frequency, travel cost, travel distance, waiting time, travel time, reason of choosing Silor instead of alternative modes	✓	✓	
V Personal information	Age, gender, marital status, occupation, education, household member, vehicle ownership, amount of members travelling altogether, income	✓		
Non-user Survey (Four sections)				
I Trip characteristic	Travel mode, frequency, time period, origin-destination, travel cost, travel distance, waiting time, travel time, transfer mode	✓		
II Reason of non-use	Level of agreement on statements relating to reason for not using Silor			✓
III Attitudes towards public transport service	Importance score on service quality of public transport mode			✓
IV Personal information	Age, gender, marital status, occupation, education, household member, vehicle ownership, amount of members travelling altogether, income	✓		

For User and Non-user Survey in section 2, this study applied the statements of reasons for using and not using SR as presented in Table 22.

Table 22 Reasons for using and not using SR

Reasons	Reference
Reasons for using SR	
Attribute 1: Drive-free benefit	
I want to get in touch with local people	1
I can have more time to do something else on board	1
Attribute 2: Traffic reduction	
I want to avoid traffic jam	1
I want to contribute to less pollution	1
I want to contribute to less traffic congestion	1
It is difficult to find parking lots	1
Attribute 3: Advantages of the SR	
SR is convenient	1
SR is very accessible	1
Travelling on SR is cheap	1,2
Attribute 4: Car unavailability and restriction	
I do not have car	1,2
Attribute 5: Safety	
Lower risk of road accidents	2
Reasons for not using SR	
Attribute 1: Inconvenience and restrictions	
Stations and stops are not conveniently located	1,2
There is no good connection to where I want to go	1
Attribute 2: Lack of information	
I do not know how to use SR	1
Attribute 3: Disadvantages of SR	
SR is too slow	1,2
I think it is not safe to travel on SR	1
I do not feel comfortable with the crowd	1,2
Fares are expensive	1,2
Attribute 4: Waiting time	
Long waiting time	2
Attribute 5: Transfer	
I do not want to transfer	2
Attribute 6: Personal preferences	
I travel by a car	1
I prefer walking or cycling	1

Note: 1. Le-Klahn *et al.* (2014) investigated the motivations for using and not using public transports in Munich, Germany
2. Mazzulla and Eboli (2006) determined relative weights of all attributes on customer satisfaction by asking public transport user and non-user to rank use and non-use reasons as well as their importance of service quality attributes, conducted with University of Calabria students, Italy

Service attributes for ratings of both importance level and satisfaction level are presented in Table 23.

Table 23 Service attributes for ratings of importance level and satisfaction level

Service attributes	Reference
Attribute 1: Availability	
Service frequency	1,2,4,5
Coverage area	5
Length of operation time	5
Attribute 2: Reliability	
Travel time	1,2
Travel speed	1
Waiting time at stop	1,5
Attribute 3: Safety and security	
Overall safety from road accident	1,2,5
Overall security from criminal incidents	1,2,4,5
Attribute 4: Fare	
Suitable fare structure	1,5
Attribute 5: In-vehicle environment	
Passenger politeness	1
Cleanliness in the vehicle free from dust or garbage	1,4,5
Quality and condition of material inside the vehicle, e.g., seat, lamps, etc. *	5
Design and arrangements inside the vehicle, ease to move, and sitting position	5
Air-conditioning in the vehicle *	1,5
Protection from exposure to the elements	1
Attribute 6: Comfort and convenience	
Seat availability	1,2,4
Seat comfort	2,3
Given sufficient stop time to board and alight	2
Ease to enter the vehicle e.g., open the car-door, height of step, etc.	5
Availability of shelter and benches at stops	4
Convenience of connections and transfers	2
Attribute 7: Information	
Availability of information regarding the service e.g., fare, etc.	1,4,5
Attribute 8: Customer service	
Driver's attitude to serving customer, including politeness, honesty, etc.	2,5
Attribute 9: Environmental impact	
Level of air and noise emission	5
Level of congestion impact caused by the mode	5
Level of road accident caused by the mode	5

Note: * Factors applicable for rating only importance level

1. Grujicic *et al.* (2014) identified public transport system service quality elements that should be primarily acted on, using Importance-Performance Analysis based on public transport users and non-users point of view in Belgrade, Serbia
2. Habib *et al.* (2011) investigated reasons for using transit, expressed as functions of perceptions and attitudes towards transit service quality and attribute, a case of residents of the City of Calgary, Canada
3. Eung (2015) examined passenger perception toward different travel modes, in Phnom Penh, Cambodia
4. Mazzulla and Eboli (2006) determined relative weights of all attributes on customer satisfaction by asking public transport user and non-user to rank use and non-use reasons as well as their importance of service quality attributes, conducted with University of Calabria students, Italy
5. Joewono and Kubota (2007) explored users' satisfaction related to quality of service, overall satisfaction and loyalty of *Angkutan Kota*, paratransit in Bandung, Indonesia

3.2.4.2 Survey method

Paper-based questionnaire were applied to conduct pilot test by using both on-board and off-board survey methods. The surveyor approached the participants randomly and introduced themselves while the purpose and procedure of the research were also explained. Participation was entirely voluntary. If respondents agreed to participate, the surveyor started to ask questions in the questionnaire.

1) Driver Survey

For on-board survey with Silor drivers, the surveyors get on Silor and ride in the front seat with the drivers while questionnaire interviews were also administered. Moreover, off-board surveys were also conducted at the route terminals, where drivers park their vehicles, during their break time or waiting in the queue. The pilot survey revealed that the questionnaire required 5 minutes to complete.

2) User Survey

Similarly, for users, both on-board and off-board survey methods have been conducted in two Silor routes. First, the 2-km VR route, which users just ride Silor for 5-10 minutes, it is more likely that respondents will not be able to finish the questionnaire. Consequently, off-board surveys were conducted in public places along the route, such as, convenience store, shopping mall, and Silor terminals. In the beginning, the surveyor will ask the respondents whether they have experience riding Silor or not. When the response is YES, the surveyor will continue by using the User Survey, while the response is NO, the surveyor will continue with the Non-user Survey.

The other route is the 13-km BT route, which users spend time riding 5-20 minutes and it is possible to do the on-board survey. Nevertheless, surveyors need to ask the respondents' destination in prior to conducting the survey as to ensure that respondents have enough time to finish the questionnaire while riding on-board. Importantly, surveyors also need to be familiar with places in local areas along the routes; otherwise, they will not be also to recognize the places that respondents mention. In addition to on-board survey, off-board surveys on Silor users have also been conducted in public spaces.

3) Non-user Survey

For non-users, all were conducted using off-board survey method by approaching respondents randomly in public places. In the beginning, respondents will be asked if they have experience riding Silor. If the response is NO, then, the Non-user Survey will be used. However, as the user and non-user questionnaire require 5-10 minutes to complete, the pilot test revealed that applying off-board survey method can ensure that users and non-users have enough time to complete the questionnaire.

3.2.5 Analytical techniques

In this study, descriptive statistics explain the current state of supply and demand sides, including socioeconomic and trip profiles as well as sustainability in various aspects. Multivariate analysis techniques are also applied namely, Factor Analysis, Logistic Regression and Cluster Analysis to study interactions among variables, including travel behavior, reasons for using and not using Silor, and perceptions on service quality

3.2.5.1 Factor analysis

Factor analysis (FA) is one of multivariate statistical methods for examining the underlying correlation structure among explanatory variables (Washington *et al.*, 2011). FA is the means of interpreting the role that each variable plays in defining each factor and reduces a large number of variables into a smaller set of variables, referred to as factors. It also establishes underlying dimensions between measured variables and latent constructs, thereby allowing the formation and refinement of theory (Williams *et al.*, 2010).

Factor loadings are correlation of each variable and factor. Loading indicates the degree of correspondence between the variable and the factor, with higher loadings making the variable representative of the factor (Hair *et al.*, 2014). Variables with higher loadings are considered more important and have greater influence on the name or label selected to represent a factor, where the signs of loading are interpreted as the direction of relationship (direct or inverse) (Hair *et al.*, 2014).

FA assumes that the ratings on various statements are really produced by some underlying and unobserved attitudes (Lehmann *et al.*, 1998). The basic form of FA model is as follows:

$$X_{ji} = \sum_{k=1}^{m} (\lambda_{jk} F_{ki}) + \varepsilon_{ji}, \quad \forall j = 1, 2, \ldots, J \text{ and } \forall i = 1, 2, \ldots, N \tag{1}$$

where X_{ji} is the rating on statement j for person i; F_{ki} is the value of the kth factor for the person i; λ_{jk} is the relation of the jth variable with the kth common factor, also known as the loading; and ε_{ji} represents the error term. The model (2) assumes that there are J statements, m factors, and N observations in the sample. It must be noted that the factor scores, F_{ki}, are not observed. FA computes both factor scores and loadings so as to maximize the information maintained from the original statements.

The objective of performing the FA in this study is to describe the statements in the survey in terms of unobserved or latent variables, while retaining the explanatory power of the original variables. Exploratory Factor Analysis (EFA) will

be conducted to extract the latent factors from the original statements and statistically estimates the correlation structure among the statement variables (Li *et al.*, 2013).

Exploratory Factor Analysis (EFA) is one class of factor analysis. In EFA the investigator has no expectations of number of nature of variables and is exploratory in nature (Williams *et al.*, 2010). It allows the researcher to explore the main dimensions to generate a theory or model from a relatively large set of latent constructs, often represented by a set of items (Thompson, 2004). For factor to be analyzed, Hair *et al.* (1995) suggested that sample size should be 100 or greater. Comrey and Lee (1992) guided the sample sizes of 100 as poor, 200 are fair, 300 as good, 500 as very good, and 1000 or more as excellent.

Prior to the extraction of factors, several tests should be used to assess the suitability of the respondent data for factor analysis. These tests include Kaiser Meyer Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity. The KMO index ranges from 0 to 1, with 0.50 considered suitable for factor analysis. The Bartlett's Test of Sphericity should be significant ($p<0.05$) for factor analysis to be suitable (Hair *et al.*, 1995; Tabachnick & Fidell, 2013).

The rotation in factor analysis aims to simplify the factor structure of a group of items, the high items loadings on one factor and smaller item loadings on the remaining factor solutions (Costello & Osborne, 2005). Orthogonal Varimax rotation, first developed by Thompson (2004), is the most common rotational technique used in factor analysis, which produce factor structures that are uncorrelated. This method attempts to make the loading either large of small to facilitate interpretation (Rencher, 2002). Regardless of which rotation method is used, the main objectives are to provide easier interpretation of results and produce a solution that is more parsimonions (Hair *et al.*, 1995).

Certain cumulative percentages of variances have been suggested in factor analysis approaches. According to Hair *et al.* (1995), in natural sciences, factors should be stopped when at least 95% of the variance is explained. In humanities, the explained variance is commonly as low as 50-60%.

Interpretation of factor analysis involves the researcher examining which variables are attributable to a factor and giving that factor a name or theme (Williams *et al.*, 2010). At least two or three variables must load on a factor so it can be given a meaningful interpretation (Henson & Roberts, 2006). The reason for thorough and systematic factor analysis is to isolate items with high loadings in the resultant pattern matrices.

3.2.5.2 Logistic regression

Logistic regression models estimate the log odds of the outcome occurring versus the log odds of the outcome not occurring for a given independent variable. These log odds ratios are functions of the probabilities. Assume that each case has a probability of having experiencing an event, defined as p_i. Since the dependent variable has values of only 0 and 1, this p_i must be estimated to treat the outcome in terms of probabilities. The value of 1 means the expected event occurs whereas the value of 0 means the expected event fails to occur. The logit transformation involves two steps (Pampel, 2000). First take the ratio of p_i to $1 - p_i$, or the odds of experiencing the event. Second, take the natural logarithm of the odds. The logit thus equals Eq.(2)

$$L_i = \ln\left[\frac{p_i}{1-p_i}\right] \tag{2}$$

The logit model solves problems in Eq.(3) and Eq.(3)

$$\ln\left[\frac{p}{1-p}\right] = \alpha + \beta x + e \tag{3}$$

$$\left[\frac{p}{1-p}\right] = \exp(\alpha + \beta x + e) \tag{4}$$

Where:

p = Probability of an outcome event (overall satisfaction)

α = Intercept

β = Estimated coefficient

x = Independent variable (attitudinal scores towards reliability, in-vehicle environment, comfort and convenience, and environmental impact)

e = Error term

Ordinal Logistic Regression (OLR) is an extension of logistic regression when there is an ordered outcome variable. In OLR, log odds ratios are calculated for the independent variable just as in logistic regression and are also calculated for the intercept of each level of the outcome variable. These intercept log odds ratios effect the change in the log odds associated with membership in a different level of the outcome variable compared to either the highest or lowest category. The relationship between the predictors and each of the levels of the outcome are proportional. Rather than estimating the probability of a single category, OLR estimates a cumulative

probability, i.e. the probability that the outcome is equal to or less than the category of interest.

Equation 5 illustrates the general logit regression model:

$$Logit(p) = \ln\left[\frac{p}{1-p}\right] \quad (5)$$

3.2.5.3 Cluster analysis

Due to their different needs and preferences towards the service, passengers have different perceptions on each service attributes. One option for capturing heterogeneity of passengers is stratifying sample of users on segments of passengers with more uniform socioeconomic characteristics as well as opinions regarding service attributes. Transit service quality analysis can benefit from Cluster Analysis (CA) to aid process of segmentation through data mining technique to separate data elements into groups where homogeneity of elements within clusters are maximized and heterogeneity between clusters are maximized (Oña *et al.*, 2016). CA has been applied with satisfactory results in fields of transport engineering as to address passenger heterogeneity by stratifying passengers into groups with common characteristics and groups with more homogenous perceptions regarding service attributes. CA not only helps address heterogeneity but also identifies specific passenger profiles and understands passenger behavior (Oña *et al.*, 2016).

Clustering techniques are normally based on variables describing socio-demographic characteristics of the population, as well as their attitudes and behaviors concerning mobility. These clusters have proven their utility in defining more targeted and effective policy actions aimed at promoting behavioral changes and increasing sustainability of transport systems (Cote & Diana, 2017).

Four types of segmentation studies can be identified: geographic, that considers the localization of consumer; demographic, according to personal characteristics of the individual; psychographic, based on lifestyle variables, including attitudes, values and beliefs; behavioral, based on the actual purchasing choices (Kotler & Armstrong, 1999). Most of segmentation studies in the travel behavior research domain are based on of one these latter two approaches and have provided important feedback to decision makers on how to personalize travel-related measures to maximize the expected benefits and impacts (Cote & Diana, 2017).

This study will apply the K-means clustering method to group users into distinct segments. Individual within the same segment share similar socioeconomic and trip characteristic while users in different segments hold different characteristics. Several distinct user segments will be generated.

Traveller attitudes are often unobservable and cannot be directly measured. However, in previous research, factor analysis has been commonly used in identifying latent variables from a series of attitudinal statements or questions. A considerable number of researchers performed EFA to identify the dimensions of public transport service quality from various service indicators (Pronello & Camusso, 2011; Sharma *et al.*, 2017; Susilawati & Nilakusmawati, 2017; Yarmen & Sumaedi, 2016). A great number of literatures applied the identified latent variables from EFA to perform market segmentation (Pronello & Camusso, 2011). Several studies evaluated the use of statistical cluster methods such as K-means clustering to segment the travel market (Anable, 2005; Ryley, 2006). K-means cluster uses the within-cluster variations as a measure to form homogeneous cluster. Specifically the procedure aims at partitioning the data in such a way that the within cluster variation is minimized (Sarstedt & Mooi, 2014).

Extensive literatures are available on users' attitudes towards service quality associated with formal public transport modes; nevertheless, research on informal transport service quality examining user perceptions and segmentation is very limited. In the context of paratransit in Thailand, Choocharukul and Sriroongvikrai (2011) conducted a survey on attitudes of passengers with two available modes, one is SR and the other is motorcycle taxi, bus or Songtaew. Respondents were asked to indicate importance and satisfaction scores, form 1-5 scale, on seven aspects, including wait time, travel time reliability, travel speed, travel cost, seat comfort, stopping location, and safety. The different scores of each paired transport modes illustrated that when considering between SR and mortorcycle taxi, the former is more advantageous for its fare and safety, whereas the advantage of the latter are speed and stopping location. Comparing to bus, SR is more advantageous in terms of lower fare and higher speed. However, the study found that some preferred bus due to the higher perception of safety. For the case of SR and Songtaew, the preference towards the former is as of the speed, while the latter are due to lower total trip cost.

Additionally, attitudinal variables are evaluated from the perspective of users and grouped into latent factors as a study on influences of informal transport mode on mass transit connectivity by Tangphaisankun *et al.* (2009). The performed factor analysis classified service measurements into four main factors. Firstly, mass transit access measurement included total access time, total wait time, total access cost, and transfer difficulty. Secondly, comfort and convenience can be measured by wait time, number of stops, and flexibility to change route. The third factor is safety and security of transport mode, measured by riding or driving quality, vehicle condition and safety equipment, and night time security from crime. The last factor is information of service, including service schedule and fare information, service and registration information, and accident insurance information. Further, the effects of commuters' satisfaction to attitudes were analyzed among three commuter segments of different income levels, low, middle and high income. The model illustrated that

satisfaction has positive effects on mass transit access trip. Result also revealed that time of access trip to stations is significant factor for middle and high income groups, while the expense and wait time for access trips are significant for both low and middle income commuters.

In Bangladesh, the paratransit users were interviewed with structured questionnaire to develop empirical modes using 24 service quality variables (Rahman *et al.*, 2016). The physical appearance and service features are found to be the two latent variables from the analysis. In addition, the study revealed that physical appearance have less influence than service features on the overall service quality. The result found that punctuality and reliability, fitness of vehicle and travel costs are the most significant observed variables having influence on the service.

In the case of informal transport in Indonesia, a service quality model was tested by Bakti and Sumaedi (2015). Four dimensions of service quality were extracted. The first dimension is comfort, measured by six indicators including passenger capacity, safety, obedience to traffic, comfortable temperature, security, and safety related to other passenger behavior. Secondly, the tangible dimension represented the cleanliness of interior, exterior, condition of public transport machine, and seat conditions. The third aspect is personnel which related to four indicators, including helpfulness, responsiveness, understanding passenger needs, and courtesy. Lastly, the reliability dimension, measured through wait time, travel time, adequacy of service, and delivery to destination. The result of service quality measurement are helpful in monitoring the service performance and further can be used to develop management strategies in order to increase the ridership and provide efficient public transport service quality to the community.

Further, the study of different transport modes in India by Sarkar and Mallikarjuna (2018) highlighted that attitudes and perceptions affect the mode choice behavior of commuters. The household survey was conducted with city residents on perceptions towards car, bus, three wheeler, two wheeler, bicycle, cycle rickshaw and walking mode. Service indicators were grouped into four latent variables, namely, comfort, safety, flexibility, and reliability. The result illustrated the underlying latent attitudes towards different travel modes in that comfort and flexibility were found to be significant factors affecting trip makers' mode choice behavior. Flexibility significantly increases the propensity to choose two wheeler and three wheeler modes whereas the desire for comfort was found to increase the tendency to use car as a mode of travel.

The literature also revealed that public perception research can be implemented as the national action plans (Joewono & Kubota, 2006). In order to improve safety and security in public transport services, understanding and awareness of users and drivers on road safety and security issues are the most important factor.

They should be informed, trained and educated in an effective way. Based on the perception of stakeholders, an improvement agenda has been developed consisting of three aspects, including technology, management, and institutions. The agenda has been clarified by a set of action plans, indicating involved parties and timeframe as to implement the action draft for road safety.

Basic ideas on market segmentation have been found in in travel behavior area. For instance, market segmentation approach was used to identify the potential transit markets (Tarigan, 2014). Travelers were clustered into eight groups by three attitudinal factors including the sensitivity to time, need for fixed schedule and willingness to use public transit. Market segmentation is also useful in developing strategies to best serve the various submarkets for increasing public transport ridership (Tarigan, 2014). Previous studies show that market segmentation analysis is a means of increasing the share of public transport modes.

Table 24 provides a summary of case studies in literatures. They explored service attributes by applying comparative, factor, and cluster analysis as well as structural equation modeling and choice modeling. For each mode of transport, previous studies explained user perceptions in a single context; there is still a lack of understanding on how users from different service areas perceived the quality of service. Therefore, this research is conducted in two route contexts and provides complementary insights on heterogeneity of users based on perception analysis and market segmentation approaches.

Table 24 Informal transport case studies

Authors	Year	Country	Mode	Techniques	Attributes
Choocharukul & Sriroongvikrai	2011	Thailand	Silor, Motorcycle taxi, Bus, Songtaew	- Comparative analysis	- Wait time, travel time, travel speed, travel cost, seat comfort, stopping location, and safety
Tangphaisankun *et al.*	2009	Thailand	Motorcycle taxi, Songtaew	- Factor analysis - Structural equation modeling	- Mass transit access, comfort and convenience, safety and security, and information
Rahman *et al*.	2016	Bangladesh	Paratransit	- Structural equation modeling	- Physical appearance and service features
Bakti & Sumaedi	2015	Indonesia	Paratransit	- Factor analysis	- Comfort, tangible, personnel, and reliability
Sarkar & Mallikarjuna	2018	India	Formal and informal transport	- Mode choice model	- Comfort, safety, flexibility, and reliability
Joewono & Kubota	2006	Indonesia	Paratransit	- Factor analysis	- Safety and security
Tarigan	2014	Indonesia	Paratransit	- Cluster analysis	- On-time performance, security, and service satisfaction

In addition to multivariate analysis, the study will apply Importance-Performance Analysis (IPA) to examine user views on service attributes. The purpose of IPA is to point out the areas where improvements would have the greatest impact on improving satisfaction with the entire system (Yang *et al.*, 2011). The IPA compares two criteria that users use in making a choice. The first criteria is the relative importance of attributes (reflection of the relative value of the various quality attributes to users) and the second is satisfaction (users' evaluation of the offering in terms of those attributes) (Slack, 1994).

The IPA is presented as a two-dimensional matrix in the coordinate system which forms four quadrants, as illustrated in Figure 28. The attributes located in Quadrant QI have both great importance and high level of performance, and they are perceived as parameters that can be used to achieve or maintain competitiveness, and the functioning of these components should be maintained at the existing level. Quadrant QII contains attributes that have high performance but low importance, which indicates that resources assigned to these attributes are too great and that they should be assigned to some other attributes. Quadrant QIII contains attributes that feature both low importance and low performance, and therefore these attributes do not require any additional effort. Attributes in Quadrant QIV are of great importance but have poor performance (low user satisfaction), and are therefore considered attributes of the greatest weakness and should be improved (Grujicic *et al.*, 2014).

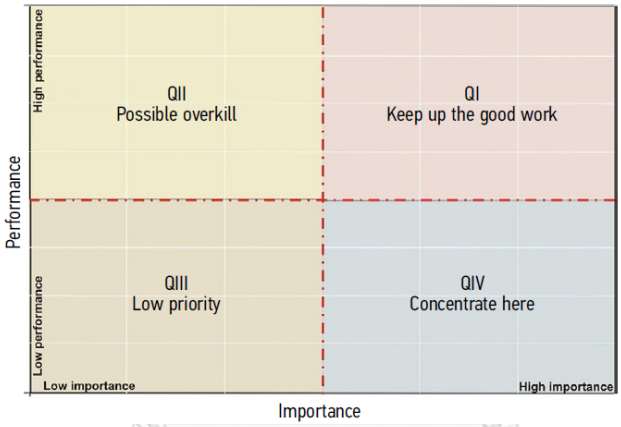


Figure 28 Quadrants in IPA (Grujicic *et al.*, 2014)

Previous research applied IPA to investigate main priority of expectation of public transport users and identify service elements to be further improved. Public transport services indicators needed to be improved are accessibility, integration, capacity, smooth and fast, convenient, safety, easy, timely, orderly, and efficient (Putra *et al.*, 2014). The most important elements from user and non-user points of view are tangible elements which involved vehicle cleanliness and ventilation in the vehicle (Grujicic *et al.*, 2014). Their results are practical guidelines for the improvement of transport service quality.

CHAPTER IV
SUPPLY AND REGULATORS OF SR SERVICES

This chapter presents the results on the supply side and regulators of SR service which involves SR drivers and Department of Land Transport (DLT) officers as the regulators. SR driver characteristics and opinions are interviewed based on questionnaire survey. Semi-structured interview is conducted with regulators focusing on roles and responsibilities, laws and regulations, challenges as well as opinions or SR development.

4.1 Drivers

This study investigates socioeconomic characteristics, occupation variables as well as challenges and opinions on SR development from drivers of SR services covering five SR routes: Bangbon-Taladplu (BT), Siriraj-Taladplu (ST), Charoennakorn-Klongsan (CK), Vibhavadi-Rachada (VR), and Sukhumvit Soi 39 (SV) routes. The distributions of driver samples from each route are listed in Table 25.

Table 25 Distribution of driver samples

Route	N	Percent
Bangbon-Taladplu (BT)	31	22.8
Siriraj-Taladplu (ST)	30	22.1
Charoennakorn-Klongsan (CK)	26	19.1
Vibhavadi-Rachada (VR)	28	20.6
Sukhumvit Soi 39 (SV)	21	15.4
Total	136	100

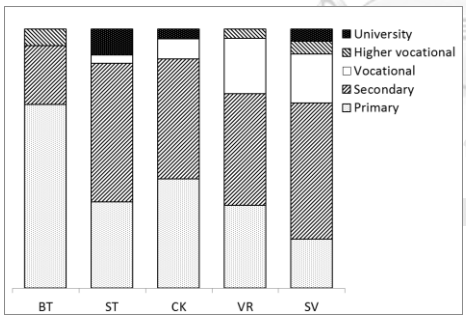
4.1.1 Socioeconomic and occupation variables

Socioeconomic data of SR drivers from all five routes are summarized in Table 26. Most of SR drivers are male scattered in all age groups. In all routes, drivers are married approximately 61-71%, except for SR route which report 52%. For education level, about 71-94% of drivers indicate primary and secondary school. All five routes are similar in terms of their hometown where “Central” ranks the first and “Northeastern” comes second. When asking numbers of supporting individuals that their incomes have to support, category of “2-4 supporting individuals” shows the highest share in all routes, accounting for 42-89%. Most drivers state that they drive SR as their only job (80-96%) while a few has other jobs besides driving SR. Other jobs are in the fields of vendor, agriculture, cook, messenger, and mechanic. Distribution of Education, Hometown, and Supporting individual among drivers of five SR routes are depicted in Figure 29.

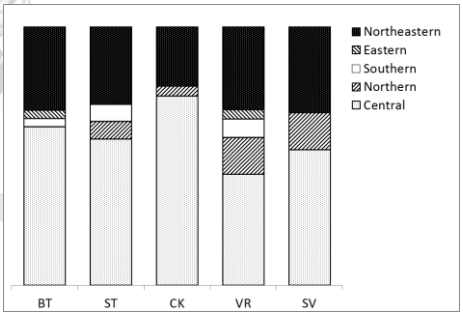
Table 26 Descriptive statistics of driver socioeconomic variables

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Gender						
Male	100.0	96.7	96.2	100.0	100.0	98.5
Female	0.0	3.3	3.8	0.0	0.0	1.5
Age						
19-34	19.4	10.0	19.2	14.3	23.8	16.9
35-44	12.9	30.0	23.1	21.4	33.4	23.5
45-54	29.0	33.4	38.5	39.3	19.0	32.4
55-64	25.8	23.3	11.5	14.3	14.3	18.4
65+	12.9	3.3	7.7	10.7	9.5	8.8
Marital status						
Single	38.7	36.7	36.0	28.6	47.6	37.0
Married	61.3	63.3	64.0	71.4	52.4	63.0
Education						
Primary	70.9	33.3	42.3	32.1	19.0	41.2
Secondary	22.6	53.4	46.2	42.9	52.4	42.6
Vocational	0.0	3.3	7.7	21.4	19.0	9.6
Higher vocational	6.5	0.0	0.0	3.6	4.8	2.9
University	0.0	10.0	3.8	0.0	4.8	3.7
Hometown						
Central	61.3	56.6	73.1	42.9	52.4	57.3
Northern	0.0	6.7	3.8	14.3	14.3	7.4
Southern	3.2	6.7	0.0	7.1	0.0	3.7
Eastern	3.2	0.0	0.0	3.6	0.0	1.5
Northeastern	32.3	30.0	23.1	32.1	33.3	30.1
Supporting individuals						
None	19.4	30.0	3.8	3.7	9.5	14.1
1	22.6	16.7	7.7	11.1	19.0	15.6
2-4	41.9	43.3	88.5	70.4	66.7	60.7
5 or more	16.1	10.0	0.0	14.8	4.8	9.6
Other jobs						
No other job	93.5	80.0	96.2	96.4	90.5	91.2
Have other jobs*	6.5	20.0	3.8	3.6	9.5	8.8

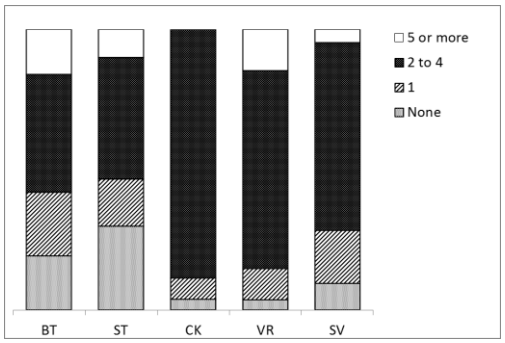
Note: *Other jobs involve vendor (4 respondents), agriculture (2 respondents), cook (1 respondent), messenger (1 respondent), and air-con mechanic (1 respondent)



a) Education



b) Hometown



c) Supporting individual

Figure 29 Distribution of socioeconomic variables among drivers of five SR routes

Summary of occupation variables is presented in Table 27. For vehicle ownership, drivers of BT, ST, and CK routes mostly rent the vehicle (73-87%) whereas about half of the drivers of VR and SV routes own the vehicles. Findings on vehicle registration are diverse among the five routes. SR vehicles of BT, ST, and CK routes are all registered properly as public vehicles with yellow plate. Half of SR vehicles in VR route are registered as public vehicle. Contrarily, all SV route vehicles are registered as private vehicle with white plate.

Table 27 Descriptive statistics of driver occupation variables

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Vehicle ownership						
Own vehicle	12.9	26.7	23.1	44.4	52.4	30.4
Rent vehicle	87.1	73.3	76.9	55.6	47.6	69.6
Vehicle registration						
As public vehicle	100.0	100.0	100.0	50.0	0.0	74.3
As private vehicle	0.0	0.0	0.0	50.0	100.0	25.7
Fuel type						
LPG	100.0	100.0	100.0	96.4	100.0	91.3
Benzene	0.0	0.0	0.0	3.6	0.0	0.7
Availability of driving license						
Yes	100.0	96.7	100.0	96.4	95.2	97.8
No	0.0	3.3	0.0	3.6	4.8	2.2
Type of driving license						
Public	71.0	65.5	80.8	21.4	5.0	51.5
Private	25.8	34.5	19.2	75.0	90.0	46.3
Both	3.2	0.0	0.0	3.6	5.0	2.2
Cooperative membership[1]						
Yes	80.0	50.0	80.8	0.0	0.0	44.4
No	20.0	50.0	19.2	100.0	100.0	55.6

	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F test
Daily income (Baht/day) (Min 300; Max 2,000)	995	278.79	903	299.99	977	283.28	975	364.77	1,013	307.20	970	305.76	0.509
Working hour (hour/day) (Min 2; Max 19)	14.59	2.18	13.72	1.80	14.58	1.96	13.25	3.58	10.24	3.81	13.44	3.06	9.851**
Working day (Day/week) (Min 1; Max 7)	6.74	0.58	6.57	0.68	6.88	0.43	6.68	0.77	6.14	1.59	6.63	0.87	2.506*
Fuel cost (Baht/day) (Min 100; Max 450)	311	50.80	302	67.57	304	79.90	219	33.08	214	59.46	274	73.06	17.492**
Rental fee (Baht/day) (Min 150; Max 500)	413	33.05	302	17.44	293	54.47	361	60.41	285	33.75	340	66.46	37.682**
Vehicle price (Thousand Baht) (Min 40; Max 500)	113	32.02	156	89.43	103	8.16	173	60.65	261	132.10	177	100.57	4.273**
Years of work (Min 0.17; Max 40)	6.23	5.49	8.41	9.24	4.50	4.47	5.74	5.89	6.34	7.37	6.30	6.74	1.259

Note: [1]Each route are regulated by different cooperatives (BT: Rattanakosin Silorlek; ST: 1. Rattanakosin Silorlek 2. Sapthavorn Silorlek 3. Chaiyo Silorlek; CK: 1. Rattanakosin Silorlek 2. Sapthavorn Silorlek 3. Chaiyo Silorlek) while VR and SV routes are not under any cooperatives

**p<0.01, *p<0.05

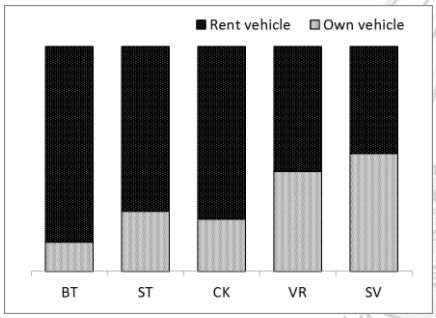
For VR and SV routes, drivers state various reasons for not registering the vehicles properly as private vehicle. Issues (number of respondents) are summarized below.

1) As registered by previous vehicle owners (3)

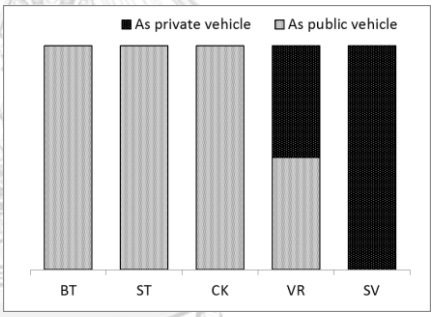
2) Public license need to pay higher tax and process is more complicate. The tax rate is similar to taxi cars but SR are not operating widely as taxis do (2)

3) Only operate for short distance service or in Soi (2)
4) Only few of us registered as public vehicle, most are registered as private vehicle (2)
5) It has been like this for many years (1)
6) I seldom drive the vehicle (1)
7) No taxation document (1)
8) I also serve as for-hire service to move things (1)
9) I do not know (1)

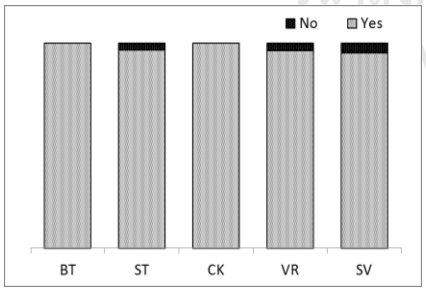
The fuel types used are all LPG, only one report using benzene for SR vehicle. Drivers 97.8% report the availability of driving license. It is noted that, mostly drivers of BT, ST, and CK routes hold driving license for public vehicles (66-81%) whereas most drivers in VR and SV routes hold license for private vehicles, 75% and 90%, respectively. Few drivers hold both licenses. Approximately 80% of drivers in BT and CK routes are cooperative members while only half of BT route are members. For VR and SV routes, all drivers are not under any cooperatives. Distributions of occupation variables among drivers of five SR routes are illustrated in Figure 30.



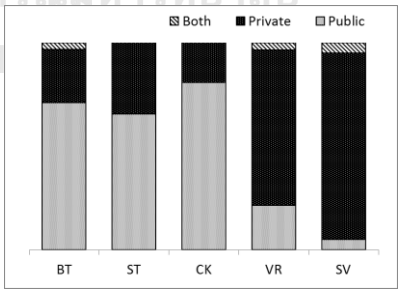
a) Vehicle ownership



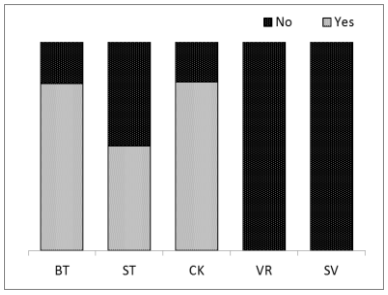
b) Vehicle registration



c) Availability of driving license



d) Type of driving license



e) Cooperative membership

Figure 30 Distribution of occupation variables among drivers of five SR routes

Results demonstrate no statistical significant differences in the daily income and years of work among all five SR routes. The average daily income for all drivers is 970 Baht/day with the range from 300 to 2,000 Baht/day. The average year of work is 6.30 year with the minimum of 0.17 and maximum of 40 years. It was found that the average working hour of all drivers are 13.44 hours/day. SV route shows shorter period

of working hour (10.24 hours/day) than all other routes (13.25-14.59 hours/day). The results on work day demonstrate similar trend with work hour in that SV route report less work day (6.14 day/week) than other routes (6.57-6.88 day/week).

The fuel cost is 274 Baht/day as the average of all SR drivers. VR and SV routes (219 and 214 Baht/day, respectively) show lower fuel cost than other routes (302-311 Baht/day). The vehicle rental fees for five routes are found to vary from 150-500 Baht/day. For vehicle price, the VR and SV route reveal higher price (173 and 261 Thousand Baht respectively) than other routes (103-156 Thousand Baht).

4.1.2 Challenges and opinions on SR development

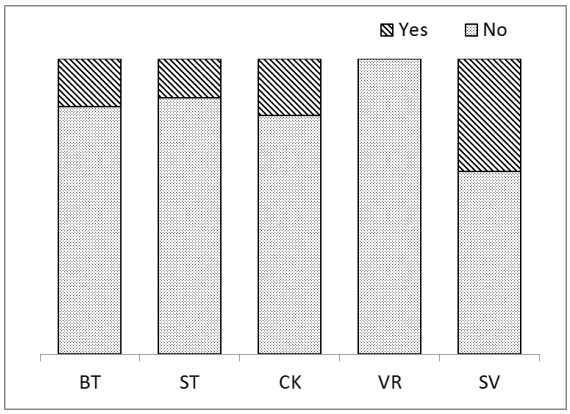
This survey explores SR driver experiences based on their challenges related to, firstly, problems with overlapping routes or other transport modes and, secondly, when they were called by police officers. In addition, opinions on setting up proper stops and integrating SR as feeder to mass transit system, like BTS and MRT, were also investigated.

The summary of descriptive statistics of challenges and opinions from drivers in each SR route is presented in Table 28. Distributions are shown to compare challenges and opinions among each route in Figure 31. Results show that overall SR drivers 83.7% neither have problems with drivers of overlapping routes nor drivers of other modes. Drivers of VR route 100% report no problems. For those who report challenges, issues of the problems are detailed in Table 29. To summarize, most drivers state that the major problems are competition for passengers and motorcycle taxi revealed to be the most frequently mentioned as problems for SR drivers.

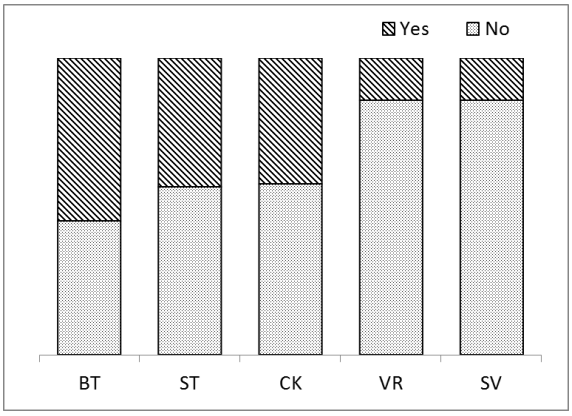
Table 28 Descriptive statistics of challenges and opinions on SR development

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Problems with drivers of overlapping routes or other modes						
No	83.9	86.7	80.8	100.0	61.9	83.8
Yes*	16.1	13.3	19.2	0.0	38.1	16.2
Called by police						
No	45.2	56.7	57.7	85.7	85.7	64.7
Yes*	54.8	43.3	42.3	14.3	14.3	35.3
Policy to set up proper stops to pick up and drop off passengers**						
Agree	41.9	63.4	42.3	35.7	9.5	40.4
Disagree	41.9	23.3	50.0	35.7	52.4	39.7
Undecided	16.2	13.3	7.7	28.6	48.1	19.9
Policy to integrate SR as feeder to mass transit e.g. BTS, MRT**						
Agree	64.5	66.6	69.2	75.0	28.6	62.5
Disagree	9.7	6.7	19.2	7.1	0.0	8.8
Undecided	25.8	26.7	11.6	17.9	71.4	28.7

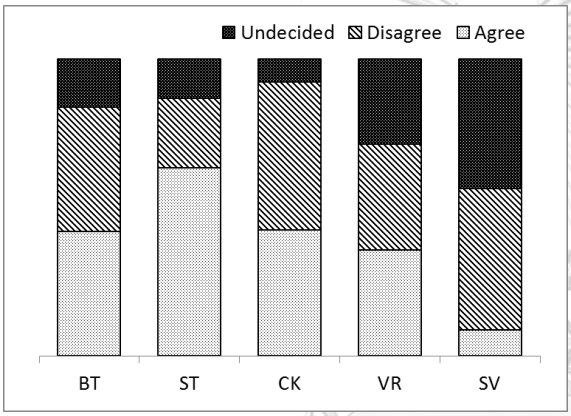
Note: *Issues mentioned by SR drivers are summarized in Table 29
**Opinions on each policy mentioned by SR drivers are summarized in Table 30



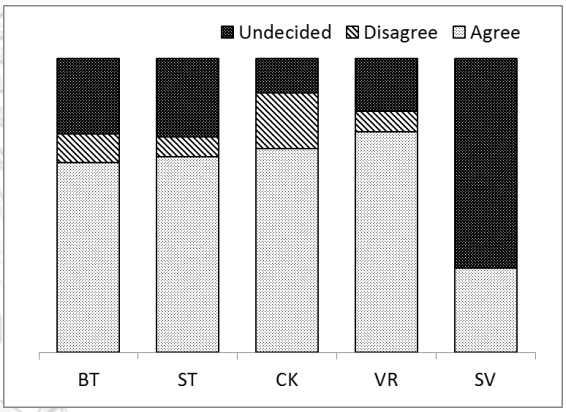
a) Problems with drivers of overlapping routes or other modes



b) Called by police



c) Policy to set up proper stops



d) Policy to integrate SR as feeder

Figure 31 Distribution of challenges and opinions among drivers of five SR routes

From the survey on drivers' experience on being called by the police, the results illustrate that 64.7% of all drivers answer "Yes". The proportion of being called by the police for drivers of BT, ST and CK routes (54.8%, 43.3%, and 42.3%, respectively) are higher than VR and SV routes, reported 14.3% for both routes. Issues of the problems are detailed in Table 29. SR are called by police officers due to the reasons associated with parking and stopping at restricted points, for inspection of driving license, vehicle license plate, taxation document, and when driving in the unauthorized routes or area. In fact, BT, ST and CK routes are authorized in the specific area including the main road whereas VR and SV routes are authorized to operate only in Sois.

Table 29 Issues relating to challenges with overlapping routes/other modes and when called by police

Problems with drivers of overlapping routes or other modes	
SR route	- BT route, in some parts, overlap with other SR route and this makes him get less income
Motorcycle taxi	- Compete for passengers, and sometimes overtake him to fight for passengers - Since the speed of SR is slower, many times, motorcycle taxis come close and speed away showing annoyance - Motorcycle taxi drive beside and cut him off - Hit by motorcycle taxi due to the sudden stop to drop passengers off SR - As the station of motorcycle taxi in Sukhumvit Soi 39 is located further inside from the Soi entrance, sometimes motorcycle taxi stop at SR station at the Soi entrance to pick up passengers who were standing at our SR station. Some park motorbike nearby our station and wait for passengers. "When we ask them to get way from our parking station area, they did not do so".
Private car	- When SR makes turns, some private car drivers express annoyance
Called by police	
Parking/stopping/obstructing traffic - Parking at the restricted/unauthorized area or park and wait for passengers too long - Stopping while obstructing the main traffic flow/drop passenger off in the middle lane sometimes during traffic jam/not stopping at the usual stopping point. In some cases, passengers would like to get off during traffic jam so it takes time to pay the fares and returning changes. - Not driving in the left lane **License and taxation** - Not holding driving license for public vehicle/inspect driver license when runs out from its own route to the unauthorized area - Inspect annual taxation document/invalid annual taxation document - License plate attached to the vehicle at the wrong position **Unauthorized area** - For VR and SV route, police called when SR runs out from Soi to the main road which is not authorized for SR - For VR route, SR is called by police when runs out of the Soi because the vehicle uses white license plate, not conforming to the regulations and sometimes got wheel cramped when waiting for passengers on the main Vibha road	

Further the survey asked drivers whether they Agree, Disagree or Undecided on policy for setting up proper stops to pick up and drop off passengers as well as the effects on their occupation. The results vary among all three choices. Overall, drivers 40.4% Agree to set up proper stops while 39.7% "Disagree" and 19.9% were "Undecided". However SV route drivers are distinct from other routes in that percentage in "Disagree" accounts for 52.4%, "Undecided" 48.1% and "Agree" only 9.5%. The opinions on the given choices are listed in Table 30.

Drivers who agree on the issue state that it would be convenient and safe for passengers. Besides, it is convenient when stopping and easy to park when boarding and alighting. Drivers would not have to fight with officers and there would be lower risks of road accidents when approaching stops. Drivers also mentioned about orderly conditions and less congestions in the neighborhood, not obstructing the traffic flow.

Nevertheless, some concern that passengers would not walk to the stops and there will be fewer passengers. It was suggested that bus stops are the most appropriate point and the most convenient waiting area for passengers.

Table 30 Opinions on policy to set up proper stops to pick up and drop off passengers

Agreement	Opinions on effects on occupations and other related issues
"Agree"	**Convenient and safe** - It is convenient for passengers to wait at SR stops separate from bus stops. They can get on and off more conveniently - Passengers would recognize where to board and alight at the specific points. Boarding and alighting at specific points would be more safe for passengers - At present, passengers are waiting for SR at any point they want. The specific SR stops would make passengers wait at the specific point. We know where to stop at the assigned point and it is easier for pick up and dropping off passengers. - It would be good for drivers, we know where to stop, but we may get less passengers "I would agree if the proper stop improve the current conditions. I think stopping at bus stop is the most appropriate for now because it is convenient for passengers" **Will not be called by officers** - Lower chances of being caught by police officers "I prefer parking at the assigned stop so we do not have to fight with officers" "That would be good. Even though ridership may be reduced, we do not have to fight with police officers as we are sometimes blamed for not parking at the assigned point, and there would be lower risk of road accident when we approach each stop to pick up passengers" **Orderly** - Although this would be more orderly, we are not sure that passengers would wait at the assigned point or not because currently most passengers wave us at any point along the route, not at the bus stop - Stopping/parking at proper space would be orderly and convenient for drivers to stop at each point **Less congestion** - There would be specific stop and we would be separate from bus stop; therefore, SR vehicles would not obstruct around the bus stop area. - Stopping at any point causes traffic congestions; thus, providing specific stopping points would result in less traffic congestion in the area **Similar to current conditions** - Currently we already have the assigned stops "It would be good and would not make any differences from the present conditions" (SV route) **No space** - Concern on not having enough space to set up SR stops **More passengers** - There would be more passengers

Agreement	Opinions on effects on occupations and other related issues
"Disagree"	**Less passengers** - Usually we stop on the main road at the entrance of the Soi and pick up passengers. If the proper stops are set up, passengers would not walk to that stop. Some will be tired to walk from their home in Soi to the stop. The ridership will be decreased. - There will be less passengers waiting at stop because usually they would wave SR at their doorsteps as near to their home as possible. Therefore, we will get less income. - There will surely be fewer users. At present, we can pick up and drop off any point even in each of the Soi network, sometimes at their residences and offices. If allowed to board and alight only at specific points, no one will use SR. (VR route) **Passengers are scattered** - Passengers are scattered all over the area; thus, setting up the stop will not make the situation better. We stop wherever the passengers are waiting at last. - Destinations are scattered all over the area. We are requested to send them at their doorsteps. If they are not sent at their doorsteps, they would not use SR. (SV route) - Not appropriate to set up proper stops. Passengers would still be waiting for SR scattered in all area, not at the proper stop. **Prefer boarding and alighting at any point** - Passengers want to get off at any specific points they want - All passengers know where to board SR. We can stop any points. We actually share the stop with buses. - Stops can be set up only at two points, at both ends of the routes. Along the routes, passenger should still be allowed to board and alight at any point. (VR route) "At present we are good. I prefer it this way that we can stop anywhere." "If so, we could not send passengers to condominium as usual because now we are running as for-hire service (SV route) **Affect passengers** - It will not be convenient for passengers "Drivers will not be influenced by this change" "I think this will affect those passengers who live in Sois. This will pose more impact on passengers than on us" **Want more passengers** "Stopping at the proper stop will make me suffer. We want more passengers because we need to pay for lots of expenses." **Congestion** - If there are many stopping points, SR will obstruct the traffic flow and may cause congestion in Soi (SV route) **Crowded** - SR could be very crowded when many passengers get on together at one point **Impossible** - Setting up proper stops is for buses not SR services. It is impossible to do with SR since all Soi network are connected. (SV route) "I think it is impossible. I cannot imagine where passengers can board SR if the proper stops are set up" (VR route)

Agreement	Opinions on effects on occupations and other related issues
"Undecided"	**Passengers and drivers know where to stop** - Passengers know where to board SR because we stop any points along the route - Currently, we already have stops that are set up at each area "I think there would be no impact on drivers. You can see that taxi stands still do no work. No taxis wait at the set up points. We all know where to stop and pick up passengers." **Passengers request to get off at any points** - Passengers need convenience from our service so they would like to get off anywhere they want. - Drop off points requested by passengers are scattered along the route **Passengers need to walk to stops** - SR drivers will not be as much affected as passengers because they need to walk to the stops - If passengers need to walk to the set up stop, there might be fewer passengers using the service **Depend on passengers** - It depends on passengers in that they prefer fixed stops or not. But setting up stops would be safer for them when boarding. **Cooperatives' policies** - It depends on the cooperatives' policies **No differences** - The situations would not be different from the present condition **Not enough space** "There are too many SR vehicles. I am afraid that the stopping and parking space will not be enough and we have to fight for the parking."

For those who disagree they may be affected by the lower ridership because of less convenience for passengers, and therefore, their income will be decreased. Some mention about uniqueness in terms of door-to-door service of SR, the scattered destinations, street network that are all connected. Therefore, it is impossible for SR to set up proper stops and passengers will be affected the most from their points of view. Some drivers prefer the current way that SR can stop anywhere. Locations of stopping points should be carefully considered for not causing congestions in the area.

Drivers who are undecided on the issue are concerned that ridership will decline due to the fact that passengers need to walk to the stops. Currently it is convenient in that they can request to send them anywhere. So it depends on passengers that in which way they prefer. Some indicated that there are already stops set up in each route. One driver is afraid that there would not be enough space for a number of SR vehicles and drivers have to fight for parking space.

This study also investigates driver opinions on policy for integrating SR as feeder to mass transit, e.g. BTS, MRT. Results show 62.5% drivers agree with the

policy, followed by 28.7% were undecided and 8.8% reporting disagreement. Majority of the drivers, except for SV routes, agree with the policy to integrate SR as feeder services, accounting for 64.5-75%. For SV route, most drivers are undecided on this policy. The opinions on their given choices are presented in Table 31.

Table 31 Opinions on policy to integrate SR as feeder to mass transit e.g. BTS, MRT

Agreement	Opinions on effects on occupations and other related issues
"Agree"	**More passengers** - More people are using BTS and MRT so the numbers of SR riders will increase as well - We will have more passengers including from BTS/MRT using SR service and we will have more income. Passengers from other areas may come to use SR in this route in case they know how to use this SR services. - It would be more convenient for passengers and we will have more passengers. - More people will use SR but the numbers of passengers would not increase much because at present we already send them very close to BTS/MRT stations **Convenient for passengers** - Passengers will benefit from the more convenient service whereas, for drivers, the situation would not make any changes. - It will be more convenient for passengers as they do not have to walk. They can board SR nearby mass transit stations. - Passengers can reach their destinations faster - It would be faster and more convenient **Routes connect with transit stations** - The situation will not make any differences because currently we are now connecting with transit system - At present, we are functioning as feeder at BTS Wuttakart. It is good. We set up the queuing area for passengers and for SR vehicles to park in the queue. (BT route) - This route is already connected with BTS. We just wait for BTS to operate in the future. (CK route) - In the future, this route will connect with BTS (CK route) **Convenient for drivers** - It will be better in that we can park near transit stations; however, numbers of passengers will remain the same. - SR drivers would have the proper parking area. We can park easily. **More popular** - This will make SR services more popular **Safer and lower fare** - Comparing to motorcycle taxi, people would prefer SR due to the lower fare and safety aspect **Traffic conditions at transit stations** - Depending on the traffic condition around transit stations; if stations are located in congested area, this may reduce vehicle speed, and therefore, reduce the ridership as well as drivers' income **Less passengers** "I think there will be fewer passengers using SR service." **Concerns on overlap with other modes** "We should ask for authorization to pick up and drop off passengers at the transit station because there are already public transportation modes running in that area and I am afraid out SR services will overlap with their services. They might not allow us to do so." **It will be better** "I think it will be better for us. Anything is alright."

Agreement	Opinions on effects on occupations and other related issues
	Want to benefit from the situation
	"If numbers of passengers increase, I want to pick up passengers at that point then we will benefit from that situation."
	Nothing changes
	"Nothing changes. BTS is still not available in every small unit of the area."
"Disagree"	**Less passengers and less income**
	- There will be fewer passengers
	- We will have less income
	Congestions and existing modes around transit stations
	- Because there are traffic congestions around transit station
	"I think we have no chance because there already exist many public transport modes competing for passengers around BTS areas."
	More fuel costs
	- Making U-turns at transit stations will consume more fuel and increase our fuel costs
	Ridership increase only at the beginning
	- Ridership increased only at the very beginning period when BTS was first operated. After that, demands decline to the same number. (BT route)
	Routes do not pass BTS
	- Because most SR routes do not run pass the BTS stations
"Undecided"	**Nothing changes**
	- There will be no differences. We currently send passengers at BTS station.
	- Nothing special
	- In almost all trips, we send passengers at drop off point very near to MRT station. Only in some periods that we send them at 7-11 (approximately 50 m before the drop off point). The situation will be the same. (VR route)
	- We will not be affected by the changes. SR riders would be the same group as the current users
	Overlap with other modes
	- May be it is not necessary for SR to function as feeders to transit system since currently there are many bus services running along BTS route and some also overlap with each other. We may not be allowed to run with them.
	- The route should not overlap with other public transport modes.
	Not allowed to park at transit stations
	- We cannot park at BTS station. If we park at station, we will be caught by the police officers (SV route)
	"I prefer the current situation. We are not allowed to park at BTS station because it is on the main road (SV route)"
	Depends on passengers
	- It depends on passengers. If they are satisfied to use SR, we can operate in that way.
	Depends on head of the Win
	- It depends on policy from head of the Wins
	Many competitive modes may reduce ridership
	- SR is better serve short-distance trips, especially in Soi like this; when operate in main roads with more competitive modes (bus, motorcycle taxi, taxi), passengers have more alternatives and this may reduce the chance of choosing SR
	Currently SR send passengers at transit stations
	- Normally, there are only few bus services along this route. SR are now sending passengers directly at BTS station. (BT route)
	More income
	- We will have more income

Agreement	Opinions on effects on occupations and other related issues
	May be better - It may be better **Uncertain with the future** "I feel uncertain with what will happen in the future, whether the BTS passengers will come to use SR services or we will serve passengers by sending them to BTS."

Based on opinions from drivers who agree with the policy, the services would be more convenient and faster for passengers, and SR may become more popular. The ridership may increase with the drivers' income. When compared to motorcycle taxis, SR are safer with lower fare. Some drivers state that they can park easily at BTS/MRT stations while some think that there will be no effect. Traffic conditions around BTS/MRT stations are concerns for them since if stations are located in the congested area SR will run in the slower speed and they will get fewer passengers. Also, one is afraid that SR will not be authorized to be feeders as there may already exist other transport services.

Those who disagree indicate that there might be fewer passengers and they would lose their income. Congestions as well as existing public transport services are also mentioned. One driver reports that demands decline after the sudden increase during the opening period at the very beginning.

For drivers who are undecided, a variety of opinions are revealed. Some are uncertain with the future conditions, some think the situation will be the same while some think it will be better and drivers will have more income. They said that they can operate in whichever way passengers want. They are now sending them very near to transit stations. Sometimes, they are caught by officers if they park at transit stations. They will follow the policy set up by head of the Wins. It is interesting that one driver expresses that SR is not necessary to be feeders because buses have already done that function and SR will overlap with their routes. They suggest that SR better serve short-distance trips like in Sois because operating in main roads with competitions with other modes would reduce the chance for people to use SR services.

Finally, this study gives a summary of the main challenges and opinions obtained from SR driver survey, as shown in Table 32. Results show that the major problem with other route or other transport modes is fighting for passengers while illegal parking and stopping stands out among issues called by police officers. For policy of setting proper stop, responses appear to be positive in terms of convenient, safe, orderly, less congestion, not called by police and more passengers. On the contrary, negative feedbacks are noted relating to effect on passengers, passengers need to walk, less passengers, congestion and vehicle crowded. Feedbacks on policy to integrate SR as feeders to mass transit are mostly positive, involving issues relevant to more passengers, more popular, more income, convenient for passengers as well as drivers, faster, safer, and lower fare. However, negative responses appear to be having less passenger, less income, and more fuel costs.

Table 32 Summary of the main challenges and opinions

		BT	ST	CK	VR	SV	Total
Challenges with overlapping routes or other modes							
Fight for passengers		4	-	5	-	3	12
Overtaken by other modes		2	2	1	-	2	7
Hit by motorcycle		-	1	-	-	1	2
Route overlap/less income		1	-	-	-	-	1
	Total	7	3	6	-	6	22
Issues when called by polices							
Illegal parking and stopping		18	10	12	2	1	43
Inspect taxation document		-	5	-	-	1	6
Inspect driving license		2	2	1	-	-	5
Service in unauthorized route		1	-	-	2	1	4
Wrong license plate registration		-	-	-	1	1	2
	Total	21	17	13	5	4	60
Feedback on policy to set up proper stops to pick up and drop off passengers							
Positive feedbacks	Convenient/safe/orderly/less congestion/not called by police	10	15	13	9	1	48
	More passengers	-	1	-	-	-	1
Negative feedbacks	Affect passenger/passengers need to walk/less passengers	10	1	5	4	3	23
	Congestion/vehicle crowded	1	-	-	3	1	4
	Total	21	17	18	16	5	76
Feedback on policy to integrate SR as feeder to mass transit e.g. BTS, MRT							
Positive feedbacks	More passenger/more popular/more income	11	13	8	9	3	44
	Convenient for passenger/convenient for driver/faster/safer/lower fare	2	8	4	10	-	24
Negative feedbacks	Less passenger/less income/more fuel costs	-	-	3	1	-	4
	Total	13	21	15	20	3	72

4.2 Regulators

Two DLT transport officers were interviewed about roles and responsibilities on SR services including laws, regulations, policies, challenges and opinions on development of the system. The interview report is detailed in Appendix B. The purpose of this interview is to learn new knowledge on SR service laws and regulations, understand practical experiences and challenges as well as explores opinions from regulators' on SR service policies. Table 33 presents the results of the interview.

Table 33 Interview results

1. Roles, responsibilities, and policies for SR services

1.1 Roles and responsibilities associated with SR services

- What are the roles and responsibilities of DLT associated with SR services?
  - Provide operator license
  - Route inspectors are responsible for inspecting the operation of each route once a year as regular inspection program
  - In case of public complaints, inspectors on sites will be assigned case by case

- What are the departments/divisions responsible for SR services and what are their responsibilities?
  - 1) Operation of SR under the Department of Passenger Transport which is responsible for providing operator license. At present Thai government is controlling the growth of SR vehicles so the department is not providing license anymore. However, operator license renewal every three years, cooperative management (in case the operators move to new cooperatives or service area), operator or vehicle cancellation when going out of operation are the responsibilities for now.
  - 2) License registration and taxation of SR after the operators are licensed are under Department of Registration and Taxation

1.2 Policies in regulating SR services

- What are the DLT policies in regulating SR services?
  - Officers are separated into five zones. Each zone is assigned to inspect SR operators in each area. The inspection results are used as information when renewing operator licenses every three years
  - If SR not operating in their own routes are found or no taxation document available for the inspection, DLT officers would report to and ask cooperatives to strictly regulate their members to operate in the authorized routes. Cooperatives must bring that SR vehicles to proceed tax payment. All evidences would be recorded for considerations of operator license renewals.
  - Actually Section of Bangkok Transport Zone 15 and Section of Inspection are responsible for inspecting SR operators while public complaints are response by Inspection Section at the Head office.

- What are the procedures in setting up the policies for SR services?
  - The current policy for SR services has been developed before 2008
  - DLT is developing SR policies in accordance with Bangkok Public Transport Reform Program from the cabinet agenda in 2016. This program is related to the operation reforms in buses, vans, songtaews as well as SR.
  - Office of Transport and Traffic Policy and Planning (OTP) coordinates and invites representatives across transport organizations of all modes to discuss on the integrations of transport modes, emphasizing mass transit system and enhancing road transport modes (buses and vans) to function as feeders to mass transit system.

- Are there any corporations among transport modes in terms of facilities for connection and transfer, route overlap avoidance, or route competition?

- Transport Network Section under the Department of Passenger Transport is responsible for coordinating among transport authorities, such as OTP, Department of Highway, Bangkok Metropolitan Administration, and Mass Rapid Transit Authority of Thailand for developing service routes, control the number of operators and vehicles

2. Laws and regulations on SR services

2.1 Laws and regulations

- What are the laws and regulations on SR registration?

- 1) Vehicle Act, B.E.2522 and 2) Ministerial regulations No. 25 and 26 under the Vehicle Act, B.E.2522 regulating vehicle size, engine capacity, color, vehicle width, length and height

- What are the laws and regulations on operating time, vehicle condition (age, quality) and operator qualification?

- Route assignment and operating time
  Cooperatives would propose the service routes and operating time that they would like to operate to the DLT. The proposed routes and operating time are probably with the high demands. Then DLT would observe on site at the proposed routes. If the routes are of high demands, DLT would then authorize the routes for SR operations. The routes and operating time are not fixed. They are flexible in response to passenger demands.
- Number of vehicle in each route
  Every SR has already been record in the DLT route-based vehicle record. The government do not allow new SR vehicle registration anymore.
- Vehicle condition
  All vehicles must be checked annually to be certified for vehicle tax renewal
- Driver
  All drivers must hold public vehicle driver license (indicated in Ministerial regulations)
- Head of the win
  DLT is not responsible for providing head of the win. Head of the win are organized by each cooperative. Not all service routes have head of the win. Some routes are managed by the drivers of their own routes.

2.2 Registration (Vehicle cooperatives, head of the win, driver)

- What are the laws and regulations on types of vehicle registration and driving license?

- Vehicles must be registered as public vehicle as well as driving license type that must be for driving public services

2.3 Inspection of SR operation

- DLT is responsible for inspection of each service route. Inspectors of each zone are assigned to inspect SR service in each zone (Vehicle Act, B.E.2522)
- Police officers are responsible for inspections of traffic-related issues (Road Traffic Act, B.E.2522)

2.4 Revision of existing laws and regulations

- What are the plans for revision of laws and regulations?

- At present DLT is revising laws and regulations on trucks and passenger cars. SR is not yet considered to be revised.
- Recently DLT has revised laws and regulations on Taxi VIP, involving the innovations relating to on-board GPS system application installation as well as calling through application for service.
- "SR is the only small segment in BKK transportation system and most of them are running in alleys. Perhaps, this is the reason why DLT pay much more attention on buses and other intercity public transport modes serving and influencing larger group of people."

3. Challenges on controlling SR services

- What are the challenges and measures on controlling SR services?
    - Major problems are, firstly, services are often found to extend the route to serve in the unauthorized area. Secondly, the service routes are still found to overlap with other public transport modes.
    - The street network in BKK changes over times; consequently, some alleys have expanded to be street/major roads. New communities, department stores, market districts emerged in the area. These evidences attract SR services to penetrate into these areas of high demands, bring a great amount of income to the SR drivers.
    - Inspectors in each zone will inspect whether SR are running conforming to the authorized route or not. SR will be fined when found running in unauthorized routes and reported to the central control center. The evidences will be recorded and used for considering in license renewal process.

4. Opinions and recommendations on SR services

4.1 Benefits and impacts of SR services

- What are the benefits of SR services?
    - Convenient, short wait time, seat availability, reduce private vehicles on streets, and rain protection when comparing to motorcycle
    - Some are functioning as for-hired taxis for moving things. They are sometimes at lower prices when comparing to taxi. Sometimes the stuff are not that much to hire a truck which the space are too large, and, of course, too expensive to hire for carrying or moving things for these passengers. The operation in this form is not legal; although, DLT does not strictly control on this matter as we recognize its benefits on providing convenience to passengers and generating incomes to the drivers.

- What are the impacts of SR services?
    - Traffic congestions, fights for passengers, for example, in the routes which are previously possessed by motorcycle taxis, the operators of both systems fight for passengers. These are also unsafe and unsecure situations for passengers.

4.2 Problems of SR services

- Do you think that the current SR service system is appropriate or not? Why?
    - Problems do still exist such as route overlapping among different modes, fighting for passengers among operators of different modes, making trouble in communities
    - In some routes that SR run along with large vehicles on the main roads, when accidents occur, SR are often more severely damaged due to the smaller size and weaker structure of vehicles when comparing to the majority of vehicles on streets. These pose risks to SR passengers and drivers as well.

4.3 Measures and management options for sustainability of the system

- What should be the measures and management options?
    - All SR routes should be moved into either alleys or narrow street network, not running in the main roads for safety reasons. The unsafe and unsecured service might push passengers away from using the services.
    - When drivers are found either holding private vehicle driving license or using vehicles with private license plate, they would be fined by inspectors who are responsible in each service zone. The evidences would be reported to the DLT head office for recording as supporting documents in the license renewal process.

- What do you think about supporting policies such as trainings on vehicle maintenance skills, road safety knowledge, provisions of parking area or station area?

- DLT organizes training programs on driver consciousness and politeness for public transport drivers every three months at times of license renewal process. The training attendants involve drivers of buses, vans, Songtaews, and SR.
- "Parking areas are not necessary as the service areas are in alleys"
- "Usually the SR drivers park the vehicle in the neighborhood, some park in front of local residences. It seems difficult for us to set up the rules on this issue. Drivers must negotiate and manage this issue on their own."
- If the stops need to be set up, SR stops would be at the bus stop. From our experiences, it is not easy to set up any new stops. No one wants bus/SR stops in front of their homes or shops, with convenient store like seven-eleven as an exception.

- What do you think about policies supporting SR to be feeders to BTS or MRT?

- OTP is developing policies that enhance road transport modes to be feeder, serving for a short distance trip, to send passengers to rail and water transport mode, such as BTS, MRT, ferry

.

4.4 Recommendations for improvement of SR services

- Cooperatives should arrange trainings for drivers of their own at the venues nearby the route service area. This would be more convenient for drivers to join the training than the one that were arranged by the DLT which receive little attention from the drivers. This may be because coming to DLT head office for training make the drivers lose their incomes and their travel costs are sometimes matters.

CHAPTER V
DEMAND OF SR SERVICES

This chapter provides the overall picture of SR users and non-users in various aspects. First, the results on travel behavior of both users and non-users of SR services are presented. The attitudes of them are also investigated including comparative analysis among users and non-user groups in various socioeconomic, trip variables and attitudes. This is followed by two case studies. One examines casual relationships between perception of service quality factor and overall satisfaction and cluster analysis is performed in cases of West BKK and East BKK SR routes. In the second case, comparative analysis of travel behavior between Thai and Japanese SR users are examined.

5.1 Travel behavior

In this section, travel behavior of SR users is firstly presented in socioeconomic and trip variables, non-user travel behavior is described, variables on travel behavior of both SR users and non-users are then comparatively analyzed.

5.1.1 Users of SR

Users of SR in this study are collected from five routes: Bangbon-Taladplu (BT), Siriraj-Taladplu (ST), Charoennakorn-Klongsan (CK), Vibhavadi-Rachada (VR), and Sukhumvit Soi 39 (SV) routes. The distributions of users from each route are presented in Table 34.

Table 34 Distribution of user samples

Route	N	Percent
Bangbon-Taladplu (BT)	125	21
Siriraj-Taladplu (ST)	129	22
Charoennakorn-Klongsan (CK)	135	23
Vibhavadi-Rachada (VR)	117	19
Sukhumvit Soi 39 (SV)	91	15
Total	597	100

Socioeconomic characteristics of five SR route users are presented in Table 35. The results reveal that users of all routes are similar in that majority are female (63%-73%) with three or more household members (66%-88%). However differences among five routes are found in various characteristics. All users are Thai except SV route where Japanese account for 52.3% and other nationalities 4.4% which includes users from Mexico, France, Turkish, and the Philippines. The ages of SR users scattered in all groups, representing that most of BT, ST, and CK users are 14-54 (77%) whereas most of VR and SV are in 25-54 age groups (70%). For marital status, except SV routes, 51-59% of users are single while only 32% are revealed for SV users. Overall, in terms of education, 37.2% are secondary school or below and 47% are university

level which involve “Studying bachelor”, “Bachelor” and “Postgraduate”. When looking at users separately in each route, it is found that proportion of users who are university graduate (“Bachelor” and “Postgraduate”) of BT (14.5%) are lower than CK (33.3%), ST (38.7%), VR (58.5%) and SV (78.9%), respectively.

Table 35 Descriptive statistics of user socioeconomic variables

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Nationality						
Thai	100.0	100.0	100.0	100.0	43.3	91.4
Non-Thai	0.0	0.0	0.0	0.0	56.7	8.6
Gender						
Male	32.3	27.9	26.7	33.3	36.7	30.9
Female	67.7	72.1	73.3	66.7	63.3	69.1
Age						
14-24	21.1	17.8	9.6	11.1	8.9	14.0
25-34	14.6	21.7	14.8	41.0	32.2	24.1
35-44	23.6	17.8	23.7	30.8	36.7	25.7
45-54	17.9	20.2	28.2	9.4	14.4	18.5
55-64	15.5	14.0	14.1	4.3	6.7	11.3
65+	7.3	8.5	9.6	3.4	1.1	6.4
Marital status						
Single	54.0	55.8	51.1	59.0	31.8	51.4
Married	46.0	44.2	48.9	41.0	68.2	48.6
Education						
Primary or below	28.2	12.4	23.7	6.0	4.5	15.8
Secondary	33.9	20.9	23.7	15.4	8.9	21.4
Vocational	9.7	7.8	7.4	9.4	3.3	7.7
Higher vocational	5.6	10.1	9.7	11.1	2.2	8.1
Studying Bachelor	8.1	10.1	2.2	2.6	2.2	5.2
Bachelor	12.1	30.2	31.1	48.7	65.6	35.6
Postgraduate	2.4	8.5	2.2	6.8	13.3	6.2
Income						
No income	6.7	2.3	3.0	0.9	27.8	6.3
9,999 or less	34.5	17.1	22.2	8.5	2.8	18.4
10,000-19,999	36.1	34.1	40.0	39.3	12.5	34.3
20,000-29,999	10.9	22.5	17.8	24.8	12.5	18.2
30,000-39,999	9.3	11.6	11.1	13.7	12.5	11.5
40,000-49,999	2.5	4.6	4.4	6.0	5.6	4.5
50,000 or above	0.0	7.8	1.5	6.8	26.4	6.8
	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD
	13,179 9,437	21,767 17,641	16,723 10,315	22,833 15,138	48,250 72,677	22,341 30,433
Income median	12,000	18,000	15,000	20,000	20,000	15,000
Occupation						
Student	18.6	7.8	4.4	2.5	6.7	8.0
Government sector	5.7	20.9	6.7	3.4	1.1	8.0
Private sector	25.8	28.7	37.0	62.4	38.9	38.2
Vendor	23.4	12.4	19.3	14.5	11.1	16.5
Employer	4.0	2.3	3.0	1.7	3.3	2.9
Retired	1.6	5.4	2.2	0.9	3.3	2.7
Housewife	4.8	7.7	8.2	2.6	4.5	5.7
Business owner	0.0	1.6	2.2	3.4	1.1	1.7
Employee	2.4	3.9	5.2	5.1	0.0	3.5
Unemployed	9.7	6.2	5.9	2.6	27.8	9.4
Other	4.0	3.1	5.9	0.9	2.2	3.4

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Household members						
1-2	12.2	19.5	18.5	34.2	20.0	20.7
3-4	50.4	53.1	45.9	46.5	57.6	50.2
5 or more	37.4	27.4	35.6	19.3	22.4	29.1
Household car						
None	67.0	41.9	55.5	39.3	58.9	52.3
1	28.2	37.2	31.9	48.7	27.8	34.9
2 or more	4.8	20.9	12.6	12.0	13.3	12.8
Car available to use						
None	73.4	50.4	62.9	44.4	76.6	60.8
1	24.2	32.5	26.7	45.3	16.7	29.6
2 or more	2.4	17.1	10.4	10.3	6.7	9.6
Household motorcycle						
None	46.0	45.0	54.5	58.1	85.6	56.1
1	37.9	41.1	33.6	31.6	12.2	32.5
2 or more	16.1	13.9	11.9	10.3	2.2	11.4
Motorcycle available to use						
None	54.0	48.1	60.4	61.5	90.0	61.1
1	36.3	39.5	29.9	32.5	8.9	30.6
2 or more	9.7	12.4	9.7	6.0	1.1	8.3
Household bicycle						
None	78.2	65.1	69.6	86.3	87.8	76.5
1	15.3	27.1	25.2	9.4	8.9	18.0
2 or more	6.5	7.8	5.2	4.3	3.3	5.5
Bicycle available to use						
None	79.8	67.4	71.1	88.9	90.0	78.5
1	14.5	25.6	24.5	7.7	7.8	16.8
2 or more	5.7	7.0	4.4	3.4	2.2	4.7

Income distributions of users in SV route are distinct from other groups in that 27.8% have no income. Totally 70.9% of all users have income between 0-29,999 Baht/month. Results of Spearman correlation indicate that there is a significant positive association between income and education level, ($r(570) = 0.489$, $p = 0.000$).

Most of users are in private sector and vendor, accounting for 54.7%, while the rest are scattered as students (8%), government sector (8%), employer (2.9%), retired (2.7%), housewife (5.7%), business owner (1.7%), employee (3.5%), unemployed (9.4%), and other jobs (3.4%). Proportion of students in BT (18.6%) and unemployed in SV route (27.8%) seems to be distinct among all users. Based on the survey on household car, most of BT, CK and SV users have no household car, accounting for 67.0%, 55.5%, and 58.9%, respectively. ST and VR routes show that majority of users have one or more household car at 58.1% and 60.7%, respectively. Similar evidence are found in car availability with BT CK and SV users, presenting higher share of not having car available to use when compared to ST and VR routes. For household motorcycle the results reveal 42%-55% of all users have one or more household motorcycle, except SV users with only 14.4% having household motorcycle. The results of motorcycle available to user in each route also show the evidence in the similar way. For household bicycle and availability of bicycle, the study reveals that most users do not have one, 76.5% and 78.5% for household bicycle and bicycle availability, respectively.

Trip variables of users are presented in Table 36, the higher proportion of regular users are found in BT and VR routes, accounting for 74.4% and 82.1% respectively. They use SR services for more than once per week. Respondents were asked to indicate the time they usually ride SR and more than one answer are allowed for each respondent. The results are shown in Figure 32 that the time period scattered throughout the day with peak period during 6.00-8.59 and 15.00-17.59. Also, SR users at 21%-60% need to transfer to other modes, including BTS (34.2%), Buses (30.8%), and MRT (21.4%) as the top three transfer modes. Majority of users in each route, except for SV route, travels alone (76%-82%) while only 46.3% of users in SV route are found travelling in group.

Table 36 Descriptive statistics of SR user trip variables

Variable	BT		ST		CK		VR		SV		Total		
	Percent		Percent		Percent		Percent		Percent		Percent		
Frequency of use													
Regular (use more than once per week)	74.4		69.0		51.9		82.1		55.6		66.8		
Non-regular	25.6		31.0		48.1		17.9		44.4		33.2		
Transfer	36.3		24.8		51.9		59.8		20.9		39.6		
Transfer mode													
BTS	53.5		25.7		50.7		N/A		70.0		34.2		
MRT	N/A		N/A		N/A		68.1		15.0		21.4		
Ferry	4.7		5.7		9.0		N/A		10.0		5.1		
Bus	25.6		42.8		34.3		31.9		5.0		30.8		
Motorcycle taxi	2.3		8.6		1.5		0.0		0.0		2.1		
Songtaew	2.3		2.9		1.5		N/A		0.0		1.3		
SR	9.3		11.4		1.5		N/A		N/A		3.8		
Train	2.3		2.9		1.5		N/A		N/A		1.3		
Travel alone	75.6		77.3		82.2		81.2		46.3		74.6		
Origin													
Home	57.6		51.9		54.1		58.1		41.7		53.3		
Work	3.2		10.1		5.9		18.8		11.0		9.5		
School/University	4.8		3.1		0.7		0.0		14.3		4.0		
Shopping	32.8		24.0		29.6		5.1		23.1		23.3		
Transfer	0.8		0.0		3.0		6.9		9.9		3.7		
Other[1]	0.8		18.9		6.7		11.1		0.0		6.2		
Destination													
Home	13.1		10.1		14.9		15.4		27.4		15.5		
Work	13.1		20.9		11.2		26.5		16.5		17.5		
School/University	5.8		6.2		2.2		4.3		3.3		4.4		
Shopping	50.8		43.4		39.6		21.3		38.5		39.0		
Transfer	9.0		3.1		16.4		24.8		9.9		12.6		
Other[2]	8.2		16.3		15.7		7.7		4.4		11.0		
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F test
SR distance (km/trip)	4.52	2.78	4.60	262	4.35	2.10	1.00	0.37	2.11	0.97	3.44	2.53	72.032**
Range	0.35-13		0.3-13		0.45-10		0.2-1.7		0.3-4.4		0.2-13		
SR cost (Baht/trip)	7.13	1.19	7.05	0.37	7.04	0.36	8.11	0.92	51.39	19.07	13.97	17.45	671.980**
Range	7-20		7-10		7-10		8-15		10-120		7-120		
SR wait time (min)	7.33	7.18	7.74	5.65	5.64	4.98	4.08	2.69	3.59	5.14	5.85	5.60	13.318**
Range	0-60		1-30		0-45		0-15		0-30		0-60		
SR travel time (min/trip)	16.22	11.07	19.12	12.48	15.55	9.14	6.97	3.25	13.72	7.24	14.58	10.28	26.634**
Range	2-60		3-60		3-60		2-15		5-40		2-60		
Overall satisfaction (1-5 Likert scale)	3.74	0.79	3.65	0.79	3.75	0.86	3.95	0.67	3.69	0.82	3.76	0.79	2.352

Note: [1] "Other" origins include visiting friends, hospital, temple, and leisure
[2] "Other" destinations include visiting relatives, hospital, temple, leisure, and restaurant
**p<0.01

The survey on origin and destination reveals that most users travel from "home", representing 53.3% of all users. "Shopping" displays in the second rank for all routes, except VR users that "work" is the second top origin. For destination of all users, "shopping" shows the highest share in all routes. The exception should be noted for VR route where "work" and "transfer" are top two destinations. The VR route is distinct among all routes in the higher share of "work" as both origin (18.8%) and destination (26.5%).

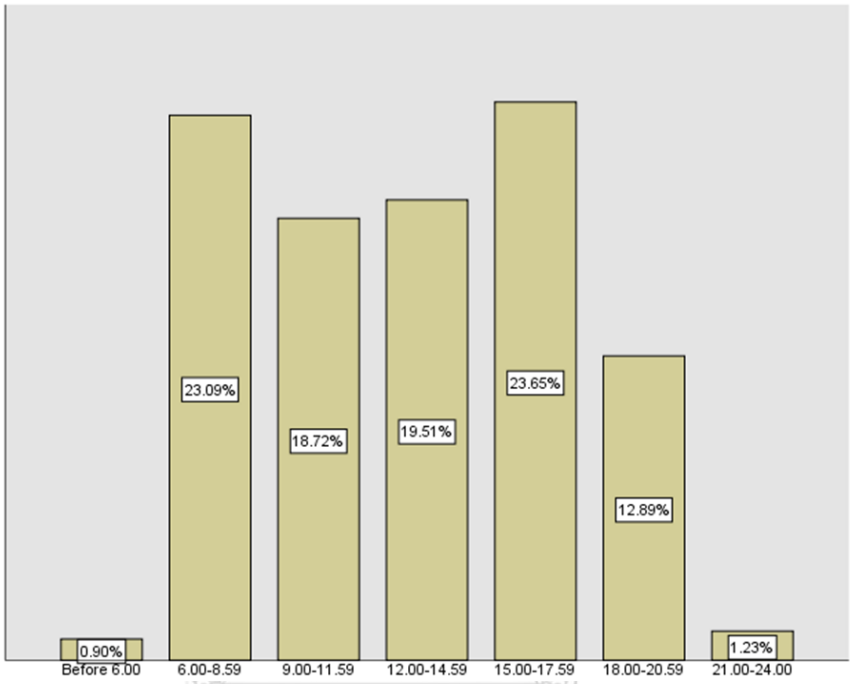


Figure 32 Distribution of time period of using SR

Findings on SR trip cost in each route are in line with fare indicated in Table 20. The mean trip costs of BT, ST, CK, VR and SV routes are 7.13, 7.05, 7.04, 8.11, and 51.39 Baht/trip respectively. Overall the mean SR travel distance of five SR routes is 3.44 km/trip. Users in West BKK, including BT, ST, and CK routes, are longer than East BKK which are the routes of VR and SV. Additionally, the shortest mean travel distance among all routes appears to be 1 km/trip in users of VR route and is shorter than the mean travel distance of SV route. Wait time and travel time of SR trip in this survey range from 0-60 minutes and 2-60 minutes, respectively, with the average of 5.85 minutes wait time and 14.58 minutes travel time. In VR route, users report the shortest travel time (6.97 minutes), shorter than all other routes. The average user overall satisfaction on SR services ranges from 3.65-3.95, evaluated on 5-point Likert scale, with the mean score of 3.76 showing no significant differences among all routes.

In addition to socioeconomic and trip variables of SR users, the survey on SR users' alternative modes was also conducted to investigate the availability of alternative modes in each SR route, frequency of using the modes, as well as travel cost, wait time and travel time. The results are shown in Table 37. Approximately 70-

76% of all SR users have alternative modes other than using SR service. The exception is noted for VR route where 56.4% of users depend on SR with other choices while 43.6% have alternative modes. Based on VR users with choices, the majority of users (43.6%) indicate walking as their choice of travel apart from SR. The proportion of bus is dominant as alternative mode indicated by 54-70% of BT, SR and CK route users. Buses are more accessible as these routes operate in the main road. For SR routes in Soi network like VR and SV routes, users are less accessible to buses due to the unavailability of bus services; therefore, alternative modes in Soi shown in the study are motorcycle taxi, private car, taxi and walking. In VR cases, walking shows the highest share (43.6%) followed by motorcycle taxi (16.4%) and private car (16.4%) whereas the top two modes in SV routes are motorcycle taxi (35.9%) and taxi (29.7%). For the frequency of using alternative modes, 50.4% of SR users indicate using alternative modes "occasionally" or less than twice per week.

Table 37 Descriptive statistics of alternative mode variables of users

Variable	BT		ST		CK		VR		SV		Total	
	Percent		Percent		Percent		Percent		Percent		Percent	
Captive user	24.2		24.8		27.4		56.4		30.0		32.2	
Have alternative modes	75.8		75.2		72.6		43.6		70.0		67.8	
Alternative mode												
Bus	53.8		57.9		69.4		9.1		4.7		45.1	
Motorcycle taxi	16.1		7.5		9.2		16.4		35.9		15.3	
Songtaew	4.3		3.7		1.0		N/A		N/A		2.2	
Tuktuk	2.1		3.7		1.0		0.0		10.9		3.3	
Private car	7.5		8.4		9.2		16.4		4.7		8.9	
Private motorcycle	5.4		3.7		3.1		9.1		1.6		4.3	
Taxi	4.3		14.9		6.1		3.6		29.7		11.3	
Bicycle	2.2		0.0		0.0		1.8		0.0		0.7	
Walk	4.3		0.0		1.0		43.6		12.5		8.9	
Frequency of using alternative mode (day/week)												
Everyday	7.5		17.8		26.5		12.7		15.9		16.5	
4-5	13.8		16.8		20.4		5.4		12.7		14.9	
2-3	11.7		22.4		14.3		16.4		28.5		18.2	
Occasionally	67.0		43.0		38.8		65.5		42.9		50.4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Alt cost (Baht/trip)	19.23	35.40	25.44	30.13	22.39	26.56	7.39	11.86	42.60	29.24	23.37	30.27
Range	0-300		3-150		0-150		0-50		0-100		0-300	
Alt wait time (min)	12.08	13.38	10.39	9.91	10.78	9.82	2.18	6.16	5.21	7.82	9.06	10.71
Range	0-60		0-60		0-45		0-30		0-45		0-60	
Alt travel time min/trip)	22.93	15.48	25.66	19.59	24.49	16.41	12.71	11.66	14.47	10.51	21.41	16.49
Range	2-60		1-120		3-90		3-60		2-60		1-120	

Note: Alt = Alternative mode

Table 38 displays the results from statistical tests for mean differences of trip cost, wait time, and travel time between travelling by SR and travelling by alternative modes derived from SR user survey. Interestingly, SR trips show significantly lower values in all variables, consisting of trip cost, wait time and travel time, when compared to trips by alternative modes.

Table 38 Comparison between SR and alternative mode trip cost, wait time and travel time

Variables	SR (n=596)	Alternative modes (n=396)	P value
Trip cost (Baht/trip)	13.97	23.37	0.000
Wait time (min)	5.85	9.06	0.000
Travel time min/trip)	14.58	21.41	0.000

5.1.2 Non-users

In parallel to data collection of SR users, this study also investigates socioeconomic and trip characteristics of SR non-users who travel along the five SR routes: Bangbon-Taladplu (BT), Siriraj-Taladplu (ST), Charoennakorn-Klongsan (CK), Vibhavadi-Rachada (VR), and Sukhumvit Soi 39 (SV) routes. The distributions of non-users from each route are presented in Table 39.

Table 39 Distribution of non-user samples

Route	N	Percent
BT	116	20
ST	125	22
CK	124	22
VR	105	19
SV	95	17
Total	565	100

Socioeconomic characteristics of non-users are presented in Table 40 with separate details of each SR routes.

Table 40 Descriptive statistics of non-user socioeconomic variables

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Nationality						
Thai	100.0	100.0	100.0	100.0	83.0	97.2
Non-Thai	0.0	0.0	0.0	0.0	17.0	2.8
Gender						
Male	53.4	51.2	45.2	45.7	44.2	48.1
Female	46.6	48.8	54.8	54.3	55.8	51.9
Age						
14-24	11.5	20.0	10.5	9.6	14.7	13.4
25-34	26.5	24.0	16.9	38.5	30.5	26.7
35-44	19.5	22.4	29.0	25.0	23.1	23.9
45-54	19.5	19.2	23.4	11.5	21.1	19.1
55-64	15.9	6.4	7.3	13.5	7.4	10.0
65+	7.1	8.0	12.9	1.9	3.2	6.9
Marital status						
Single	57.5	60.8	35.5	53.4	51.1	51.5
Married	42.5	39.2	64.5	46.6	48.9	48.5
Education						
Primary or below	23.3	16.8	24.4	12.4	5.3	17.0
Secondary	26.7	17.6	31.6	21.9	15.8	23.1
Vocational	13.0	7.2	4.1	12.4	6.3	8.5
Higher vocational	11.2	12.0	5.7	14.3	6.3	9.9
Studying Bachelor	1.7	8.8	4.9	0.0	10.5	5.1
Bachelor	22.4	32.8	25.2	37.1	29.5	29.3
Postgraduate	1.7	4.8	4.1	1.9	26.3	7.1

Variable	BT	ST	CK	VR	SV	Total
	Percent	Percent	Percent	Percent	Percent	Percent
Income						
No income	3.5	1.6	1.6	1.0	12.1	3.6
9,999 or less	15.8	16.9	14.6	4.8	3.3	11.7
10,000-19,999	43.0	41.1	52.0	49.5	24.2	42.7
20,000-29,999	21.1	20.2	13.0	21.0	17.6	18.5
30,000-39,999	7.0	11.3	8.1	15.2	12.0	10.6
40,000-49,999	7.0	5.6	2.5	3.8	5.5	4.8
50,000 or above	2.6	3.2	8.1	4.8	25.3	8.1
	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD	Mean SD
	17,955 11,344	19,615 14,483	19,969 21,654	22,768 19,044	34,863 41,711	22,439 23,610
Income median	15,000	16,000	15,000	18,000	22,000	17,000
Occupation						
Student	6.0	7.2	3.3	0.0	12.6	5.7
Government sector	5.2	21.6	4.1	3.8	4.2	8.2
Private sector	31.0	27.2	34.9	53.3	41.1	36.9
Vendor	28.5	20.8	20.3	26.6	10.5	21.6
Employer	7.8	2.4	1.6	1.0	11.6	4.6
Retired	1.7	6.4	4.1	2.9	2.1	3.6
Housewife	4.3	0.8	6.4	1.9	0.0	2.8
Business owner	1.7	0.8	4.9	3.8	1.1	2.5
Employee	4.3	4.8	13.8	1.9	4.2	6.0
Unemployed	5.2	1.6	3.3	2.9	10.5	4.4
Other	4.3	6.4	3.3	1.9	2.1	3.7
Household members						
1-2	25.9	23.2	20.2	29.7	22.6	24.1
3-4	38.8	44.8	51.6	43.6	46.2	45.1
5 or more	35.3	32.0	28.2	26.7	31.2	30.8
Household car						
None	45.7	39.2	53.2	46.7	34.7	44.3
1	37.9	37.6	34.7	41.9	41.1	38.4
2 or more	16.4	23.2	12.1	11.4	24.2	17.3
Car available to use						
None	54.3	47.2	57.2	56.2	41.1	51.5
1	31.9	39.2	34.7	34.3	42.1	36.3
2 or more	13.8	13.6	8.1	9.5	16.8	12.2
Household motorcycle						
None	25.9	40.8	48.4	32.4	64.2	41.8
1	55.2	42.4	44.3	57.1	29.5	46.0
2 or more	18.9	16.8	7.3	10.5	6.3	12.2
Motorcycle available to use						
None	31.0	45.6	50.0	35.2	69.5	45.7
1	50.0	39.2	42.7	55.2	25.2	42.8
2 or more	19.0	15.2	7.3	9.6	5.3	11.5
Household bicycle						
None	70.7	68.8	74.2	85.7	75.8	74.7
1	23.3	21.6	21.8	10.5	14.7	18.8
2 or more	6.0	9.6	4.0	3.8	9.5	6.5
Bicycle available to use						
None	74.1	73.6	77.4	87.6	78.9	78.1
1	22.4	19.2	18.6	9.5	11.6	16.6
2 or more	3.5	7.2	4.0	2.9	9.5	5.3

Non-users are scattered in all age groups. The two dominant groups 25-34 and 35-44 are at 26.7% and 23.9%, respectively. The marital status single (51.5%) and married (48.5%) are approximately the same. Results on education level reveal that university graduate group ("Bachelor" and "Postgraduate") account for 24.1% of BT group which is the lowest proportion of all routes. CK route (37.6%) shows the second lowest,

followed by ST route (29.3%), VR routes (39.0%) and SV route (55.8%) as the highest. Similar to university graduate group, the proportion of respondents in the upper income (30,000 Baht and above) illustrate the same with the lowest proportion found in BT route (16.6%), followed by CK route (18.7%), ST route (20.1%), VR route (23.8%) and SV route (42.8%). Results of Spearman correlation indicate that there is a significant positive association between income and education level, ($r(554) = 0.521$, $p = 0.000$).

Majority of non-users are in private sector (36.9%) and vendor (21.6%). Others are scatter as student (5.7%), government sector (8.2%), employer (4.6%), retired (3.6%), housewife (2.8%), business owner (2.5%), employee (6.0%), unemployed (4.4%) and other (3.7%). The proportion of "student" and "unemployed" in SV route stand out from other routes.

In terms of household members, 70-80% of respondents in each route have three or more household members. The entire non-users display 47-65% with household cars and 43-59% with cars available to use. Household motorcycle and availability of motorcycle to use reveal similar result in that the proportion of one or more motorcycle is the highest in BT route, followed by VR, SR, CK and SV route, respectively. Most of the respondents have no household bicycle and no bicycle available to use, as reported 74.7% and 78.1%, respectively.

Trip variables of non-users as detailed in Table 41 reveal that bus is the dominant travel mode for non-users in BT, ST and CK routes. Nevertheless, non-users in Soi network like VR and SV routes are less accessible to bus; thus, private motorcycle (33.7%) seems dominant in VR route whereas private car (31.9%) has the highest share in SV route. The total respondents indicate that the top three modes are bus (38.0%), private car (20.3%) and private motorcycle (17.1%). Majority of the non-users (80.5%) uses the mode regularly, more than once per week. Only 21.5% indicate that they need to transfer. BTS (33.1%), bus (28.8%), and MRT (16.9%) appear to be the top three transfer modes. The results show 71-81% of users in each route travelling alone, except SV route.

Table 41 Descriptive statistics of non-user trip variables

Variable	BT Percent	ST Percent	CK Percent	VR Percent	SV Percent	Total Percent
Mode of transport						
Bus	37.1	41.6	66.9	17.8	18.1	38.0
Motorcycle taxi	6.0	3.2	0.8	8.9	18.1	6.8
Songtaew	6.9	4.0	0.8	N/A	2.1	2.9
Tuktuk	0.0	0.8	0.0	0.0	0.0	0.2
Private car	19.0	25.6	11.3	15.8	31.9	20.3
Private motorcycle	23.3	12.8	9.7	33.7	7.4	17.1
Taxi	3.4	6.4	3.2	4.0	5.3	4.5
Bicycle	1.7	1.6	0.0	2.0	1.1	1.3
Walk	2.6	1.6	7.3	17.8	11.7	7.7
Shuttle service[1]	N/A	2.4	N/A	N/A	N/A	0.5
Airport Rail Link	N/A	N/A	N/A	N/A	3.2	0.5
Ferry	0.0	0.0	0.0	N/A	1.1	0.2

Variable	BT	ST	CK	VR	SV	Total
	Percent	Percent	Percent	Percent	Percent	Percent
Frequency of use						
Regular (use more than once per week)	79.3	78.4	78.2	87.6	79.8	80.5
Non-regular	20.7	21.6	21.8	12.4	20.2	19.5
Transfer	18.1	8.8	21.0	25.0	38.9	21.5
Transfer mode						
BTS	14.3	10.0	26.9	3.8	77.1	33.1
MRT	N/A	N/A	3.9	50.0	17.1	16.9
Ferry	4.8	10.0	7.7	3.8	2.9	5.1
Bus	42.8	70.0	42.3	27.0	0.0	28.8
Motorcycle taxi	14.3	0.0	7.7	7.7	2.9	6.8
Songtaew	9.5	0.0	11.5	N/A	N/A	4.2
Public van	0.0	0.0	0.0	7.7	0.0	1.7
Train	14.3	10.0	0.0	N/A	N/A	3.4
Travel alone	75.0	76.8	71.0	81.0	53.8	72.1
Origin						
Home	75.8	72.0	71.0	85.7	77.7	76.1
Work	5.2	7.2	5.6	9.5	10.6	7.4
School/University	0.0	0.8	0.8	0.0	2.1	0.7
Shopping	16.4	14.4	22.6	3.8	3.2	12.8
Transfer	0.0	0.0	0.0	0.0	4.3	0.7
Other[2]	2.6	5.6	0.0	1.0	2.1	2.3
Destination						
Home	9.5	9.7	10.5	4.8	5.3	8.2
Work	27.6	26.6	21.0	52.9	31.6	31.3
School/University	4.3	6.4	6.4	4.8	27.4	9.2
Shopping	42.2	33.9	47.6	21.2	23.1	34.4
Transfer	0.9	1.6	2.4	4.8	9.5	3.6
Other[3]	15.5	21.8	12.1	11.5	3.1	13.3

	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Trip distance (km/trip)	12.29	23.03	13.46	41.24	9.64	8.51	6.67	11.80	8.12	9.67	10.22	23.39
Range	0.2-114		0.3-447		0.3-43		0.03-90		0.45-43		0.03-447	
Trip cost (Baht/trip)	44.40	101.40	43.33	97.03	27.87	45.54	26.19	51.62	35.12	40.22	35.65	74.12
Range	0-500		0-900		0-330		0-300		0-200		0-900	
Wait time (min)	8.45	14.79	8.51	11.18	13.84	13.78	3.74	7.05	3.71	6.87	8.02	12.04
Range	0-120		0-60		0-60		0-30		0-30		0-120	
Travel time (min/trip)	25.63	23.77	43.11	65.79	33.12	24.36	20.89	21.31	27.56	21.63	30.55	37.65
Range	3-120		2-660		3-120		3-120		3-120		2-660	
Public transport mode that are usually used												
Bus	56.2		53.2		72.6		69.7		30.3		58.1	
Motorcycle taxi	14.9		8.1		8.1		10.1		29.0		12.9	
Songtaew	14.0		4.8		1.6		N/A		3.9		5.0	
Tuktuk	0.9		2.4		0.8		0.0		0.0		0.9	
Taxi	14.0		31.5		16.9		20.2		36.8		23.1	
Frequency of use												
Regular (use more than once per week)	49.5		48.8		56.9		42.7		54.0		50.6	
Non-regular	50.5		51.2		43.1		57.3		46.0		49.4	

Note: [1] Shuttle service for Siriraj Hospital officers (only available in ST route)

[2] "Other" origins include visiting friends, hospital, temple, and leisure

[3] "Other" destinations include visiting friends and relatives, hospital, temple, leisure, and restaurant

As a whole, the top three origins stated by non-users are “home” (76.1%), “shopping” (12.8%) and “work” (7.4%), respectively. For destinations, “shopping” (34.4%) is the highest proportion followed by “work” (31.3%) and “other” (13.3%), respectively. Trips of non-users range from destinations nearby to destinations in other provinces. Distances range from 0.03-447 km/trip with the average of 10.22 km/trip. Cost per trip range from 0-900 Baht with the average of 35.65 Baht. Wait time and travel time range from 0-120 min and 2-660 min, respectively, with the average of 8.02 min and 30.55 min, respectively.

Moreover, this study asked non-users to state the public transport mode that they usually use and it is found that bus reports the highest share, accounting for 58.1% of all respondents, followed by taxi (23.1%) and motorcycle taxi (12.9%), respectively. In terms of frequency of use, approximately half of them are regular users (using the mode more than once per week).

5.1.3 Comparative analysis of travel behavior between users and non-users of SR

In this section, socioeconomic and trip variables of SR users and non-users are comparatively analyzed. Pearson chi square test for independence are performed to test whether distributions of categorical variables differ from each other, presented in Table 42.

The distributions of 11 out of 19 variables are significantly different between users and non-users. Based on nationality, non-users display higher proportion of Thai while users show higher share of other nationality, mostly the Japanese. The distributions of gender are different in that female exhibits higher share in user group. It is noted that percentage of “no income” and “9,999 or less” are higher in SR users whereas “10,000-19,999” is at lower proportion. For occupation distributions, users reveal higher share of “student”, “housewife” and “unemployed”. The significant differences are found among categories of household car, car availability, household motorcycle, as well as motorcycle availability. The proportions of users with household car and car available to use display the lower share when compared to non-users. Also, the similar trend is found in household motorcycle and motorcycle availability. Users of SR report higher proportion of transfer trip when compared to non-users. “Shopping” and “transfer” are of higher share for both origin and destination of SR trips when compared to other modes. In other travel modes, “home” is at higher proportion for origin and “work” is of higher share for destination, both when compared to SR trips. However, no differences are found in the distribution of age, marital status, education, household member, household bicycle, availability of bicycle, transfer mode, and travel pattern.

Table 42 Comparative analysis between user and non-user socioeconomic and trip variables

Variable	Chi square	P value
Nationality	17.455	0.000
Gender	36.009	0.000
Age	1.927	0.859
Marital status	0.001	0.975
Education	5.932	0.431
Income	18.696	0.005
Occupation	30.319	0.001
Household members	3.419	0.181
Household car	8.835	0.012
Car available to use	10.301	0.006
Household motorcycle	25.743	0.000
Motorcycle available to use	27.782	0.000
Household bicycle	0.700	0.705
Bicycle available to use	0.223	0.894
Transfer	44.775	0.000
Transfer mode	18.750	0.016
Travel alone	0.917	0.338
Origin	77.433	0.000
Destination	77.566	0.000

From this survey, the top six non-user modes are presented in Figure 33 which involves bus, motorcycle (combining motorcycle taxi and private motorcycle), private car, walk, taxi and songtaew. Variables associated with socioeconomic and trip profiles are comparatively analyzed between SR and other transport modes. Bus, private car, private motorcycle and motorcycle taxi are dominant and are selected for comparative analysis in Table 43.

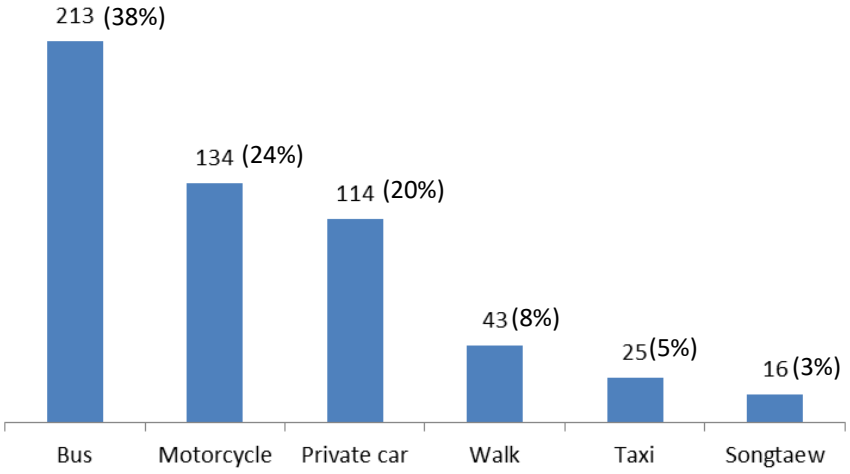


Figure 33 Distribution of non-user modes

Table 43 Socioeconomic and trip profiles of users of different travel modes

Variable	Unit	SR (n=597)		Bus (n=213)		PC (n=114)		Private MC (n=96)		MC taxi (n=38)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Trip distance	Km	3.44	2.53	10.16	7.82	11.07	10.74	5.65	8.11	3.56	5.84
Travel cost per trip	Baht/trip	13.97	17.45	12.97	11.99	60.96	59.00	25.02	31.05	34.12	28.87
Wait time	Min	5.85	5.60	17.91	10.86	0.00	0.000	0.00	0.000	3.91	5.81
Travel time	Min	14.72	10.45	35.48	24.63	40.19	28.83	17.99	16.07	10.56	7.45
Income*	Baht/month	21,860	19,775	18,417	12,414	38,377	24,429	19,397	10,416	19,412	18,292
Income median		17,000		15,000		27,000		15,000		15,000	
		Percent		Percent		Percent		Percent		Percent	
Transfer		39.6		29.6		12.3		2.1		36.8	
Female		69.1		59.2		40.4		34.4		60.5	
University level		47.1		34.9		67.5		27.1		39.5	

Note *Respondents with no income are excluded from analysis

Percentage of trip distance among different travel modes is illustrated in Figure 34. Trip distance of all modes reveal that majority of SR and motorcycle modes are between 0-4.9 km/trip whereas bus and private car mostly are used for 5 km/trip and above.

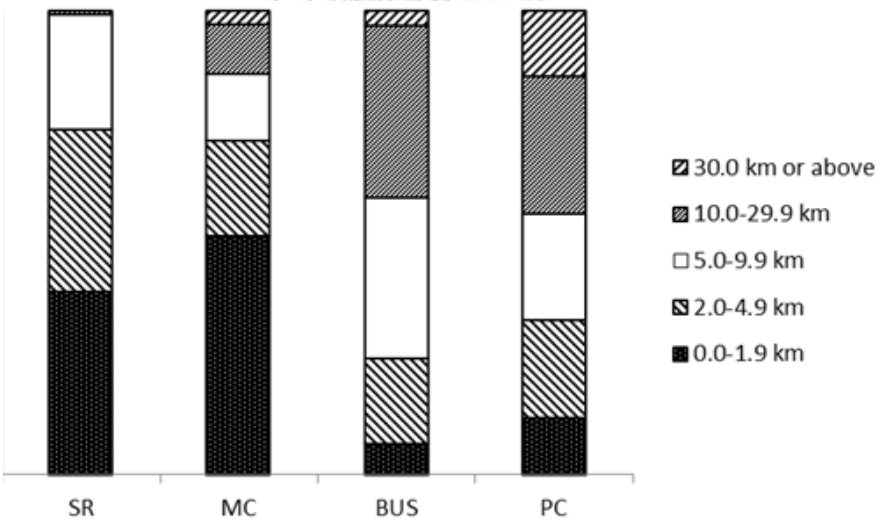
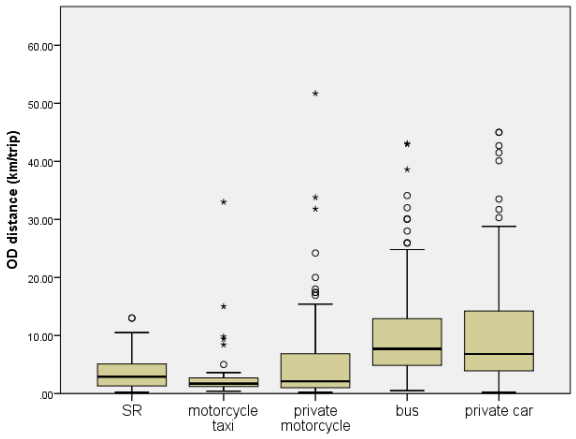


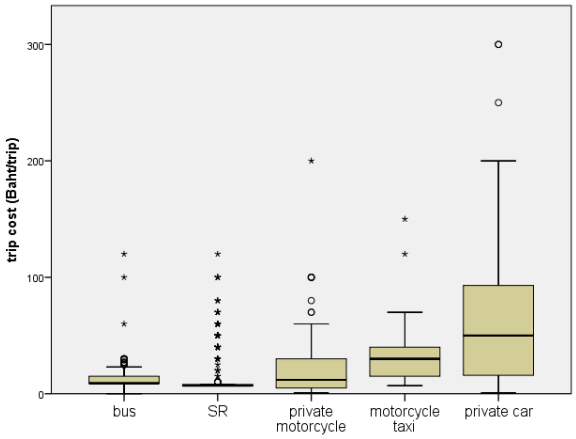
Figure 34 Percentage of trip distance among transport modes

Comparative analysis of trip variables among five travel modes is shown in Figure 35. Mean distances of SR, motorcycle taxi, private motorcycle are 3.44, 3.56 5.65 km/trip, respectively. Longer mean distances are found in bus (10.16 km/trip) and private car (11.07 km/trip). Travel cost per trip is found to be the lowest in bus (12.97 Baht), followed by SR (13.97 Baht), private motorcycle (25.02 Baht), motorcycle taxi (34.12 Baht) and private car (60.96 Baht), reporting the highest cost. The private vehicles including car and motorcycle, require no wait time while the longest wait time found in bus services (17.91 min), followed by SR (5.85 min) and motorcycle taxi (3.91 min), respectively. For travel time among transport t modes, results show that travel time of bus (35.48 min) and private car (40.19 min) are in the longest group whereas private motorcycle (17.99 min), SR (14.72 min), and motorcycle taxi (10.56 min) are in the shorter travel time group. SR, motorcycle taxi and bus report higher proportion of transfer trip, accounting for 39.6%, 36.8%, and 29.6%, respectively, when compared to private modes like private car (12.3%) and private motorcycle (2.1%).

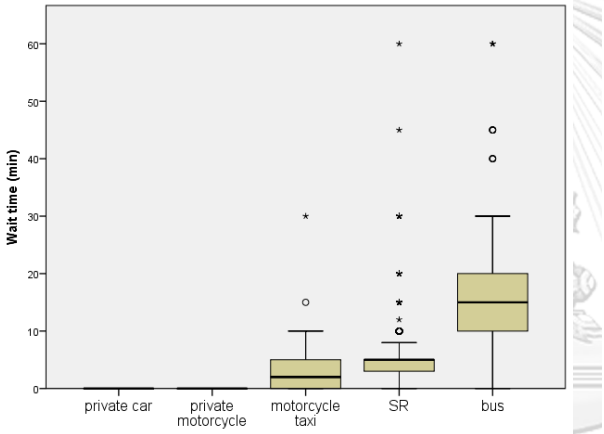
Figure 36 presents the comparative analysis of socioeconomic variables among different transport modes. Three of public transport modes (SR, bus, and motorcycle taxi) exhibit higher share of female than male users. For private vehicle users (car and motorcycle), male users show higher proportion than female users. Based on user education categories, private car differs from other modes in the dominant university level group, accounting for 67.5% whereas majority of SR, bus, motorcycle taxi and private motorcycle users are in non-university group. Private car users have the highest income median (27,000 Baht/month), followed by SR (17,000 Baht/month), bus, private motorcycle, and motorcycle taxi users illustrating the lowest income median. The lowest three modes have the same income median value, 15,000 Baht/month. The highest mean income is found in private car users (38,377 Baht/month), followed by SR (21,860 Baht/month), motorcycle taxi (19,412 Baht/month), private motorcycle taxi (19,397 Baht/month), and bus (18,417 Baht/month), respectively.



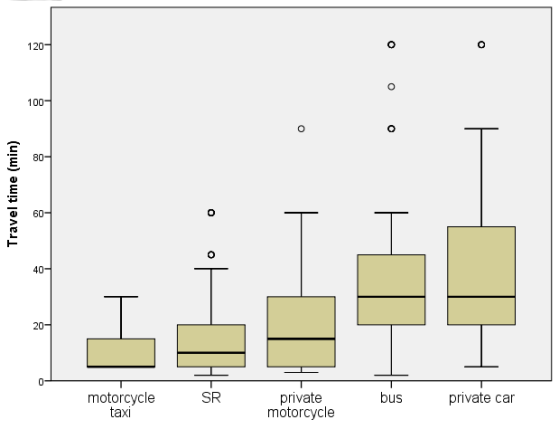
(a) Distance



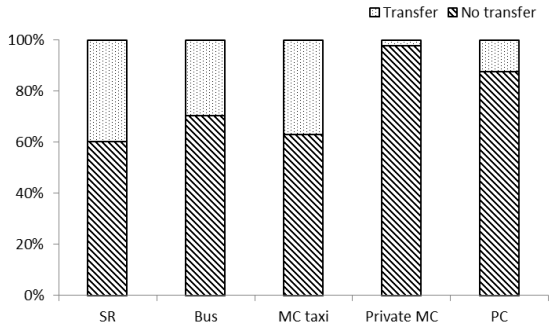
(b) Trip cost



(c) Wait time

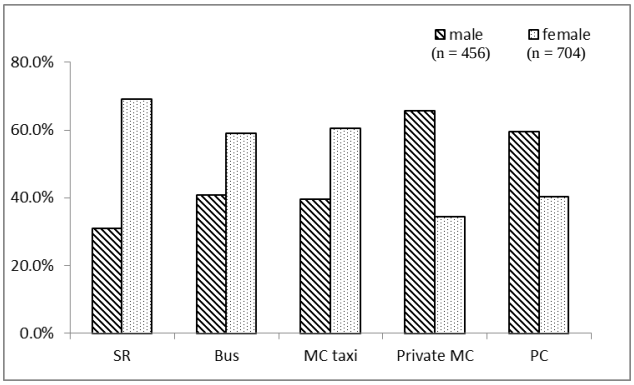


(d) Travel time

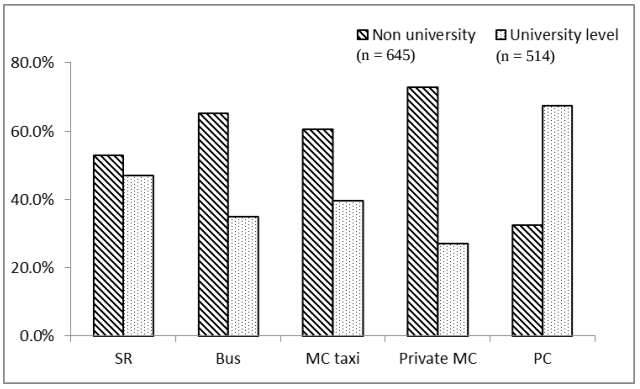


(e) Transfer

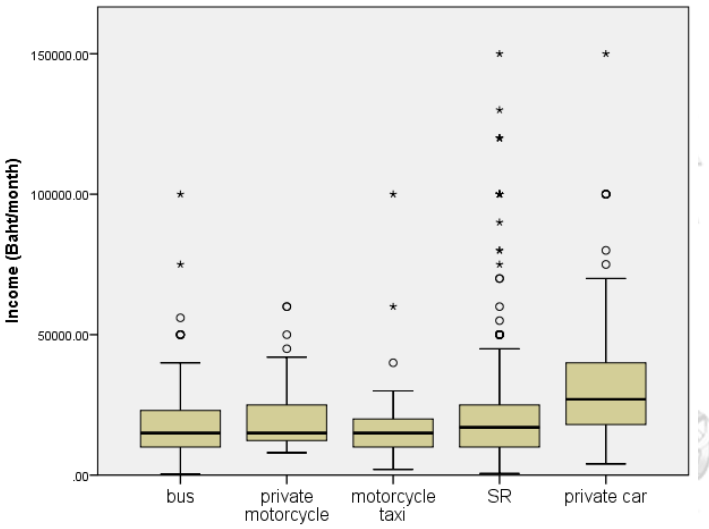
Figure 35 Comparative analysis of trip characteristics among different transport modes



(a) Gender



(b) Education



(c) Income

Figure 36 Comparative analysis of socioeconomic characteristics among different transport modes

5.2 Attitudes on service quality

This section descries results on attitudes towards service quality from SR users and non-users points of view. First, SR users' attitudes are presented based on their reason for using SR services, satisfaction on service, and the importance score evaluated on public transport aspects. Then, attitudes of non-users are explored in terms of reasons for not using SR and the importance score on public transport aspects. The evaluation of importance score by SR users and non-users are comparatively analyzed.

5.2.1 Users of SR

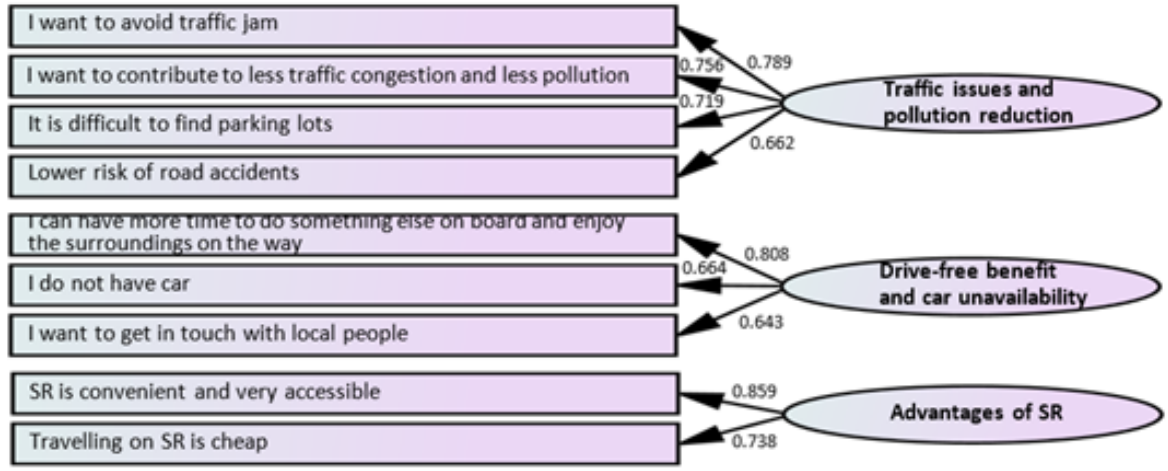
In this survey, SR users of five routes were asked to rate their level of agreements on nine statements as reasons for using SR based on five-point Likert scale from 1 (Strongly disagree) to 5 (Strongly agree). The results are presented separately in each route, in Table 44. The results of all SR users are further analyzed through Exploratory Factor Analysis (EFA) except users in SV route. This is because the route is different from all others in terms of service characteristics as reported in Table 20 (in Chapter 3) and the high proportion of foreign users that may create attitude variations.

Table 44 Descriptive statistics of reason for using SR services derived from five SR routes

Reason for using SR	BT		ST		CK		VR		SV		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. SR is convenient and very accessible	4.44	0.06	4.44	0.06	4.54	0.07	4.55	0.05	4.20	0.11	4.44	0.77
2. Travelling on SR is cheap	4.28	0.09	4.26	0.08	4.33	0.08	4.27	0.08	3.32	0.14	4.14	1.03
3. Lower risk of road accidents	3.33	0.09	3.37	0.11	3.71	0.10	3.96	0.09	3.27	0.12	3.54	1.15
4. It is difficult to find parking lots	3.38	0.10	3.72	0.10	3.81	0.10	3.75	0.11	3.47	0.14	3.64	1.16
5. I want to avoid traffic jam	3.52	0.09	3.67	0.09	3.78	0.10	3.79	0.11	3.16	0.14	3.60	1.13
6. I want to contribute to less traffic congestion and less pollution	3.35	0.09	3.56	0.09	3.80	0.08	3.63	0.11	3.07	0.13	3.51	1.09
7. I do not have car	3.79	0.10	3.40	0.11	3.44	0.13	3.10	0.12	3.79	0.13	3.50	1.31
8. I can have more time to do something else on board and enjoy the surroundings on the way	3.73	0.08	3.48	0.10	3.51	0.08	3.28	0.09	3.18	0.12	3.46	1.02
9. I want to get in touch with local people	2.94	0.09	2.84	0.10	2.86	0.10	2.88	0.08	2.77	0.13	2.86	1.11

Note: Scores are evaluated on 5-point Likert scale

EFA reveals that all factor loadings exceed 0.5. The construct arbitrarily are labeled in accordance with the content of component variables. Figure 37 illustrates factor analysis results of reason for using SR showing latent constructs, statement groupings, and factor loadings. The results demonstrate that three latent variables were extracted, *Traffic issues and pollution reduction*, *Drive-free benefit and car unavailability*, and *Advantages of SR*. Nine attitudinal statements explain 59.7% of the total variance. *Traffic issues and pollution reduction* explains the highest total variance (26.6%), followed by *Drive-free benefit and car unavailability* (17.0%) and *Advantages of SR* (16.1%), respectively.



Note: Cronbach's Alpha: 0.685; KMO: 0.689; Bartletts's: 866.532, p-value 0.000
Data are derived from BT, ST, CK, and VR routes; Scores are evaluated on 5-point Likert scale

Figure 37 Exploratory factor analysis of the reasons for using SR service statements with latent constructs, attitudinal statements groupings, and construct loadings

The statements are ranked from the highest score to the lowest score as presented in Table 45. It is found that the top scores are the reasons related to *Advantages of SR*, followed by *Traffic issues and pollution reduction* and *Drive-free benefit and car unavailability*, respectively.

Table 45 Rank of the reasons for using SR services

Reason for using SR	Total	
	Mean	SD
SR is convenient and very accessible	4.50	0.70
Travelling on SR is cheap	4.29	0.89
I want to avoid traffic jam	3.69	1.07
It is difficult to find parking lots	3.67	1.12
I want to contribute to less traffic congestion and less pollution	3.59	1.06
Lower risk of road accidents	3.58	1.15
I can have more time to do something else on board and enjoy the surroundings on the way	3.51	0.98
I do not have car	3.44	1.32
I want to get in touch with local people	2.88	1.09

Note: Data are derived from BT, ST, CK, and VR routes; Scores are evaluated on 5-point Likert scale

This study further explores user counts based on their ratings on "Agree" (Score 4) and "Strongly agree" (Score 5) on each of the statement. User counts of score 4 and 5 are added up and the percentage are calculated. Results of users with different alternative modes are presented separately in each column in Table 46. Reason 1 and 2 report the highest percentages from all groups of SR users, indicating that convenience, accessibility and cheap fare are the main reasons for using SR.

Table 46 User counts based on their ratings on “Agree” and “Strongly agree” on the reasons of use statements

Reason for using SR	Bus (n=187)		Motorcycle (n=82)		Taxi (n=47)		Private car (n=37)		Walk (n=37)		No alt* (n=192)		Total (n=582)	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
1. SR is convenient and very accessible	168	90	69	84	42	89	31	84	35	95	178	93	523	90
2. Travelling on SR is cheap	158	84	59	72	30	64	29	78	25	68	160	83	461	79
3. Lower risk of road accidents	104	56	45	55	20	43	19	51	20	54	115	60	323	55
4. It is difficult to find parking lots	106	57	41	50	24	51	23	62	20	54	113	59	327	56
5. I want to avoid traffic jam	107	57	36	44	18	38	15	41	19	51	121	63	316	54
6. I want to contribute to less traffic congestion and less pollution	99	53	36	44	12	26	21	57	19	51	110	57	287	49
7. I do not have car	99	53	44	54	24	51	9	24	20	54	89	46	285	49
8. I can have more time to do something else on board and enjoy surroundings	96	51	40	49	22	47	11	30	22	59	81	42	253	43
9. I want to get in touch with local people	58	31	20	24	10	21	5	14	14	38	41	21	148	25

Note: Cases that did not rate all the nine aspects were excluded from the analysis

* No alt = No alternatives

Rating scores of SR users with three alternatives, including bus, motorcycle and private car, are comparatively analyzed. The results in Table 47 show that Alt-bus reports significantly higher score than Alt-motorcycle on the reasons “SR is convenience and very accessible” and “I want to avoid traffic jam”. For Alt-bus, they are more likely to agree that “Travelling on SR is cheap” when compared to Alt-motorcycle and Alt-private car groups as they show significantly higher score in such the reason. The score on reason “I do not have car” is significantly higher in Alt-bus and Alt-motorcycle when compared to Alt-private car.

Table 47 Comparative analysis of reasons of SR usage from users with various alternative modes

Reason for using SR	Alt-bus (n=187)		Alt-motorcycle (n=82)		Alt-private car (n=37)	
	Mean	SD	Mean	SD	Mean	SD
1. SR is convenient and very accessible	4.48 [a]	0.74	4.24 [b]	0.87	4.27 [ab]	0.87
2. Travelling on SR is cheap	4.29 [a]	0.88	3.94 [b]	1.17	3.89 [b]	0.91
3. Lower risk of road accidents	3.51 [a]	1.09	3.52 [a]	1.06	3.32 [a]	1.23
4. It is difficult to find parking lots	3.63 [a]	1.11	3.41 [a]	1.17	3.78 [a]	1.23
5. I want to avoid traffic jam	3.66 [a]	1.06	3.20 [b]	1.19	3.35 [ab]	1.14
6. I want to contribute to less traffic congestion and less pollution	3.59 [a]	1.01	3.31 [a]	1.16	3.41 [a]	1.17
7. I do not have car	3.64 [a]	1.30	3.49 [a]	1.30	2.46 [b]	1.24
8. I can have more time to do something else on board and enjoy the surroundings on the way	3.56 [a]	1.01	3.35 [ac]	1.09	3.11 [bc]	1.10
9. I want to get in touch with local people	2.99 [a]	1.18	2.78 [a]	1.09	2.65 [a]	0.98

Note: - Scores are derived from five-point Likert scale

- Statistical tests were performed to explore mean differences among each mode. Letters following mean values indicate the mean significant differences among each route derived from the statistical tests

SR users of each route are asked to rate their satisfaction on SR service quality aspects of 18 attitudinal statements based on five-point Likert scale from 1 (Strongly disagree) to 5 (Strongly agree). Table 48 presents descriptive statistics of satisfaction scores on 18 attitudinal statements in each route separately.

Table 48 Descriptive statistics of satisfaction scores on SR service quality aspects

Attitudinal statement	BT		ST		CK		VR		SV		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. SR has frequent service	4.31	0.08	4.33	0.07	4.55	0.07	4.51	0.05	4.02	0.11	4.36	0.84
2. I am satisfied that SR routes cover places I want to go	4.19	0.08	4.34	0.06	4.48	0.06	4.36	0.05	3.89	0.10	4.28	0.77
3. SR operates in the time period I need to travel	4.01	0.09	4.16	0.08	4.50	0.06	4.39	0.06	3.98	0.10	4.23	0.84
4. Travelling by SR is fast and I can save my time	4.12	0.08	4.15	0.08	4.47	0.06	4.52	0.06	3.95	0.10	4.26	0.85
5. I do not have to wait for SR for long time	4.20	0.09	4.20	0.07	4.46	0.07	4.49	0.06	3.93	0.11	4.27	0.87
6. SR has suitable fare	4.17	0.08	4.11	0.89	4.35	0.08	4.41	0.08	3.49	0.12	4.14	1.01
7. I always get a seat when riding SR and the seat is comfort	4.06	0.09	3.69	0.11	4.20	0.08	4.33	0.06	3.66	0.12	3.99	1.05
8. Shelter and benches at stops are available	3.77	0.10	3.48	0.11	4.01	0.09	3.74	0.10	3.05	0.12	3.65	1.14
9. SR gives sufficient stop time to board and alight and it is easy to enter the vehicle	3.76	0.09	3.51	0.11	3.95	0.10	4.11	0.08	3.44	0.11	3.76	1.10
10. It is convenient to connect with and transfer to other modes	3.87	0.09	3.83	0.09	4.23	0.08	4.27	0.07	3.48	0.11	3.95	0.98
11. Riding SR is safe from road accident and secured from criminal incidents	3.30	0.10	3.33	0.10	3.62	0.10	3.74	0.07	3.22	0.11	3.46	1.06
12. SR is clean, free from dust or garbage, seat are in good condition, easy to move, protected from exposure to the elements	3.13	0.10	3.01	0.11	3.46	0.10	3.64	0.07	3.02	0.13	3.27	1.13
13. Passengers riding SR are polite	3.51	0.09	3.46	0.09	3.67	0.09	3.86	0.06	3.25	0.12	3.57	0.97
14. SR drivers are polite and honest	3.46	0.10	3.44	0.10	3.45	0.09	3.83	0.07	3.16	0.11	3.49	1.05
15. Fare structure are provided	3.96	0.08	3.84	0.09	3.69	0.09	3.79	0.08	2.73	0.14	3.66	1.09
16. SR causes air and noise pollution	3.25	0.09	3.41	0.10	3.29	0.08	3.06	0.79	3.05	0.11	3.23	0.99
17. SR causes traffic congestion	3.26	0.10	3.42	0.10	3.15	0.09	2.85	0.10	2.94	0.14	3.15	1.12
18. SR causes road accidents	3.02	0.10	3.13	0.10	3.12	0.09	2.73	0.10	2.86	0.13	2.99	1.10

Note: Scores are evaluated on 5-point Likert scale

In additions, SR users are asked to evaluate importance scores of service aspects of public transport modes consisting of 19 attitudinal statements. All attributes are paralleled with the 18 statements applied in satisfaction survey as previously explained, except for Statement 14 “Air-conditioning in the vehicle” which was added in this Importance score survey. The ratings are based on 1-5 Likert scale, from 1 (Unimportant) to 5 (Very important). The results in Table 49 present descriptive statistics of importance score on 19 attitudinal statements in each route separately.

Subsequently, both satisfaction score and importance score of the 18 aspects are analyzed by Importance-Performance Analysis (IPA) to identify areas of improvements. The purpose of IPA is to point out the areas where improvements would have the greatest impact on improving satisfaction with the entire system (Yang *et al.*, 2011). The two-dimensional graphic is displayed with average values of each attribute, related to importance score and performance score. Then, two lines are placed parallel to importance axis and performance axis, defining average values of all attributes.

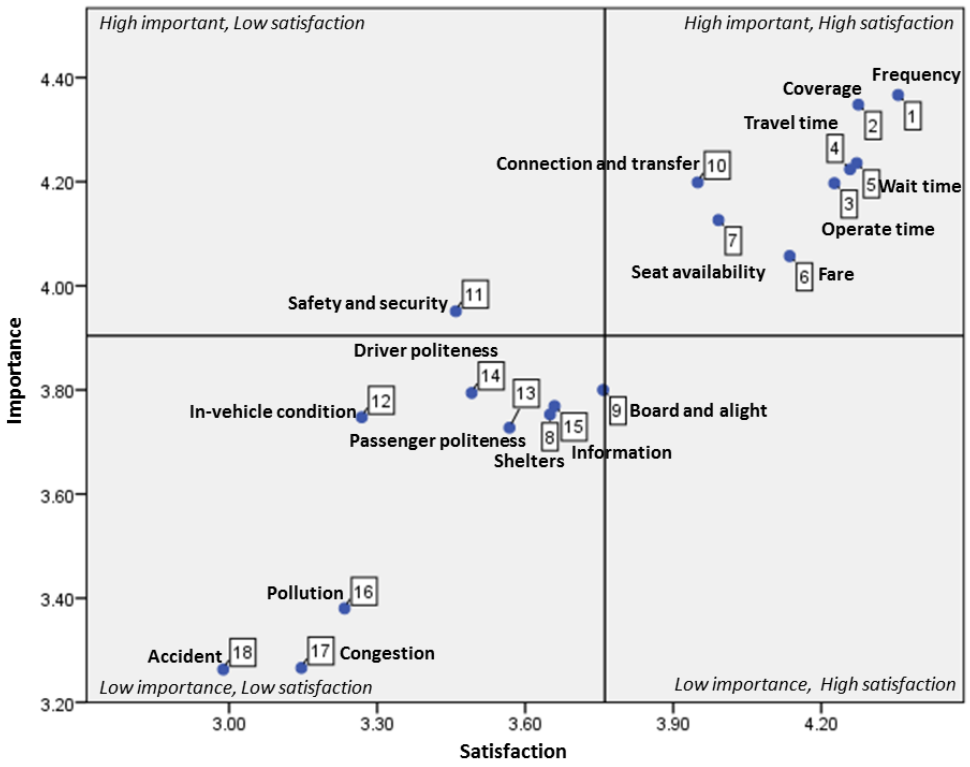
Table 49 Importance scores of public transport service quality from user perspectives

Attitudinal statement	BT		ST		CK		VR		SV		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Service frequency	4.28	0.08	4.24	0.09	4.64	0.05	4.43	0.06	4.16	0.10	4.37	0.82
2. Coverage area	4.34	0.07	4.34	0.07	4.58	0.06	4.33	0.07	4.09	0.09	4.35	0.76
3. Length of operation time	4.04	0.09	4.02	0.09	4.42	0.08	4.32	0.06	4.17	0.10	4.20	0.89
4. Travel time	4.06	0.08	3.99	0.09	4.45	0.07	4.32	0.08	4.28	0.10	4.22	0.90
5. Waiting time at stop	4.16	0.09	4.19	0.08	4.36	0.08	4.32	0.08	4.13	0.10	4.24	0.91
6. Suitable fare structure	4.08	0.10	3.91	0.10	4.17	0.10	4.22	0.09	3.84	0.11	4.06	1.06
7. Seat availability and seat comfort	4.08	0.09	4.08	0.08	4.27	0.09	4.27	0.08	3.87	0.11	4.13	0.96
8. Availability of shelter and benches at stops	3.70	0.10	3.65	0.10	3.92	0.11	4.00	0.10	3.46	0.12	3.75	1.16
9. Given sufficient stop time to board and alight and ease to enter the vehicle e.g., open the car-door, height of step	3.69	0.10	3.66	0.10	4.10	0.09	3.88	0.10	3.60	0.12	3.80	1.10
10. Convenience of connections and transfers	4.10	0.08	4.05	0.08	4.44	0.07	4.43	0.07	3.87	0.12	4.20	0.91
11. Safety from road accident and security from criminal incidents	3.89	0.08	3.74	0.09	4.28	0.08	3.99	0.07	3.76	0.12	3.95	0.97
12. In-vehicle environment, e.g. cleanliness, seat quality, ease to move, absence of noise, protection from exposure to elements, etc.	3.65	0.09	3.45	0.10	3.88	0.10	3.96	0.07	3.87	0.12	3.75	1.07
13. Passenger politeness	3.68	0.09	3.64	0.09	3.67	0.10	3.93	0.08	3.76	0.09	3.73	1.00
14. Air-conditioning in the vehicle	3.44	0.11	3.23	0.11	3.55	0.12	3.66	0.10	3.51	0.12	3.47	1.24
15.. Driver behavior, e.g. polite, honest, provide help to passenger, etc.	3.82	0.09	3.67	0.10	3.86	0.09	3.83	0.09	3.81	0.10	3.79	1.02
16. Availability of information regarding route direction (e.g., map, route, etc.) and information regarding service (e.g., fare, etc.)	3.78	0.09	3.74	0.09	3.83	0.09	3.84	0.08	3.60	0.11	3.77	0.97
17. Level of air emission and noise pollution	3.35	0.09	3.30	0.10	3.32	0.09	3.42	0.10	3.60	0.12	3.38	1.08
18. Level of congestion impact caused by the mode	3.21	0.09	3.09	0.09	3.23	0.08	3.34	0.11	3.56	0.13	3.27	1.09
19. Level of road accident caused by the mode	3.19	0.10	3.05	0.10	3.25	0.09	3.27	0.11	3.67	0.14	3.26	1.14

Note: Scores are evaluated on 5-point Likert scale

Results of IPA between importance score and satisfaction score of users are presented in Figure 38. Attributes that appear in the high importance and high satisfaction quadrant are Reliability aspects (including Frequency, Coverage, Operate time, Travel time, and Wait time), Connection and transfer aspects, Seat availability, and Fare. The attributes evaluated in the high importance but low satisfaction quadrant is Safety and security. Other attributes are rated at lower importance with lower satisfaction.

In User Survey Part 4, the survey also asked respondents to give the reason for choosing SR instead of their alternative modes, for those having alternative modes. The word cloud depicted in Figure 39 extract the top 17 most commonly occurring words derived from this qualitative feedback written on User Survey. Notably, users' experiences reveal top four wordings which include convenient (150 respondents), faster (125 respondents), frequent (90 respondents), and cheaper (81 respondents).



Note: **Service aspects**:

1 = Frequent service
2 = Route coverage
3 = Operating time
4 = Travel time
5 = Wait time
6 = Fare
7 = Seat availability and comfort
8 = Shelter and bench at stops
9 = Sufficient time to board and alight
10 = Convenience of connection and transfer
11 = Safety and security
12 = Cleanliness, seat condition, ease to move, protection from elements
13 = Polite passengers
14 = Polite and honest drivers
15 = Information provision
16 = Impact on air and noise pollution*
17 = Impact on traffic congestion*
18 = Impact on road accidents*

* Negative statements in the 'Satisfaction' evaluation

Figure 38 IPA of users' mean satisfaction ratings vs. mean satisfaction ratings on 18 service attributes

Figure 39 Word cloud of advantages of SR over other modes

5.2.2 Non-users

Non-users in this study are asked to evaluate their level of agreements on reasons for not using SR which involve 11 statements. The evaluation is based on five-point Likert scale, ranging from 1 (Strong disagree) to 5 (Strongly agree). The results of each route are reported in Table 50. Further, EFA was performed on 11 attitudinal statements of all non-users with exception of SV route as reasons mentioned in EFA of users in Section 5.2.1.

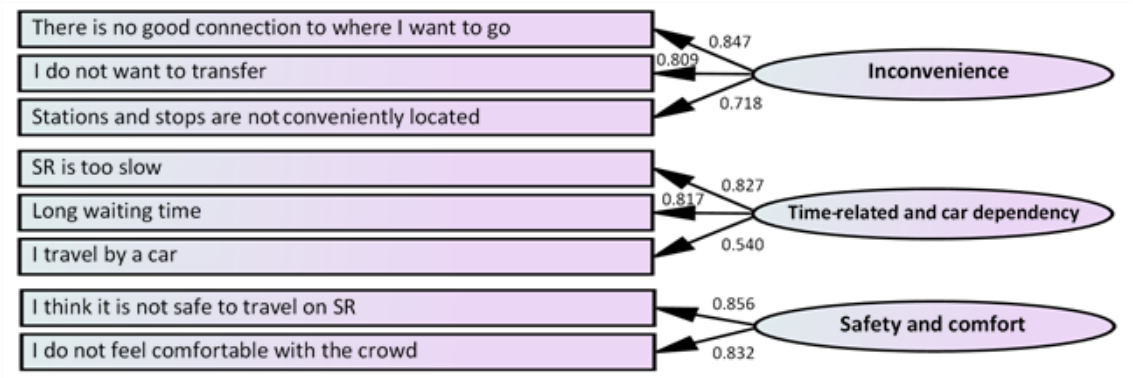
Table 50 Descriptive statistics of reason for not using SR services derived from five SR routes

Reason for not using SR	BT		ST		CK		VR		SV		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. I do not know how to use SR	2.71	0.13	2.79	0.13	2.75	0.14	2.85	0.11	3.90	0.15	2.96	1.40
2. Stations and stops are not conveniently located	3.26	0.13	3.36	0.11	3.27	0.12	3.18	0.13	3.84	0.13	3.36	1.25
3. There is no good connection to where I want to go	3.79	0.11	3.80	0.11	3.80	0.11	3.63	0.13	3.87	0.14	3.78	1.19
4. I do not want to transfer	3.90	0.11	3.97	0.10	3.83	0.10	3.73	0.13	3.62	0.14	3.80	1.15
5. Long waiting time	3.17	0.11	3.38	0.10	3.03	0.10	3.10	0.13	3.13	0.14	3.18	1.16
6. SR is too slow	2.93	0.11	2.89	0.11	2.66	0.93	2.97	0.12	2.79	0.14	2.86	1.12
7. Fares are expensive	2.80	0.11	2.72	0.09	2.62	0.10	3.20	0.11	3.26	0.14	2.92	1.14
8. I think it is not safe to travel on SR	3.76	0.11	3.49	0.11	3.62	0.11	3.09	0.13	2.99	0.16	3.42	1.20
9. I do not feel comfortable with the crowd	3.83	0.10	3.91	0.10	3.80	0.10	3.44	0.14	3.04	0.16	3.65	1.18
10. I prefer walking or cycling	3.46	0.12	3.11	0.11	3.34	0.10	3.44	0.13	2.85	0.18	3.29	1.26
11. I travel by a car	3.22	0.15	3.41	0.12	3.34	0.12	3.55	0.15	3.19	0.19	3.37	1.44

Note: Scores are evaluated on 5-point Likert scale

All factor loadings exceed 0.5, except statement 1 “I do not know how to use SR” and statement 10 “I prefer walking or cycling”. Also statement 7 “Fares are expensive” shows out to be the only variable that does not load on any factor. Thus, statement 1, 10 and 7 are dropping off and 8 statements remain. Then the constructs arbitrarily are labeled according to the content of component variables.

Figure 40 displays results of factor analysis of reasons for not using SR with the latent constructs, statement groupings and factor loadings. Three factors are extracted from the EFA, involving *Inconvenience*, *Time-related and car-dependency*, and *Safety and comfort.* Eight attitudinal statements explain 64.5% of the total variances. *Inconvenience* explains the highest total variance (29.4%), followed by *Time-related and car-dependency* (21.5%), and *Safety and comfort* (18.6%), respectively.



Note: Cronbach's Alpha: 0.622; KMO: 0.628; Bartletts's: 686.636, p-value 0.000
Data are derived from BT, ST, CK, and VR routes; Scores are evaluated on 5-point Likert scale

Figure 40 Exploratory factor analysis of the reasons for not using SR service statements with latent constructs, attitudinal statements groupings, and construct loadings

All statements are ranked from high to low score, as presented in Table 51. It is shown that the top reasons for not using SR are related to *Inconvenience*, followed by *Safety and comfort* issues, *and Time-related and car-dependency*, respectively.

Table 51 Rank of the reasons for not using SR services

Reason for not using SR	Total	
	Mean	SD
I do not want to transfer	3.85	1.14
There is no good connection to where I want to go	3.76	1.19
I do not feel comfortable with the crowd	3.74	1.15
I think it is not safe to travel on SR	3.49	1.18
I travel by a car	3.38	1.41
I prefer walking or cycling	3.33	1.20
Stations and stops are not conveniently located	3.28	1.27
Long waiting time	3.18	1.17
SR is too slow	2.87	1.13
Fares are expensive	2.83	1.11
I do not know how to use SR	2.78	1.35

Note: Data are derived from BT, ST, CK, and VR routes; Scores are evaluated on 5-point Likert scale

Further, this study investigates counts of non-users' ratings on each statements of the reasons of not using SR. The ratings on "Agree" (4) and "Strongly agree" (5) in each statement are summed up and calculated into percentage as shown in Table 52. Results are classified into five non-user modes, including bus, motorcycle, private car, walk and taxi.

Table 52 Non-user counts based on their ratings on “Agree” and “Strongly agree” on the reasons of non-use statements

Reason of not use	Bus (n=213)		Motorcycle (n=134)		Private car (n=113)		Walk (n=43)		Taxi (n=25)		Total (n=528)	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
1. I do not know how to use SR	72	34	56	42	38	34	16	37	11	44	193	37
2. Stations and stops are not conveniently located	108	51	72	54	44	39	20	47	12	48	256	48
3. There is no good connection to where I want to go	141	66	79	59	61	54	24	56	17	68	302	57
4. I do not want to transfers	141	66	78	58	77	68	23	53	16	64	335	63
5. Long waiting time	73	34	64	48	49	43	14	33	11	44	211	40
6. SR is too slow	46	22	52	39	22	19	10	23	9	36	139	26
7. Fares are expensive	53	25	33	25	25	22	18	42	4	16	144	27
8. I think it is not safe to travel on SR	116	54	52	39	60	53	17	40	11	44	256	48
9. I do not feel comfortable with the crowd	120	56	79	59	66	58	22	51	16	64	303	57
10. I prefer walking or cycling	78	37	66	49	51	45	25	58	8	32	228	43
11. I travel by a car	35	16	94	70	103	91	11	26	4	16	247	47

Note: Cases that did not rate all the nine aspects were excluded from the analysis

The results note that Reason 10 “I prefer walking or cycling” is distinct in non-users who walk (58%) as well as Reason 11 “I travel by car” which stands out in non-users with private car (91%). The Reason 2,3, and 9 reveal the highest percentages in all non-user mode groups which reflect the reasons that are related to no good connection, no need to transfer, and not comfortable with the crowd. Non-users who travel by bus and private car mostly agree on unsafe issues of SR services. The reason that SR is too slow is stated by most of motorcycle users and taxi users. Additionally, motorcycle, private car, and taxi users are more likely to agree that SR has long wait time.

Ratings on reasons for not using SR are comparatively analyzed among three travel modes, including bus, motorcycle and private car users. Table 53 presents the results with the statistical test for mean differences. There are no significant differences among three non-user groups in Reasons 1, 2, 3, 7, 9, and 10. Nonetheless, significant differences are found in five reason statements which are “I do not want to transfer”, “Long waiting time”, “SR is too slow”, “I think it is not safe to travel on SR”, and “I travel by a car”. Bus and private car users are more likely to agree on the reason of “do not want to transfer” and “it is not safe to travel on SR”, showing significantly higher mean score than motorcycle users. Motorcycle users report significantly higher mean score on long wait time and slow speed of SR. Private car users show significantly higher mean score on “I travel by a car”.

Table 53 Comparative analysis of reasons of not using SR from non-users with different modes

Reason for not using SR	Bus (n=213)		Motorcycle (n=134)		Private car (n=113)	
	Mean	SD	Mean	SD	Mean	SD
1. I do not know how to use SR	2.85 [a]	1.46	3.07 [a]	1.31	2.92 [a]	1.42
2. Stations and stops are not conveniently located	3.40 [a]	1.29	3.40 [a]	1.16	3.20 [a]	1.27
3. There is no good connection to where I want to go	3.91 [a]	1.14	3.72 [a]	1.13	3.67 [a]	1.21
4. I do not want to transfer	3.93 [a]	1.11	3.65 [b]	1.16	3.96 [a]	1.11
5. Long waiting time	3.07 [a]	1.10	3.34 [b]	1.21	3.30 [ab]	1.21
6. SR is too slow	2.78 [a]	1.06	3.11 [b]	1.19	2.67 [a]	1.09
7. Fares are expensive	2.85 [a]	1.14	3.04 [a]	1.15	2.80 [a]	1.14
8. I think it is not safe to travel on SR	3.55 [a]	1.19	3.13 [b]	1.25	3.73 [a]	1.08
9. I do not feel comfortable with the crowd	3.63 [a]	1.21	3.67 [a]	1.21	3.82 [a]	1.07
10. I prefer walking or cycling	3.15 [a]	1.22	3.37 [a]	1.29	3.35 [a]	1.19
11. I travel by a car	2.57 [a]	1.16	4.01 [b]	1.27	4.71 [c]	0.69

Note: - Scores are derived from five-point Likert scale
- Statistical tests were performed to explore mean differences among each mode. Letters following mean values indicate the mean significant differences among each route derived from the statistical tests

All non-users were asked to evaluate the importance level on each service quality aspects of public transport mode they usually use. The ratings are based on five-point Likert scale ranging from 1 (Unimportant) to 5 (Very important). Descriptive statistics of 19 service attributes are presented in Table 54 with separate columns showing results of each route.

Table 54 Importance scores of public transport service quality from non-user perspectives

Attitudinal statement	BT		ST		CK		VR		SV		Total	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Service frequency	4.41	0.07	4.24	0.08	4.48	0.07	4.25	0.09	4.09	0.10	4.31	0.84
2. Coverage area	4.47	0.07	4.36	0.07	4.57	0.05	4.47	0.08	4.19	0.11	4.43	0.76
3. Length of operation time	4.26	0.10	4.04	0.09	4.38	0.08	4.06	0.12	4.12	0.12	4.19	1.00
4. Travel time	4.12	0.10	3.98	0.10	4.39	0.07	4.24	0.10	4.09	0.12	4.18	0.97
5. Waiting time at stop	4.20	0.09	4.20	0.08	4.33	0.08	4.33	0.09	3.94	0.14	4.23	0.91
6. Suitable fare structure	4.04	0.09	3.66	0.10	4.27	0.09	4.15	0.11	3.66	0.13	3.98	1.06
7. Seat availability and seat comfort	4.12	0.10	3.99	0.10	4.37	0.08	4.25	0.11	3.56	0.15	4.08	1.08
8. Availability of shelter and benches at tops	3.86	0.11	3.63	0.12	4.03	0.10	4.09	0.12	3.46	0.14	3.81	1.17
9. Given sufficient stop time to board and alight and ease to enter the vehicle e.g., open the car door, height of step	3.56	0.11	3.61	0.11	4.09	0.09	3.96	0.12	3.56	0.14	3.77	1.13
10. Convenience of connections and transfers	4.02	0.10	3.85	0.10	4.16	0.09	4.15	0.11	3.81	0.13	4.02	1.04
11. Safety from road accident and security from criminal incidents	4.07	0.09	3.76	0.10	4.29	0.08	4.03	0.10	3.68	0.14	3.99	1.01
12. In-vehicle environment, e.g. cleanliness, seat quality, ease to move, absence of noise, protection from exposure to elements, etc.	3.65	0.11	3.58	0.11	4.10	0.08	3.81	0.11	3.65	0.14	3.78	1.08
13. Passenger politeness	3.62	0.11	3.41	0.09	3.75	0.09	3.57	0.11	3.50	0.13	3.60	1.04
14. Air-conditioning in the vehicle	3.67	0.12	3.54	0.11	3.95	0.10	3.74	0.13	3.65	0.15	3.71	1.21
15.. Driver behavior, e.g. polite, honest, provide help to passenger, etc.	3.84	0.10	3.66	0.09	4.01	0.09	3.67	0.12	3.72	0.13	3.79	1.05
16. Availability of information regarding route direction (e.g., map, route, etc.) and information regarding service (e.g., fare, etc.)	3.80	0.10	3.71	0.09	4.01	0.08	3.92	0.13	3.69	0.14	3.83	1.07
17. Level of air emission and noise pollution	3.36	0.11	3.60	0.10	3.56	0.08	3.69	0.13	3.57	0.14	3.57	1.11
18. Level of congestion impact caused by the mode	3.26	0.12	3.41	0.11	3.36	0.09	3.51	0.12	3.41	0.16	3.41	1.18
19. Level of road accident caused by the mode	3.30	0.13	3.36	0.10	3.38	0.09	3.54	0.12	3.57	0.17	3.44	1.19

Note: Scores are derived from five-point Likert scale

5.2.3 Comparative analysis of attitudes between users and non-users of SR

In this study, both users and non-users were asked to evaluate the importance level of all 19 service aspects as listed in Table 49 and Table 54. Accordingly, the scores of both groups were comparatively analyzed and results are presented in Table 55. The statistical tests for mean differences show no significant differences between mean scores from user and non-user perspectives on 12 service attributes. These include "Service frequency", "Operation time", "Travel time", "Wait time", "Fare structure", "Seat availability and comfort", "Availability of shelters and benches", "Sufficient time to board and alight and ease to enter the vehicle", "Safety and security", "In-vehicle environment", "Driver behavior", and "Availability of information".

Table 55 Comparative analysis between user and non-user perspective on evaluating importance score of public transport service quality

Attitudinal statement	User		Non-user		Total		P value
	Mean	SD	Mean	SD	Mean	SD	
1. Service frequency	4.37	0.82	4.31	0.84	4.34	0.83	0.204
2. Coverage area	4.35	0.76	4.43	0.76	4.39	0.76	0.032*
3. Length of operation time	4.20	0.89	4.19	1.00	4.20	0.95	0.382
4. Travel time	4.22	0.90	4.18	0.97	4.20	0.94	0.622
5. Waiting time at stop	4.24	0.91	4.23	0.91	4.23	0.91	0.866
6. Suitable fare structure	4.06	1.06	3.98	1.06	4.02	1.06	0.121
7. Seat availability and seat comfort	4.13	0.96	4.08	1.08	4.10	1.02	0.954
8. Availability of shelter and benches at stops	3.75	1.16	3.81	1.17	3.79	1.17	0.285
9. Given sufficient stop time to board and alight and ease to enter the vehicle e.g., open the car-door, height of step	3.80	1.10	3.77	1.13	3.78	1.12	0.663
10. Convenience of connections and transfers	4.20	0.91	4.02	1.04	4.11	0.98	0.009**
11. Safety from road accident and security from criminal incidents	3.95	0.97	3.99	1.01	3.97	1.00	0.275
12. In-vehicle environment, e.g. cleanliness, seat quality, ease to move, absence of noise, protection from exposure to elements, etc.	3.75	1.07	3.78	1.08	3.77	1.07	0.504
13. Passenger politeness	3.73	1.00	3.60	1.04	3.66	1.02	0.049*
14. Air-conditioning in the vehicle	3.47	1.24	3.71	1.21	3.58	1.23	0.000**
15. Driver behavior, e.g. polite, honest, provide help to passenger, etc.	3.79	1.02	3.79	1.05	3.79	1.03	0.900
16. Availability of information regarding route direction (e.g., map, route, etc.) and information regarding service (e.g., fare, etc.)	3.77	0.97	3.83	1.07	3.80	1.02	0.115
17. Level of air emission and noise pollution	3.38	1.08	3.57	1.11	3.47	1.10	0.001**
18. Level of congestion impact caused by the mode	3.27	1.09	3.41	1.18	3.34	1.14	0.011*
19. Level of road accident caused by the mode	3.26	1.14	3.44	1.19	3.35	1.17	0.007**

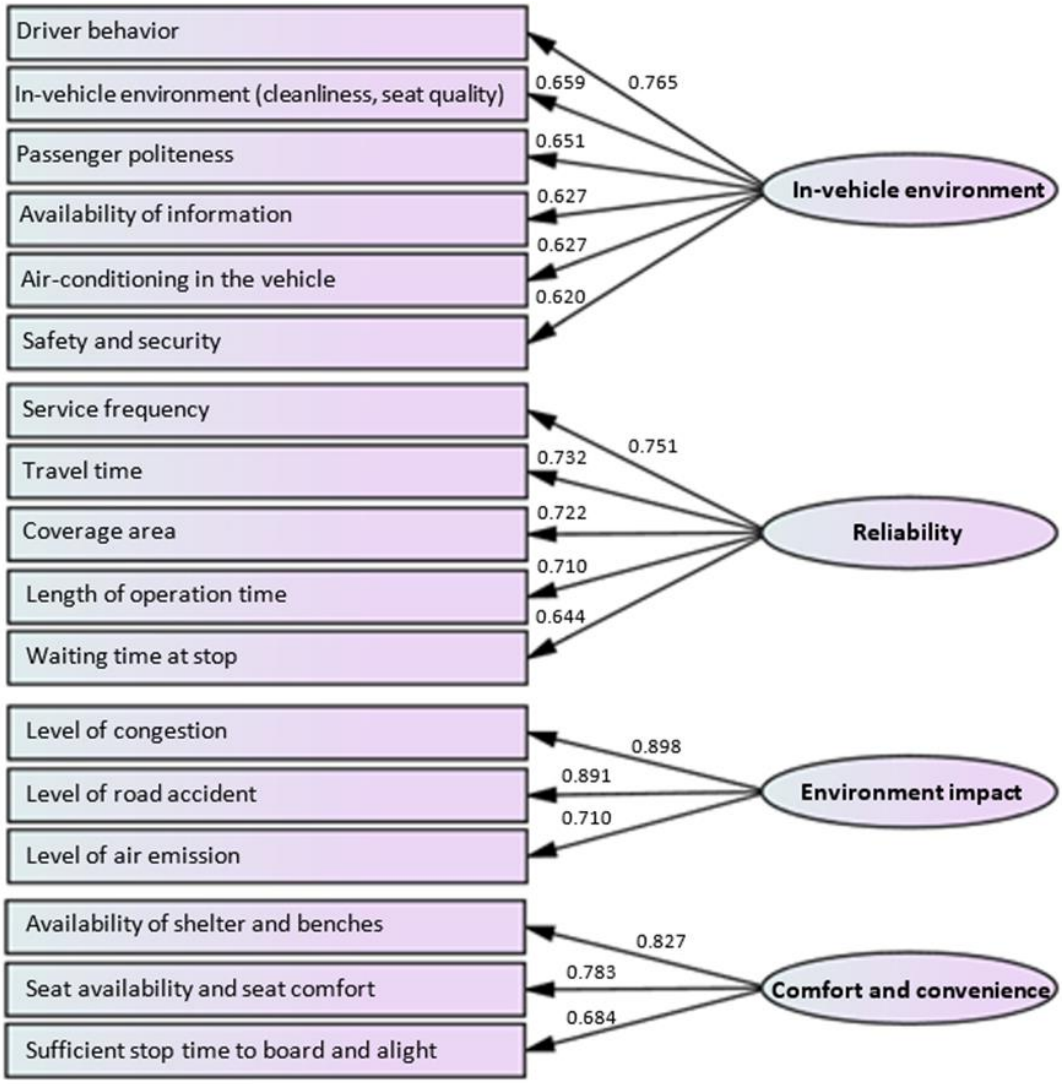
Note: Scores are derived from five-point Likert scale
**p<0.01, *p<0.05

However, evaluations on seven service attributes display significant differences between users and non-user groups. "Coverage area" and "Air-conditioning in the vehicle" seem to be significantly more important to non-users than users whereas users are more likely to be concern of "Convenience of connections and transfers" and "Passenger politeness". Three environmental aspects, including "Level of air emission and noise pollution", "Level of congestion impact caused by the mode", and "Level of road accident caused by the mode", are found to be of the least importance for both users and non-user groups. When compared between the

two groups, the three aspects seem to be of significantly higher concern for non-user than user group.

Subsequently, importance scores towards different service dimensions of public transport which are extracted from users and non-users are combined then are factor analyzed. EFA is performed with 19 attitudinal statements. Attitudinal variable 10, which covers convenience of connections and transfers cross-loads on tow factor and is interpretable. Costello and Osborne (2005) suggested that cross-loading items can be dropped if it compromises the integrity of the data. Attitudinal variable 6, which explains aspect of suitable fare, is not in harmony with the group and therefore is removed. After attitudinal variables 9 and 10 are removed, each construct appeared to be distinct in the underlying attitudinal variables. All factor loadings exceed 0.6 and no cross-loadings. The constructs arbitrarily are labeled according to the content of component variables.

Figure 41 illustrates factor analysis results of importance scores towards different service dimensions showing latent constructs, statement groupings and factor loadings. EFA demonstrates that four latent variables were extracted, *In-vehicle environment, Reliability, Environmental impact, and Comfort and convenience*. The 17 attitudinal statements explain 58.6% of the total variance. It is noted that *In-vehicle environment* (17.2%) explains the highest total variance, followed by *Reliability* (16.6%), *Environmental impact* (12.7%), and *Comfort and convenience* (12.2%), respectively.



Note: Cronbach's Alpha: 0.877; KMO: 0.871; Bartletts's: 8667.280, p-value 0.000

Figure 41 Exploratory factor analysis of public transport service dimensions with latent constructs, attitudinal statements groupings, and factor loadings

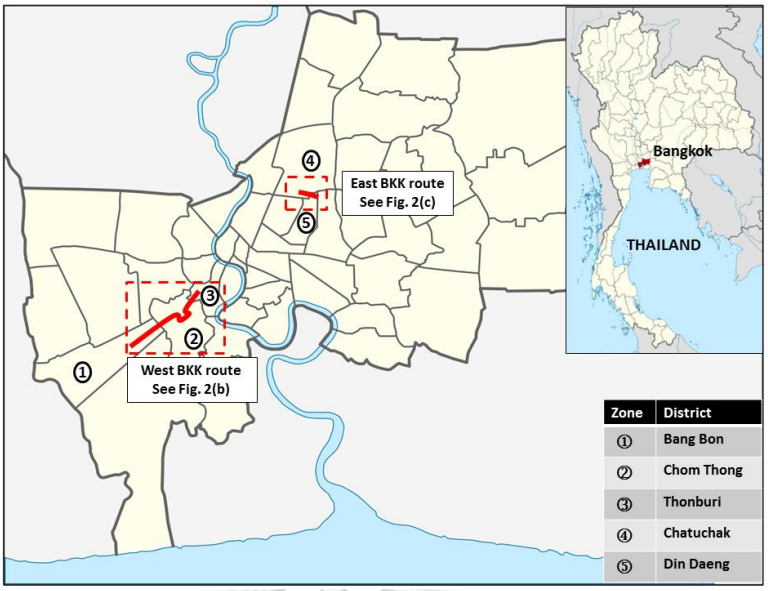
When all importance scores extracted from all respondents (Table 55) are ranked, it is found that the top aspects that receive much attention are Reliability factor, consisting of frequency, travel time, coverage area, operating time and wait time.

5.3 Perceived service quality and commuter segmentation

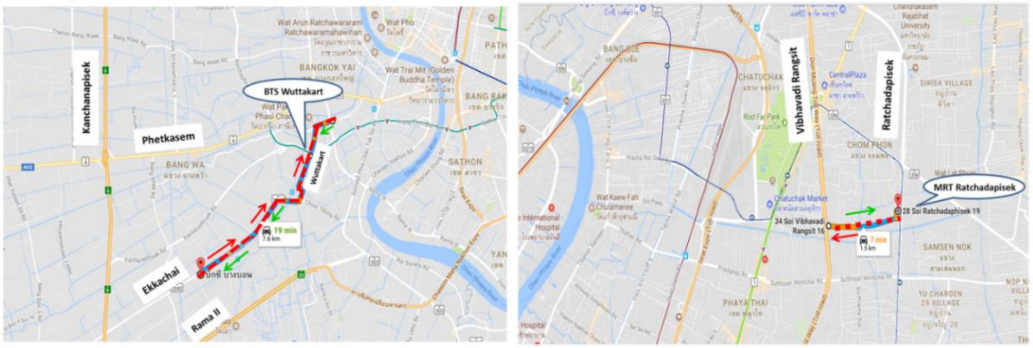
This section explores users' perceptions regarding SR service quality and present SR user subgroups characterized by users' attitudes through Exploratory Factor Analysis (EFA) followed by Cluster Analysis (CA) based on the obtained latent variables. This section applies EFA to extract latent variables of service attributes based on user survey of two SR routes in Bangkok. Logistic regression analysis is performed to investigate the casual relationship between the perception of service quality factors as independent variables and overall satisfaction as dependent variables. In order to identify user subgroups, market segmentation is performed to classify users into segments having similar features. Then, socioeconomic, travel profiles and attitudes of each user subgroups are cross-analyzed to understand interaction among significant variables.

This research aims to compare user characteristics and attitudes among SR service in two areas of Bangkok, namely, West and East, which are distinct in socioeconomic characteristics. Therefore, this study intentionally selects one SR route from each area. Both of them are operated as fixed routes with flat fare. For West BKK, Bangbon-Taladplu route is selected as a case study, of which the service span covering three districts, i.e. Bangbon, Chomthong, and Thonburi. In the case study of East BKK, Vibhavadirangsit-Ratchadapisek route is chosen, serving Chatuchak and Dindaeng district areas. The two routes are chosen in this research as they have been serving the demands in districts of high population density. Bangkok districts map with the alignments of the two routes is illustrated in Figure 42.

The characteristics of each route are presented in Table 56, including population of each district with population density, average income, and the connecting transport modes. The West BKK route runs through industrial zone, commercial zone, medium and high-density residential zone. For the East BKK, the route operates in the high-density residential zone. Both routes connect with mass transit lines, which is BTS sky train Wuttakart station for West BKK route and MRT subway Ratchadapisek station for East BKK route. The length of the service routes are approximately 8 kilometers for West route and 2 kilometer for East route.



(a) Map of Bangkok districts showing location of West BKK and East BKK routes



(b) West BKK route (c) East BKK route

Figure 42 Location of West BKK and East BKK routes

Table 56 Characteristics of route location

Route	District	Population[a]	Population density (people/km^2)[a]	Income (Baht/month)[b] Mean (SD)	Connecting to other transport modes
West BKK	① Bangbon	107,397	3,091	10,761 (578)	BTS sky train Silom Line
	② Chomthong	155,048	5,903	11,161 (654)	(Wuttakart Station)
	③ Thonburi	113,338	13,254	10,030 (533)	
East BKK	④ Chatuchak	159,514	4,847	13,060 (571)	MRT subway Blue Line
	⑤ Dindaeng	125,964	15,078	11,701 (443)	(Ratchadapisek Station)

[a]BMA (2015), [b]NSO (2009)

5.3.1 User characteristics and trip profiles

Summary of descriptive statistics of user characteristics and trip profiles are shown in Table 57. In brief, both routes share common features in that the majority of users are female, single, travelling alone and uses SR more than once per week. The higher

Table 57 Descriptive statistics of dataset

Variable	West BKK (n=125) Percent	East BKK (n=117) Percent	Total (n=242) Percent	Chi square	p value
Socioeconomic status					
Gender				0.032	0.822
Male	32.3	33.3	32.8		
Female	67.7	66.7	67.2		
Age				32.350	0.000
14-24	21.1	11.1	16.3		
25-34	14.6	41.0	27.4		
35-44	23.6	30.8	27.1		
45-54	17.9	9.4	13.8		
55-64	15.5	4.3	10.0		
65+	7.3	3.4	5.4		
Marital status				0.598	0.439
Single	54.0	59.0	56.4		
Married	46.0	41.0	43.6		
Education				60.500	0.000
Primary school or below	28.2	6.0	17.4		
Secondary	33.9	15.4	24.9		
Vocational	9.7	9.4	9.5		
Higher vocational	5.6	11.1	8.3		
Studying bachelor	8.1	2.6	5.4		
Bachelor	12.1	48.7	29.9		
Postgraduate	2.4	6.8	4.6		
Income (Baht/month)				40.775	0.000
9,999 or less	41.2	9.4	25.4		
10,000-19,999	36.1	39.3	37.7		
20,000-29,999	11.0	24.8	17.8		
30,000-39,999	9.2	13.7	11.5		
40,000-49,999	2.5	6.0	4.2		
50,000 or above	0.0	6.8	3.4		
SR trip					
Frequency of use (day/week)				5.562	0.135
Everyday	27.2	32.5	29.8		
2-5	47.2	49.6	48.3		
1 or less	25.6	17.9	21.9		
Transfer	36.0 (n=45)	59.8 (n=70)	47.7 (n=115)	13.370	0.000
Transfer mode				80.996	0.000
BTS	53.5	Not available	20.5		
MRT	Not available	68.9	41.9		
Bus	25.6	31.1	29.5		
MC taxi	2.3	Not available	0.9		
Songtaew	2.3	Not available	0.9		
Silor	9.3	Not available	3.6		
Train	2.3	Not available	0.9		
Ferry	4.7	Not available	1.8		
Travel alone	75.0	81.2	78.0	1.103	0.294
Captive users[1]	24.2	56.4	39.8	26.070	0.000
	Mean SD	Mean SD	Mean SD		
SR distance (km/trip)	4.52 2.78	1.00 0.38	2.74 2.65		
SR travel time (min/trip)	16.22 11.07	7.96 6.71	12.26 10.11		

Note: [1] Captive users are defined as respondents who have no other options rather than SR

share of female SR users is in line with previous study by DLT and TRI (2009) which revealed 65% female SR users. However, the differences among their characteristics are revealed.

For East BKK route, most users are in the middle-age, between 25-44 years, while users from West BKK are widely distributed in allage groups. The higher proportion of users with the monthly income over 20,000 Baht are found in East BKK. The similar evidence is also found in terms of university graduates in the East route. When compared to West BKK route, higher proportions of users are captive riders and need to transfer for the case of East BKK route. Due to the longer route length of West BKK route, longer distance traveled and longer travel time are observed. Figure 43 presented the comparison among dominant characteristics of users from West and East BKK routes.

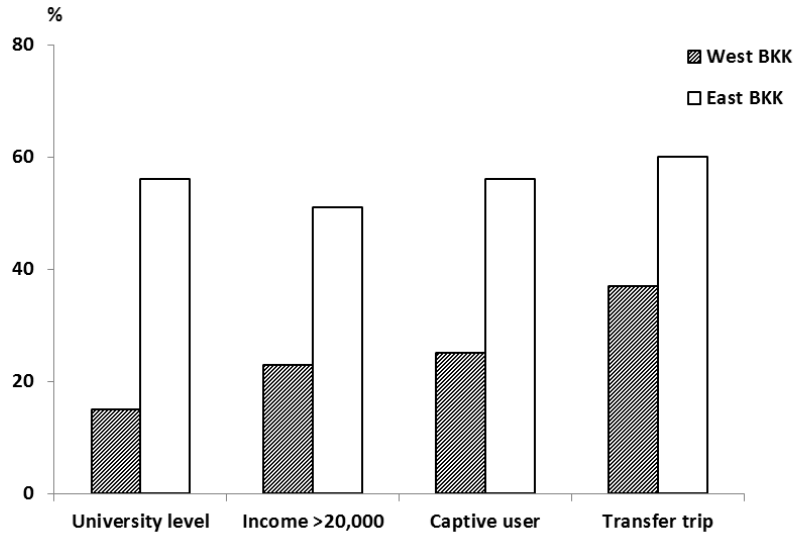


Figure 43 Comparison among dominant characteristics of users from West and East BKK routes

5.3.2 Exploratory factor analysis

Respondents were asked to rate the level of satisfaction towards different service dimensions and overall satisfaction of the service. Five-point Likert-scale was applied to 16 attitudinal statements and overall satisfaction level, ranging from 1 (strongly disagree) to 5 (strongly agree). Descriptive statistics from both routes are shown in Table 58. The statistical tests reveal significant mean differences in most variable scores and, therefore, support the research hypothesis.

Table 58 Attitudinal variable and overall satisfaction score

No.	Variables	West BKK (n= 125)		East BKK (n= 116)		Total (n= 241)		p value[1]
		Mean	SD	Mean	SD	Mean	SD	
1	SR has frequent service	4.30	0.89	4.52	0.55	4.41	0.75	0.025*
2	I am satisfied that SR routes cover places I want to go	4.18	0.86	4.36	0.58	4.27	0.74	0.058
3	SR operates in the time period I need to travel	4.02	0.94	4.40	0.63	4.20	0.83	0.000**
4	Travelling by SR is fast and I can save my time	4.12	0.88	4.53	0.63	4.32	0.79	0.000**
5	I do not have to wait for SR for long time	4.19	0.95	4.50	0.68	4.34	0.84	0.004**
6	I always get a seat when riding SR and the seat is comfort	4.06	0.94	4.33	0.67	4.19	0.83	0.011*
7	Shelter and benches at stops are available	3.78	1.06	3.76	1.10	3.77	1.08	0.855
8	SR gives sufficient stop time to board and alight and it is easy to enter the vehicle	3.75	1.03	4.11	0.86	3.93	0.97	0.003**
9	It is convenient to connect with and transfer to other modes	3.85	1.01	4.26	0.72	4.05	0.90	0.000**
10	Riding SR is safe from road accident and secured from criminal incidents	3.30	1.09	3.77	0.77	3.53	0.97	0.000**
11	SR is clean, free from dust or garbage, seat are in good condition easy to move, protected from exposure to the elements	3.17	1.13	3.65	0.79	3.40	1.01	0.000**
12	Passengers riding SR are polite	3.53	0.96	3.87	0.67	3.69	0.85	0.001**
13	SR drivers are polite and honest	3.48	1.08	3.85	0.77	3.66	0.96	0.002**
14	SR causes air and noise pollution	3.26	0.97	3.05	0.86	3.16	0.92	0.085
15	SR causes traffic congestion	3.26	1.11	2.83	1.02	3.05	1.09	0.003**
16	SR causes road accidents	3.02	1.06	2.72	1.03	2.88	1.05	0.026*
	Overall satisfaction	3.74	0.79	3.95	0.67	3.84	0.74	0.030*

Note: [1] p values are derived from statistical test for mean differences between the two routes, ** p <0.01, * p <0.05

EFA are performed separately on West and East BKK routes. For East BKK route, the attitudinal variable 5, which covers perceptions of wait time, cross-loads on two factors and is uninterpretable. Costello and Osborne (2005) suggested that cross-loading items can be dropped if it compromises the integrity of the data. After attitudinal variable 5 is removed from East BKK route, each construct appeared to be distinct in the underlying attitudinal variables. All factor loadings exceed 0.4, no cross-loadings, and no factors with less than three variables (Costello & Osborne, 2005). The constructs arbitrarily are labeled in accordance with the content of component variables.

Table 59 presents the factor analysis results of West BKK and East BKK routes showing latent constructs, statement groupings, and factor loadings. EFA of both routes similarly demonstrate that four latent variables were extracted, *Reliability, In-vehicle environment, Comfort and convenience, and Environmental impact*. In West BKK route, 16 attitudinal statements explain 63.3% of the total variance, whereas in East BKK route, total 15 attitudinal statements explain 61.7% of the total variance. It is noted that in both routes, each latent factor grouped similar sets of the underlying aspects despite the variable 5 dropped off in East BKK route. *Reliability* explains the highest total variance in both routes, 20.8% and 17.0% for West BKK and East BKK routes, respectively.

Table 59 Exploratory factor analysis of service quality indicator with latent constructs, attitudinal statements groupings, and construct loadings

Attitudinal variables	Factor 1 Reliability		Factor 2 In-vehicle environment		Factor 3 Comfort and convenience		Factor 4 Environmental impact	
	West	East	West	East	West	East	West	East
SR has frequent service	0.847	0.791						
I do not have to wait for SR for long time	0.763							
I am satisfied that SR routes cover places I want to go	0.743	0.862						
Travelling by SR is fast and I can save my time	0.731	0.548						
SR operates in the time period I need to travel	0.711	0.760						
Passengers riding SR are polite			0.868	0.898				
SR drivers are polite and honest			0.828	0.737				
SR is clean, free from dust or garbage, seat are in good condition, easy to move, protected from exposure to the elements			0.645	0.657				
Shelter and benches at stops are available					0.787	0.568		
SR gives sufficient stop time to board and alight and it is easy to enter the vehicle					0.625	0.755		
It is convenient to connect with and transfer to other modes					0.551	0.621		
Riding SR is safe from road accident and secured from criminal incidents					0.551	0.688		
I always get a seat when riding SR and the seat is comfort					0.542	0.441		
SR causes traffic congestion							0.832	0.892
SR causes air and noise pollution							0.826	0.765
SR causes road accidents							0.813	0.904
Total variance explained (%)	20.8	17.0	15.7	12.2	13.6	16.7	13.2	15.8

Note: West BKK route Cronbach's Alpha: 0.802; KMO: 0.761; Bartlett's: 783.517, p-value 0.000
East BKK route Cronbach's Alpha: 0.767; KMO: 0.706; Bartlett's: 723.739, p-value 0.000
Factor loadings lower than 0.40 are not shown in the table

5.3.3 Logistic regression analysis

The latent constructs of EFA are further analyzed to determine the degree to which attitudes towards SR quality of service influence the overall satisfaction with the service. Ordinal logistic regression is conducted separately for West BKK and East BKK route applying the overall satisfaction as the dependent variable, while the independent variables involve the latent constructs associated with the perception of SR service.

The models of OLR for West BKK and East BKK route are presented in Table 60. The model for West BKK route shows the differences in explaining variance in overall satisfaction of SR customers with a significant chi-square and the Nagelkerke pseudo R^2 of 0.219. Two constructs show significant effect over the satisfaction. First, *Reliability* reveals the highest coefficient, signifying that SR service frequency, service area, operation period, wait time, and travel time are major aspects in evaluating the overall satisfaction of SR customers. The second latent construct, still with significant effect, shows smaller coefficients, indicating that perceptions of *In-vehicle environment* and are minor attributes in satisfaction evaluation. The last two constructs have no significant effect over the satisfaction, suggesting that *Comfort and convenience* and *Environmental impact* of the service is not concerned in the evaluation of customers' overall satisfaction.

Table 60 Ordinal logistic regression analysis of overall satisfaction and attitudes towards service quality

Variable	West BKK route			East BKK route		
	Estimates	S.E.	p value	Estimates	S.E.	p value
Intercept						
Overall satisfaction = 2.00	3.257	1.389	0.019*	4.353	2.338	0.063
Overall satisfaction = 3.00	5.774	1.425	0.000**	7.390	2.310	0.001**
Overall satisfaction = 4.00	8.425	1.537	0.000**	10.996	2.473	0.000**
Reliability	0.777	0.284	0.001**	1.030	0.466	0.027*
In-vehicle environment	0.549	0.236	0.020*	0.030	0.362	0.933
Comfort and convenience	0.280	0.308	0.363	1.579	0.441	0.000**
Environmental impact	0.108	0.201	0.590	-0.670	0.238	0.005**
-2LL (intercept)	289.456			230.396		
-2LL (final)	261.944			192.993		
Chi square (df=4)	27.512**			37.403**		
Nagelkerke pseudo R^2	0.219			0.318		

** p<0.01; * p<0.05

For East BKK route, the model reveals that differences in explaining variance in overall satisfaction exist with a significant chi-square and the Nagelkerke pseudo R^2 of 0.318. This suggests that the model accounts for one-third of the variation in overall satisfaction level. The increase in perceived *Comfort and convenience* would significantly raise overall satisfaction level, meaning that boarding and alighting, seat availability and comfort, suitability for transfer, amenities at stops, safety and security are the main attributes used to evaluate the overall satisfaction level. Although with significant effect, the perception towards *Reliability* has less impact on the satisfaction. On the contrary, the model illustrates that *Environmental impact* perception affect satisfaction level in different way. The more the perceived environmental impact of the mode, the less overall satisfaction was found. As the last latent variable, *In-vehicle environment* has no significant effect on satisfaction level, suggesting that customers are less concerned on the issue.

Interestingly, the factor analysis performed separately in two routes reveal the similar result in that the four underlying latent constructs, which are reliability, in-vehicle environment, comfort and convenience, and environmental impact; nonetheless, logistic regression model illustrated that there exist the differences in degree of effect for each aspects on the overall satisfaction.

5.3.4 User segmentation

Clustering method is performed to divide users into heterogeneous groups showing homogenous features within each subgroup. Five variables are selected to perform user segmentation through K-means clustering method, including three latent constructs i.e. reliability, in-vehicle environment, and environmental awareness, and two socioeconomic variables, i.e. income and education. The clustering method results in the appropriate cluster solution of 4. Then, the four clusters of traveler

profiles are analyzed. Table 61 summarizes characteristics of each commuter segments, reporting mean with standard deviation of attitudinal variables, socioeconomic and trip variables.

The first cluster includes 93 individuals and it is the largest one (40%). Mostly, approximately 68% of commuters in this group earn the income ranging from 0-19,999 Baht per month. 86% of the members are secondary or university graduates. Majority (72%) are of the age below 40. About 62% of the individuals make their trips over one kilometer. One-third of them travel longer than 10 minutes and half of them need to transfer. Commuters forming this group are highly satisfied with reliability, in-vehicle environment, comfort, and convenience of the service, making them '*pleasurable experience*'. Users in this cluster are 43% and 57% from West and East BKK route, respectively.

The second cluster is the smallest one. It contains 39 individuals (17%) characterized by the lowest reliability satisfaction of all. 77% of the members receive monthly income ranging from 0-19,999 Baht. About 64% of the members are secondary or university graduates. Nearly half of them are above 40 years old. 36% of the members travel over 10 minutes. Most of their trips are long direct journey with the highest proportion of travel distance over one kilometer (82%) and trips with no transfer (69%). Accordingly, the reliability aspects are of high importance for them and this cluster is labeled as '*reliability oriented*'. Three-quarter of the group are users from West BKK route.

The third cluster made up by 53 individuals (22%) revealing the lowest value on in-vehicle environment satisfaction. At the same time, this cluster shows inferior satisfaction on service comfort and convenience. Half of the commuters in this group earn monthly in come over 20,000 Baht and most of them (85%) are secondary or university graduates. Among all groups, this group includes the highest proportion of people over 40 years old (47%). It is found that 66% of the members make trips over one kilometer. This group reports the highest proportion of transfer trip (60%) as well as trip duration over 10 minutes (53%). Thus, in-vehicle environment, comfort and convenience of the service are considered essential factor when choosing the service. These individuals can be named '*in-vehicle environment desire*'. Two-thirds of the users in this group are from West BKK route.

Table 61 User profiles of each cluster

Variables		*Pleasurable experience*	*Reliability oriented*	*In-vehicle environment desire*	*Environmentally conscious*
Reliability	Mean	4.50	3.37	4.48	4.56
	SD	0.04	0.08	0.06	0.07
In-vehicle environment	Mean	4.15	3.27	2.69	3.70
	SD	0.04	0.08	0.09	0.09
Comfort and convenience	Mean	4.14	3.41	3.74	4.02
	SD	0.06	0.10	0.09	0.09
Environmental awareness	Mean	3.45	3.15	3.38	1.74
	SD	0.06	0.08	0.09	0.07
Age	Mean	0.29	0.46	0.47	0.31
(> 40=1)	SD	0.05	0.08	0.07	0.07
Education	Mean	0.86	0.64	0.85	0.88
(Secondary or higher=1)	SD	0.04	0.08	0.05	0.05
Monthly income	Mean	0.32	0.23	0.49	0.45
(>20,000 Baht=1)	SD	0.05	0.07	0.07	0.07
Travel distance	Mean	0.62	0.82	0.66	0.59
(>1 km=1)	SD	0.05	0.06	0.07	0.07
Travel time	Mean	0.32	0.36	0.53	0.29
(>10 min=1)	SD	0.05	0.08	0.07	0.07
Transfer	Mean	0.51	0.31	0.60	0.45
(Need transfer=1)	SD	0.05	0.07	0.07	0.07
West BKK	%	43	74	62	35
East BKK	%	57	26	38	65
Cluster size	n	93	39	53	49
	%	40	17	22	21

The last cluster includes 49 individuals (21%) characterized by the lowest score on environmental attitudes. Nearly half of the members (45%) are in the upper economic strata with the income above 20,000 Baht per month. Majority of people (88%) are secondary or university graduates. 69% are users of age 40 or below. Almost half of the members (45%) travel with the need to transfer. 50% of the trips are over one kilometer and mostly (71%) are in short duration, 0-10 minutes. In general, they satisfied with reliability, in-vehicle environment, comfort and convenience of the service. What makes them distinct from other groups is their environmental awareness. From their perspectives, SR causes impact on pollution, traffic congestion, and accidents, though at low level, while other groups are more likely to be neutral for this issue. This cluster is then named '*environmentally conscious*'. It is found that two-thirds of users in this group are from the East route.

5.4 Comparative study of travel behavior between Thai and Japanese SR users in Sukhumvit area

In Sukhumvit Soi 39 area, SR services operate in the non-fixed routes and stops with cash fare paid upon negotiations. Service hours are flexible from 6 am to 8 pm. They function as the main transport mode and feeder services for people to get access to the more formal modes, such as buses and mass transit lines. Figure 44 shows SR vehicle and parking area.

(a) SR vehicle

(b) Parking area at entrance of Sukhumvit Soi 39

Figure 44 Characteristics of SR services in Sukhumvit Soi 39

SR users in this route are of different nationalities, including Thai, Japanese, Mexican, French, Turkish, and Philippines. This study focuses on Thai and Japanese SR users as of its uniqueness in the high proportion of international users, especially Japanese. It is important to understand how national cultures influence travel behavior and perceptions on service quality of transport service, especially the informal ones.

This research aims to investigate travel behavior and determine service delivery gaps of Thai and Japanese SR users in order to propose policy recommendations for maximizing user satisfactions and service performance. Therefore, travel behavior and perceptions on multidimensional service aspects based on their expectations and satisfactions are compared between Thai and Japanese users. Service delivery gaps are then determined.

In this study, SR service at Sukhumvit Soi 39 was selected as a case study due to its uniqueness in the high proportion of international users, especially the Japanese. This area is known to be Japanese community with restaurants, supermarkets and associations distributed in the neighborhoods. The route service span covers two districts including Watthana and Klongtoei. Bangkok districts map with the SR service area is shown in Figure 45.

Figure 45 Map of Bangkok districts with SR Sukhumvit route service area

A total of 39 Thai and 47 Japanese users were interviewed through questionnaire survey conducted in Sukhumvit Soi 39 area. Questionnaires were primarily designed in Thai and later were translated into Japanese language. Survey team approached SR users randomly at SR parking station, drop-off area at Emporium department store, Srinakharinwirot University (SWU), as well as restaurants and shops in Soi 39 network. From the survey, the average trip fare is 51.65 $\pm$ 19.33 Baht/trip with the minimum and maximum fares 10 and 120 Baht/trip, respectively. The average individual fare is 30.66 $\pm$ 22.32 Baht/person/trip with the minimum and maximum 5 and 120 Baht/person/trip. On average, wait time is 3.54 $\pm$ 5.11 minutes with minimum 0 minute and maximum of 30 minutes. Trips are average 2.12 $\pm$ 0.98 kilometers. It was found that 80% of users need to transfer to other transport modes, where BTS Phrom Phong station, SWU, and Emporium department store appeared to be top three origins-destinations.

5.4.1 Socioeconomic variables and trip profiles

Summary of user characteristics and trip profiles are shown in Table 62. For socioeconomic variables and trip profiles, Thai and Japanese SR users are similar in that majority are female, university graduates. The majorities are found to be regular users, making trips with no transfer and mostly are shopping-based trips. Approximately 70% have alternative modes, noted that motorcycle taxi and for-hired taxi are the two primary options. Besides, the statistical tests for mean differences illustrate no significant difference was found in terms of travel distance, trip cost, wait time, and travel time.

Table 62 Descriptive statistics of dataset applied in analysis

Variable	Thai users (n= 39) Percent		Japanese users (n= 47) Percent		Total (n= 86) Percent		Chi-square	P value
Socioeconomic status								
Female	65.8		66.0		65.9		0.000	0.987
Married	53.8		86.4		71.1		10.636	0.001
University level	71.8		87.0		80.0		3.032	0.082
Age							7.646	0.177
14-24	12.8		6.5		9.4			
25-34	35.9		28.3		31.8			
35-44	25.6		47.8		37.6			
45-54	12.8		15.2		14.1			
55-64	10.3		2.2		5.9			
65+	2.6		0.0		1.2			
Occupation							17.170	0.028
Student	7.7		6.5		7.1			
Government sector	2.6		0.0		1.2			
Private sector	43.6		32.6		37.5			
Vendor	17.9		6.5		11.8			
Employer	5.1		2.2		3.5			
Retired	2.6		2.2		2.4			
Business owner	2.6		0.0		1.2			
Unemployed	12.8		50.0		32.9			
Other	5.1		0.0		2.4			
Income (Baht/month)							39.502	0.000
9,999 or less	9.2		51.2		30.9			
10,000-19,999	27.3		0.0		13.2			
20,000-29,999	24.2		2.9		13.2			
30,000-39,999	24.2		0.0		11.9			
40,000-49,999	3.0		2.9		2.9			
50,000 or above	12.2		42.9		27.9			
Have household car	55.3		30.4		41.7		5.278	0.022
SR trip								
Regular user (More than once per week)	51.3		63.0		57.6		1.196	0.274
Trip purpose								
Home based[1]	53.8		85.1		70.9		10.101	0.001
Work based[2]	48.7		6.4		25.6		20.066	0.000
Shopping based[3]	51.3		66.0		59.3		4.424	0.109
Need transfer	20.5		19.1		19.8		0.025	0.874
Have alternative mode	68.4		70.2		69.8		0.032	0.859
Alternative modes							4.974	0.547
Bus	3.8		6.1		5.0			
MC taxi	29.6		39.3		35.0			
Tuktuk	7.4		12.1		10.0			
Private car	3.7		6.1		5.0			
Private MC	0.0		3.0		1.7			
Taxi	33.3		27..3		30.0			
Walk	22.2		6.1		13.3			
Members travelling together							9.976	0.002
Single traveler	62.9		26.8		43.4			
Travel with companions	37.1		73.2		56.6			
	Mean	SD	Mean	SD	Mean	SD		
SR travel distance (km/trip)	2.05	1.15	2.19	0.81	2.12	0.98		0.540
SR cost (Baht/trip)	51.58	22.96	51.70	16.06	51.65	19.33		0.978
SR cost (Baht/trip/person)	34.56	22.81	27.32	21.59	30.66	22.32		0.155
SR wait time (min)	4.03	6.71	3.15	3.34	3.54	5.11		0.472
SR travel time (min)	14.44	8.00	13.67	6.69	14.01	7.26		0.635
Overall satisfaction (1=Very dissatisfied to 5= Very satisfied)	3.41	0.69	3.92	0.81	3.70	0.80		0.017

Note: [1] Either origin or destination is Home [2] Either origin or destination is Work [3] Either origin or destination is Shopping

The Chi square tests reveal no significant difference in age group distributions among Thai and Japanese users, while significant differences are found in the distribution of their occupation and income groups. Japanese users mainly work for private sector (32.6%) and 50% are unemployed. Monthly incomes of Japanese users are 51.2% in the lowest category, which includes not earning any income, and 42.9% are in the highest category. In addition, Chi square statistics indicate significant differences in that Thai users are more likely owning household cars and they have higher proportion of work-based trips whereas Japanese users are more likely travelling in groups and they have higher proportion of home-based trips.

Figure 46 presents SR services in Sukhumvit Soi 39 area where SR parking station is located at the entrance of Sukhumvit Soi 39 and the main point for alighting is at Phrom Phong BTS station. The three main origins-destinations include SR station/BTS Phrom Phong, SWU and Emporium. From the total of 77 responses, 20, 17, and 3 respondents indicate that their origins are SR station/ BTS Phrom Phong, SWU, and Emporium, respectively. For destinations, 14, 13 and 10 respondents indicate SR station/BTS Phrom Phong, SWU, and Emporium, respectively, as illustrated in Figure 47.

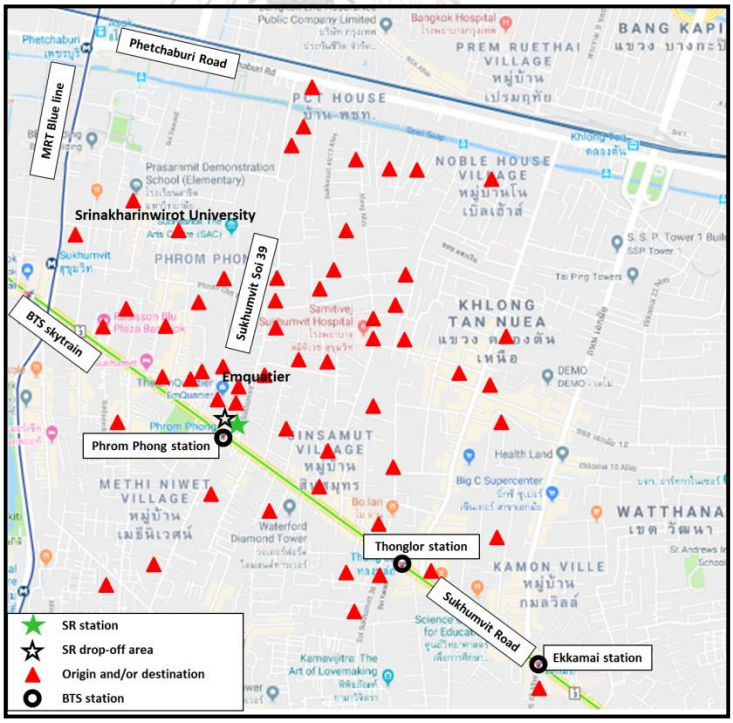


Figure 46 SR services in Sukhumvit Soi 39 area and users' trip origins-destinations

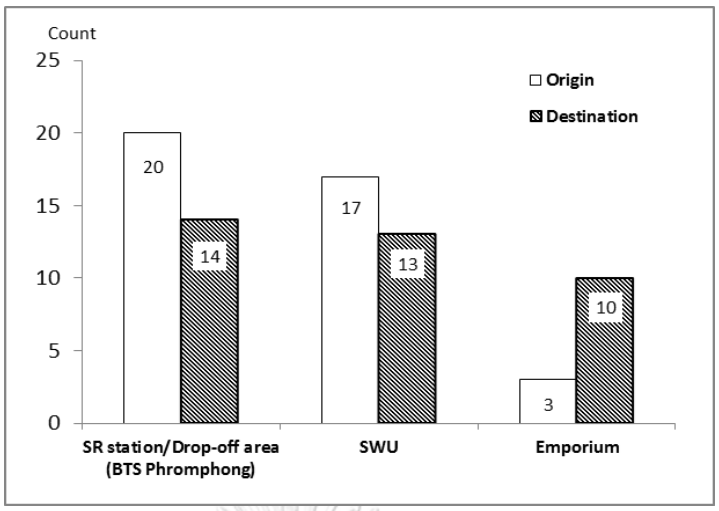


Figure 47 Dominant trip origins and destinations

5.4.2 Perceptions on SR services

Descriptive statistics of Thai and Japanese user perceptions are shown in Table 63 including satisfaction ratings and importance ratings on SR service quality. The statistical tests reveal significantly higher score in Japanese SR users on evaluating satisfaction towards fare aspect, importance of travel time, level of congestion impact and road accident cause by the mode.

Further, Importance-Performance Analysis (IPA) is applied. IPA is a useful analytical tool in determining differences that exist between expected and real state, as well as areas where improvements are possible (Grujicic *et al.*, 2014). The purpose of IPA is to point out the areas where improvements would have the greatest impact on improving satisfaction with the entire system (Yang *et al.*, 2011). The two-dimensional graphic is displayed with average values of each attribute, related to importance score and performance score. Then, two lines are placed parallel to importance axis and performance axis, defining average values of all attributes.

The mean importance and satisfaction ratings from Thai and Japanese perspectives on SR aspects are comparatively analyzed, detail in Figure 48. Both groups are similar in rating the 'Reliability'-related aspects to be of importance and high satisfaction, whilst travel time stands out as the most important aspect for the Japanese. For 'Road accident', the Japanese value at high importance level, ranking lower than 'Reliability' aspects but higher than 'In-vehicle environment', 'Comfort and Convenience', whereas, for Thai users, 'Road accident' appears to be of the second lowest importance, lower than 'In-vehicle environment', 'Comfort and Convenience'.

'Driver politeness' is at the average importance level and tends to be less satisfied by both groups of users. Thai and Japanese SR users are highly satisfied with 'Seat availability' but not the 'In-vehicle environment'. Both aspects are of higher

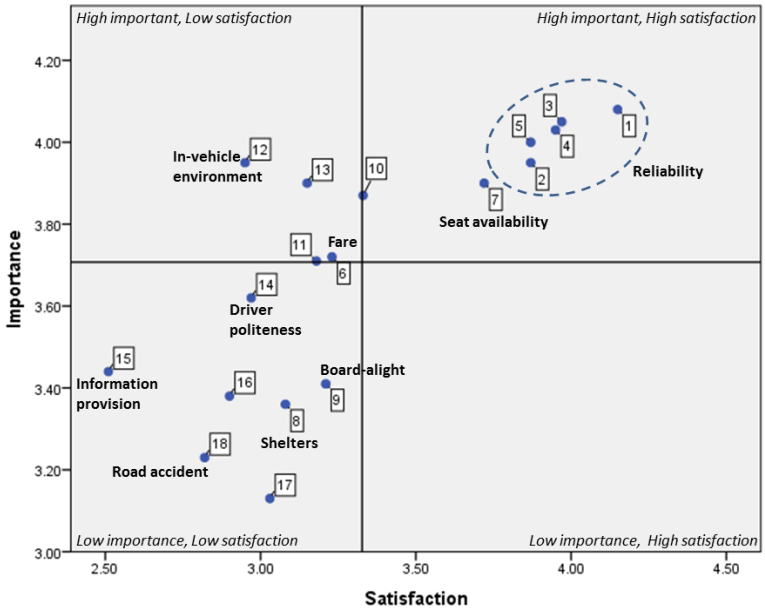
importance for Thai and Japanese users. For both groups, 'Fare' is evaluated at the average importance level. Thai users are less satisfied with Fare, whereas the aspect is above average satisfaction for the Japanese. Both evaluate 'Information provision' as the least satisfied aspect; however, it is not perceived as significant ones. 'Shelters' and 'Board-alight' are the other aspects with low importance as well.

Table 63 Descriptive statistics of Thai and Japanese SR user perceptions

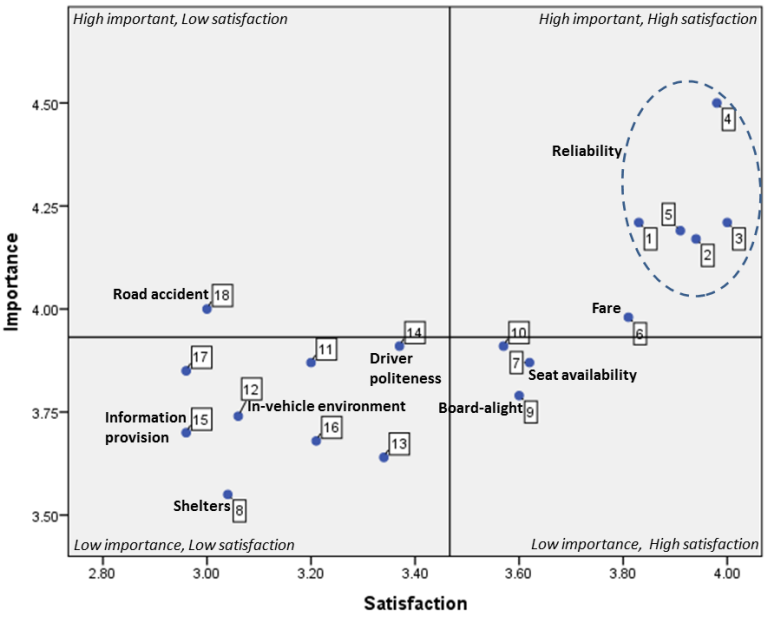
No.	Variable	Thai users		Japanese users		Total		P value[1]
		Mean	SD	Mean	SD	Mean	SD	
	Satisfaction ratings							
1	SR has frequent service	4.15	0.93	3.83	1.03	3.98	0.99	0.133
2	I am satisfied that SR routes cover places I want to go	3.87	0.98	3.94	0.84	3.91	0.90	0.744
3	SR operates in the time period I need to travel	3.97	0.81	4.00	0.98	3.99	0.90	0.895
4	Travelling by SR is fast and I can save my time	3.95	0.83	3.98	1.05	3.97	0.95	0.885
5	I do not have to wait for SR for long time	3.87	1.00	3.91	1.02	3.90	1.01	0.845
6	SR has suitable fare	3.23	1.25	3.81	1.04	3.55	1.16	0.021*
7	I always get a seat when riding SR and the seat is comfort	3.72	1.05	3.62	1.23	3.66	1.14	0.686
8	Shelter and benches at stops are available	3.08	1.13	3.04	1.12	3.06	1.12	0.888
9	SR gives sufficient stop time to board and alight and it is easy to enter the vehicle	3.21	1.15	3.60	0.90	3.42	1.03	0.081
10	It is convenient to connect with and transfer to other modes	3.33	1.11	3.57	0.90	3.47	1.00	0.269
11	Riding SR is safe from road accident and secured from criminal incidents	3.18	1.05	3.20	0.96	3.19	0.99	0.941
12	SR is clean, free from dust or garbage, seat are in good condition, easy to move, protected from exposure to the elements	2.95	1.19	3.06	1.15	3.01	1.63	0.650
13	Passengers riding SR are polite	3.15	1.06	3.34	1.09	3.26	1.08	0.427
14	SR drivers are polite and honest	2.97	1.09	3.37	0.95	3.19	1.03	0.078
15	Fare structure are provided	2.51	1.34	2.96	1.26	2.75	1.31	0.120
16	SR causes air and noise pollution	2.90	1.07	3.21	1.08	3.07	1.08	0.180
17	SR causes traffic congestion	3.03	1.37	2.96	1.28	2.99	1.32	0.812
18	SR causes road accidents	2.82	1.27	3.00	1.25	2.92	1.26	0.513
	Importance ratings							
1	Service frequency	4.08	0.87	4.21	0.98	4.15	0.93	0.502
2	Coverage area	3.95	0.94	4.17	0.82	4.07	0.88	0.247
3	Length of operation time	4.05	0.86	4.21	0.91	4.14	0.88	0.402
4	Travel time	4.03	0.96	4.50	0.84	4.28	0.92	0.017*
5	Waiting time at stop	4.00	0.86	4.19	0.95	4.10	0.91	0.333
6	Suitable fare structure	3.72	0.83	3.98	1.07	3.86	0.97	0.218
7	Seat availability and seat comfort	3.90	0.88	3.87	1.10	3.88	1.00	0.908
8	Availability of shelter and benches at stops	3.36	1.11	3.55	1.14	3.47	1.12	0.428
9	Given sufficient stop time to board and alight and ease to enter the vehicle	3.41	1.02	3.79	1.14	3.62	1.10	0.113
10	Convenience of connections and transfers	3.87	1.00	3.91	1.18	3.90	1.10	0.857
11	Safety from road accident and security from criminal incidents	3.71	1.11	3.87	1.08	3.80	1.09	0.499
12	In-vehicle environment	3.95	1.07	3.74	1.07	3.84	1.07	0.383
13	Passenger politeness	3.90	0.75	3.64	0.97	3.76	0.88	0.166
14	Driver behavior	3.62	0.94	3.91	0.88	3.78	0.91	0.131
15	Availability of information regarding route direction and information regarding service	3.44	0.91	3.70	1.12	3.58	1.03	0.237
16	Level of air emission and noise pollution	3.38	1.07	3.68	1.07	3.55	1.07	0.203
17	Level of congestion impact caused by the mode	3.13	1.20	3.85	1.08	3.52	1.19	0.004**
18	Level of road accident caused by the mode	3.23	1.27	4.00	1.10	3.65	1.23	0.003**

Note: Mean and standard deviation values are based on 1-5 Likert scale

[1]p values are derived from statistical test for mean differences between the two routes, ** p <0.01, * p <0.05



(a) Thai users' ratings



(b) Japanese users' ratings

Note: **Service aspects**:

1 = Frequent service
2 = Route coverage
3 = Operating time
4 = Travel time
5 = Wait time
6 = Fare
7 = Seat availability and comfort
8 = Shelter and bench at stops
9 = Sufficient time to board and alight
10 = Convenience of connection and transfer
11 = Safety and security
12 = Cleanliness, seat condition, ease to move, protection from elements
13 = Polite passengers
14 = Polite and honest drivers
15 = Information provision
16 = Impact on air and noise pollution*
17 = Impact on traffic congestion*
18 = Impact on road accidents*

* Negative statements in the 'Satisfaction' evaluation

Figure 48 IPA of users' mean importance rating vs. mean satisfaction rating on 18 service attributes

CHAPTER VI
SUSTAINABILITY OF SR SERVICES

This chapter describes the sustainability of transport services including the comparative analysis in two approaches, sustainability between SR and alternative travel modes, and sustainability among SR users in different socioeconomic groups. The sustainability indicators in three dimensions are applied, social, economic and environmental aspects.

6.1 Indicators for sustainability of transport services

Revisions on sustainable development goals, objectives, and indicators, recommended transport indicators, and indicators for sustainable urban transport index are presented in Table 64, Table 65 and Table 66, respectively. Key sustainable transport goals, objectives and indicators cover four dimensions of sustainability goals involving economic, social and environmental, good governance and planning (Litman, 2019). The relevant indicators for this study are equity/fairness, portion of budgets devoted to transport, service quality, per capita emissions and per capita fuel consumption. For recommended transport indicators as suggested by Litman (2007), the indicators are grouped into economic, social and environmental dimensions. Some in the "More important" category are relevant to thus study. Thus, this research applied these indicators to analyze the sustainability aspects which consist of average commute travel time and reliability, quality of transport for disadvantaged people, affordability, overall satisfaction ratings of transport system, per capita energy consumption and per capita air pollution emissions. For revisions on indicators for sustainable urban transport index by UNCRD (2018), several indicators are relevant to this study namely public transport quality and reliability, and affordability.

Regarding the dimensions and indicators in the literatures, while taking into account data availability constraints, a total of 7 indicators under 3 dimensions were selected for sustainability assessment to compare both among socioeconomic groups and across travel modes. As illustrated in Table 67, the selected indicators cover social, economic, and environmental dimensions. Indicators units are adjusted to be suitable for comparison across travel modes as well as across socioeconomic groups. Social dimension indicators are compared among socioeconomic groups whereas economic and environmental indicators of SR are compared with alternative travel modes, including bus, motorcycle, private car, taxi, and songtaew.

Table 64 Key Sustainable Transport Goals, Objectives and Indicators

Sustainability Goals	Objectives	Performance Indicators
I. Economic		
Economic productivity	Transport system efficiency. Transport system integration. Maximize accessibility. Efficient pricing and incentives.	• Per capita GDP • Portion of budgets devoted to transport. • Per capita congestion delay. • Efficient pricing (road, parking, insurance, fuel, etc). • Efficient prioritization of facilities
Economic development	Economic and business development	• Access to education and employment opportunities. • Support for local industries.
Energy efficiency	Minimize energy costs, particularly petroleum imports.	• Per capita transport energy consumption • Per capita use of imported fuels.
Affordability	All residents can afford access to basic (essential) services and activities.	• Availability and quality of affordable modes (walking, cycling, ridesharing and public transport). • Portion of low-income households that spend more than 20% of budgets on transport.
Efficient transport operations	Efficient operations and asset management maximizes cost efficiency.	• Performance audit results. • Service delivery unit costs compared with peers. • Service quality.
II. Social		
Equity / fairness	Transport system accommodates all users, including those with disabilities, low incomes, and other constraints.	• Transport system diversity. • Portion of destinations accessible by people with disabilities and low incomes.
Safety, security and health	Minimize risk of crashes and assaults, and support physical fitness.	• Per capita traffic casualty (injury and death) rates. • Traveler assault (crime) rates. • Human exposure to harmful pollutants. • Portion of travel by walking and cycling.
Community development	Helps create inclusive and attractive communities.	• Land use mix. • Walkability and bikability • Quality of road and street environments.
Cultural heritage preservation	Respect and protect cultural heritage. Support cultural activities.	• Preservation of cultural resources and traditions. • Responsiveness to traditional communities.
III. Environmental		
Climate stability	Reduce global warming emissions Mitigate climate change impacts	• Per capita emissions of greenhouse gases (CO_2, CFCs, CH_4, etc.).
Prevent air pollution	Reduce air pollution emissions Reduce harmful pollutant exposure	• Per capita emissions (PM, VOCs, NOx, CO, etc.). • Air quality standards and management plans.
Minimize noise	Minimize traffic noise exposure	• Traffic noise levels
Protect water quality & hydrologic functions	Minimize water pollution. Minimize impervious surface area.	• Per capita fuel consumption. • Management of used oil, leaks and stormwater. • Per capita impervious surface area.
Openspace and biodiversity protection	Minimize transport facility land use. Encourage compact development. Preserve high quality habitat.	• Per capita land devoted to transport facilities. • Support for smart growth development. • Policies to protect high value farmlands and habitat.
IV. Good Governance and Planning		
Integrated, comprehensive and inclusive planning	Clearly defined planning process. Integrated and comprehensive analysis. Strong citizen engagement. Lease-cost planning.	• Clearly defined goals, objectives and indicators. • Availability of planning information and documents. • Portion of population engaged in planning decisions. • Range of objectives, impacts and options considered. • Efficient and equitable funding allocation

Source: Litman (2019)

Table 65 Recommended Transport Indicators

	Economic	Social	Environmental
Most Important *(Should usually be used)*	• Per capita mobility (daily or annual person-miles or trips) • Mode split (personal travel: non-motorized, automobile and public transport; freight: truck, rail, ship and air) • Average commute travel time and reliability • Per capita congestion costs • Total per capita transport expenditures (vehicles, parking, roads and transit services)	• Per capita traffic crashes and fatalities • Quality of transport for disadvantaged people (disabled, low incomes, children, etc.) • Affordability (portion of household budgets devoted to transport). • Overall satisfaction rating of transport system (based on objective user surveys). • Universal design (consideration of disabled people's needs in transport planning).	• Per capita energy consumption, disaggregated by mode • Energy consumption per freight ton-mile • Per capita air pollution emissions (various types), disaggregated by mode • Per capita land devoted to transport facilities (roads, parking, ports and airports) • Air and noise pollution exposure and health damages • Impervious surface coverage and storm water management practices.
Helpful *(Should be used if possible)*	• Relative quality (availability, speed, reliability, safety and prestige) of non-automobile modes (walking, cycling, ridesharing and public transit) relative to automobile travel. • Number of public services within 10-minute walk and job opportunities within 30-minute commute of residents.	• Portion of residents who walk or bicycle sufficiently for health (15 minutes or more daily) • Portion of children walking or cycling to school. • Community cohesion (quality of interactions among neighbours). • Degree cultural resources are considered in transport planning.	• Community livability ratings • Water pollution emissions • Habitat preservation • Use of renewable fuels • Transport facility resource efficiency (such as use of renewable materials and energy efficient lighting).
Specialized *(Use to address particular needs or objectives)*	• Portion of households with internet access. • Change in property values.	• Transit affordability. • Housing affordability in accessible locations.	• Impacts on special habitats and environmental resources • Heat island effects
Planning Process	Comprehensive (takes into account all significant impacts, using best current evaluation practices). Inclusive (substantial involvement of affected people, with special efforts to insure that disadvantaged and vulnerable groups are involved). Based on accessibility rather than mobility Application of smart growth land use policies		
Market Efficiency	Portion of total transportation costs that are efficiently priced Neutrality (public policies do not arbitrarily favour a particular mode or group) in transport pricing, taxes, planning, investment, etc. Applies least cost planning.		

Source: Litman (2007)

Table 66 Indicators for sustainable urban transport index

No.	Indicators	Measurement units	Weights	Range	
				Min.	Max.
1.	The extent to which transport plans cover public transport, intermodal facilities and infrastructure for active modes	0 - 16 scale	0.1	0	16
2.	Modal share of active and public transport in commuting	Trips/mode share	0.1	10	90
3.	Convenient access to public transport service	Percentage of population	0.1	20	100
4.	Public transport quality and reliability	Percentage satisfied	0.1	30	95
5.	Traffic fatalities per 100.000 inhabitants	Number of fatalities	0.1	0	35
6.	Affordability – travel costs as part of income	Percent of income	0.1	35	3.5
7.	Operational costs of the public transport system	Cost recovery ratio	0.1	22	175
8.	Investment in public transport systems	Percentage of total investment	0.1	0	50
9.	Air quality (PM 10)	µg/m3	0.1	150	10
10.	Greenhouse gas emissions from transport	CO_2 Eq. tons/capita/year	0.1	2.75	0
	Total		1.00		

Source: UNCRD (2018)

Table 67 Indicators applied in assessment of transport sustainability in this study

Indicator	Unit	Level of analysis
Social Dimension		
Transport equity – quality of accessibility and transport services for all groups		
• Affordability	Proportion of travel cost by daily income	By income
• Reliability	% satisfied	By income
• Comfort and convenience	% satisfied	By age
Economic Dimension		
• Affordability – travel cost relative to income	Proportion of travel cost by daily income	By mode
• Average commute travel time	Minute	By mode
Environmental Dimension		
• Energy consumption- per capita energy consumption	MJ/passenger km	By mode
• CO_2 emission – per capita CO_2 emission	$kgCO_2$/passenger km	By mode

6.2 Social dimension

The concept of equity is essential in transport because inequities lead to the formation of transport-disadvantaged groups, such as the elderly, disabled and low-income people (Bajada *et al.*, 2016). Equity ensures that the population segments that are at a disadvantage are provided with the same opportunities as other population segments. In fact, the concept of transport equity is built upon connecting citizens to

key activity destinations by means of public and private transport infrastructure (Di Ciommmo & Lucas, 2014).

In this study, transport equity is assessed through the dimensions of affordability, reliability, comfort, and convenience satisfaction. Transport affordability refers to the financial ability of people to access adequate transport services without compromising their ability to purchase other basic goods and services. Affordability can be assessed from the cost of alternative transport modes such as public transport (UN, 2015). Indicator used for assessing transport affordability is typically the amount of money individuals or households spend in order to access and use the transport system, compared to their monthly or annual income (Di Ciommo & Shiftan, 2017).

Affordability aspect is compared between the lower income SR users and the upper income users. According to the National Economic and Social Development Plan 12 (2017-2021), the strategy of building equity and poverty reduction targeted at the lower 40% of the income group country wide. NESDB (2018) has reported the average income in the lowest 40% group in Bangkok 5,249 Baht/month, as data of 2015. Therefore, income groups in this study are categorized into lower income with monthly income 0-5,249 Baht and upper income SR users with monthly income of 5,250 Baht and above.

The results are presented in Table 68 in two circumstances, one is when SR are used as the main mode (no transfer), the other is when SR are served as the access mode (with transfer). For the main mode, results show that the lower income users spend approximately 14% of their income on travel cost, while the upper income group spends less than 3% of their income on their daily trips. In terms of access mode, the estimations reveal 47% and 9% of daily income on travelling for the lower income and upper income groups, respectively.

Table 68 Comparative analysis of affordability: trip cost per daily income* among income groups

Income group	Main mode (No transfer)		Access mode (Transfer)	
	N	% Travel cost/daily income	N	% Travel cost/daily income**
Lower income group (0-5,249 Baht/month)	25	14	12	47
Upper income group (5,250 Baht/month and above)	288	3	209	9
Total	313		221	

Note: *This study assumed that respondents use SR in both trips so the values are timed 2; daily incomes are derived from monthly income divided by 22 days

**All transfer modes are assumed to be transit system (BTS/MRT); total trip cost of SR and mass transit are 10.89 and 33.69 Baht/trip, respectively (OTP, 2018a). Then trip of SR with transfer to mass transit would be 44.58 Baht/trip. SR trip cost is approximately 25% of the total trip cost. Therefore, total trip cost equal SR trip times 4.

Passenger perception is one element of socially sustainable public transport. Public transport quality and reliability can be measured by percentage satisfied (UNCRD, 2018). This study analyzed reliability, comfort and convenience aspects by estimating percentages of satisfied users derived from User Survey on satisfaction on SR services. Counts of satisfaction ratings on Agree (score =4) and Strongly Agree (score = 5) are combined and calculated to percentages.

In reliability assessment, satisfaction evaluation on five reliability aspects of SR are compared between the lower income users and upper income users. The results in Table 69 reveal that the lower income group reports lower satisfied percentages in three of the five reliability aspects when compared to the upper income users, which include frequency, travel time and wait time aspects. Average coverage are found to be slightly higher in satisfied percentages in the lower group while satisfied percentages in operation period show no differences among two groups.

Table 69 Comparison of percentage of satisfied users in SR reliability dimensions among income groups

Satisfaction statement	Reliability aspects	% Satisfied			
		Lower income group 0-5,249 Baht/month (n=73)	Upper income group 5,250 Baht/month and above (n=498)	Chi square	Pvalue
SR has frequent service	Frequency	84	90	2.693	0.101
I am satisfied that SR routes cover places I want to go	Area coverage	89	87	0.167	0.682
SR operates in the time period I need to travel	Operation period	84	84	0.016	0.900
Travelling by SR is fast and I can save my time	Travel time	82	85	0.369	0.544
I do not have to wait for SR for long time	Wait time	73	85	6.987	0.008

For the comparison of perception on comfort and convenience, this study applied four service quality aspects in order to assess the percentage of user satisfied among elderly and non-elderly SR riders. With regard to the Elderly Person Act, B.E. 2546 (2003) which defines “Elderly” as persons aged 60 and above, this study classified the elderly group as aged 60 and above whereas their counterparts are aged 14-64. As results shown in Table 70, for the elderly group, four aspects associated with comfort and convenience are more likely to be perceived in lower satisfaction with less percentage of satisfied users in comparison with the younger SR user group.

Table 70 Comparison of percentage of satisfied users in SR comfort and convenience dimensions among age groups

Satisfaction statement	Comfort and convenience aspects	% Satisfied			
		Non-elderly(14-59) (n=538)	Elderly (60+) (n=54)	Chi square	Pvalue
I always get a seat when riding SR and the seat is comfort	Seat availability and seat comfort	74	70	0.412	0.521
Shelter and benches at stops are available	Shelter and benches	61	56	0.452	0.501
SR gives sufficient stop time to board and alight and it is easy to enter the vehicle	Boarding and alighting	64	56	1.556	0.212
It is convenient to connect with and transfer to other modes	Convenience of transfer	70	59	3.291	0.070

6.3 Economic dimension

For affordability and average commute travel time, this study analyzed trip data, only from users that use SR as the main mode with no transfer, derived from User Survey in order to compare among each mode. Since trip cost and travel time may vary with the trip lengths, this research therefore applied data from SR and alternative modes in order to control the trip length variation to be in the range of current condition of SR service, and thus the meaningful results would be revealed.

In economic dimension, affordability are analyzed among transport modes instead of among socioeconomic groups in previous section so as to be able to compare between SR trips and the alternative ones. Only the cases of SR as the main travel mode are selected for the analysis. Affordability evaluations are proportion of travel cost per individual income while the average commute travel times are estimated in minutes.

Results in Table 71 highlight that songtaew, SR and bus, which are considered as public transportation modes, seems to be more affordable than car, motorcycle and taxi. For average commute time, buses illustrate the highest travel time among public transport modes while songtaew show the shortest travel time among all transport modes.

Table 71 Comparative analysis of affordability and average commute travel time among transport modes

Affordability: Travel cost/daily income					**Average commute travel time: Minute**				
	N	Mean	SD	% (Relative to SR)		N	Mean	SD	Min (Relative to SR)
Songtaew	5	0.031	0.020	3.1 (-0.7)	Songtaew	6	11.17	5.56	- 2.95
SR	313	**0.038**	**0.070**	**3.8**	Motorcycle	35	13.43	19.35	- 0.69
Bus	90	0.043	0.046	4.3 (+0.5)	SR	353	**14.12**	**9.84**	**14.12**
Private car	18	0.072	0.114	7.2 (+3.4)	Taxi	31	18.55	8.08	+ 4.43
Motorcycle	30	0.076	0.077	7.6 (+3.8)	Bus	95	23.66	15.79	+ 9.54
Taxi	29	0.303	0.808	30.3 (+26.5)	Private car	17	25.35	17.27	+ 11.23

6.4 Environmental dimension

Energy intensity and CO_2 emission are sustainability indicators for measuring environmental sustainability (UNDESA, 2007). Energy intensity of transport defined as fuel used per unit of freight-kilometer (km) hauled and per unit of passenger-km traveled by mode. The indicator measures how much energy is used for moving both goods and people. CO_2 emission measures the emissions of carbon dioxide, which is known to be the most important, in terms of impact of global warming, anthropogenic greenhouse gas.

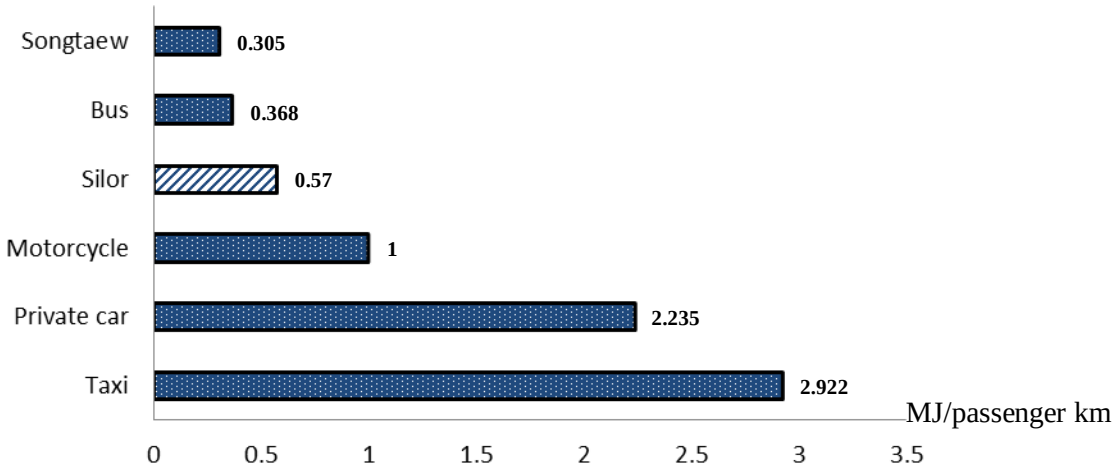
This study analyzes both energy intensity and CO_2 emission in order to compare SR with other alternative travel modes. Table 72 shows the result from comparative analysis of SR and six travel modes that SR users indicated as their alternative modes. The average energy consumptions were calculated by dividing energy consumption for each fuel type by fuel efficiency, then the values were divided by vehicle occupancy to gain per capita energy consumption in MJ/passenger km. For the emission estimations, average CO_2 emissions were divided by emission value for each fuel type, then the values were divided by vehicle occupancy to obtaining per capita CO_2 emissions.

Interestingly, when compared to motorcycle, private car, and taxi, SR illustrates the lowest per capita energy consumption and per capita CO_2 emission, and therefore is the most efficient mode. For Songtaew and bus, they both result in the two lowest per capita consumption and emission, lower than SR, and also being the two most environmental efficient transport modes according to the estimations. The alternative mode energy consumption and CO_2 emission comparing to SR are depicted in Figure 49.

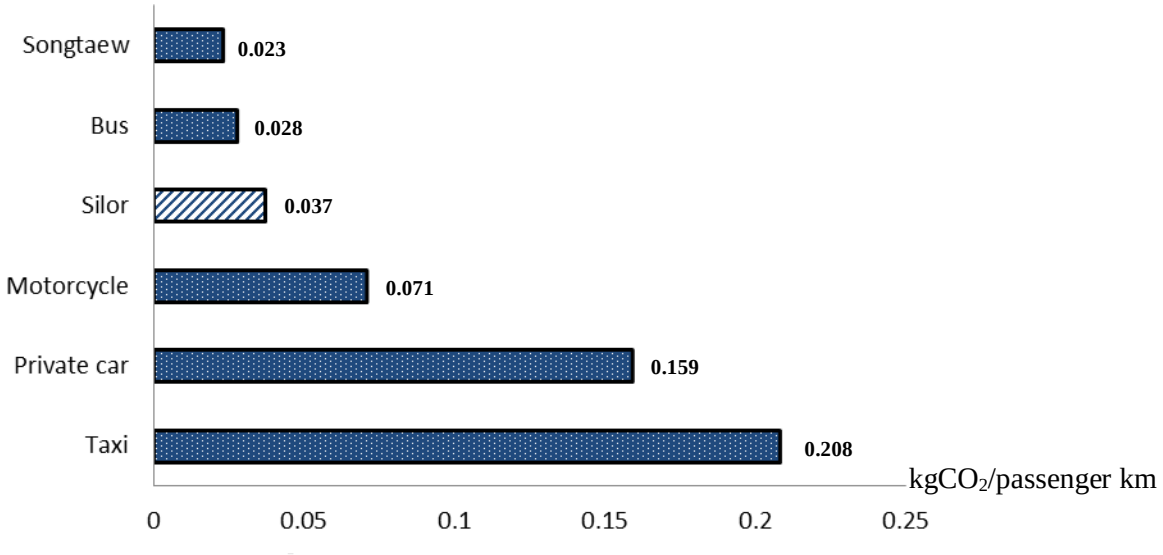
Table 72 Comparative analysis of energy consumption and CO_2 emission among transport modes

Mode	Average vehicle occupancy	Fuel type	Fuel efficiency for each vehicle type (km/L)	Energy efficiency			Environmental emission		
				Energy consumption for each fuel type (MJ/L)[4]	Average energy consumption		CO_2 emission for each fuel type ($kgCO_2/L$)[5]	Average CO_2 emission	
					MJ/km	MJ/passenger km		$kgCO_2/km$	$kgCO_2$/passenger km
Songtaew	10	Diesel	11.93[2]	36.42	3.05	0.305	2.74	0.230	0.023
Bus	25.10[1]	Diesel	3.94[2]	36.42	9.24	0.368	2.74	0.695	0.028
Silor	4.3	LPG	10.86[3]	26.62	2.45	0.570	1.72	0.158	0.037
Motorcycle	1.10[1]	Gasoline	28.71[2]	31.48	1.10	1.000	2.24	0.078	0.071
Private car	1.15[1]	Gasoline	12.27[2]	31.48	2.57	2.235	2.24	0.183	0.159
Taxi	1.15[1]	Gasoline	9.37[1]	31.48	3.36	2.922	2.24	0.239	0.208

Note 1 OTP (2008)
2 Pongthanaisawan (2011)
3 PCD (2007) The Fuel efficiency of Tuktuk is applied to Silor since their vehicle characteristics seem to be similar (DLT & TRI, 2009)
4 DEDE (2016)
5 TGO (2013)
- Average vehicle occupancy of SR are derived from estimations based on field observations. The seat capacity of all routes are average 8.5 (BT,ST,CK: 11 seats; VR, SV: 6 seats); assume average daily loading factor = 50% (0.5)
- Average vehicle occupancy of Songtaew are derived from seat capacity of 20 (Wongwiriya *et al.*, 2017); assume average daily loading factor = 50% (0.5)



(a) Energy consumption



(b) CO_2 emission

Figure 49 Alternative mode energy consumption and CO_2 emission comparing to SR

CHAPTER VII
DISCUSSION

In this chapter, findings from previous literatures in relation to this study are considered together with results based on supply side, demand side and sustainability of SR services and are discussed separately in each sub-section. Key issues are summarized and policy considerations are presented accordingly.

7.1 Supply and regulators of SR services

This section discusses the results associated with drivers and regulators, including socioeconomic profiles, challenges and opinions in operating and regulating SR services.

7.1.1 Drivers of SR

7.1.1.1 Socioeconomic and occupation variables

In this study, it is found that education level of most SR drivers (83.8%) are secondary school level or below and is in line with previous study which found that 90% of drivers of SR fixed route are secondary school or below (DLT & TRI, 2009). Also, 8.8% of drivers in this study stated that they have other jobs. This evidence is similar trend to former study of DLT and TRI (2009) which found 18% doing other jobs along with driving SR, including vendor, agriculture and mechanics.

The findings reveal no differences in driver daily income. However, the significantly shorter work hours and less work days in SV route can be explained by the highest fare rate of this for-hire service route as shown in Table 36. Thus, drivers of this route require shorter period of time and less day to receive the same amount of income as the other four routes. It is also noted from previous study of DLT and TRI (2009) that work day and work hour of SR operators are found to be more flexible in the fixed route when compared to for-hire service. They reported work day of 6-7 days/week and 5-7 days/week for fixed route and for-hire service, respectively while work hours are 8-15 hours/day and 4-15 hours/day in fixed route and for-hire service, respectively. Overall, this research show work day 6-7 days/week and work hour 10-15 hours/day. This findings are similar to Cervero (2000) that generally service hours of informal transport drivers range from 10 to 12 hours per day for 6 or 7 days per week. It was argued that informal transport drivers have low education level and their daily income is uncertain. Some drivers are willing to work longer hours than usual to earn a minimal income as to be sufficient to support them (Phun & Yai, 2016).

From this study, the fuel cost is 274 Baht/day at the average and is consistent with the former study by DLT and TRI (2009) which reveal the average fuel cost

from 100 to 400 Baht/day. Additionally, the fuel cost per day seems to be associated with service area characteristics and the route length. It is noted that VR and SV routes operating in Sois with shorter route length (2-4 km as presented in Table 20) are less likely to face traffic congestions and, therefore, report lower fuel cost in one day. The rental fee in this study is 340 Baht/day at the average which is in line with DLT and TRI (2009) which report the average rental fees of 200-350 Baht/day. Previous study on auto rickshaws in India also reported that majority of drivers are running rented vehicles on a 12 hour shift, paying approximately Rs.300 to the vehicle owners on a daily basis (Uteng, 2011).

The findings point out that VR and SV routes are not regulated under cooperatives since drivers 100% state that they are not member of cooperatives. In terms of vehicle ownership, it is found that higher proportion of drivers in VR and SV routes are more affordable to own SR vehicles when compared to BT, SR and CK routes. The calculations of net revenue by subtracting fuel cost from daily income reveal that VR and SV routes show higher net revenue 756 and 799 Baht/day, respectively. The lower revenues are found in BT, ST, and CK route, accounting for 684, 601, and 673 Baht/day respectively and the evidence is understandable.

Nevertheless, some non-conformity to the regulations is still found. For instance, vehicles that are registered as private vehicles are currently used in public services. All vehicles of SV route and 50% of VR routes are private vehicles with white license plates. Besides, 2% of all drivers are working with no or unavailable driving licenses. Also, this study reports drivers 46% hold driving licenses for private vehicle instead of for the public ones. The evidences shown in the present study are in line with Cervero and Golub (2007) that usually informal service vehicles and operators do not have appropriate licenses, permits or registration papers from public authorities to provide collective-ride services to the general public. Literatures also stated that paratransit in Bangkok are illegal in that they are licensed under the Motor Vehicle Act as personal transportation modes, barring them from providing commercial, for-hire services (Cervero & Golub, 2007). Nor are informal operators are illegal in all respects – even among non-registered operators some have commercial driving permits and most respect territorial limits.

7.1.1.2 Challenges and opinions on SR development

Drivers of VR route are distinct in that 100% stated not having any problems with overlapping routes or other transport modes. From observations VR route operates in Sois with the length of only 2 km where neither buses nor motorcycle taxis are available. Motorcycle taxis are available only in the connecting Soi network. Also this route shows the lowest number of alternative modes; therefore, drivers have the least chance to confront with other transport modes.

Findings revealed that overlapping routes bring about a wide range of problems, involving dangerous driving behavior, annoyance, accidents, and competitions among transport modes. Problems occur among SR and SR, SR and motorcycle taxi, and SR and private cars. However, conflicts between SR and motorcycle taxis seem to be mentioned by most SR drivers. It is important to note that when there are problems in public transport services, not only operators fight for passengers, but passengers are also in danger due to the unsafe situations such as when accidents occur or unexpected evidences caused by annoyance.

Results show the higher percentages of drivers in BT, ST and CK routes report that they have been called by police officers when compared to VR and SV routes. This evidence is possibly because the coverage areas for the first three routes run on the major arterials where they are more likely to be called for inspections. On the contrarily, VR and SV route operate in Soi network with the shorter route lengths so there are less change to be called by police officers.

Previous study in Ethiopia stated that the most relevant effects of informal operators on formal industry and long distance bus in particular are the accelerated increase in the rate of accidents, lack of tax payments and driving over the distance limit (Ayichew, 2014). This research report in the similar way that some non-conformity to the regulations is still found in SR services in terms of vehicle registration, driving license, and annual taxation. Regulations regarding these issues should be strictly enforced otherwise unauthorized SR vehicles will continue to mushroom in the areas, causing congestions and unsafe conditions from unauthorized operators.

It is observed that in some areas SR operate in main arterials with large vehicles and their parking stations are set up on their own. This is in line with previous study on auto rickshaws in India which argued that, despite their strong presence on the road, there are neither dedicated lanes for them nor are there parking provision (Uteng, 2011). Parking facilities in market areas are operated by private groups. Parking and stopping at unauthorized areas may result in congestions, chaos, and sometimes accidents. Drivers sometimes want to pick up and drop off passengers at some specific points while neglecting the speed of the main traffic flow when they make sudden stops. Therefore, it is necessary to consider the existing SR route alignments and the service patterns which would best fit with the traffic conditions and street network in the neighborhoods.

Due to the fact that SV routes currently operates in for-hire pattern like taxi services, SV route drivers report the lowest share of agreement (9.5%) and the highest share of disagreement (52.4%) in setting up the proper stops for SR services. They possibly prefer the for-hire pattern that SR can stop anywhere as the way it is. It is revealed from drivers' opinions and concerns that setting up proper stops would provide convenience and safety to passengers and drivers. For VR route, if the

parking spaces are full or the parked vehicles already exceed the maximum allowance, they have to keep driving around in the area. Nonetheless, several issues should be carefully considered when setting stops for SR, involving traffic congestions, accidents, parking locations and adequate spaces for SR vehicles. It is noted that the uniqueness in terms of door-to-door service of SR plus the demands in scattered area make SR service operate in this existing way. Ridership may decline when the system changes. This, therefore, would also influence drivers' income.

It is interesting that most drivers agree on integrating SR as feeder services to BTS and MRT system with opinions that the services will be more convenient and faster, the ridership may increase as well as the driver income. Exception is noted for drivers of SV route where 71.4% were undecided and only 28.6% agree with the policy. This is possibly because they were now operating in a non-fixed route service pattern similar to for-hire taxi which they can run in Soi 39 and its connecting network. Not like all other routes that operate in the route-based pattern, SV route operates in the area-based pattern and seems to be more flexible. Drivers in SV route may feel unsecured with their income if the route changes to be feeder services which need to operate in the more limited area when compared to the present conditions.

However, traffic conditions in terms of congestions and existing transport mode around transit stations should be taken into considerations in order to avoid route overlap and conflicts among operators. Some drivers are uncertain that the future situations will be better, worse and the same as the existing ones. Also, they state that they can operate in whichever way the passengers want.

7.1.2 Regulators

Three interesting facts are observed from this interview. First, the government limits number of SR vehicles so at present no more registrations of SR vehicles are allowed. That is why many SR are found operating with the white license plates which means they are using their private vehicles to serve passengers.

Second, SR services seem to be small segments in the whole transportation system of Bangkok which received little attention from transport authorities. Due to its small size, proper parking space and station area do not seem to be the concern for regulators. From regulator's point of view, in case of any problems, drivers have to negotiate for space with the space owners as stated by DLT officers (DLT, 2018).

"Parking areas are not necessary as the service areas are in alleys"

"Usually the SR drivers park the vehicle in the neighborhood, some park in front of local residences. It seems difficult for us to set up the rules on this issue. Drivers must negotiate and manage this issue on their own."

"SR is the only small segment in Bangkok transportation system and most of them are running in alleys. Perhaps, this is the reason why DLT pay much more attention on buses and other intercity public transport modes serving and influencing larger group of people"

However, the observations on site found that some SR already possessed the area for parking properly while some are found parking on sidewalks, obstructing pedestrian walkways and some park on the main roads causing congestions.

Finally, many SR routes are still found to compete with other public transport modes. The routes overlap with bus and motorcycle routes. Operators among different modes sometimes fight for passengers which poses unsafety issues to passengers. Besides, the services which run on main roads in the flow with larger vehicles like buses are at risk of severe accidents that are due to the slower starting and stopping speed which obstruct the traffic flow. The other factors that intensify the severity are the unstandardized vehicle designs in terms of protection structures as well as seat arrangement modified to occupy as many passengers as possible. To be in harmony with the whole transportation system of Bangkok, there should be rearrangement of public transport service routes involving buses and songtaew. For safety purposes, SR should be serving in alleys and the system should function as potential feeders to the formal modes, such as buses and mass transit lines.

All in all, the results provide better understanding on many evidences through the discussion with regulators, such as the mushroom of private vehicles serving as SR services in places as well as parking space provisions which should not be ignored. Also, the arrangement of public transport service routes in Bangkok should be inserted in the planning process to solve the overlap route problems. In additions, the shift of SR services to Sois or alleys along with the control in vehicle design standard would be necessary for safety reasons.

7.2 Demand of SR services

In this section, results on SR users and non-users are discussed based on travel behavior and attitudes. The discussions on user subgroups are also presented, including the SR users in West and East Bangkok as well as Thai and Japanese SR users.

7.2.1 Travel behavior

7.2.1.1 Users of SR

Findings reveal that 52% of SR users in SV are Japanese because SR in SV route operates in Sukhumvit Soi 39 area. This area is known to be Japanese community with restaurants, supermarkets, and associations distributed in the

neighborhood. The findings that 27.8% of SR users in this route have no income may be due to the fact that Japanese users are mostly expatriate partners who have no jobs in Thailand. Therefore this evidence is reflected in the high share of unemployed users in this route. In the case of BT route, the highest proportion of students (18.6%) is in line with the highest share of user in 14-24 age groups (21.1%) which explains that most users in this age group are students.

Interestingly users with higher mean income are more likely to own cars and have cars available to use, as revealed in BT and VR routes, while exception should also be noted in SV routes where users although display the highest mean income, most of them do not own cars and have no car available to use. This explains that expatriates may not plan to own cars if not staying for long duration.

In this study, higher proportion of regular users (using SR more than once a week) is found in BT and VR routes. From observations, both VR and SV routes operate in Soi but more alternative modes are found in SV route. So in VR route, SR are popular among users due to the frequent service that run in narrow road network or alley. Motorcycle taxi services are available in the connecting Soi but not along the SR route. Neither buses nor motorcycle taxis are available along SR route. In case of BT route, when compared to ST and CK which run in major road, BT route is different in that it runs in minor street network with less bus routes available. This explains the evidence that users are more likely to ride SR regularly. In addition, users in SV route are less likely to travel alone. This may be due to the for-hired service pattern of SV route that make users, especially the Japanese, prefer to travel in groups. For users in VR routes, the higher share of "work" as the origin and destination stands out among other routes. This evidence is in line with the higher share of 25-44 age group (71.8%), the middle age group, also known as the working age.

It is noted that the mean distance travelled by the three West BKK routes (BT, ST and CK) are longer than VR and SV respectively. This evidence is consistent with the approximate service route length that West routes are the longest group followed by VR and SV respectively. Additionally, the shortest mean travel time of VR route is reflected from the shortest mean travel time and the shortest service length.

In considering alternative modes of SR users, although both VR and SR routes are similar in operating in Soi network, the proportion of alternative modes are found to be different. In VR route, walking is the dominant alternative mode (43.6%) because the mean travel distance is 1 km/trip in the walking distance, while in SV route, motorcycle taxi is the dominate alternative (35.9%) as the mean travel distance of 2.11 km/trip, longer than the walking distance. Moreover, taxi (29.7%) appear to be the second top alternative for users in SV route and is distinct from VR route even though they both operate in Soi network. This evidence is supported by the higher mean income of users in SV routes; consequently, they are more affordable to the

high fare of taxi when compared to VR route. On the contrary, the proportion of private car in SV route is lower than VR route and possibly resulted from the lower proportion in car availability.

This study further compares between SR trips and alternative mode trips of SR users on three trip variables. The significantly lower trip cost, wait time and travel time of SR trips than alternative trips reflect the advantages that travelling by SR is cheaper with shorter wait time and travel time.

7.2.1.2 Non-users of SR

It is interesting to note that ranking in proportion of university graduate group of non-users are similar to users which BT route shows the lowest proportion, followed by CK, ST, VR, and SV routes, respectively. This implies the characteristics of people in each area in terms of their different education level. The proportion of "student" and "unemployed" stand out in SV route when compared to other routes. From observations, students are possibly respondents from Srinakharinwirot University which is located in this area while the unemployed include the Japanese respondents that make the proportion distinct from other routes.

Both VR and SV routes operate in Soi network; however, private motorcycle dominates in the former route whereas private car lead in proportion of the latter. The higher mean income of respondents in SV route explains such evidence. Therefore, they seem to be more affordable to own private cars when compared to VR route. Findings that private car dominates the travel modes of respondents in SV route can be explained with the highest proportion of travelling in groups since cars seem to be convenient for and facilitate travelling in groups.

7.2.1.3 Comparative analysis of travel behavior between users and non-users of SR

Female dominates the user group and is in line with previous study of DLT and TRI (2009) that female are responsible for 65% of SR users. A consistent finding from around the world is that compared to men, women are more dependent on public transport services (Uteng, 2011). Women are less likely to own a vehicle or have a license to drive it and they tend to have a lower proportion of trips involving personal vehicles. Analysis of women behavior in Indonesia showed that women 88.7% depend on public transport and further reported that women tend to choose door to door service that can reduce walk trip such as *becak* (tricycle), *Ojek* (taxi-motorcycle) or minibus (oplet, mikrolet) in Indonesia and cycle rickshaws in India (Uteng, 2011). Similarly, mode choice analysis in Chengdu and Chennai (Srinivasan, 2008) found lower proportion of female using personal vehicle than male travellers.

For SR users, the higher share in “student”, “housewife”, and “unemployed” groups explains the evidence of the higher proportion of “no income” and “9,999 or less”. Results on household vehicles and vehicles availability reveal that over half of SR users neither have household vehicles nor vehicles available to use.

It is interesting to note that higher proportions of SR trips need transfer when compared to trips by other modes. This finding is also consistent with the higher share of “transfer” as both origin and destination of SR trips. Additionally “shopping” seems to be the main purpose of using SR, showing the higher proportion when compared to other modes.

SR and motorcycle mostly facilitate short-distance trips while bus and car are mostly used for long-distance journey. It is noted that SR and motorcycle, the shorter distance group, also report the shorter travel time when compared to bus and private car. In fact, travelling in the shorter distance takes shorter time. When considering transfer trip, public transport modes (SR, motorcycle taxi, and bus) reveal higher proportion of transfer trip whereas private vehicle mostly make direct trips. In addition, it is noted that private motorcycle only transfer 2.1% which may be due to its advantages in speed and accessibility in terms of penetration into alleys are able to reach destination directly. On the contrary, private car users sometimes face with congestions and need transfer to other modes to reach destinations on time, especially long-distance trips. This reflects in higher proportion of transfer trip in private car (12.3%) when compared to private motorcycle.

7.2.2 Attitudes on service quality

7.2.2.1 Users of SR

It is noted that top reasons of using SR are related to advantages of SR including convenient, accessible, and cheap fare. When SR users are classified into different alternative modes, advantages of SR in aspects of convenience, accessibility and cheap fare report the highest proportion in all groups, and this, therefore, confirms the previous evidence in that advantages of SR are the top reasons. Perception of bus users in Indonesia (Budiono, 2009) also revealed that frequency, price, punctuality and travel time are crucial factors to bring higher level of satisfaction.

The score on “SR is convenient and very accessible” and “I want to avoid traffic jam” in Alt-bus is significantly higher than Alt-motorcycle. This implies that, when compared to bus, SR is more convenient and accessible as well as able to avoid traffic jam. However, for Alt-motorcycle, it is not obvious in their feelings on such aspects since travelling by motorcycles also provide convenience, accessibility and is able to avoid traffic jam. For Alt-private car, the score of “I do not have car” report significantly lower than other groups as they have private car as alternative mode and, thus, it is understandable.

Findings from IPA of users' perspective on importance score and satisfaction score on service quality reflect that the strength of SR are due to reliability of SR services which are associated with service frequency, route coverage, operation time, travel time and wait time. Also, connection and transfer, seat availability and fare are evaluated as the highly important aspects with high satisfaction. It is noted that the services should keep up with these advantages. Findings in this study are consistent with the public transport users that are most satisfied with punctuality, reliability, network connection and service frequency (Le-Klahn *et al.*, 2014). Also advantages of small vehicles are mentioned, including more frequent headway, guaranteed seat, and ability to penetrate in crowded city streets (Cervero & Golub, 2007).

On the contrary, users seem to pay much attention to safety and security, which illustrates importance level above the average, but the satisfactions are rated below the average. Therefore, improving these aspects would enhance users' satisfaction and may increase the ridership. Similar to this research findings, the study on paratransit in Thailand based on commuter satisfaction (Tangphaisankun *et al.*, 2009) also found that safety and security are dissatisfied. Other aspects are rated at the lower importance with low satisfaction when compared to the attributes previously mentioned. The improvement in these aspects may not result in the significant increase in their satisfaction.

7.2.2.2 Non-users of SR

This research has indicated that the perceived difficulties of SR are reasons associated with Inconveniences, Safety and comfort, and Time-related and car dependency. Transfer, connections and crowdedness are the top three aspects for not using SR services. It is reasonable that non-users who walk mostly state the preference of walking of cycling as well as the private car users who mostly mention travelling by car as the reasons for not using SR. It is also interesting that issues associated with no good connection, no need to transfer, and not comfortable with the crowd are mentions in most of non-user groups.

The findings reveal that bus and private car users feel that SR services are less likely to provide safety to them. Also, it is noted that motorcycle users and taxi users are more likely to mention that SR is slow with long wait time. This is understandable and can be explained that motorcycle and taxi both are for-hired and mostly are served as door-to-door service without transfer; therefore, these characteristics are advantages over SR services, particularly in time-related aspects. The evidence that private car users agree with the long wait time of SR is due to the fact that using cars require no wait time.

The evidences that bus and private car users are more concern on transfer and safety aspects reveal that these two modes are more likely to provide direct trip without transfer as well as more safety than SR. Motorcycle users do not concern much on these issues, travel time aspects such as wait time and travel speed seem to be of higher significant instead. Bus users report the lowest mean score on "I travel by a car" when compared to motorcycle and private car users and is understandable as the highest mean score are found in non-users that travel by private cars.

7.2.2.3 Comparative analysis of attitudes between users and non-users of SR

The findings that coverage area seems to be more important to non-users is because the results reveal the higher mean travel distance in non-users (10.77 km/trip in Table 41) when compared to users (3.44 km/trip in Table 36). For those who travel long distance the service coverage area is very necessary and need to cover the area they want to go; thus, they pay more attention to this aspect.

Regarding the evaluation on air-conditioning, SR users show lower importance score on this attribute and this is in line with the fact that SR has no air-con. On the contrary, non-users rate this aspect in the significantly higher score. It is possible that they prefer travelling in air-con vehicles, such as private car, taxi or some bus services rather than SR and this evidence is understandable.

For SR users, the convenience in terms of connections and transfers are evaluated at higher importance score than non-user group. The higher proportion in transfer rate of users (approximately 40% in Table 36) than non-users (approximately 22% in Table 41) explains such results. For those who need to transfer seem to pay more attention to the convenience when compared to those of the opposite.

In the aspect of passenger politeness, SR users express in the similar way with transfer attributes. From observations, cabin space of SR is quite compact and sitting in the limited space, therefore, makes passengers be close to each other. This results can explain that passengers sitting close to each other require politeness from others who travel together, especially in a crowded atmosphere.

It is noted that the importance score of environmental aspects, concerning pollution, congestion and accidents, rank the lowest of all aspects, both for SR users and non-users. Previous study in reported in the similar way that transport users were unaware of energy and environmental footprints of their travel, and 85% were not able to estimate emission and air pollution costs across different modes (Daher *et al.*, 2018). Findings that non-users rate all these aspects of higher importance when compared to users do not imply that environmental concerns influence people to use public transportation mode. This is in line with previous study in Ireland (O'Mahony *et al.*, 2002) which concluded that people are aware of some negative consequences of

car use, such as those associated with air and noise pollution; however, they are not changing their behavior in accordance with this awareness.

This study applies factor analysis on a set of 19 attitudinal variables relating to service quality dimensions of public transport services. These variables are grouped into four distinct components including In-vehicle environment, Reliability, Environmental impact, and Comfort and convenience. Findings reveal that Reliability aspects ranked in the highest importance scores, noting that respondents generally pay much attention to frequency, travel time, coverage area, operating time, and wait time of public transport services.

7.2.3 Perceived service quality and commuter segmentation

7.2.3.1 Factors influencing perceived satisfaction of SR service

Result from ordinal logistic regression model explains the way perception towards service quality affect customers' overall satisfaction. The four factors that have a significant effect on customer overall satisfaction are reliability, in-vehicle environment, comfort and convenience as well as environmental impact. Three factors, i.e. reliability, in-vehicle environment, comfort and convenience are in line with previous research results. Dell'Olio *et al.* (2011) explored bus service quality in Spain and found that users most valued wait time, cleanliness, and comfort. These three variables can be viewed as aspects of reliability, in-vehicle environment, and comfort and convenience respectively. Results in this study confirm the significant effect of reliability on overall satisfaction for customers of both routes. Such finding is conforming to previous study on service quality of paratransit in developing countries in that reliability is one of the most significant observed variables having influence on the service (Rahman *et al.*, 2016). Polat (2012) argued that reliability refers to the degree of dependability on and trust-ability of passengers in a specific mode of transport and PT services. It also includes features such as accessibility and confidence. Passengers should be able to depend on those services and be able to see that they are obtainable on regular basis and are long termed. Besides, Cantwell *et al.* (2009) reported that commuters travelling on an unreliable public transport service experience lower levels of commute satisfaction than those who commute on a reliable service. The longer time a respondent spends travelling, the lower the satisfaction level with their commute. According to the study on overall view of perceived total quality formed by the various groups of respondents (Vanhanen & Kurri, 2005), all public transport passengers valued most the availability and reliability of the service while the value-added quality factors come in second. However, the diverse results were found in the context of Indonesian bus services (Tarigan, 2014), where safety and comfort were, instead, the dominant factors influencing customer satisfaction. Therefore, when comparing among international

contexts, local factors, such as cultural values and transport operational characteristics must be taken into account.

The previous studies on bus transit in Scotland indicated that in-vehicle environment and convenience displayed moderately strong significant correlation coefficients with perceived satisfaction (Morton *et al.*, 2016). This study reports in a similar way that the aspects associated with in-vehicle environment significantly influence the overall satisfaction in the West route. It can be said that, with the longer average trip distance of 4.52 kilometers in West BKK route, the in-vehicle environment seems to be important factor for riders when choosing transport service. Comfort, convenience and environmental impacts are also significant factors in evaluating overall satisfaction only for customers of the East route. In fact, most East route users (60%) need to transfer. It can be inferred that users with the need to transfer pay much attention to comfort and convenience aspects; consequently, they use these factors to evaluate their overall satisfaction of the service. This result supports the previous literature in that comfort has some value for travellers in spite of varying degrees in different circumstances (Polat, 2012). Gebeyehu and Takano (2008) demonstrated that transfer is a convenience factor when making connecting trips for bus travellers. Further, the environmental awareness shows significantly negative effect on their overall satisfaction on the service in East BKK route. 56% of users in the East route are university graduates and 51% of them earn monthly income of over 20,000 Baht. The education and income level could positively affect their understanding and awareness on environmental threats. This result is consistent with the study of the way education and income level influence people's environmental awareness by Yilmaz *et al.* (2006) and Marquart-Pyatt (2012).

7.2.3.2 Heterogeneity of SR commuter segments

Socioeconomic and travel behavior are found to influence the way commuters perceived SR service. From the findings, young riders tend to be more satisfied with the quality of service, as illustrated in '*pleasurable experience*' and '*environmentally conscious*'. This finding shares a common trend with Antoniou and Tyrinopoulos (2013), which reported that younger people are in general more satisfied with the services, possibly because they are in good physical shape. This may affect comfort and convenience particularly when boarding and alighting the vehicle, waiting for the service, or sitting in the compact cabin space. However, in a case of formal public transport context, students of age group below 18 expressed the lowest satisfaction on bus services while the age group of 45-54 had high satisfaction (Weng *et al.*, 2018). The adverse evidence was likely due to the formality of vehicle design and operation which the accessibilities are standardized and convenience are signified.

Considering the trip characteristics, Hu *et al.* (2015) revealed that for long distance trips, passengers are not satisfied with reliability or comfort of buses. This study supports the previous study in that commuters travelling long distance with no transfer, as presented in '*reliability oriented*', pay much attention to reliability attributes. Wardman (2004) pointed out that when journey distance increase, fatigue, boredom and discomfort set it. The findings in this study also report that commuters travelling longer duration need better cabin environment, as described for '*in-vehicle environment desire*'. Apart from having high proportion of long distance trips, high proportion of transfer trips and older users over 40 years old are found as well. The study on bus traveler's satisfaction in Ethiopia suggested that transfer is a convenience factor when making connect trips (Gebeyehu & Takano, 2008). So, the level of required convenience increases with the need to transfer. Additionally, older people were found to express dissatisfaction with bus design which may reflect their inability to step on/off the buses. Buses with high steps makes difficult to older people to board and alight (Gebeyehu & Takano, 2008). This study also supports the previous literatures that '*in-vehicle environment desire*', which comprises higher proportion of older users, prefer the service with more comfort and convenience, i.e. seat comfort, convenience of transfer, shelter and bench at stops, sufficient time to board and alight, ease to enter the vehicle, safety and security as well.

Among the four clusters, '*environmentally conscious*' is the only group that is aware of the impact of SR on pollution, traffic congestion and accidents, though at low level, while other groups seem to be neutral on this matter. When compared to '*reliability oriented*', their average incomes are in the upper economic strata with the higher proportion of secondary or university graduates. Yilmaz *et al.* (2006) stated that with the rising of education level, people have improved ability to comprehend complex environmental problems as a result of higher level of awareness of public affairs based on increasing cognitive skill. Thus, the higher levels of education raise environmental awareness (Movsesyan & Zagheni, 2014). Marquart-Pyatt (2012) investigated the measure of environmental concern in terms of awareness of environmental threats and education was revealed as a key factor in the expression of environmental concern. The result in current study also supports Ustun and Celep (2007) that socioeconomic structures affect environmental awareness of people. Poorly-educated people do not show a lower level of environmental concern when compared to responds of people who are high school or university graduates. In addition, the similar relationship has been seen between people who are in the lower and upper income strata. Marquart-Pyatt (2012) also stated that environmental concern is positively associated with income. The priorities of lower income people are more likely to meet the basic needs of their own and families and concern for environmental issues can be ignored when compare with meeting their basic needs. Nonetheless, higher income people have the proper conditions for meeting the basic needs such as adequate nutrition or health care (Yilmaz *et al.*, 2006). That is why it is

much more possible to be interested in environmental issues for them when compared to the lower income people.

7.2.3.3 Implications on service dimensions improvement among SR user segments

Beside theoretical contributions, this study is useful in its provision of managerial implication. Firstly, when it comes to improving service quality of SR, the result suggests transportation planners to concentrate on dimensions of reliability, in-vehicle environment, comfort and convenience, and environmental impact. Second, based on SR user segmentation, they should pay attention to the differences in users' need regarding user profile and trip patterns existing in each service area.

Due to the fact that '*reliability oriented*' have high needs of reliable, comfort and convenient service, managing the frequency of service especially during peak period to sufficiently serve the travel demand would increase the service quality and reduce the waiting time. Besides, integration of multimodal transfer infrastructures and facilities, such as shelters and benches, would enhance seamless transfer and improve the comfort and convenience of the service. As mentioned by Polat (2012), the integration of public transport would increase the service quality. These could be effective ways to increase the ridership.

As particular preferences are illustrated in '*in-vehicle environment desire*', vehicle designs and seating structures should be observed. Standards should be set up for aspects of seating condition, cabin space, and structures for protection from elements. Also, drivers should have participated in trainings for public service industry. These strategies could improve the quality of service and increase the overall satisfaction.

Lastly, '*pleasurable experience*' and '*environmentally conscious*' have already shown high satisfaction level on the service quality. The best way is to keep up with the existing level of service; nonetheless, improving any service aspects would possibly exceed their expectations.

7.2.4 Comparative study of travel behavior between Thai and Japanese SR users in Sukhumvit area

7.2.4.1 Travel behavior

Thai SR user socioeconomic profiles in this study are consistent with previous evidences of DLT and TRI (2009) which reported 65% female and 67% have household cars. These observations reveal the role of SR as significant options for users with private vehicles. In previous study, SR services that were investigated operate in fixed routes so the average trip cost (6 Baht/trip/person) is lower than average cost in this study (35 Baht/trip/person). The higher fare may influence the distribution of

age group and education of SR users. Results from this study note 61% of users are 25-44 years while 64% are 15-30 years in previous study. Also, this study shows that university level users are at higher proportion (72%) when compared to previous one (45%). It is possible that users of older age or of higher education have higher income and are more affordable for services with higher fare. Nonetheless, average travel time from this study (14.44 minutes) is in line with the previous one (13.76 minutes).

Japanese user profiles differ from Thais' in that the Japanese are expatriates who moved to Thailand to serve Japanese companies and receive the higher income rates while some are expatriates' partners who have no jobs in Thailand. The reason for the higher income is that Japanese is the developed country where per capita income is higher than that of the developing nations. The findings are similar to the comparison of foreign tourists and domestic tourists visiting Kodaikanal, India (Fowzia Sultana, 2015). Japanese users display lower proportion of availability of household car which explains that expatriates may not plan to own cars if not staying for long duration. The findings that Japanese users prefer to travel with companions is consistent with the concept of belongingness in Japanese consumer behavior which reflects the comfort in togetherness that encourages group travel style (Ahmed & Krohn, 1992). Moreover, Pizam and Sussmann (1955) mentioned that travelling with their own countrymen in a different culture reduces the intensity of cultural shock and fulfills their need to socialize with people of a similar culture. The group provides identity and a sense of security in an alien culture.

This research reveals that SR services in Sukhumvit Soi 39 are mainly shopping-based trips for both Thai and Japanese users. For the Japanese, shopping is very important to them (Reisinger, 1990). Travel behavior of Japanese users that shop near home and shop frequently might be due to the reason of lack of space, especially in urban areas in Japan (Synodinos, 2001). The study of Synodinos (2001) also argued that the practical difficulties associated with transporting purchased goods in public transportation contribute to the attractiveness of shopping near home. Japanese users are more likely to make home-based trip than Thai users since residences of Japanese users are in the neighborhood areas whereas Thai users come to this area for shopping and work. Work-based trips, therefore, report the higher proportion for Thai user cases. Actually, SR services benefits both user groups in the average short distance, short or no wait time and, mainly, need no transfer.

7.2.4.2 Perceptions on SR service quality

In this study, the Japanese users show higher overall satisfaction when comparing to Thai users. It is consistent with Tombs *et al.* (2014)'s findings that Japanese is in the culture cluster which appeared to mask their dissatisfaction of the service with positive facial expressions such as a smile. However, the comparative analysis in this study points out the shared value that both Thai and Japanese SR users highly expect from using SR service, and this involves 'Frequency', 'Route coverage', 'Operating time', 'Travel time' and 'Wait time'. Interestingly, these 'Reliability' aspects are, indeed, major strengths of SR services. It is obvious that 'Shelters at stops' and 'Sufficient time to board-alight' are not necessary for both user groups. The results show that these are quality-added aspects which come second after main service factors. Weiermair and Fuchs (2000) confirmed that punctuality of travel is the globally shared valued and standards of transport services which is important to all tourists. In respect to cross-cultural comparison of bus service reliability (Loyola *et al.*, 2019), users from all three different countries considered that being on-time was very important.

Findings from this research show that, from Japanese perspectives, 'Travel time' is the most significant aspect standing out in the Reliability group. Also, 'Road accident' and 'Driver politeness' rank higher in the importance rating when compared to Thai users who, in contrast, pay much attention to 'In-vehicle environment', 'Comfort and Convenience'. Previous studies are in line with this research. Many Japanese have little free time and this points to the importance of certain time-saving products and services (Synodinos, 2001); therefore, they are time conscious and punctual (Reisinger, 2009). Promptness is service aspect Japanese people considered the most important (Seo, 2012; Winsted, 1999). Along with that, security is always a concern for Japanese (Dace, 1995) as revealed in the high importance of 'Road accident' in this study. Service providers in Japan think of customer as king (Fojt, 1995; Seo, 2012). Thus, customers are always treated with extreme courtesy, patience and respect (Dace, 1995; Fojt, 1995; Synodinos, 2001). Moreover, their culture puts emphasis on politeness to one another. They are used to these service philosophies and they expected the same treatment when travelling abroad (Seo, 2012).

From observations, 'Fare' aspect is less satisfied to the Thai than Japanese users. This may be due to the fact that SR fare is more expensive than other means of public transport services, such as buses and motorcycle taxi. As a consequence for Thai users, the fares account for higher percentage of monthly income when comparing to the Japanese. Contrarily, Japanese's high uncertainty avoidance (Hofstede, 1980) and risk aversion characteristics resulted in the more likely to pay a higher price because of its assured level of quality and subsequent service. This does not imply that price is unimportant; rather, there are other factors which are more important to them (Synodinos, 2001).

7.2.4.3 Implications on service improvement priorities for domestic and international SR users

This study provides useful insights and guidelines for transportation planners to improve SR operations to be attractive to both domestic and international users, specifically in locations which depend on tourists. Firstly, SR service providers should maintain and promote the strengths on reliability aspects. Findings suggest that shelter, board-alight, and information provision aspects are, in fact, not very special. The increase in these attributes would result in very small perceived benefits. Additionally, the development of strategies to increase SR users' satisfaction, especially for Thai users, should consider in-vehicle environment aspects, involving on-board experience such as cleanliness, seat condition, ease to move and protection from elements.

Moreover, road accidents and driver politeness are the main priorities in improving SR performance, and therefore should be primarily acted on. The need for polite and courteous drivers would encompass good customer service (Burkhardt, 2003). Also, service providers should understand heterogeneity of preferences in each culture and be trained to deliver appropriate services in intercultural situations. For instance, providing foreign language skills to encourage efficient communication would be helpful tools to assist foreign customers in optimizing their experience with overall service quality. Besides, emphasizing road safety in driving behavior would increase satisfaction, particularly, of Japanese users.

7.3 Sustainability of SR services

This study further analyzes the sustainability of SR travel mode by considering the social, economic and environmental dimensions. Affordability benchmarking is arbitrary. For developing economies, the transportation threshold is generally 15–20 percent of household income (Estache *et al.*, 2018). In Thailand the average travel cost account for 9.4% of household income (NSO, 2017). For SR as the main mode, this study reveals affordability 3% for upper income and 14% for lower income groups. However results of SR as the access mode show that affordability of the upper income is 9% whereas 47% is reported for the lower counterparts, which highly exceed the affordability threshold mentioned in literatures. It is found that lower income group devoted higher percentages of income on and, therefore, is less affordable to travel costs when compared with the upper income category.

Results also illustrated in the same direction with previous studies. An evidence in Mumbai reported that poorest respondents spend almost 15% of their income on public transport while the highest income category spend less than 10% of their income on transport (Baker *et al.*, 2005). A study in Brazil revealed the similar trend that the lowest income group accounts for more than 30% their income while only 7% are reported in the highest income group (Barone & Rebelo, 2003). In additions, the

national survey on household expenditure and income in Uruguay (Hernandez, 2017) found that, on expenditure of public transport, the poorest households spent higher proportion of their income when comparing to the upper income group. In contrast, for private transport expenditure, the wealthier households spend higher proportion of their income on this category than the lower income households. It is important to note that lower affordability level in lower income users in this study revealed the social inequity in terms of accessibility to occupation, education, social activities as well as health services, and therefore seems to influence social well-beings and livability.

For reliability aspects, findings from this research report that lower income group seem to have time constraints as they show less percentage satisfied with time-related attributes which include frequency, travel time and wait time. Previous study on perceptions of the quality of Mumbai bus service were rated on a three-point scale, corresponding to Positive, Neutral and Negative and the result showed that the lowest income group reported 62% positive on reliability attribute whereas 67% positive was revealed in the highest income respondents (Baker *et al.*, 2005).

This research showed that for comfort and convenience aspects, the satisfied elderly (aged 60+) SR users account for lower proportions when compared to the non-elderly group (aged 14-59). These are attributes covering seat availability and comfort, benches and shelters, boarding and alighting, and convenience of transfers. This may be due to informality of vehicle structures and facilities. The similar trend was revealed in Sweden which the elderly (aged 58-94) experience difficulties with long distances to bus stops, stairs and level-differences at interchanges (Berg & Levin, 2011). The study in Nigeria found that 46% of transport constrains for elderly were relating to boarding problems and inappropriate vehicle conditions (Olawole & Aloba, 2014), such as absence of low floor buses (Wixey *et al.*, 2005). Nonetheless, diverse results are revealed in bus services in Malta (Bajada *et al.*, 2016). They reported that elderly bus users appreciate comfort and also rated positively accessibility in terms of low-floor buses, which is convenient for elderly persons. This notes the differences from the present study and can be explained that public transport vehicle design may be varied across modes and countries.

Social and economic dimensions tend to overlap (Karjalainen & Juhola, 2019), for instance, affordability in this study. In social perspective, affordability are analyzed in terms of transport equity among lower and upper income group while in economic views, affordability on the basis of proportion of income devoted to commute travel time are estimated among each transport mode.

Based on the current SR users, findings in this research point out that all of their alternative modes are less affordable in terms of proportion of travel cost by their daily income and require more commuting travel time than using SR service. The only exception

is noted for affordability and travel time of songteaw and travel time of motorcycle which appear to be more desirable than SR services. Evidences here are therefore understandable since affordability and commute travel time are possibly the main aspects that these users benefit from. These could be the reasons they choose to travel by SR.

It is generally accepted that all forms of public transport are more sustainable than private transport, although there is much debate over these relative efficiencies as they are dependent on the assumptions made on occupancy levels, whether the vehicles operate at given levels of efficiency, the speed of vehicle and types of externalities (Banister, 2003). In general principles, per capita energy consumption rates of taxis appear to be higher than cars, motorcycles, and buses, respectively (Banister, 2003). Also, the study results on per capita energy consumption depict in the same way as the previous one.

Emission rates in this study demonstrate similar trends with previous research conducted in Thailand (Nilrit *et al.*, 2017) which the average CO_2 emissions of passenger cars reported 183.7$\pm$43.1 gCO_2/km and of buses are reported 577.3$\pm$91.6 gCO_2/km. Also, the estimates of per capita CO_2 emissions by private and public transport modes (Smith & Serras, 2012) presented that London taxis demonstrated higher emissions than car drivers, motorbikes and London buses, respectively. Previous research in China (Liu *et al.*, 2015) revealed that CO_2 emissions of car are higher than taxi and buses, respectively, while in this present study taxis show higher emission rates than cars. This may be due to the diverse assumption in fuel type and vehicle occupancy applied in the calculations as well as vehicle energy efficiency factors in different national contexts.

To summarize, this study points out advantages and challenges in terms of sustainability of SR services as one of public transportation modes in Bangkok. SR users benefit from affordability and commute travel time since the services are more affordable than bus, private car, motorcycle, and taxi, with shorter time than taxi, bus and private car. Per capita energy consumption and CO_2 emission when travelling by SR are more desirable than travelling by motorcycle, private car and taxi. However social inequity are revealed in affordability and reliability aspects for the lower income users who although need to pay higher proportions of their income on travel expenses, less percentages are satisfied with the services. Transport inequity among age groups are also found as the elderly illustrate less percentages satisfied with comfort and convenience of the service. It is obvious that using SR mode is an affordable way of travelling in Bangkok with desirable commute travel time, less energy consumption and emissions. More attentions however are required on provisions of affordable, reliable, comfort and convenience services to users in all socioeconomic categories.

7.4 Policy recommendations

All in all, this study has investigated the SR services in various dimensions covering both supply, demand sides and regulators while further explore the sustainability of the services. It is interesting to note that SR services serve as a vital mobility option in Bangkok currently. The challenge for now is to find ways of promoting the advantages and mitigating difficulties in its services. Table 73 presents the key issues and inter-linkage to stakeholders together with policy consideration. These policy consideration based on results from supply, demand, regulators and sustainability dimensions can be adopted by transport authorities and relevant sectors, and therefore offer rooms for service to be improved and be harmonized with urban transport network in Bangkok.

Table 73 Key issues and policy consideration for SR service development

Key issues		**Stakeholders**			
		Driver	**SR users**	**PT operators**	**Community**
Excessive work hour (6-7 days/week; 10-15 hours/day)	- Mental and physical health deterioration, e.g. risk of illness, stress	●●			
	- Risks of road accidents from health deterioration	●●	●●	●	
	- When work hours are not controlled and revenues are based on ridership, drivers sometimes fight for passengers at bus stop or terminals. Consequently, the driving becomes aggressive and dangerous, causing accidents.	●●	●	●●	●
	Policy consideration - Propose policies and regulations on work hour restriction				
Wrong registration of vehicles and drivers without permit are allow to operate and remain unchecked (26% vehicles registered as private vehicle; 46% drivers hold private driving license)	- Possibly the increasing number of unregistered SR vehicles and drivers will lead to excessive SR on the road, resulting in unnecessary congestion and vehicle overcrowding at terminals.			●	●
	- Drivers without permits may cause safety problems such as lack of driving skill training, using vehicles inappropriately for high loadings, poor vehicle maintenance, not able to save and secure passengers in case of accidents and crimes.	●●	●●		●

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
	Policy consideration - Requirements set up to ensure all drivers participate in the training courses, e.g. on practical training, customer cares. - Include technology to assist in operator registration and licensing - Regulations for registration to govern the operation. For example of informal transport sector in Jamaica, to become registered, operators must have the minimum insurance requirements and receive certificates of fitness (Anderson, 1987). - Strengthen inspection and monitoring program on site regarding vehicle registration and driving permits. - Provide sufficient resources to monitor activities in the field, e.g. trained officers, smart technologies. - Monitoring and enforcement programs by adopting color schemes and logos to identify legally sanctioned operators. As a case in the Philippines, system of colors and licensing numbers were used to formalize illegal services (Kirby *et al.*, 1986).				
Unstandardized vehicle condition	- Unsafe condition may pose high risk of accidents. - Lack of comfort in terms of cabin environment and seat capacity may push users to other transport modes - Environmental pollution from the old vehicles and unstandardized engines.	●●	●● ●●	●	● ●●
	Policy consideration - Regulate the minimum standard of service vehicles based on approval and prohibition of vehicles, e.g. good appearance of vehicle, safety standard, less-polluted or fuel-efficient engine type. - Replace or upgrade SR vehicle by applying advanced technologies. For example, informal transport mode with electric-powered mobility are Safa Tempos in Nepal, EV taxi in Laos, e-trikes and E-jeepneys in the Philippines, and solar-powered tuktuk in Cambodia and Thailand (Dijk *et al.*, 2013).				

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
Routes overlap with other modes	- Competition for passengers and confrontation among public transport mode.	●●	●	●●	●
	- Fighting for passengers at bus stops or terminals may cause dangerous driving behavior, annoyance, and safety problems	●●	●	●●	●
	Policy consideration - Inspect current operation of SR routes in each zone in order to set up the operation rules. As an example in Jeepney in the Philippines, at least 75% of the service route should not overlap with public transport route on the existing road, - Consider route allocation to serve as feeder services to the formal mode so all public transport modes would complement each other.				
Inappropriate/inadequate parking space	- Drivers park in unauthorized area, e.g. bus stops, pedestrian crossings, intersection, which obstructs traffic flow, causing congestion, chaos and sometimes they were caught, wheel cramped or fined by police officers	●●		●	●●
	- If parking space is full, drivers keep driving around in the area causing unnecessary pollution and congestion.	●			●●
	- Poor working condition, e.g. no shelter, no benches, no restroom, causing stress and health issues. Sometimes drivers have to sit in the vehicle while waiting for passengers.	●●	●		
	Policy consideration - Consider space allocation along major streets for drivers to stop or park vehicle properly outside traffic lanes. - Support facilities in parking and waiting area to provide comfort and convenience to both drivers and users of SR services as well as assist intermodal transfer. - Set up more effective policies and regulations to manage drivers, e.g. on-street parking regulation				

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
SR are allowed to pick up and drop off passengers at any points	- Drivers make sudden turn, stop carelessly and incautiously to pick up and drop off passengers at all points along the street causing high risks of accident, e.g. crashed into other vehicle, pedestrians, or crashed by vehicles behind.	●●	●	●●	●
	- Passengers request to get off in the middle of traffic lanes or in traffic congestions. Some passengers need to wait for changes after they get off which obstruct and delay traffic flow, causing traffic chaos.			●	●●
	- Drivers sometimes pick up, drop off, or wait for passengers at bus stops which may lead to confrontation among public transport operators, e.g. bus, motorcycle taxi.	●●	●	●●	●
	Policy consideration - Consider space allocation along major streets for drivers to stop or park vehicle properly outside traffic lanes while also limit the number of stopping points along the street.				
Self-regulations	- Parking regulations indicate the limited numbers of vehicles allowed at terminal due to the limited space. When parking is full, drivers keep driving around in the area causing unnecessary pollution and congestion.	●●			●●
	- Variations of route pattern and fare structure are found. Some operate in fixed route with flat fare, while some are non-fixed route with differentiate fare regarding the distance, time, and sometimes based on negotiations with drivers. There is no standard control on these aspects which may bring about overlapping routes or unreasonable fare.		●●	●	
	- Route deviations are found in response to passenger demand sometimes overlap with other public transport modes. This leads to traffic chaos, competition and possible confrontation among transport modes.			●●	

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
	Policy consideration - Support parking space, inspect and revise existing SR route alignment to avoid overlapping route and assure adequate distribution of services. - Propose formal control on parking regulations at terminals, route area coverage, and reasonable fare standard.				
40% are access trips that need transfer and bring users to the larger scale transport modes	- Transfer nodes are not well-equipped with facilities may be inconvenience for users. This may push users to use private vehicles or other public transport modes instead.	●	●●		
	Policy consideration - Consider to build necessary facilities at transfer terminals, e.g. shelter, benches, access sidewalk, corridors, in order to assist passengers in term of convenient and safe access. - Coordination among relevant public transport operators with emphasis on integrating SR into large-scale transport mode so as to encourage the use of public transport mode for connecting trips. SR would be more attractive among commuters.				
Top reasons for using SR are convenient, accessible and cheap fare	- SR services provide convenience, accessibility and cheap fare which are the main reasons of use that were stated by SR users. These aspects seem to be advantages that users benefit from using SR services		●●		●
	Policy consideration - Operators should keep these aspects at certain level as to retain existing demand as well as attract potential demand.				
Reliability, connection and transfer, seat availability and fare are perceived to be of high importance and high satisfaction	- The strengths of SR services are the reliability, connection and transfer, seat availability and fare. These are perceived to be high satisfied as SR users expected.		●●		●
	Policy consideration - Operators should keep up with these dimensions so as to satisfy current users and may attract potential demand.				

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
Safety and security are perceived to be of high importance but less satisfied by users	- Safety and security issues may be associated with vehicle conditions, competition, or driving behavior. Problems not only happen due to accident or over competition but also lack of driver trainings and knowledge on technical and services skills.	●●	●●	●	●
	- Poor quality of service can lead to lower level of user satisfaction and may reduce the ridership.	●●	●		
	Policy consideration - Propose inspection and monitoring program on SR vehicle conditions. - Set up minimum requirements for SR drivers and include safety and security skills in driver training programs. - Increase coordination of service by intervention of relevant sectors such as improving security at SR stations, interchanges, waiting area.				
Top reasons for not using SR are associated with transfer, connections and crowdedness	- Improving service performance relating to transfer, connections, and crowdedness aspects may increase SR ridership.	●●	●●		●
	Policy consideration - Formulate regulations to manage the operations by controlling vehicle standards including in-vehicle environment and seat arrangement. - Provide supports on facilities for seamless transfers, convenience in connections.				
Variations in user needs are found among different user backgrounds, trip patterns, and cultures	- Heterogeneous perceptions on SR service quality are revealed among users of different socioeconomic backgrounds, travel behavior and cultures. Some service attributes are higher, while some are lower, expected from one user segment than the other.		●●		
	- Improvement in service performance that can satisfy current users would contribute to higher satisfaction. They tend to further support the service and demand would likely to increase.	●	●●		●

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
	Policy consideration - Propose monitoring program to investigate users' socioeconomic profile, trip data, and perceptions in each service area in order to identify are of improvement to meet the needs as well as satisfy different user segments.				
Travelling by SR are more affordable with shorter commute time, more environmental-friendly than several alternative modes	- SR services are more affordable than bus, motorcycle taxi, and private car. Shorter commute travel times are revealed in SR when compared to bus, taxi and private car. Additionally, per capita energy consumption and emissions are more desirable than travelling by motorcycle, taxi and private car.		●●		●●
	Policy consideration - Government and relevant authorities should provide supports to encourage the use of SR services with rules and regulations for appropriate control on operators and policies to benefit users. - Monitoring program should be set up in inspection schedules and included in the transportation planning in order to identify areas of improvement to maintain the performance and sustain user satisfactions.				
Transport equity in affordability and service quality	- Lower income users are less affordable to service. They devoted higher proportion of income to travel costs while lower percentages are satisfied with reliability aspects of the service when compared to the upper income group. - For the elderly, lower percentage satisfied with comfort and convenience which may be due to the informality of vehicle structures and facilities.		●● ●●		
	Policy consideration - Inspect current fare structure to be appropriate and affordable to users of all groups. The unaffordable transport may limit their accessibility and mobility, and further impact their quality of life and livability.				

Note: ●● Very important
● Important

Key issues		Stakeholders			
		Driver	SR users	PT operators	Community
	- Consider allocation of service routes that are accessible to all groups of users, especially to those in areas where public transport are limited and those need to access the main modes. The routes should cover the widely distributed demands so that reliable services are provided equally in all area. - Regulate the service by strategies based on approval and prohibition of vehicle conditions to assure the accessibility standards, especially for user comfort and convenience.				
This research confirms the significance of SR as both the main travel mode and access mode	- Reliability aspects, connection and transfer, seat availability and fare are evaluated as of high importance and high satisfaction from users' point of view.		●●		●
	Policy consideration - These aspects should be maintained. - Policy makers should consider the way to include SR in the urban transport system to be harmonized with existing system. - Focus group among relevant stakeholders from operators, regulators and government sectors should be conducted to discuss the mitigations measures in order to solve difficulties towards a more efficient service.				

Note: ●● Very important
● Important

CHAPTER VIII
CONCLUSION

8.1 Silor service development: Current situation and the way forward

This dissertation investigated service characteristics of SR services and explored users' travel behavior and attitudes to identify factors affecting the use and non-use of the service, determine service delivery gaps and finally propose policy recommendations to enhance Silor performance improvement.

8.1.1 Current situation

This study confirms the function of informal transport sector as a complimentary of formal transportation. SR services assist the mobility for all socioeconomic groups as the main travel mode and access modes to transit lines. SR services are used as either principal mode or for the first and last segment of the trips in combination with other transport mode, specifically the formal ones as BTS, MRT and buses. This flexible means of transport can replace walking in any segment of the trips, and therefore, improve accessibility and provide opportunities for people, particularly those who do not have household car available to use, to get access to other transport modes of which the service routes do not pass nearby their home, workplace, etc.

SR services have the ability to satisfy their users because of their reliability, connection and transfer, seat availability and fare, especially for trips that are not covered by other public transport modes, for instance, short door-to-door trips in narrow road network and for access as well as egress trips in zones with poor transport services. Based on demand-side perspectives, main reasons for using SR comprise of convenience, accessibility and cheap fare. The quality of service can be improved in safety and security aspects to satisfy the current users. To encourage the use of SR, the service must be attractive not only for the current users but also potential users. To be attractive, the service must provide comfort in reducing crowdedness, transfer facilities, and implement seamless transfer for those who need to travel more than one transport mode.

This research also provides the insights into the difficulties and opportunities associated with SR services in Bangkok. Results on supply side found excessive work hour, inappropriate work condition, wrong vehicle registration, experiences when called by police, and challenges such as competition among transport modes. Stress and unsafe issues have wide impact on service operations and illegal operators still remain. Opinions and concerns mentioned in this study are, perhaps, worth considering when planning for policy implementation since these are revealed from the real experiences of the service providers' points of view.

Results illustrate significant degree of interactions between the four service factors and overall satisfaction, indicating that SR customers consider these issues when evaluating their perceived service quality. From route-based perspective, 'reliability' seems to be the key factor that travelers in both routes concerned with. Interestingly, the 'in-vehicle environment' is the main issue only for customers of West BKK route while 'comfort and convenience' as well as 'environmental impact' are the significant aspects only for users of East BKK route. In fact, the more satisfaction level on these service factors, the higher the overall satisfaction was found. However, the exception is revealed in the case of environment attitude where the effect was inversed. In other words, the less users perceived the environmental impact, the more they are satisfied with the overall service quality. To summarize, reliability, in-vehicle environment, comfort and convenience, and environmental impact represent useful indicators of customer satisfaction. In developing policies and strategies to maintain SR ridership, the government and transport authorities should prioritize the aspects of each route to best serve the user needs.

From system-based viewpoint, the result illustrated that segmentation approach was practical in capturing the heterogeneity among SR users. The four user subgroups with different features provide the understanding of how different socioeconomic and trip characteristics and attitudes are interrelated. Younger riders seem to be more satisfied with quality of SR service, while the older prefer the service with comfort and convenience. Additionally, people in the higher economic strata and education level pay attention to environmental issues. Some have particular desires when travelling in different circumstances. Long distance travellers with no transfer pay much attention to reliability, whereas commuters travelling for a long duration desire for better in-vehicle environment. The segmentation approach in this study can be applied by local authorities to identify SR user subgroups in Bangkok. Thus, policies can be developed regarding the specific features of SR subgroups. This study provides foundations for decision makers to act on the transport service quality in order to deliver a better transport service to commuters.

In Sukhumvit area, SR services serve mobility to Thai and Japanese users in the neighborhood with the benefits in the short travel time and no transfer. Shopping appears to be the most common needs driving its utilization. In fact, SR Reliability is the aspect to be maintained whereas in-vehicle environment, road safety and customer services might make the operation more satisfied. This study finds considerable variations in Thai and Japanese evaluation of service quality aspects, providing evidences that national cultures influence the way users perceive the service. Thus service providers need to understand cultural values and prioritize the main quality to maximize satisfaction of users from different cultures. Importantly, the combined evidence suggests that for the future development plan, particularly in service area with multi-cultural environments, the cultural values should be taken into account.

Satisfied transport services would contribute to not only the sustainable mobility, but also effective tourism development in the city.

In sustainability dimensions, SR services are one of the sustainable travel options in Bangkok. Travelling by SR consumes less time, more affordable, and more desirable in terms of energy consumption and emissions when compared with alternative modes. However there are still social inequity among age groups and income groups observed from perception on reliability, comfort and convenience aspects.

8.1.2 Policy recommendations

This research has summarized key issues and linkage to the influences on stakeholders involving drivers, users, public transport operators, and community. Most feasible options for future policy suggest transport authorities and relevant sectors in formalization and integration of SR service into urban transportation system.

Five SR routes in this study operate in area with their own unique characteristics. BT, ST and CK routes, in some parts, are on the main roads while VR and SV routes operate mainly in sois. Their operational characteristics are diverse in terms of service patterns, service lengths and fare rates as presented in Table 20 (Chapter 3). Table 74 prioritizes policy considerations for applications to cases of SR routes. In the first priority, the study suggests incorporations on vehicle standard, registration, parking and stopping locations, and on-street parking. For the second priority level, policy considerations include overlap routes, facilities, trainings, work hours, and satisfaction evaluations.

Table 74 Policy priorities

Policy priorities	**Applicable to**
First priority	
• Vehicle structure and standard e.g. seat arrangement	BT, ST, CK
• Vehicle registration system, i.e. color scheme, logos, licensing number	VR, SV
• Space allocations for parking area and terminals	VR, SV
• Space allocations for stopping points	BT, ST, CK
• Enforcement to manage on-street parking	All
Second priority	
• Minimum allowance of overlap distance with other modes i.e. bus services	BT, ST, CK
• Facilities at terminals, wait area e.g. shelters and benches	All
• Coordination among authorities to provide transfer facilities to include SR in the system	All
• Training program for drivers on safety driving, technical skills and customer cares	All
• Regulations on driver work hours	All
• Customer satisfaction survey to identify potential areas for improvement for user segments	All

Note: BT = Bangbon-Taladplu route; ST = Siriraj-Taladplu route; CK = Charan-Klongsan route; VR = Vibhavadi-Ratchada route; SV = Sukhumvit Soi 39 route

In order to efficiently integrate SR service into urban transportation system in Bangkok, coordination among relevant parties and transport authorities are necessary in all process from policy planning, implementation, construction, monitoring

program to evaluation of the projects. SR as feeder route network should be included in urban transport master plan to provide seamless operations among transport modes. All stakeholders, e.g. drivers, regulators, and users, should be involved in public participations activities in all stages as to discuss the needs as well as concerns from all perspectives. Thus the operation would provide convenience, seamless transfer and connections among transport modes, for example, in terms of station locations, transfer facilities, and universal passes.

There are still opportunities for SR services in Bangkok to improve the service quality in order to maintain ridership as well as to attract potential users. The proposed policies would not only provide the society with high quality of public transport services in response to the rising travel demand, but also encourage the use of SR as an efficient alternative for a more sustainable means of travelling.

8.2 Research contributions

The contributions of this research are firstly, new knowledge on SR services quality factors, strengths, weaknesses, and area of improvements. Second, the study contributes to empirical evidence on current sustainability of SR services to apply in policy directions and practices for SR improvement. Thirdly, research findings contribute to insights on user overall satisfaction relationship to attribute performance and finally, better understanding on challenges from operators, regulators, and diverse perceptions from different user segments.

8.3 Limitations and future study

Limitations should be noted in this study. As there exist various forms of SR services in Bangkok in terms of operational characteristics, seat capacity and fare structure. The SR services in this study are only the five routes selected from 143 routes operating in Bangkok. Therefore, findings from the present study is considered empirical and might not be generalized for all SR users in all service routes in Bangkok due to heterogeneous backgrounds, travel behavior and perceptions.

This suggests that future work on SR services should look deeper into the field. Travel behavior and attitudes of individual social groups should be investigated, for instance, comparative study of behavior and attitudes among gender, age and income groups. It is essential to explore the impact of socioeconomic variables on travel behavior in order to identify areas of improvement, problems and gaps in the service provisions. This will assist policy makers in designing applicable, implementable and successful initiatives to maintain the current users and attract potential users. Additionally, application of other analytical tools such as choice modeling would contribute to novel dimensions on service quality aspects practical for the development of SR services and Bangkok transportation system as a whole.

REFERENCES

Ahmed, Z. U., & Krohn, F. B. (1992). Understanding the unique consumer behavior of Japanese tourists. *J Travel Tour Mark, 1*(3), 73-86.

Anable, J. (2005). 'Complacent car addicts' or 'aspiring environmentalists'? Identifying travel behavior segments using attitude theory. *Transport Policy, 12*, 65-78.

Anderson, P. (1987). Mini Bus Ride: A Journey through the Informal Sector of Kingston's Mass Transportation System. *Institute of Social and Economic Research.*

Antoniou, C., & Tyrinopoulos, Y. (2013). Factors affecting public transport use in touristic areas. *International Journal of Transportation, 1*(1), 91-112.

Ayichew, F. K. (2014). Informal transport and its effects in the developing world: a case study of Addis Ababa, Ethiopia. *Journal of Transport Literature, 8*(2), 113-133.

Bajada, T., Mifsud, D., & Di Ciommo, F. (2016). Accessibility as an indicator of transport equity: the case of public transport infrastructure in Malta, and its impact on the elderly. *Journal of the Malta Chamber of Scientists, 7*, 72-81.

Baker, J., Basu, R., Cropper, M., Lall, S., & Takeuchi, A. (2005). Urban poverty and transport: The case of Mumbai. *World Bank Policy Research Working Paper, 3693* (September 2005).

Bakti, I., & Sumaedi, S. (2015). P-TRANSQUAL: A service quality model of public land transport services. *International Journal of Quality and Reliability Management, 32*, 534-558.

Balcombe, R., Mackett, R., Paulley, N., Preston, J., Shires, J., Titheridge, H., . . . White, P. (2004). *The demand for public transport: a practical guide*

Banister, D. (2003). Sustainable transport and public policy. In T. J. Kim (Ed.), *Transportation Engineering and Planning*. Oxford: EOLSS Publishers Co. Ltd.

Barone, M., & Rebelo, J. (2003). Potential impact of Metro's Line 4 on poverty in Sau Paulo metropolitan region. from World Bank https://pdfs.semanticscholar.org/5f98/648f4aff621c128722d52f4d5163e03e50cd.pdf

Beimborn, E., Greenwald, M., & Jin, X. (2003). Accessibility, Connectivity, and Captivity: Impacts on Transit Choice. *Transportation Research Record, 1835*(1), 1-9.

Berg, J., & Levin, L. (2011). Older people's everyday travel – Choice of travel mode and experience of public transport. *VTI rapport, 734*.

BMA. (2015). Demographic record and area of districts in Bangkok 2015. Retrieved 20 November 2017, from Strategy and Evaluation Department, Bangkok Metropolitan Administration http://www.bangkokgis.com/gis_information/population/

BMA. (2018). *Population and Housing Statistics*. http://www.bangkokgis.com/gis_information/population/

Boschmann, E. E., & Kwan, M. P. (2008). Toward socially sustainable urban transportation: Progress and potentials. *International Journal of Sustainable Transport, 2*, 138-157.

Budiono, O. A. (2009). *Customer satisfaction in public bus transport: a study of travellers' perception in Indonesia.* (Master's Thesis), Karlstad University, Retrieved from http://www.diva-portal.org/smash/get/diva2:232419/fulltext01.pdf

Burkhardt, J. (2003). Critical measures of transit service quality in the eyes of older travelers. *TRB Journal, 1835*(1), 84-92.

Cantwell, M., Caulfield, B., & O'Mahony, M. (2009). Examining the factors that impact public transport commuting satisfaction. *J Public Trans, 12*(2), 1-21.

Cascajo, R., Diaz Olvera, L., Monzon, A., Plat, D., & Ray, J. B. (2018). Impacts of the economic crisis on household transport expenditure and public transport policy: Evidence of the Spanish case. *Transport Policy, 65*, 40-50.

Cervero, R. (1991). Paratransit in Southeast Asia: A Market Response to Poor Roads? *Review of Urban & Regional Development Studies, 3*(1), 3-27. doi:10.1111/j.1467-940X.1991.tb00076.x

Cervero, R. (2000). *Informal Transport in the Developing World*. https://www.accessmagazine.org/wp-content/uploads/sites/7/2016/07/access18-03-informal-transit-learning-from-the-developing-world.pdf

Cervero, R., & Golub, A. (2007). Informal Transport: a global perspective. *Transport Policy, 14*, 445-457.

Chiu Chuen, O., Karim, M. R., & Yusoff, S. (2014). Mode choice between private and public transport in Klang Valley, Malaysia. *The Scientific World Journal*. doi:10.1155/2014/394587

Choocharukul, K., & Sriroongvikrai, K. (2011). Service characteristics of informal public transport: A case of Bangkok's small-sized converted pickup trucks. *Proceedings of the Eastern Asian Society for Transportation Studies, 8*.

Cihat, P. (2012). The Demand Determinants for Urban Public Transport Services: A Review of the Literature. *Journal of Applied Sciences, 12*(12), 1211-1231.

Cleland, F., & Thompson, B. (2000). *Transit Customer Satisfaction Index*. http://jwww.dot.state.fl.usjresearchcenter/Completed_Proj/SummaryPTO/FOOTBC13710_rpt.pdf

Coffel, K., Parks, J., Semler, C., Ryus, P., Sampson, D., Kachadoorian, C., & Schofer, J. L. (2012). *Guidelines for Providing Access to Public Transportation Stations*. https://nacto.org/wp-content/uploads/2016/04/1-4_Coffell-et-al_Guidelines-for-Providing-Access-to-Public-Transportation-Stations_TCRP-153_2012.pdf

Comrey, A. L., & Lee, H. B. (1992). *A First Course in Factor Analysis*. New Jersey: Lawrence Erlbaum Associates, Inc.

Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: Four recommendations for getting the most from your analysis. *Pract Assess Res Eval, 10*(7), 1-9.

Cote, J. D. R., & Diana, M. (2017). Exploring the benefits of a traveller clustering approach based on multimodality attitudes and behaviours. *Transportation Research Procedia, 25*, 2552-2565. doi:10.1016/j.trpro.2017.05.295

Dace, R. (1995). Japanese Tourism: How a knowledge of Japanese buyer behavior and culture can be of assistance to British Hotelier in seeking to develop this valuable market. *J Vact Mark, 1*(3), 281-288.

Daher, N., Yasmin, F., Wang, M., Moradi, E., & Rouhani, O. (2018). Perceptions, Preferences, and Behavior Regarding Energy and Environmental Costs: The Case of Montreal Transport Users. *Sustainability, 10*(2).

DEDE. (2016). *Energy Content of Fuel in Thailand Energy Situation: January-November 2016 (in Thai)*

Dell'Olio, L., Ibeas, A., & Cecin, P. (2011). The quality of service desired by public transport users. *Transport Policy, 18*(1), 217-227.

Di Ciommmo, F., & Lucas, K. (2014). Evaluating the equity effects of road-pricing in

the European urban context – The Madrid Metropolitan Area. *Applied Geography, 54*, 74-82.
Di Ciommo, F., & Shiftan, Y. (2017). Transport equity analysis. *Transport Reviews, 37*(2), 139-151.
Diaz Olvera, L., Plat, D., Pochet, P., & Sahabana, M. (2012). Motorbike taxis in the "transport crisis" of West and Central African cities. *EchoGeo, 20*.
Dijk, M., Orsato, R. J., & Kemp, R. (2013). The emergence of an electric mobility trajectory. *Energy Policy, 52*, 135-145.
DLT. (2018) *Silor routes and vehicles registered in Bangkok as of February 2018*.
DLT, & TRI. (2009). *Current situation of Silor-lek transport mode in Bangkok*
Dobranskyte-Niskota, A., Perujo, A., & Pregl, M. (2007). *Indicators to assess sustainability of transport activities Part 1: Review of the existing transport sustainability indicators initiatives and development of and indicator set to assess transport sustainability performance*
DOPA. (2018). *Population and Housing Statistics*. http://stat.bora.dopa.go.th/stat/statnew/statTDD/views/showProvinceData.php
Dowling, R. G., Reinke, D. B., Flannery, A., Ryus, P., Vandehey, M., Petritsch, T. A., . . . Bonneson, J. A. (2008). *NCHRP Report 616: Multimodal Level of Service Analysis for Urban Streets*. http://jonlinepubs.trb.orgjonlinepubsjnchrpjnchrp_rpt_616.pdf
Dupuy, G. (1992). *L'Urbanisme des Réseaux–Théories et méthodes*. Paris, France: Armand Colin Éditeur.
EPA. (2011). *Guide to sustainable transportation performance measures*: Environmental Protection Agency,.
ESCAP/UNCHS. (1987). *Study on the Role of Informal Paratransit in the Socio-economic Development of Urban Areas*
Estache, A., Bagnoli, L., & Bertomeu, S. (2018). Infrastructure Affordability in Developed and Developing Economies: Rules of Thumbs and Evidence. *Working Paper ECARES 2018-02, Université Libre de Bruxelles*.
Etherington, K., & Simon, D. (1996). Paratansit and Employment in Phnom Penh the Dynamics and Development Potential of Cyclo Riding. *Transport Geography, 4*(1), 37-53.
Eung, N. (2015). *Travel Behavior and Factors Influencing Frequency of Using Informal Transport and Public Bus in Urban Area of Phnom Penh.* (Master's), Chulalongkorn University,
Eung, N., & Choocharukul, K. (2018). Modeling frequency of using informal public transport and public bus: A case study in Phnom Penh, Cambodia. *Engineering Journal, 22*(3), 109-122.
Fellesson, M., & Friman, M. (2008). Perceived Satisfaction with Public Transport Service in Nine European Cities. *Journal of Transport Research Forum, 47*, 93-103.
Ferro, P. S., & Behrens, R. (2015). From direct to trunk-and-feeder public transport services in the Urban South: Territorial implications. *Journal of Transport and Land Use, 8*(1), 123-136.
Fojt, M. (1995). The kingdom of customer. *J Serv Mark, 9*(3), 40-42.
Fowzia Sultana, M. (2015). *Marketing of tourism in Kodaikanal* (Doctoral), Yadava College, India,
Gebeyehu, M., & Takano, S. (2008). Modeling the relationship between travelers' level of satisfaction and their mode choice behavior using ordinal models. *JTRF,*

47(2), 103-118.
Grujicic, D., Ivanovic, I., Jovic, J., & Dovic, V. (2014). Customer Perception of Service Quality in Public Transport. *Transport*, *29*(3), 285-295.
Gudmundsson, H., & Regmi, M. B. (2017). *Developing the sustainable urban transport index*. https://www.unescap.org/sites/default/files/bulletin87_3%20Developing%20the%20Sustainable%20Urban%20Transport%20Index_0.pdf
Habib, K. N., Kattan, L., & Islam, M. T. (2011). Model of personal attitudes towards transit service quality. *Journal of Advanced Transportation*, *45*(4), 271-285. doi:10.1002/atr.106
Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate data analysis* (4th ed.). New Jersey: Prentice-Hall Inc.
Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis*. Harlow, Essex: Pearson.
Henson, R. K., & Roberts, J. K. (2006). Use of Exploratory Factor Analysis in Published Research: Common Errors and Some Comment on Improved Practice. *Educational and Psychological Measurement, 66*(3).
Hernandez, D. (2017). Public transport, well-being and inequality: coverage and affordability in the city of Montevideo. *CEPAL Review, 122*.
Hertel, S., Keil, R., & Collens, M. (2016). *Next stop: Equity – Routes to fairer transit access in the Greater Toronto and Hamilton Area*.
Hofstede, G. (1980). *Cultural consequences*. Beverly Hills, CA: Sage.
Hu, X., Zhao, L., & Wang, W. (2015). Impact of perceptions of bus service performance on mode choice preference. *Advances in Mechanical Engineering, 7*(3).
Hull, A. (2008). Policy Integration: What will it take to achieve more sustainable transport solutions in cities? *Transport Policy, 15*, 94-103.
Jain, S., Aggarwal, P., Kumar, P., Singhal, S., & Sharma, P. (2014). Identifying public preferences using multi-criteria decision making for assessing the shift of urban commuters from private to public transport: A case study of Delhi. *Transportation Research Part F: Psychology and Behaviour, 24*, 60-70. doi:10.1016/j.trf.2014.03.007
Joewono, T. B., & Kubota, H. (2006). Transportation: Safety and Security Improvement in Public Transportation Based on Public Perception in Developing Countrie. *IATSS Research, 30*, 86-100.
Joewono, T. B., & Kubota, H. (2007). User satisfaction with paratransit in competition with motorization in Indonesia: anticipation of future implications. *Transportation, 34*(3), 337-354. doi:10.1007/s11116-007-9119-7
Joewono, T. B., Santoso, D. S., & Susilo, Y. O. (2015). Paratransit transport in Indonesia: Characteristics and user perceptions. *Journal of the Eastern Asia Society for Transportation Studies, 11*, 1346-1361.
Karjalainen, L. E., & Juhola, S. (2019). Framework for assessing public transportation sustainability in planning and policy making. *Sustainability,, 11*(4).
Kennedy, C., Miller, E., Shalaby, A., Maclean, H., & Coleman, J. (2005). The four pillars of sustainable urban transportation. *Transport Reviews, 25*(4), 393-414.
Kirby, R., Sayeg, P., & Fehon, K. (1986). Traffic management in Metro Manila: specifying traffic management measures. *Traffic Engineering and Control, 27*(6), 332-338.
Kittelson and Assoc, I., Parsons Brinckerhoff, I., KFH Group, I., Texas A&M

Transportation, I., & Arup. (2013). *Transit Capacity and Quality of Service Manual*. https://www.nap.edu/catalog/24766/transit-capacity-and-quality-of-service-manual-third-editions

Kittelson and Assoc, I., Urbitran, I., LKC Consulting Services, I., MORPACE International, I., Queensland University of Technology, & Nakanishi, Y. (2003). *TCRPReport 88: A Guidebook for Developing a Transit Performance-Measurement System*.http:IIonlinepu bs.trb.org/ onlinepubsjtcrp jtcrp_report_88 /Guidebook pdf.

Kotler, P., & Armstrong, G. (1999). *Principles of marketing*. Upper Saddle River, N.J. : Prentice Hall International.

Lave, R. E., & Mathias, R. G. (2000). State of the Art of Paratransit. *Transportation Research Board Millennium Papers, 7*.

Le-Klahn, D. T., Hall, C. M., & Gerike, R. (2014). Analysis of visitors satisfaction with public transport in Munich. *Journal of Public Transportation, 17*(3).

Lehmann, D. R., Gupta, S., & Steckel, J. H. (1998). *Marketing research*. Reading, MA Addison-Wesley.

Li, Z., Wang, W., Yang, C., & Ragland, D. R. (2013). Bicycle commuting market analysis using attitudinal market segmentation approach. *Transportation Research Part A, 47*, 56-68. doi:10.1016/j.tra.2012.10.017

Litman, T. (2007). *Well Measured: Developing indicators for comprehensive and sustainable transport planning*

Litman, T. (2016). *Well-measured: Developing Indicators for Sustainable and Livable Transport Planning*.http://www.vtpi.org/wellmeas.pdf

Litman, T. (2017). Developing indicators for comprehensive and sustainable transport planning. *Transportation Research Record*, 10-15.

Litman, T. (2019). *Well Measured: Developing indicators for sustainable and livable transport planning*.https://www.vtpi.org/wellmeas.pdf

Litman, T., & Burwell, D. (2006). Issues in sustainable transportation. *International Journal of Global Environmental Issues, 6*(4), 331-347.

Liu, Y. Y., Wang, Y. Q., An, R., & Li, C. (2015). The spatial distribution of commuting CO2 emissions and the influential factors: a case study in Xian, China. *Advances in Climate Change Research, 6*, 46-55.

Loyola, M., Y, S., Aviram, H., & Monterde-i-Bort, H. (2019). Impact of Public Transport Context Situation and Culture on Mode Choice. *Soc Sci, 8*(2).

Marquart-Pyatt, S. T. (2012). Environmental concerns in cross-national context: How do mass publics in central and eastern Europe compare with other regions of the world? *Sociol Cas, 48*(3), 641-666.

Mazzulla, G., & Eboli, L. (2006). A service quality experimental measure for public transport. *European Transport, 34*, 42-53.

MORPACE International, I., & Cambridge Systematics, I. (1999). *TCRP Report 47: A Handbook for Measuring Customer Satisfaction and Service Quality*. Washington, D.C. .

Morton, C., Caulfield, B., & Anable, J. (2016). Customer perceptions of quality of service in public transport: Evidence for bus transit in Scotland. *Case Stud Transp Policy, 4*, 199-207.

Movsesyan, G., & Zagheni, E. (2014). How do demographic factors influence environmental attitudes? *Population Association of America: 2014 Annual*

Meeting Program.
Mulley, C., & Nelson, J. D. (2009). Flexible transport service: A new market opportunity for public transport. *Research in Transportation Economics, 25*, 39-45.
Murrey, A. T., & Davis, R. (2001). Equity in Regional Service Provisions. *Journal of Regional Science, 41*, 577-600.
Murrey, A. T., Davis, R., Stimson, R. J., & Ferreira, L. (1998). Public Transportation Access. *Transportation Research Part D, 3*, 319-328.
NESDB. (2018). Situation regarding poverty and income inequality in Thailand: Regional level report. from Social Data-based and Indicator Development Office, Office of the National Economic and Social Development Council
Neuman, W. L. (2014). *Social Research Methods: Qualitative and Quantitative Approaches* (7th ed.). Essex: Pearson Education limited.
Neumann, A. (2014). *A paratransit-inspired evolutionary process for public transit network design.* (Doctoral), Technische Universität Berlin, Germany
Nilrit, S., Sampanpanish, P., & Bualert, S. (2017). Comparison of CO2 emissions from Vehicles in Thailand. *Applied Environmental Research, 39*(1), 65-74.
NSO. (2009). Indicator in poverty map. Ministry of Digital Economy and Society. Retrieved 20 November 2017, from National Statistical Office http://service.nso.go.th/nso/nsopublish/poverty/poverty.html
NSO. (2017). Report of the household socioeconomic survey: First semester of 2017. from National Statistical Office, Ministry of Digital Economy and Society
O'Mahony, M., Broderick, B., Gill, L., Ahern, A., & English, L. (2002). *Scope of Transport Impacts on the Environment (2000-DS-4-M2) Final Report*
Okamura, T., Kaneko, Y., Nakamura, F., & Wang, R. (2013). Passengers' attitudes to the service items of Jeepneys in Metro Manila by different lifestyles. *Journal of the Eastern Asia Society for Transportation Studies, 10*, 1384-1395.
Olawole, M. O., & Aloba, O. (2014). Mobility characteristics of the elderly and their associated level of satisfaction with transport services in Osogbo, Southwestern Nigeria. *Transport Policy, 35*, 105–116.
Oña, J., Oña, R. R., & López, G. (2016). Transit service quality analysis using cluster analysis and decision trees: a step forward to personalized marketing in public transportation. *Transportation, 43*(5), 725-747.
Orski, C. K. (1975). Paratransit: The Coming of Age of a Transportation Concept. *Transportation, 4*(4), 329-334.
OTP. (2016). Draft National Transportation Development Strategic Plan (20 years, 2017-2036). from Office of Transport and Traffic Policy and Planning http://www.otp.go.th/uploads/files/1476954025-s659q-a0kz3.pdf
OTP. (2018a). *Travel demand survey and good transport database system improvement for national transportation planning, Executive summary report*. http://www.otp.go.th/uploads /tiny_uploads/ProjectOTP/2560/Projcet01/2.1-TDS_Exsum_TH_Final_20180515.pdf
OTP. (2018b). *Travel survey in the Greater Bangkok area*. http://www.otp.go.th/uploads/tiny_uploads/DataStatistics/2562/25611012-SumData01.pdf
Pampel, F. C. (2000). *Logistic Regression: A Primer* (Vol. 07-132). Thousand Oaks, CA: Sage.
PCD. (2007). *Feasibility study on transforming three-wheelers (Tuktuk) engine from two-stroke engine to four-stroke engine and installing noise reduction equipment*
Phun, V. K., & Yai, T. (2016). State of the art of paratransit literatures in Asian

developing countries. *Asian Transport Studies, 4*(1), 57-77.
Pizam, A., & Sussmann, S. (1955). Does Nationality affect Tourist Behavior. *22*(4), 901-917.
Pojani, D., & Stead, D. (2015). Sustainable Urban Transport in the Developing World: Beyond Megacities. *Sustainability, 7*(6), 7784-7805 doi:10.3390/su7067784
Polat, C. (2012). The Demand Determinants for Urban Public Transport Services: A Review of the Literature. *J Applied Sci, 12*(12), 1211-1231.
Pongthanaisawan, J. (2011). *Energy demand of road transport sector and fuel/vehicle technology alternatives for greenhouse gas emissions mitigation in Thialand.* (Doctoral), King Mongkut's University of Technology Thonburi, Bangkok, Thailand,
Prado, C. F., Jiemian, Y., Hongyuan, Y., & Mohanty, C. R. (2012). Sustainable urban transport. In *Shanghai Mannual – A Guide for Sustainable Urban Development in the 21st Century* (pp. 1-36). Beijing, China: United Nations, Department of Economic and Social Affairs (UNDESA).
Pronello, C., & Camusso, C. (2011). Travellers' profiles definition using statistical multivariate analysis of attitudinal variables. *Journal of Trans Geog, 19*, 1294-1308.
Putra, A. A., Yamin, J. M., Riyanto, B., & Mulyono, A. T. (2014). The Satisfaction Analysis for the Performance of Public Transport Urban Areas. *IRJES, 3*(8), 38-44.
Rahman, F., Das, T., Hadiuzzaman, M., & Hossain, S. (2016). Perceived service quality of paratransit in developing countries: A structural equation approach. *Transp Res A, 93*, 23-38.
Reisinger, Y. (1990). *The perceptions of Australian hosts by Japanese tourists* (Master's), Victoria University of Technology, Australia,
Reisinger, Y. (2009). *International Tourism: Cultures and Behavior*. MA: Elsevier Ltd.
Rencher, A. C. (2002). *Methods of Multivariate Analysis*. Canada: A John Wiley and Sons, Inc.
Richardson, B. C. (2005). Sustainable transport analysis frameworks. *Journal of Transport Geography, 13*, 29-39.
Rodrigue, J., Comtois, C., & Slack, B. (2006). *The Geography of Transport Systems*. London: Taylor & Francis
Ryley, T. (2006). Use of non-motorized modes and life stage in Edinburgh. *Journal of Trans Geog, 14*, 367-375.
Sarkar, P. P., & Mallikarjuna, C. (2018). Effect of perception and attitudinal variables on mode choice behavior: A case study of Indian city, Agartala. *Travel Behav Soc, 12*, 108-114.
Sarstedt, M., & Mooi, E. (2014). *A Concise Guide to Market Research*. Berlin Heidelberg, Germany: Springer-Verlag.
Schiller, P. L., Bruun, E. C., & Kenworthy, J. R. (2010). *An Introduction to Sustainable Transportation: Policy, Planning and Implementation*. London, UK: Earthscan Ltd.
Seo, Y. (2012). *Cultural Impact on Customer Satisfaction and Service Quality Evaluation in Hotels.* (Master's), University of Neveda, Las Vegas,
Sharma, P., Jain, J. K., & Reddy, S. (2017). Analysis of service quality attributes for Jaipur Urban Bus Transportation. *IJET, 8*(1), 43-48.
Shimazaki, T., & Rahman, M. (1995). Operational characteristics of paratransit in developing countries of Asia. *Transportation Research Record, 1503*, 49-56.
Slack, N. (1994). The Importance-Performance Matrix as a Determinant of Improvement Priority. *International Journal of Operations & Production*

Management, 14(5), 59-75.
Smith, D. A., & Serras, J. (2012). Estimating intra-metropolitan journey-to-work CO2 emissions: a multi-modal network approach applied to the London Region 2001. *Working Papers Series, 183, UCL Center for Advanced Spatial Analysis*.
Srinivasan, S. (2008). A spatial exploration of the accessibility of low-income women: Chengdu, China and Chennai, India. In T. P. Uteng & T. Cresswell (Eds.), *Gendered Mobilities*. Ashgate: Aldershot.
Susilawati, M., & Nilakusmawati, D. P. E. (2017). Study on the factors affecting the quality of public bus transportation service in Bali Province using factor analysis. *J Phys Conf, 855*.
Synodinos, N. E. (2001). Understanding Japanese consumers: Some important underlying factors. *Jpn Psychol Res, 43*(4), 235-248.
Tabachnick, B. G., & Fidell, L. S. (2013). *Using Multivariate Statistics* (6th ed.). New Jersey: Pearson Education.
Tangphaisankun, A., Okamura, T., & Nakamura, F. (2009). Influences of paratransit as a feeder of mass transit system in developing countries based on commuter satisfaction. *Journal of the Eastern Asia Society for Transportation Studies, 8*.
Tarigan, A. K. M. (2014). Segmentation of paratransit users based on service quality and travel behavior in Bandung, Indonesia. *Transport Plan Techn, 37*(2), 200-218.
TGO. (2013). *Thailand Guidance for Quantification of Carbon Footprint for Organization (in Thai)*
Thompson, B. (2004). *Exploratory and Confirmatory Factor Analysis: Understanding Concepts and Applications*. Washington, DC: American Psychological Association.
Tombs, A. G., Russell-Bennett, R., & Ashkanasy, N. M. (2014). Recognizing emotional expressions of complaining customers: a cross-cultural study. *Eur J Mark, 48*(7), 1354-1374.
UN. (1987). *Report of the World Commission on Environment and Development: Our Common Future* https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf
UN. (2015). *Transport for sustainable development: the case of inland transport* New York: United Nation.
UNCRD. (2018). Sustainable Urban Transport Index for Asian Cities. *Intergovernmental Eleventh Regional Environmentally Sustainable Transport (EST) Forum in Asia*.
UNDESA. (2007). *Indicators of sustainable development: Guideline and Methodologies,* New York: Department of Economic and Social Affairs, United Nations.
Ustun, B., & Celep, B. (2007). The connection between environmental awareness and socio-economic and cultural structure. *WIT Trans Ecol Envir, 102*, 621-631.
Uteng, T. P. (2011). Gender and mobility in the developing world. *World Development Report 2012, Gender equity and development (Background paper)*.
Vanhanen, K., & Kurri, J. (2005). Quality factors in public transport," Transport Today and Tomorrow: Promoting sustainable transportation in Israel. *WSP Finland Ltd and Helsinki University of Technology*.
Walker, W. E., Van Grol, R., Rahman, S. A., Van de Voort, M., Rohling, W., & Burg, R. (2007). *Policy analysis of sustainable transport and mobility: The SUMMA Project*. Bingley, UK: Emerald Group Publishing Limited.
Wardman, M. (2001). A review of British evidence on time and service quality valuations. *Transportation Research Part E: Logistics and Transportation*

Review, 37, 107–128.
Wardman, M. (2004). Public transport values of time. *Transport Policy, 11*, 363-377.
Washington, S., Karlaftis, M. G., & Mannering, F. L. (2011). *Statistical and Econometric Methods for Transportation Data Analysis*. Boca Raton, FL: CRC Press.
Weiermair, K., & Fuchs, M. (2000). The impact of cultural distance on perceived service quality gaps: The case of Alpine tourism. *J Qual Assur Hospit Tourism, 1*(2), 59-76.
Wener, R., Evans, G., Phillips, D., & Nadler, N. (2003). Running for the 7:45: The effects of public transit improvements on commuter stress. *Transportation, 30*(2), 203-220.
Weng, J., Di, C., Wang, J., & Mao, L. (2018). A bus service evaluation method from passenger's perspective based on satisfaction surveys: A case study of Beijing, China. *Sustainability, 7*(2723), 1-15.
Weningtyas, W. (2013). *Optimization of Paratransit System Operation by Considering Driver's Quality of Life.* Hiroshima University,
Wicaksono, A., Lim, I., Muromachu, Y., Vergel, K. N., Choocharukul, K., Tan, V. H., & Yai, T. (2015). Road-based Urban Public Transport and Paratransit in Six Asian Countries: Legal Conditions and Intermodal Issues. *Journal of the Eastern Asia Society for Transportation Studies, 11*, 227-242. doi:10.11175/easts.11.227
Williams, B., Onsman, A., & Brown, T. (2010). Exploratory Factor Analysis: A Five-step Guide for Novices. *Journal of Emergency Primary Health Care (JEPHC), 8*(3), 1-13.
Winsted, F. K. (1999). Evaluating service encounters: A cross-cultural and cross industry exploration. *J Market Theor Pract, 7*(2), 106-123.
Wixey, S., Jones, P., Lucas, K., & Aldridge, M. (2005). User Needs Literature Review', Measuring Accessibility as Experienced by Different Socially Disadvantaged Groups. *Social Research in Transport (SORT)*.
Wongwiriya, P., Nakamura, F., Tanaka, S., & Ariyoshi, R. (2017). User satisfaction of Songtaew in Thailand: case study of Khon Kaen City. *Transport Research Procedia 25C*, 4946-4953.
Yang, L. J., Chou, T. C., & Ding, J. F. (2011). Using the Importance-Performance Analysis (IPA) approach to measure the service quality of mobile application stores in Taiwan. *AJBM, 5*(12), 4824-4834.
Yarmen, M., & Sumaedi, S. (2016). Perceived service quality of youth public transport passengers. *Transp Probl, 11*(1), 99-111.
Yilmaz, S., Yaman, S., & Alkaya, I. (2006). *The impact of socio-economic structure on environmental awareness in Kucukcekmece Basin.* (Bachelor), Yildiz Technical University. Turkey,

APPENDICES

APPENDIX A QUESTIONNAIRE

แบบสำรวจการให้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานคร

แบบสำรวจนี้เป็นส่วนหนึ่งของการทำวิทยานิพนธ์ของนิสิตบริญญาเอก หลักสูตรสิ่งแวดล้อม การพัฒนา และความยั่งยืน บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย โดยมีวัตถุประสงค์เพื่อสำรวจการให้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานคร และนำเสนอแนวทางในการปรับปรุงระบบไปสู่การพัฒนาการขนส่งอย่างยั่งยืนต่อไป โดยแบบสำรวจนี้มีทั้งหมด 3 ส่วน ได้แก่

ส่วนที่ 1 ข้อมูลการให้บริการรถสี่ล้อเล็ก

ส่วนที่ 2 ปัญหาและข้อคิดเห็นในการให้บริการ

ส่วนที่ 3 ข้อมูลส่วนบุคคล

ขอขอบคุณที่ให้ความร่วมมือในการตอบแบบสอบถามนี้ คำตอบของท่านจะเป็นไปด้วยความสมัครใจและท่านสามารถเลือกตอบได้โดยอิสระ โดยคำตอบของท่านจะถูกเก็บเป็นความลับและใช้วิเคราะห์สำหรับการศึกษาวิจัยเชิงวิชาการเท่านั้น ท่านมีสิทธิ์ที่จะไม่ตอบคำถามใด ๆ หากท่านเห็นว่าไม่เหมาะสม การให้คำตอบอย่างตรงไปตรงมาของท่านจะช่วยให้ผู้วิจัยสามารถนำผลการสำรวจไปใช้วิเคราะห์การให้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานครได้อย่างถูกต้องต่อไป

บัณฑิตวิทยาลัย
จุฬาลงกรณ์มหาวิทยาลัย

DRIVER: D - ☐☐☐

แบบสำรวจการให้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานคร

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

วันที่ ..... เวลา ..... ผู้รับผิดชอบ .....

ส่วนที่ 1: ข้อมูลการให้บริการรถสี่ล้อเล็ก

เส้นทาง ☐ บางบอน-ตลาดพลู ☐ ศิริราช-ตลาดพลู ☐ จรัญสนิทวงศ์ ซอย 13-คลองสาน
☐ วิภาวดีรังสิต ซอย 16-รัชดาภิเษก ซอย 19 ☐ สุขุมวิท ซอย 39

1. ท่านขับรถสี่ล้อเล็กรับจ้างมาเป็นเวลา ..... **ปี**
2. ส่วนใหญ่ขับรถสี่ล้อเล็กรับจ้างในช่วงเวลาใด **ตั้งแต่เวลา** ..... **ถึง** .....
3. ท่านประกอบอาชีพอื่นด้วยหรือไม่ ☐ 1) ประกอบอาชีพอื่นด้วย; **โปรดระบุ** ..... ☐ 2) ขับสี่ล้อเล็กอย่างเดียว
4. ใน 1 **วัน** ท่านมีรายได้จากการขับรถสี่ล้อเล็กรับจ้าง (**โดยไม่หักค่าใช้จ่าย**) ..... **บาท/วัน**
5. ใน 1 **สัปดาห์** ท่านขับรถสี่ล้อเล็กรับจ้างกี่วัน ..... **วัน**
6. ท่านเป็นเจ้าของรถสี่ล้อเล็กหรือไม่ ☐ 1) เป็นเจ้าของรถ; **ราคา** ..... **บาท**
☐ 2) ไม่ได้เป็นเจ้าของรถ; **ค่าเช่ารถ** ..... **บาท/วัน**
7. เชื้อเพลิงที่ใช้ ☐ 1) แอลพีจี ☐ 2) เบนซิน ☐ 3) ดีเซล
8. ค่าเชื้อเพลิง.....บาท/วัน
9. จดทะเบียนประเภท ☐ 1) รถรับจ้าง ☐ 2) รถส่วนบุคคล; เพราะ.....

ส่วนที่ 2: ปัญหาและข้อคิดเห็นในการให้บริการ

1. เคยมีปัญหากับผู้ให้บริการสี่ล้อเล็กเส้นทางเดียวกันหรือผู้ให้บริการรูปแบบอื่นหรือไม่
☐ 1) ไม่เคย ☐ 2) เคย; (1) **เรื่อง**.....
(2) **เรื่อง**.....
(3) **เรื่อง**.....
2. เคยถูกตำรวจเรียกจับหรือไม่ ☐ 1) ไม่เคย ☐ 2) เคย; (1) **เรื่อง**.....
(2) **เรื่อง**.....
(3) **เรื่อง**.....
3. ถ้ามีนโยบายจัดทำป้ายจอดรับส่งผู้โดยสาร เห็นด้วยหรือไม่ ☐1) เห็นด้วย ☐2) ไม่เห็นด้วย ☐3) ไม่แน่ใจ
และคิดว่าจะมีผลกับท่านอย่างไร.....
4. ถ้ามีนโยบายให้สี่ล้อเล็กเป็นระบบเชื่อมต่อกับระบบรถไฟฟ้าในอนาคต เห็นด้วยหรือไม่ ☐1) เห็นด้วย ☐2) ไม่เห็นด้วย ☐3) ไม่แน่ใจ
และคิดว่าจะมีผลกับท่านอย่างไร.....

ส่วนที่ 3: ข้อมูลส่วนบุคคล

1. เพศ ☐ 1) ชาย ☐ 2) หญิง
2. อายุ .....
3. ภูมิลำเนา จังหวัด .....
4. สถานภาพสมรส ☐ 1) โสด ☐ 2) สมรส
5. รายได้ที่ท่านได้รับ ท่านจะต้องดูแลรับผิดชอบกี่คน (ไม่รวมตัวเอง) ..... **คน**
6. การศึกษา ☐ 1) ประถมศึกษา ☐ 2) มัธยมศึกษา ☐ 3) ปวช. ☐ 4) ปวส. ☐ 5) มหาวิทยาลัย
7. ใบขับขี่ ☐ 1) ไม่มี ☐ 2) มี; ประเภท.....
8. การเป็นสมาชิกสหกรณ์สี่ล้อเล็ก ☐ 1) ไม่เป็นสมาชิก ☐ 2) เป็นสมาชิกสหกรณ์ (**ระบุชื่อ**) .....

ขอขอบคุณที่ให้ความร่วมมือในการตอบแบบสอบถาม

แบบสำรวจพฤติกรรมการเดินทางและทัศนคติของผู้ใช้บริการรถยนต์สี่ล้อเล็กในกรุงเทพมหานคร

แบบสำรวจนี้เป็นส่วนหนึ่งของการทำวิทยานิพนธ์ของนิสิตบริญญาเอก หลักสูตรสิ่งแวดล้อม การพัฒนา และความยั่งยืน บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย โดยมีวัตถุประสงค์เพื่อสำรวจการเดินทางและทัศนคติของผู้ใช้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานคร และนำเสนอแนวทางในการปรับปรุงระบบไปสู่การพัฒนาการขนส่งอย่างยั่งยืนต่อไป โดยแบบสำรวจนี้มีทั้งหมด 5 ส่วน ได้แก่

ส่วนที่ 1 การใช้บริการรถสี่ล้อเล็ก

ส่วนที่ 2 เหตุผลที่ใช้บริการรถสี่ล้อเล็ก

ส่วนที่ 3 ทัศนคติต่อการให้บริการขนส่งสาธารณะ

ส่วนที่ 4 รูปแบบการเดินทางอื่นๆ

ส่วนที่ 5 ข้อมูลส่วนบุคคล

ขอขอบคุณที่ให้ความร่วมมือในการตอบแบบสอบถามนี้ คำตอบของท่านจะเป็นไปด้วยความสมัครใจและท่านสามารถเลือกตอบได้โดยอิสระ โดยคำตอบของท่านจะถูกเก็บเป็นความลับและใช้วิเคราะห์สำหรับการศึกษาวิจัยเชิงวิชาการเท่านั้น ท่านมีสิทธิ์ที่จะไม่ตอบคำถามใด ๆ หากท่านเห็นว่าไม่เหมาะสม การให้คำตอบอย่างตรงไปตรงมาของท่านจะช่วยให้ผู้วิจัยสามารถนำผลการสำรวจไปใช้วิเคราะห์พฤติกรรมและทัศนคติเกี่ยวกับการใช้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานครได้อย่างถูกต้องต่อไป

บัณฑิตวิทยาลัย
จุฬาลงกรณ์มหาวิทยาลัย

USER: U -☐☐☐

แบบสำรวจพฤติกรรมการเดินทางและทัศนคติของผู้ใช้บริการรถสี่ล้อเล็กในกรุงเทพมหานคร

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

วันที่ ..... เวลา ..... ผู้รับผิดชอบ .....

ส่วนที่ 1: การใช้บริการรถสี่ล้อเล็ก

เส้นทาง ☐ บางบอน-ตลาดพลู ☐ ศิริราช-ตลาดพลู ☐ จรัญสนิทวงศ์ ซอย 13-คลองสาน
☐ วิภาวดีรังสิต ซอย 16-รัชดาภิเษก ซอย 19 ☐ สุขุมวิท ซอย 39

1. ใน 1 สัปดาห์ ท่านใช้บริการรถสี่ล้อเล็กบ่อยแค่ไหน

➔ "รถสี่ล้อเล็ก"

☐ 1) ทุกวัน ☐ 2) 4-5 วัน/สัปดาห์
☐ 3) 2-3 วัน/สัปดาห์ ☐ 4) นาน ๆ ครั้ง

2. ส่วนใหญ่ท่านใช้บริการรถสี่ล้อเล็กในช่วงเวลา**กี่โมง**
(ตอบได้มากกว่า 1 ช่วงเวลา) **เช่น 8.00, 14.30**
1) ..... 2) ..... 3) ..... 4) .....

3. โดยทั่วไป ท่านใช้บริการรถสี่ล้อเล็ก เพื่อเดินทาง

จาก (เลือกเพียง 1 ข้อ)		**ไป** (เลือกเพียง 1 ข้อ)	
	☐ 1) บ้าน ☐ 2) ที่ทำงาน ☐ 3) โรงเรียน/มหาวิทยาลัย ☐ 4) ตลาด/ห้างสรรพสินค้า ☐ 5) อื่นๆ		☐ 1) บ้าน ☐ 2) ที่ทำงาน ☐ 3) โรงเรียน/มหาวิทยาลัย ☐ 4) ตลาด/ห้างสรรพสินค้า ☐ 5) อื่นๆ .....
	ตำแหน่งที่ตั้ง.....		**ตำแหน่งที่ตั้ง**.....

4. การใช้บริการ**รถสี่ล้อเล็ก** 1 เที่ยว
มีค่าเดินทาง ..... **บาท**, ใช้เวลารอรถ ..... **นาที**, ใช้เวลาเดินทาง ..... **นาที**

5. ท่านใช้เพื่อเชื่อมต่อกับระบบขนส่งอื่นหรือไม่
☐ 1) ไม่ ☐ 2) เชื่อมต่อกับ;

เลือกเพียง 1 ข้อ		
☐ รถไฟฟ้า (สถานี.....)	☐ รถใต้ดิน (สถานี .....)	☐ เรือ (ท่าเรือ .....)
☐ รถเมล์	☐ มอเตอร์ไซค์รับจ้าง ☐ สองแถว ☐ รถสี่ล้อเล็ก ☐ ตุ๊กตุ๊ก ☐ รถตู้ ☐ รถไฟ (สถานี.....)	

6 โดยรวมท่านพอใจกับการให้บริการรถสี่ล้อเล็กเพียงใด ☐ไม่พอใจอย่างยิ่ง (1) ☐ ไม่พอใจ (2) ☐ เฉยๆ (3) ☐ พอใจ (4) ☐ พอใจอย่างยิ่ง (5)

ส่วนที่ 2: เหตุผลที่ใช้บริการรถสี่ล้อเล็ก

โปรดระบุ**เหตุผลที่ใช้**บริการรถสีล้อเล็ก
(เกณฑ์การให้คะแนน ดังนี้: 1 = **ไม่เห็นด้วยอย่างยิ่ง**, 2 = **ไม่เห็นด้วย**, 3 = **ไม่แน่ใจ**, 4 = **เห็นด้วย**, 5 = **เห็นด้วยอย่างยิ่ง**)

	ท่านใช้รถสี่ล้อเล็ก เพราะ ..... ?	1 ไม่เห็นด้วยอย่างยิ่ง ➔ เห็นด้วยอย่างยิ่ง 5				
1	รถสี่ล้อเล็กใช้สะดวก มีให้บริการในพื้นที่	1	2	3	4	5
2	ค่าโดยสารราคาถูก	1	2	3	4	5
3	ลดความเสี่ยงจากอุบัติเหตุทางถนน	1	2	3	4	5
4	ที่จอดรถหายาก	1	2	3	4	5
5	หลีกเลี่ยงการจราจรติดขัด	1	2	3	4	5
6	ไม่อยากทำให้การจราจรติดขัด ลดปัญหามลพิษบนถนน	1	2	3	4	5
7	ไม่มีรถส่วนตัว	1	2	3	4	5
8	มีเวลาทำอย่างอื่นขณะเดินทาง และได้ชมทิวทัศน์ระหว่างทาง	1	2	3	4	5
9	อยากพูดคุยทำความรู้จักกับคนในพื้นที่	1	2	3	4	5

ส่วนที่ 3: ทัศนคติต่อการให้บริการขนส่งสาธารณะ

3-1 ท่านมีความคิดเห็นอย่างไรต่อคุณภาพการให้บริการ**รถสี่ล้อเล็ก**

(เกณฑ์การให้คะแนน ดังนี้: 1 = **ไม่เห็นด้วยอย่างยิ่ง**, 2 = **ไม่เห็นด้วย**, 3 = **ไม่แน่ใจ**, 4 = **เห็นด้วย**, 5 = **เห็นด้วยอย่างยิ่ง**)

		1 ไม่เห็นด้วยอย่างยิ่ง → เห็นด้วยอย่างยิ่ง 5				
1	ฉันรู้สึกว่ารถสี่ล้อเล็กมาบ่อย	1	2	3	4	5
2	ฉันพึงพอใจที่รถสี่ล้อเล็กมีให้บริการในที่ที่ต้องการไป	1	2	3	4	5
3	รถสี่ล้อเล็กมีให้บริการในช่วงเวลาที่ฉันต้องการใช้	1	2	3	4	5
4	ใช้รถสี่ล้อเล็กทำให้การเดินทางของฉันรวดเร็ว ไม่เสียเวลา	1	2	3	4	5
5	ฉันรอรถไม่นาน	1	2	3	4	5
6	ฉันคิดว่าค่าโดยสารมีความเหมาะสม	1	2	3	4	5
7	ฉันได้ที่นั่งทุกครั้งเมื่อขึ้นรถสี่ล้อเล็ก รถนั่งสบาย	1	2	3	4	5
8	ฉันพึงพอใจที่มีเก้าอี้นั่งและที่พักบริเวณที่รอรถสี่ล้อเล็ก	1	2	3	4	5
9	รถสี่ล้อเล็กจอดรับ-ส่ง มีเวลาให้ขึ้น-ลงรถ โดยไม่ต้องรีบ และก้าวขึ้นรถได้ง่าย	1	2	3	4	5
10	รถสี่ล้อเล็กทำให้สะดวกในการต่อรถหรือเชื่อมต่อกับรูปแบบอื่นๆ	1	2	3	4	5
11	ใช้รถสี่ล้อเล็กแล้วฉันรู้สึกปลอดภัยต่อร่างกายและทรัพย์สิน	1	2	3	4	5
12	รถสี่ล้อเล็กสะอาด ไม่มีฝุ่น ไม่มีเศษขยะ ที่นั่งอยู่ในสภาพที่ดี ขยับตัวได้สะดวก และมีการป้องกันสิ่งต่าง ๆ จากภายนอกรถ เช่น ม่าน มู่ลี่	1	2	3	4	5
13	ฉันพึงพอใจที่ผู้โดยสารที่นั่งด้วยกัน มีความสุภาพและเรียบร้อย	1	2	3	4	5
14	ฉันพึงพอใจที่คนขับรถสี่ล้อเล็กให้บริการด้วยความสุภาพและซื่อสัตย์	1	2	3	4	5
15	ฉันพึงพอใจที่รถสี่ล้อเล็กมีป้ายบอกราคาค่าโดยสาร	1	2	3	4	5
16	รถสี่ล้อเล็กมีส่วนทำให้เกิดมลพิษทางอากาศและระดับเสียง	1	2	3	4	5
17	รถสี่ล้อเล็กมีส่วนทำให้รถติด	1	2	3	4	5
18	รถสี่ล้อเล็กมีส่วนทำให้เกิดอุบัติเหตุบนถนน	1	2	3	4	5

3-2 ท่านให้**ความสำคัญ**ต่อปัจจัยต่อไปนี้มากน้อยเพียงใด ในการ "เลือกใช้" บริการ**ระบบขนส่งสาธารณะ**

(เกณฑ์การให้คะแนน ดังนี้: 1 = **ไม่มีความสำคัญเลย** → **มีความสำคัญมากอย่างยิ่ง** = 5)

		1ไม่มีความสำคัญเลย → มีความสำคัญมากอย่างยิ่ง 5				
1	รถมาบ่อย	1	2	3	4	5
2	เส้นทางให้บริการ	1	2	3	4	5
3	ช่วงเวลาในการให้บริการ	1	2	3	4	5
4	ความเร็วในการเดินทาง	1	2	3	4	5
5	เวลารอรถ	1	2	3	4	5
6	ราคาค่าโดยสารเหมาะสม	1	2	3	4	5
7	ได้ที่นั่งบนรถ รถนั่งสบาย	1	2	3	4	5
8	เก้าอี้นั่งและที่พักรอ บริเวณป้ายรอรถ	1	2	3	4	5
9	มีเวลาจอดเพียงพอให้ขึ้น-ลงรถ และเข้าไปนั่งในรถง่าย เช่น การเปิดประตู และบันไดสำหรับก้าวขึ้นรถ	1	2	3	4	5

		1ไม่มีความสำคัญเลย → มีความสำคัญมากอย่างยิ่ง 5				
10	สะดวกในการเชื่อมต่อกับรูปแบบการเดินทางอื่น ๆ	1	2	3	4	5
11	ความปลอดภัยต่อร่างกายและทรัพย์สิน	1	2	3	4	5
12	สภาพภายในรถ เช่น ความสะอาด ที่นั่งสภาพดี ขยับตัวสะดวก ไม่มีเสียงรบกวน มีการป้องกันสิ่งต่าง ๆ จากภายนอกรถ เช่น ม่าน มู่ลี่	1	2	3	4	5
13	ความสุภาพเรียบร้อยของผู้ที่เดินทางด้วยกัน	1	2	3	4	5
14	เครื่องปรับอากาศภายในรถ	1	2	3	4	5
15	พฤติกรรมคนขับ เช่น ให้บริการด้วยความสุภาพ ซื่อสัตย์ ช่วยยกสัมภาระ	1	2	3	4	5
16	ข้อมูลเส้นทางให้บริการ เช่น แผนที่ และข้อมูลราคาค่าโดยสาร	1	2	3	4	5
17	การปล่อยมลพิษทางอากาศและระดับเสียง	1	2	3	4	5
18	การทำให้รถติด	1	2	3	4	5
19	การทำให้เกิดอุบัติเหตุบนถนน	1	2	3	4	5

ส่วนที่ 4: รูปแบบการเดินทางอื่น ๆ

1. **ในเส้นทางเดียวกับส่วนที่ 1** ท่านมีทางเลือกในการเดินทางรูปแบบอื่นหรือไม่ ☐ 1) มี ☐ 2) ไม่มี **ข้ามไปส่วนที่ 5**
2. ท่านมีทางเลือกการเดินทางรูปแบบใด (**เลือกเพียง 1 ข้อ**)

   ☐1) รถแมล์ ☐2) มอเตอร์ไซค์รับจ้าง ☐3) สองแถว ☐4) ตุ๊กตุ๊ก ☐5) รถส่วนตัว ☐6) จักรยานยนต์ส่วนตัว ☐7) แท็กซี่ ☐8) จักรยาน ☐9) เดิน
3. ท่านใช้บ่อยแค่ไหน ☐ 1) ทุกวัน ☐ 2) 4-5 วัน/สัปดาห์ ☐ 3) 2-3 วัน/สัปดาห์ ☐ 4) นาน ๆ ครั้ง
4. การเดินทาง (**ตามข้อ 2.**) ใน 1 เที่ยว มีค่าเดินทาง……..…..**บาท**, ใช้เวลารอรถ…….. **นาที**, ใช้เวลาเดินทาง…….... **นาที**
5. ท่าน**เลือกใช้รถสี่ล้อเล็กแทนรูปแบบ ตามข้อ 2**. เพราะ ……

ส่วนที่ 5: ข้อมูลส่วนบุคคล

1. เพศ ☐ 1) ชาย ☐ 2) หญิง
2. อายุ ……
3. สถานภาพสมรส ☐ 1) โสด ☐ 2) สมรส
4. อาชีพ ☐ 1) นักเรียน/นักศึกษา ☐ 2) พนักงานภาครัฐ ☐ 3) พนักงานภาคเอกชน ☐ 4) ค้าขาย
   ☐ 5) นายจ้าง ☐ 6) เกษียณอายุ ☐ 7) ไม่มีงาน ☐ 8) อื่นๆ; **โปรดระบุ** ……..
5. การศึกษา

   ☐ 1) ประถมศึกษา ☐ 2) มัธยมศึกษา ☐ 3) ปวช. ☐ 4) ปวส. ☐ 5) กำลังศึกษา ป.ตรี ☐6) ป.ตรี ☐ 7) สูงกว่า ป. ตรี
6. จำนวนสมาชิกในครัวเรือน (รวมตัวท่านด้วย) …… **คน**
7. จำนวนยานพาหนะในครัวเรือน (โปรดระบุจำนวน)

   ☐ รถยนต์ส่วนตัว **จำนวน** …..... ท่านพร้อมใช้งานได้ตลอดเวลา **จำนวน** …....

   ☐ รถจักรยานยนต์ **จำนวน**..... ท่านพร้อมใช้งานได้ตลอดเวลา **จำนวน** …....

   ☐ จักรยาน **จำนวน** …..... ท่านพร้อมใช้งานได้ตลอดเวลา **จำนวน** …....

   ☐ ไม่มี
8. ส่วนใหญ่มีผู้ร่วมเดินทางด้วยกัน (รวมตัวท่านด้วย) …… **คน**
9. รายได้ต่อเดือน …… **บาท**

ขอขอบคุณที่ให้ความร่วมมือในการตอบแบบสอบถาม

แบบสำรวจพฤติกรรมการเดินทางและทัศนคติของผู้ที่ไม่ใช้บริการรถยนต์สี่ล้อเล็กในกรุงเทพมหานคร

แบบสำรวจนี้เป็นส่วนหนึ่งของการทำวิทยานิพนธ์ของนิสิตปริญญาเอก หลักสูตรสิ่งแวดล้อม การพัฒนา และความยั่งยืน บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย โดยมีวัตถุประสงค์เพื่อสำรวจการเดินทางและทัศนคติของผู้ที่ไม่ใช้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานคร และนำเสนอแนวทางในการปรับปรุงระบบไปสู่การพัฒนาการขนส่งอย่างยั่งยืนต่อไป โดยแบบสำรวจนี้มีทั้งหมด 4 ส่วน ได้แก่

ส่วนที่ 1 การเดินทาง

ส่วนที่ 2 เหตุผลที่ไม่ใช้บริการรถสี่ล้อเล็ก

ส่วนที่ 3 ทัศนคติต่อการให้บริการขนส่งสาธารณะ

ส่วนที่ 4 ข้อมูลส่วนบุคคล

ขอขอบคุณที่ให้ความร่วมมือในการตอบแบบสอบถามนี้ คำตอบของท่านจะเป็นไปด้วยความสมัครใจและท่านสามารถเลือกตอบได้โดยอิสระ โดยคำตอบของท่านจะถูกเก็บเป็นความลับและใช้วิเคราะห์สำหรับการศึกษาวิจัยเชิงวิชาการเท่านั้น ท่านมีสิทธิ์ที่จะไม่ตอบคำถามใด ๆ หากท่านเห็นว่าไม่เหมาะสม การให้คำตอบอย่างตรงไปตรงมาของท่านจะช่วยให้ผู้วิจัยสามารถนำผลการสำรวจไปใช้วิเคราะห์พฤติกรรมและทัศนคติเกี่ยวกับการใช้บริการรถยนต์สี่ล้อเล็กรับจ้างในกรุงเทพมหานครได้อย่างถูกต้องต่อไป

บัณฑิตวิทยาลัย
จุฬาลงกรณ์มหาวิทยาลัย

NON USER: NU -☐☐☐

แบบสำรวจพฤติกรรมการเดินทางและทัศนคติของผู้ที่ไม่ใช้บริการรถสี่ล้อเล็กในกรุงเทพมหานคร

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

วันที่ ..... เวลา ..... ผู้รับผิดชอบ .....

ส่วนที่ 1: การเดินทาง

เส้นทาง ☐ บางบอน-ตลาดพลู ☐ ศิริราช-ตลาดพลู ☐ จรัญสนิทวงศ์ ซอย 13-คลองสาน
☐ วิภาวดีรังสิต ซอย 16-รัชดาภิเษก ซอย 19 ☐ สุขุมวิท ซอย 39

1. ส่วนใหญ่ ท่านเดินทางอย่างไร (**เลือกเพียง 1 ข้อ**)
☐1) รถเมล์ ☐2) มอเตอร์ไซค์รับจ้าง ☐3) สองแถว ☐4) ตุ๊กตุ๊ก ☐5) รถส่วนตัว ☐6) จักรยานยนต์ส่วนตัว ☐7) แท็กซี่ ☐8) จักรยาน ☐9) เดิน
2. ท่านใช้บ่อยแค่ไหน
☐ 1) ทุกวัน ☐ 2) 4-5 วัน/สัปดาห์ ☐ 3) 2-3 วัน/สัปดาห์ ☐ 4) นาน ๆ ครั้ง
3. ท่านใช้บริการในช่วงเวลา**กี่โมง** (ตอบได้มากกว่า 1 ช่วงเวลา) **เช่น 8.00, 14.30**
1) ..... 2) ..... 3) ..... 4) .....
4. ท่านเดินทาง

จาก (เลือกเพียง 1 ข้อ)	☐ 1) บ้าน ☐ 2) ที่ทำงาน ☐ 3) โรงเรียน/มหาวิทยาลัย ☐ 4) ตลาด/ห้างสรรพสินค้า ☐ 5) อื่นๆ ..... **ตำแหน่งที่ตั้ง**.....	ไป (เลือกเพียง 1 ข้อ)	☐ 1) บ้าน ☐ 2) ที่ทำงาน ☐ 3) โรงเรียน/มหาวิทยาลัย ☐ 4) ตลาด/ห้างสรรพสินค้า ☐ 5) อื่นๆ ..... **ตำแหน่งที่ตั้ง**.....

5. การเดินทาง (**ตามข้อ 1.**) ใน 1 เที่ยว
มีค่าเดินทาง ..... **บาท**, ใช้เวลารอรถ ..... **นาที**, ใช้เวลาเดินทาง ..... **นาที**
6. ท่านใช้เพื่อเชื่อมต่อกับระบบขนส่งอื่นหรือไม่
☐ ไม่ ☐ เชื่อมต่อกับ; เลือกเพียง 1 ข้อ
☐ รถไฟฟ้า (สถานี.....) ☐ รถใต้ดิน (สถานี .....) ☐ เรือ (ท่าเรือ .....)
☐ รถเมล์ ☐ มอเตอร์ไซค์รับจ้าง ☐ สองแถว ☐ รถสี่ล้อเล็ก ☐ ตุ๊กตุ๊ก ☐ รถตู้ ☐ รถไฟ (สถานี.....)

ส่วนที่ 2: เหตุผลที่ไม่ใช้บริการรถสี่ล้อเล็ก

➔ "รถสี่ล้อเล็ก"

โปรดระบุ**เหตุผลที่ไม่ใช้**บริการรถสี่ล้อเล็ก
(เกณฑ์การให้คะแนน ดังนี้: 1 = **ไม่เห็นด้วยอย่างยิ่ง**, 2 = **ไม่เห็นด้วย**, 3 = **ไม่แน่ใจ**, 4 = **เห็นด้วย**, 5 = **เห็นด้วยอย่างยิ่ง**)

	ท่านไม่ใช้รถสี่ล้อเล็ก เพราะ ..... ?	1 ไม่เห็นด้วยอย่างยิ่ง ➔ เห็นด้วยอย่างยิ่ง 5				
1	ไม่ทราบวิธีการใช้บริการ	1	2	3	4	5
2	จุดจอดรับ-ส่ง ไม่สะดวกสำหรับใช้บริการ	1	2	3	4	5
3	ไม่มีจุดเชื่อมต่อกับที่ที่ต้องการไป	1	2	3	4	5
4	ไม่อยากต่อรถ	1	2	3	4	5
5	รอรถนาน	1	2	3	4	5
6	คนขับขับช้าเกินไป	1	2	3	4	5
7	ค่าโดยสารแพง	1	2	3	4	5
8	คิดว่ารถสี่ล้อเล็กอันตราย	1	2	3	4	5
9	ไม่ชอบบรรยากาศคนแน่นๆ	1	2	3	4	5
10	ชอบเดินหรือปั่นจักรยานมากกว่า	1	2	3	4	5
11	ปกติใช้รถส่วนตัว	1	2	3	4	5

ส่วนที่ 3: ทัศนคติต่อการให้บริการขนส่งสาธารณะ

1. ระบบขนส่งสาธารณะที่ท่าน**ใช้บ่อย (เลือกเพียง 1 ข้อ)**
   ☐ 1) รถเมล์ ☐ 2) มอเตอร์ไซค์รับจ้าง ☐ 3) สองแถว ☐ 4) ตุ๊กตุ๊ก ☐ 5) แท็กซี่
2. ท่านใช้บ่อยแค่ไหน ☐ 1) ทุกวัน ☐ 2) 4-5 วัน/สัปดาห์ ☐ 3) 2-3 วัน/สัปดาห์ ☐ 4) นาน ๆ ครั้ง
3. ท่านให้**ความสำคัญ**ต่อปัจจัยการให้บริการระบบขนส่งสาธารณะ **ตามข้อ 1**. อย่างไร
   (เกณฑ์การให้คะแนน ดังนี้: 1 = **ไม่มีความสำคัญเลย →มีความสำคัญมากอย่างยิ่ง** = 5)

		1ไม่มีความสำคัญเลย →มีความสำคัญมากอย่างยิ่ง5				
1	รถมาบ่อย	1	2	3	4	5
2	เส้นทางให้บริการ	1	2	3	4	5
3	ช่วงเวลาในการให้บริการ	1	2	3	4	5
4	ความเร็วในการเดินทาง	1	2	3	4	5
5	เวลารอรถ	1	2	3	4	5
6	ราคาค่าโดยสารเหมาะสม	1	2	3	4	5
7	ได้ที่นั่งบนรถ รถนั่งสบาย	1	2	3	4	5
8	เก้าอี้นั่งและที่พักรอ บริเวณป้ายรอรถ	1	2	3	4	5
9	มีเวลาจอดเพียงพอให้ขึ้น-ลงรถ และเข้าไปนั่งในรถง่าย เช่น การเปิดประตู และบันไดสำหรับก้าวขึ้นรถ	1	2	3	4	5
10	สะดวกในการเชื่อมต่อกับรูปแบบการเดินทางอื่น ๆ	1	2	3	4	5
11	ความปลอดภัยต่อร่างกายและทรัพย์สิน	1	2	3	4	5
12	สภาพภายในรถ เช่น ความสะอาด ที่นั่งสภาพดี ขยับตัวสะดวก ไม่มีเสียงรบกวน มีการป้องกันสิ่งต่าง ๆ จากภายนอกรถ เช่น ม่าน มู่ลี่	1	2	3	4	5
13	ความสุภาพเรียบร้อยของผู้ที่เดินทางด้วยกัน	1	2	3	4	5
14	เครื่องปรับอากาศภายในรถ	1	2	3	4	5
15	พฤติกรรมคนขับ เช่น ให้บริการด้วยความสุภาพ ซื่อสัตย์ ช่วยยกสัมภาระ	1	2	3	4	5
16	ข้อมูลเส้นทางให้บริการ เช่น แผนที่ และข้อมูลราคาค่าโดยสาร	1	2	3	4	5
17	การปล่อยมลพิษทางอากาศและระดับเสียง	1	2	3	4	5
18	การทำให้รถติด	1	2	3	4	5
19	การทำให้เกิดอุบัติเหตุบนถนน	1	2	3	4	5

ส่วนที่ 4: ข้อมูลส่วนบุคคล

1. เพศ ☐ 1) ชาย ☐ 2) หญิง
2. อายุ .....
3. สถานภาพสมรส ☐ 1) โสด ☐ 2) สมรส
4. อาชีพ ☐ 1) นักเรียน/นักศึกษา ☐ 2) พนักงานภาครัฐ ☐ 3) พนักงานภาคเอกชน ☐ 4) ค้าขาย
   ☐ 5) นายจ้าง ☐ 6) เกษียณอายุ ☐ 7) ไม่มีงาน ☐ 8) อื่นๆ; **โปรดระบุ** .....
5. การศึกษา
   ☐ 1) ประถมศึกษา ☐ 2) มัธยมศึกษา ☐ 3) ปวช. ☐ 4) ปวส. ☐ 5) กำลังศึกษา ป.ตรี ☐6) ป.ตรี ☐ 7) สูงกว่า ป. ตรี
6. จำนวนสมาชิกในครัวเรือน (รวมตัวท่านด้วย) ..... **คน**
7. จำนวนยานพาหนะในครัวเรือน (โปรดระบุจำนวน)
   ☐ รถยนต์ส่วนตัว **จำนวน** ..... ท่านพร้อมใช้งานได้ตลอดเวลา **จำนวน** .....
   ☐ รถจักรยานยนต์ **จำนวน**..... ท่านพร้อมใช้งานได้ตลอดเวลา **จำนวน** .....
   ☐ จักรยาน **จำนวน** ..... ท่านพร้อมใช้งานได้ตลอดเวลา **จำนวน** .....
   ☐ ไม่มี
8. ส่วนใหญ่มีผู้ร่วมเดินทางด้วยกัน (รวมตัวท่านด้วย) ..... **คน**
9. รายได้ต่อเดือน ..... **บาท**

ขอขอบคุณที่ให้ความร่วมมือในการตอบแบบสอบถาม

DRIVER: D -☐☐☐

Survey Questionnaire on Operation of Silor-lek Service in Bangkok

Graduate School, Chulalongkorn University

Date ..... Time ..... Collected by .....

PART I: About Silor-lek service

Route ☐ Bang Bon-Talad Plu ☐ Siriraj-Talad Plu ☐ Charansanitwong Soi 13-Klong San
☐ Vibhavadi Rangsit 16-Ratchadapisek Soi 19 ☐ Sukhumvit Soi 39

1. How long have your been driving Silor-lek? ..... **Years**
2. During what time period do you mostly drive? **From** ..... **To** .....
3. Do you have any other jobs? ☐ 1) Other job; **Please specify** ..... ☐ 2) Only Silor-lek driver
4. How much is your daily income from driving Silor-lek? ..... **Baht/day**
5. How many work days per week? ..... **Days/week**
6. Do you own this vehicle? ☐ 1) Yes; **Price** ..... **Baht**
   ☐ 2) No; **Rental fee** ..... **Baht/day**
7. **Fuel type** ☐ 1) LPG ☐ 2) Benzene ☐ 3) Diesel
8. Fuel cost ..... **Baht/day**
9. Vehicle is registered as □ 1) Public vehicle □ 2) Private vehicle; **Reason** .....

PART II: Challenges and Opinions on the Service

1. Any problem with drivers of overlapping routes or of other modes?
   □ 1) No □ 2) Yes; **(1)** .....
   (2) .....
   (3) .....
2. Have you ever been called by the police? □ 1) No □ 2) Yes; **(1)** .....
   (2) .....
   (3) .....
3. If the government purpose a policy to set up proper stops to pick-up and drop-off passengers,
   do you agree with this? □ 1) Agree □ 2) Disagree □ 3) Undecided
   And what will be the effect on your occupation? **Please describe** .....
4. If the government purpose a policy to integrate Silor-lek, as feeder mode, into BTS,
   do you agree with this? □ 1) Agree □ 2) Disagree □ 3) Undecided
   And what will be the effect on your occupation? **Please describe** .....

PART III: About Yourself

1. Gender ☐ 1) Male ☐ 2) Female
2. Age .....
3. Hometown .....
4. Marital status ☐ 1) Single ☐ 2) Married
5. Your income received has to support (excluding yourself) ..... **member(s)**
6. Education
   □ 1) Primary school □ 2) Secondary school □ 3) Vocational □ 4) High vocational □ 5) University
7. Do you have driving license? ☐ 1) No ☐ 2) Yes; Type of license.....
8. Co-operative membership? ☐ 1) No ☐ 2) Yes; Name .....

Thank you for your participation!

USER: U - ☐☐☐

Survey Questionnaire on Travel Behavior and Attitude of Silor-lek Users in Bangkok

Graduate School, Chulalongkorn University

Date ..... Time ..... Collected by .....

PART I: About Silor-lek

Route ☐ Bang Bon-Talad Plu ☐ Siriraj-Talad Plu ☐ Charansanitwong Soi 13-Klong San ☐ Vibhavadi Rangsit 16-Ratchadapisek Soi 19 ☐ Sukhumvit Soi 39

1 How often do you use Silor-lek?

☐ 1) Everyday ☐ 2) 4-5 days/week

☐ 3) 2-3 days/week ☐ 4) Occasionally

➔ "Silor-lek"

2 During what time period do you mostly use Silor-lek? (Answer can be MORE THAN ONE)
(For example, 8.00; 14.30)

1) ..... 2) ..... 3) ..... 4) .....

3 You usually use Silor-lek to travel

From

Please choose only one
☐ 1) Home ☐ 2) Work ☐ 3) School/University
☐ 4) Shopping ☐ 5) Other.....
Location.....

To

Please choose only one
☐ 1) Home ☐ 2) Work ☐ 3) School/University
☐ 4) Shopping ☐ 5) Other.....
Location.....

4 On average, for a trip using **Silor-lek** you spend

Travel cost ..... **Baht**, Waiting time ..... **Min**, Travel time ..... **Min**

5 Do you have to transfer to other modes

☐ 1) No ☐ 2) Yes;

Please choose only one
☐ BTS (Station .....) ☐ MRT (Station .....) ☐ Ferry (Name .....)
☐ Public Bus ☐ Motorcycle taxi ☐ Songtaew ☐ Silor-lek ☐ Tuk-tuk ☐ Public van ☐ Train (Station .....)

6 Overall satisfaction on the service ☐ Very satisfied (5) ☐ Satisfied (4) ☐ Neutral (3) ☐ Dissatisfied (2) ☐ Very dissatisfied (1)

PART II: Reasons for Using Silor-lek

Please indicate how do you personally agree with the following reasons for using Silor-lek from 1 (Strongly disagree) to 5 (Strongly agree)

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

	I use Silor-lek because ..... ?	**1 Strongly disagree → Strongly agree 5**				
1	Silor-lek is convenient and very accessible	1	2	3	4	5
2	Travelling on Silor-lek is cheap	1	2	3	4	5
3	Lower risk of road accidents	1	2	3	4	5
4	It is difficult to find parking lots	1	2	3	4	5
5	I want to avoid traffic jam	1	2	3	4	5
6	I want to contribute to less traffic congestion and less pollution	1	2	3	4	5
7	I do not have car	1	2	3	4	5
8	I can have more time to do something else on board and enjoy the surroundings on the way	1	2	3	4	5
9	I want to get in touch with local people	1	2	3	4	5

PART III: Attitudes Towards Public Transport Services

3-1 Please indicate how do you personally agree with the following statements about Silor-lek from 1 (Strongly disagree) to 5 (Strongly agree)

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

		1 Strongly disagree → Strongly agree 5				
1	Silor-lek has frequent service	1	2	3	4	5
2	I am satisfied that Silor-lek routes cover places I want to go	1	2	3	4	5
3	Silor-lek operates in the time period I need to travel	1	2	3	4	5
4	Travelling by Silor-lek is fast and I can save my time	1	2	3	4	5
5	I do not have to wait for Silor-lek for long time	1	2	3	4	5
6	Silor-lek has suitable fare	1	2	3	4	5
7	I always get a seat when riding Silor-lek and the seat is comfort	1	2	3	4	5
8	Shelter and benches at stops are available	1	2	3	4	5
9	Silor-lek gives sufficient stop time to board and alight and it is easy to enter the vehicle	1	2	3	4	5
10	It is convenient to connect with and transfer to other modes	1	2	3	4	5
11	Riding Silor-lek is safe from road accident and secured from criminal incidents	1	2	3	4	5
12	Silor-lek is clean, free from dust or garbage, seat are in good condition, easy to move, protected from exposure to the elements	1	2	3	4	5
13	Passengers riding Silor-lek are polite	1	2	3	4	5
14	Silor-lek drivers are polite and honest	1	2	3	4	5
15	Fare structure are provided	1	2	3	4	5
16	Silor-lek causes air and noise pollution	1	2	3	4	5
17	Silor-lek causes traffic congestion	1	2	3	4	5
18	Silor-lek causes road accidents	1	2	3	4	5

3-2 Please indicate how important are the following aspects when "choosing" public transport services from **1 (Unimportant) to 5 (Very important)**

		1 Unimportant → Very important 5				
1	Service frequency	1	2	3	4	5
2	Coverage area	1	2	3	4	5
3	Length of operation time	1	2	3	4	5
4	Travel time	1	2	3	4	5
5	Waiting time at stop	1	2	3	4	5
6	Suitable fare structure	1	2	3	4	5
7	Seat availability and seat comfort	1	2	3	4	5
8	Availability of shelter and benches at stops	1	2	3	4	5
9	Given sufficient stop time to board and alight and ease to enter the vehicle e.g., open the car-door, height of step	1	2	3	4	5
10	Convenience of connections and transfers	1	2	3	4	5
11	Safety from road accident and security from criminal incidents	1	2	3	4	5
12	In-vehicle environment, e.g. cleanliness, seat quality, ease to move, absence of noise, protection from exposure to elements, etc.	1	2	3	4	5
13	Passenger politeness	1	2	3	4	5
14	Air-conditioning in the vehicle	1	2	3	4	5
15	Driver behavior, e.g. polite, honest, provide help to passenger, etc.	1	2	3	4	5

		1 Unimportant → Very important 5				
16	Availability of information regarding route direction (e.g., map, route, etc.) and information regarding service (e.g., fare, etc.)	1	2	3	4	5
17	Level of air emission and noise pollution	1	2	3	4	5
18	Level of congestion impact caused by the mode	1	2	3	4	5
19	Level of road accident caused by the mode	1	2	3	4	5

PART IV: Other Transport Modes

1 **For the route in Part I**, do you have other alternative mode? □ 1) Yes □ 2) No; **Skip to Part V**

2 Alternative mode (Please choose ONLY ONE)

□ 1) Bus □ 2) Motorcycle taxi □ 3) Songtaew □ 4) Tuk-tuk
□ 5) Private car □ 6) Private motorcycle □ 7) Taxi □ 8) Bicycle □ 9) Walk

3 How often?

☐ 1) Everyday ☐ 2) 4-5 days/week ☐ 3) 2-3 days/week ☐ 4) Occasionally

4 On average for the **Transport Mode in No. 2.**, you spend
Travel cost ..... **Baht,** Waiting time ..... **Min,** Travel time ..... **Min**

5 You **choose Silor-lek instead of Transport Mode in No. 2**. because .....

PART V: About Yourself

1. Gender ☐ 1) Male ☐ 2) Female Nationality .....
2. Age .....
3. Marital Status ☐ 1) Single ☐ 2) Married
4. Occupation

☐ 1) Student ☐ 2) Public-sector staff ☐ 3) Private-sector staff ☐ 4) Vendor
☐ 5) Employer ☐ 6) Retired ☐ 7) Unemployed ☐ 8) Other; .....

5. Education

□ 1) Primary □ 2) Secondary □ 3) Vocational □ 4) High vocational
□ 5) Studying Bachelor □ 6) Bachelor □ 7) Higher than Bachelor
□ 8) Have never been to school

6. Total members in the household (Include yourself) **Amount** .....
7. Vehicle ownership in the household (Please specify the number)

□ Car **Amount** .....; Always available for you to use **Amount** .....
□ Motorcycle **Amount** .....; Always available for you to use **Amount** .....
□ Bicycle **Amount** .....; Always available for you to use **Amount** .....
□ Do not have any

8. Members travelling all together (Include yourself) **Amount** .....
9. Monthly income ..... Baht

Thank you for your participation!

NON USER: NU - ☐☐☐

Survey Questionnaire on Travel Behavior and Attitude of Silor-lek Non-users in Bangkok

Graduate School, Chulalongkorn University

Date ..... Time ..... Collected by .....

PART I: Transport Modes

Route ☐ Bang Bon-Talad Plu ☐ Siriraj-Talad Plu ☐ Charansanitwong Soi 13-Klong San
☐ Vibhavadi Rangsit 16-Ratchadapisek Soi 19 ☐ Sukhumvit Soi 39

1 Generally you travel by (Please choose ONLY ONE)

☐ 1) Bus ☐ 2) Motorcycle taxi ☐ 3) Songtaew ☐ 4) Tuk-tuk
☐ 5) Private car ☐ 6) Private motorcycle ☐ 7) Taxi ☐ 8) Bicycle ☐ 9) Walk

2 How often?

☐ 1) Everyday ☐ 2) 4-5 days/week ☐ 3) 2-3 days/week ☐ 4) Occasionally

3 During what time period do you mostly use? (Answer can be MORE THAN ONE)

(For example, 8.00; 14.30)

1) ..... 2) ..... 3) ..... 4) .....

4 You usually travel

From

Please choose only one
☐ 1) Home ☐ 2) Work ☐ 3) School/University
☐ 4) Shopping ☐ 5) Other.....
Location.....

To

Please choose only one
☐ 1) Home ☐ 2) Work ☐ 3) School/University
☐ 4) Shopping ☐ 5) Other.....
Location.....

5 On average for the **Transport Mode in No. 1.**, you spend

Travel cost ..... **Baht**, Waiting time ..... **Min**, Travel time ..... **Min**

6 Do you have to transfer to other modes

☐ No ☐ Yes;

Please choose only one
☐ BTS (Station .....) ☐ MRT (Station .....) ☐ Ferry (Name .....)
☐ Public Bus ☐ Motorcycle taxi ☐ Songtaew ☐ Tuk-tuk ☐ Public van ☐ Train (Station .....)

PART II: Reasons for Not Using Silor-lek

➔ "Silor-lek"

Please indicate how do you personally agree with the following reasons for not using Silor-lek from 1 (Strongly disagree) to 5 (Strongly agree)

1 = Strongly disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly agree

	I do not use Silor-lek because ..... ?	**1 Strongly disagree → Strongly agree 5**				
1	I do not know how to use Silor-lek	1	2	3	4	5
2	Stations and stops are not conveniently located	1	2	3	4	5
3	There is no good connection to where I want to go	1	2	3	4	5
4	I do not want to transfer	1	2	3	4	5
5	Long waiting time	1	2	3	4	5
6	Silor-lek is too slow	1	2	3	4	5
7	Fares are expensive	1	2	3	4	5
8	I think it is not safe to travel on Silor-lek	1	2	3	4	5
9	I do not feel comfortable with the crowd	1	2	3	4	5

	I do not use Silor-lek because ..... ?	1 Strongly disagree → Strongly agree 5				
10	I prefer walking or cycling	1	2	3	4	5
11	I travel by a car	1	2	3	4	5

PART III: Attitudes towards Public Transport Services

1 Public transport mode you usually use (Please choose ONLY ONE)
□ 1) Bus □ 2) Motorcycle taxi □ 3) Songtaew □ 4) Tuk-tuk □ 5) Taxi

2 How often? □ 1) Everyday □ 2) 4-5 days/week □ 3) 2-3 days/week □ 4) Occasionally

3 Please indicate how important are the following aspects of the **Transport Mode in No. 1.** from **1 (Unimportant) to 5 (Very important)**

		1 Unimportant → Very important 5				
1	Service frequency	1	2	3	4	5
2	Coverage area	1	2	3	4	5
3	Length of operation time	1	2	3	4	5
4	Travel time	1	2	3	4	5
5	Waiting time at stop	1	2	3	4	5
6	Suitable fare structure	1	2	3	4	5
7	Seat availability and seat comfort	1	2	3	4	5
8	Availability of shelter and benches at stops	1	2	3	4	5
9	Given sufficient stop time to board and alight and ease to enter the vehicle e.g., open the car-door, height of step	1	2	3	4	5
10	Convenience of connections and transfers	1	2	3	4	5
11	Safety from road accident and security from criminal incidents	1	2	3	4	5
12	In-vehicle environment, e.g. cleanliness, seat quality, ease to move, absence of noise, protection from exposure to elements, etc.	1	2	3	4	5
13	Passenger politeness	1	2	3	4	5
14	Air-conditioning in the vehicle	1	2	3	4	5
15	Driver behavior, e.g. polite, honest, provide help to passenger, etc.	1	2	3	4	5
16	Availability of information regarding route direction (e.g., map, route, etc.) and information regarding service (e.g., fare, etc.)	1	2	3	4	5
17	Level of air emission and noise pollution	1	2	3	4	5
18	Level of congestion impact caused by the mode	1	2	3	4	5
19	Level of road accident caused by the mode	1	2	3	4	5

PART IV: About Yourself

1. Gender ☐ 1) Male ☐ 2) Female Nationality .....
2. Age .....
3. Marital Status ☐ 1) Single ☐ 2) Married
4. Occupation
   ☐ 1) Student ☐ 2) Public-sector staff ☐ 3) Private-sector staff ☐ 4) Vendor
   ☐ 5) Employer ☐ 6) Retired ☐ 7) Unemployed ☐ 8) Other; .....
5. Education
   □ 1) Primary □ 2) Secondary □ 3) Vocational □ 4) High vocational
   □ 5) Studying Bachelor □ 6) Bachelor □ 7) Higher than Bachelor
   □ 8) Have never been to school
6. Total members in the household (Include yourself) **Amount** .....
7. Vehicle ownership in the household (Please specify the number)
   □ Car **Amount** .....; Always available for you to use **Amount** .....
   □ Motorcycle **Amount** .....; Always available for you to use **Amount** .....
   □ Bicycle **Amount** .....; Always available for you to use **Amount** .....
   □ Do not have any
8. Members travelling all together (Include yourself) **Amount** .....
9. Monthly income ..... Baht

Thank you for your participation!

ユーザー: U -☐☐☐

バンコク都内の 4 輪小型乗合いタクシー利用者の移動行動および傾向の調査

チュラロンコン大学大学院

日付 ..... 時間 ..... 担当者 .....

第 1 部: 4 輪小型乗合いタクシーの利用

路線 ☐ バンボーン- タラートプルー ☐ シリラート- タラートプルー ☐ チャランサニットウォンソイ 13-クローンサーン ☐ ウィパーワディランシットソイ 16 -ラチャダーピセークソイ 19 ☐ スクムビットソイ 39

1. あなたは 1 週間にどれぐらいの頻度で 4 輪小型タクシーを利用しますか。

☐ 1) 毎日 ☐ 2) 4-5 日/週

☐ 3) 2-3 日/週 ☐ 4) 時々

➔ "4 輪小型乗合タクシー"

2. あなたは主に**何時頃**に 4 輪小型タクシーを利用しますか。

(複数の時間を回答可) **例 8:00, 14:30**

1) ..... 2) ..... 3) ..... 4) .....

3. 普段あなたはどこからどこまでの移動に 4 輪小型タクシーを利用しますか。

～から (1つのみ選択)	～まで (1つのみ選択)
☐ 1) 自宅 ☐ 2) 職場 ☐ 3) 学校/大学 ☐ 4) 市場/デパート ☐ 5) その他 **(英語で記入して下さい)** ..... 所在地 (英語で記入して下さい) **例 コンドミニアム/アパート名、学校/大学名 店舗/デパート名、小路名**	☐ 1) 自宅 ☐ 2) 職場 ☐ 3) 学校/大学 ☐ 4) 市場/デパート ☐ 5) その他 **(英語で記入して下さい)** ..... 所在地 (英語で記入して下さい) **例 コンドミニアム/アパート名、学校/大学名 店舗/デパート名、小路名** .....

4. **4 輪小型タクシー**1 回の利用の

運賃.....**バーツ**, 車の待ち時間.....**分**, 所要時間.....**分**

5. あなたは他の交通機関との接続のために利用していますか。

☐ 1) いいえ ☐ 2)～と接続;

1 つのみ選択(駅名は英語で記入して下さい)

☐ 高架鉄道 (駅名.....) ☐ 地下鉄(駅名 .....) ☐ 船 (船着場名 .....)

☐ バス ☐ バイクタクシー ☐ ソンテウ ☐ 4 輪小型タクシー ☐ トゥクトゥク ☐ バン

☐ 電車 (駅.....)

6 あなたは 4 輪小型タクシーの利用に満足していますか。 ☐満足していない(1) ☐あまり 満足していない(2) ☐ 普通(3) ☐ やや満足(4) ☐ 満足(5)

第 2 部: 4 輪小型乗合いタクシーの利用動機

4 輪小型乗合いタクシーを利用する理由をお答えください。

(選択基準は次の通り: 1 = そう思わない, 2 = あまりそう思わない, 3 = 分からない, 4 = ややそう思う, 5 = そう思う)

	あなたが 4 輪小型乗合いタクシーを利用する理由は.....?	1 そう思わない➔ そう思う 5				
1	4 輪小型乗合いタクシーは便利。地区内で運行されている。	1	2	3	4	5
2	運賃が安い。	1	2	3	4	5
3	路上での事故を減らす。	1	2	3	4	5
4	駐車場を探すのが困難。	1	2	3	4	5
5	交通渋滞を避ける。	1	2	3	4	5
6	交通渋滞を発生させたくない。道路上の汚染を減らす。	1	2	3	4	5
7	自分の車を持っていない。	1	2	3	4	5
8	移動中に他のことができる。車窓の景色を楽しめる。	1	2	3	4	5
9	地域の人々と知り合って会話をしたい。	1	2	3	4	5

第 3 部: 公共交通機関のサービス提供に対する考え

3-1 あなたは**4輪小型乗合いタクシー**のサービス提供品質についてどのように考えますか。
(選択基準は次の通り: 1 = そう思わない, 2 = あまりそう思わない, 3 = 分からない, 4 = ややそう思う, 5 = そう思う)

		1 そう思わない → そう思う 5				
1	4 輪小型タクシーが頻繁に来ると感じる。	1	2	3	4	5
2	目的地エリアで 4 輪小型タクシーが運行していることに満足している。	1	2	3	4	5
3	4 輪小型タクシーは利用したいと思う時間帯に運行している。	1	2	3	4	5
4	4 輪小型タクシーの利用により、移動が早くできて時間が無駄にならない。	1	2	3	4	5
5	車を長時間待つことがない。	1	2	3	4	5
6	運賃が適正であると考える。	1	2	3	4	5
7	4 輪小型タクシーに乗るときは毎回座れる。座り心地がよい。	1	2	3	4	5
8	4 輪小型タクシー乗車場所付近に椅子や休憩所があることに満足している。	1	2	3	4	5
9	4 輪小型タクシーは、乗車—降車に時間をとってくれるため慌てなくてよい。また車へ乗り込むのも容易である。	1	2	3	4	5
10	4 輪小型タクシーは、他の車または他の交通機関への接続に便利である。	1	2	3	4	5
11	4 輪小型タクシーの利用は、身体や携行品に対して安全だと感じる。	1	2	3	4	5
12	4 輪小型タクシーは、清潔で塵やゴミがなく座席の状態もよく、体も楽に動かせる。またカーテンやブラインドなどで車外のあらゆるものから守られている。	1	2	3	4	5
13	一緒に座る乗客が礼儀正しく規律があることに満足している。	1	2	3	4	5
14	4 輪小型タクシーの運転手の礼儀正しく誠実なサービスに満足している。	1	2	3	4	5
15	4 輪小型タクシーに料金表が貼られていることに満足している。	1	2	3	4	5
16	4 輪小型タクシーは、大気汚染や騒音を発生させる一因となっている。	1	2	3	4	5
17	4 輪小型タクシーは、渋滞を発生させる一因となっている。	1	2	3	4	5
18	4 輪小型タクシーは、交通事故を発生させる一因となっている。	1	2	3	4	5

3-2 あなたは利用する**公共交通システム**の選択に関する次の要因についてどの程度の**重要性**を感じていますか。
(選択基準は次の通り: 1 = **重要性がない → 重要性がとても高い** = 5)

		1 重要性がない → 重要性がとても高い 5				
1	車が頻繁に来る。	1	2	3	4	5
2	運行経路。	1	2	3	4	5
3	運行時間帯。	1	2	3	4	5
4	移動の早さ。	1	2	3	4	5
5	車の待ち時間。	1	2	3	4	5
6	運賃の適切性。	1	2	3	4	5
7	座席に座れる。座席の座り心地が良い。	1	2	3	4	5
8	車の停車場所付近の椅子や待合所。	1	2	3	4	5
9	乗車 - 降車のための時間が十分である。またドアの開閉や、車の乗降のための階段などにより、車内へ入って座るのが容易。	1	2	3	4	5
10	他の移動手段への接続に便利。	1	2	3	4	5
11	身体および携行品に対する安全性。	1	2	3	4	5

		1 重要性がない → 重要性がとても高い 5				
12	清潔、座席の状態が良い、体が動かしやすい、騒音がない、カーテンやブラインドなどで車外のあらゆるものから守られているといった車内の状態。	1	2	3	4	5
13	同乗する客の礼儀正しさ。	1	2	3	4	5
14	車内のエアコン設備。	1	2	3	4	5
15	礼儀正しいサービス提供、誠実さ、荷物積み込みの手伝いといった運転手の態度。	1	2	3	4	5
16	地図や運賃情報といった運行路線情報。	1	2	3	4	5
17	大気汚染や騒音を放出すること。	1	2	3	4	5
18	交通渋滞を引き起こすこと。	1	2	3	4	5
19	交通事故を引き起こすこと。	1	2	3	4	5

第 4 部: その他の移動手段

1. **第 1 部と同じ路線について、**あなたには他の移動手段の選択肢がありますか。 ☐ 1) ある ☐ 2) ない **第 5 部へ**
2. あなたにはどのような移動手段の選択肢がありますか。(**回答は 1 つのみ選択**)

   ☐1)バス ☐2) バイクタクシー ☐3) ソンテウ ☐4) トゥクトゥク ☐5) 自家用車 ☐6) 自家用バイク ☐7) タクシー ☐8) 自転車 ☐9) 徒歩
3. あなたの使用頻度は ☐ 1) 毎日 ☐ 2) 4-5 日/週 ☐ 3) 2-3 日/週 ☐ 4) 時々
4. (**2.項の**) 移動 1 回当たりの 運賃……..…..**バーツ**, 車の待ち時間……..**分**, 所要時間……... **分**
5. あなたが **2 項の移動手段の代わりに 4 輪小型タクシーの利用を選択する**理由は。(**英語で回答して下さい**)

   ……

第 5 部: 個人情報

1. 性別 ☐ 1) 男性 ☐ 2) 女性
2. 年齢 ……
3. 婚姻状況 ☐ 1) 独身 ☐ 2) 既婚
4. 職業 ☐ 1) 学生/大学生 ☐ 2) 公務員 ☐ 3) 会社員 ☐ 4) 商売
   ☐ 5) 雇用主 ☐ 6) 定年退職 ☐ 7) 無職
   ☐ 8) その他; (**英語で回答して下さい**) …….....
5. 最終学歴

   ☐ 1) 小学校 ☐ 2) 中等・高等教育 ☐ 3) 職業専門校 ☐ 4) 上級職業専門校 ☐ 5) 大学在学中 ☐6) 大学 ☐7) 大卒より上
6. 家族の人数(あなたを含む) …… **人**
7. 家庭内の車両数(台数を回答して下さい)

   ☐ 自家用車 **台数**…..... あなたがいつでも使用可能 **台数**…....

   ☐ バイク **台数**..... あなたがいつでも使用可能 **台数**…....

   ☐ 自転車 **台数**…..... あなたがいつでも使用可能 **台数**…....

   ☐ なし
8. 多くの場合、一緒に移動する人がいる。(あなたを含む) …… **人**
9. 月給…… **バーツ**

アンケートの回答にご協力いただきありがとうございました。

ノンユーザー: NU - ☐☐☐

バンコク都内の 4 輪小型乗合いタクシー非利用者の移動行動および傾向の調査

チュラロンコン大学大学院

日付 ..... 時間 ..... 担当者 .....

第 1 部:移動

路線　☐ バンボーン- タラートプルー　☐ シリラート- タラートプルー　☐ チャランサニットウォンソイ 13-クローンサーン
☐ ウィパーワディランシットソイ 16 -ラチャダーピセークソイ 19　☐ スクムビットソイ 39

1. 主にあなたはどのように移動しますか。(**回答は 1 つのみ選択**)
☐1)バス　☐2) バイクタクシー　☐3) ソンテウ　☐4) トゥクトゥク　☐5) 自家用車　☐6) 自家用バイク　☐7) タクシー　☐8) 自転車　☐9) 徒歩
2. あなたの利用頻度は
☐ 1) 毎日　☐ 2) 4-5 日/週　☐ 3) 2-3 日/週　☐ 4) 時々
3. あなたは**何時頃**に利用しますか。(複数の時間を回答可) **例 8:00, 14:30**
1) .....　2) .....　3) .....　4) .....
4. あなたはどこからどこまで移動しますか。

～から (1 つのみ選択)	～まで (1 つのみ選択)
☐ 1) 自宅　☐ 2) 職場　☐ 3) 学校/大学 ☐ 4) 市場/デパート ☐ 5) その他 (**英語で記入して下さい**) ..... **所在地**　(英語で記入して下さい) 例　コンドミニアム/アパート名、学校/大学名 店舗/デパート名、小路名	☐ 1) 自宅　☐ 2) 職場　☐ 3) 学校/大学 ☐ 4) 市場/デパート ☐ 5) その他 (**英語で記入して下さい**) ..... **所在地**　(英語で記入して下さい) 例　コンドミニアム/アパート名、学校/大学名 店舗/デパート名、小路名 .....

5. (**1 項の**)1 回の移動の
運賃.....　**バーツ**,　車の待ち時間.....　**分**,　所要時間.....　**分**
6. あなたは他の交通機関との接続のために利用していますか。
☐ いいえ　☐ ～と接続:
1 つのみ選択(駅名は英語で記入して下さい)
☐ 高架鉄道 (駅名.....)　☐ 地下鉄(駅名 .....)　☐ 船 (船着場名 .....)
☐ バス　☐ バイクタクシー　☐ ソンテウ　☐ 4 輪小型タクシー　☐ トゥクトゥク　☐ バン
☐ 電車 (駅.....)

第 2 部: 4 輪小型乗合いタクシーを利用しない理由

➔ "4 輪小型乗合いタクシー"

4 輪小型乗合いタクシーを利用しない理由をお答えください。
(選択基準は次の通り: 1 = そう思わない, 2 = あまりそう思わない, 3 = 分からない, 4 = ややそう思う, 5 = そう思う)

	あなたが 4 輪小型乗合いタクシーを利用しない理由は.....？	1 そう思わない➔ そう思う 5				
1	利用方法を知らない。	1	2	3	4	5
2	停車場所が利用するには不便である。	1	2	3	4	5
3	目的地への接続点がない。	1	2	3	4	5
4	車の乗り換えをしたくない。	1	2	3	4	5
5	車の待ち時間が長い。	1	2	3	4	5
6	運転手の運転が遅すぎる。	1	2	3	4	5
7	運賃が高い。	1	2	3	4	5
8	4 輪小型乗合いタクシーは危険である。	1	2	3	4	5
9	混み合った雰囲気が好きではない。	1	2	3	4	5
10	徒歩や自転車での移動の方が好きである。	1	2	3	4	5
11	普段は自家用車で移動している。	1	2	3	4	5

第 3 部: 公共交通機関のサービス提供に対する考え

1. あなたが**良く**利用する公共交通システムは何ですか。**(回答は１つのみ選択)**
   ☐ 1) バス　☐ 2) バイクタクシー　☐ 3) ソンテウ　☐ 4) トゥクトゥク　☐ 5) タクシー
2. あなたの利用頻度は　☐ 1) 毎日　☐ 2) 4-5 日/週　☐ 3) 2-3 日/週　☐ 4) 時々
3. **1 項の**公共交通システムのサービス提供に関する要因についてどの程度の**重要性**を感じていますか。
   (選択基準は次の通り: 1 = **重要性がない**→**重要性がとても高い** = 5)

		1 重要性がない → 重要性がとても高い 5				
1	車が頻繁に来る。	1	2	3	4	5
2	運行経路。	1	2	3	4	5
3	運行時間帯。	1	2	3	4	5
4	移動の早さ。	1	2	3	4	5
5	車の待ち時間。	1	2	3	4	5
6	運賃の適切性。	1	2	3	4	5
7	座席に座れる。座席の座り心地が良い。	1	2	3	4	5
8	車の停車場所付近の椅子や待合所。	1	2	3	4	5
9	乗車 - 降車のための時間が十分である。またドアの開閉や、車の乗降のための階段などにより、車内へ入って座るのが容易。	1	2	3	4	5
10	他の移動手段への接続に便利。	1	2	3	4	5
11	身体および携行品に対する安全性。	1	2	3	4	5
12	清潔、座席の状態が良い、体が動かしやすい、騒音がない、カーテンやブラインドなどで車外のあらゆるものから守られているといった車内の状態。	1	2	3	4	5
13	同乗する客の礼儀正しさ。	1	2	3	4	5
14	車内のエアコン設備。	1	2	3	4	5
15	礼儀正しいサービス提供、誠実さ、荷物積み込みの手伝いといった運転手の態度。	1	2	3	4	5
16	地図や運賃情報といった運行路線情報。	1	2	3	4	5
17	大気汚染や騒音を放出すること。	1	2	3	4	5
18	交通渋滞を引き起こすこと。	1	2	3	4	5
19	交通事故を引き起こすこと。	1	2	3	4	5

第 5 部: 個人情報

1. 性別　☐ 1) 男性　☐ 2)女性
2. 年齢 ……
3. 婚姻状況　☐ 1) 独身　☐ 2) 既婚
4. 職業　☐ 1) 学生/大学生　☐ 2) 公務員　☐ 3) 会社員　☐ 4) 商売
   ☐ 5) 雇用主　☐ 6) 定年退職　☐ 7) 無色
   ☐ 8) その他; **(英語で回答して下さい)** ……
5. 最終学歴
   ☐ 1) 小学校　☐ 2) 中等・高等教育　☐ 3) 職業専門校　☐ 4) 上級職業専門校　☐ 5) 大学在学中　☐ 6) 大学　☐ 7) 大卒より上
6. 家族の人数(あなたを含む) …… **人**
7. 家庭内の車両数(台数を回答して下さい)
   ☐ 自家用車　**台数** ……　あなたがいつでも使用可能　**台数**……
   ☐ バイク　**台数**……　あなたがいつでも使用可能　**台数**……
   ☐ 自転車　**台数**……　あなたがいつでも使用可能　**台数**……
   ☐ なし
8. 多くの場合、一緒に移動する人がいる。(あなたを含む) …… **人**
9. 月給…… **バーツ**

アンケートの回答にご協力いただきありがとうございました。

APPENDIX B SEMI-STRUCTURED INTERVIEW

แบบสัมภาษณ์

การศึกษาวิจัย เรื่อง "นโยบายเพื่อความยั่งยืนของระบบขนส่งอย่างไม่เป็นทางการ: กรณีศึกษาการให้บริการเชื่อมต่อในกรุงเทพมหานคร ประเทศไทย"

ชื่อผู้สัมภาษณ์ ..... วันที่ .....

เวลา ..... สถานที่.....

ชื่อผู้ให้สัมภาษณ์ .....

ตำแหน่ง ..... สังกัด .....

1. บทบาท หน้าที่และนโยบายของหน่วยงานในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้าง

1.1 บทบาทและหน้าที่ในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้าง

- กรมการขนส่งทางบก มีบทบาทและหน้าที่ในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้างอย่างไร

.....

.....

.....

- กรมฯ มีการแบ่งส่วนงานย่อยและมอบหมายความรับผิดชอบด้านต่างๆ ในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้างอย่างไร

.....

.....

.....

1.2 นโยบายในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้าง

- กรมฯ มีนโยบายในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้างอย่างไรบ้าง

.....

.....

.....

- มีกระบวนการและขั้นตอนในการกำหนดนโยบายอย่างไร มีปัญหาในแต่ละกระบวนการหรือไม่ อย่างไร

.....

.....

.....

- กรมฯ มีการประสานงานระหว่างระบบขนส่งรูปแบบต่าง ๆ หรือไม่ อย่างไร (เช่น BUS, MC, BTS, MRT, Ferry) เช่น จัดให้มีสิ่งอำนวยความสะดวกสำหรับเชื่อมต่อรูปแบบการเดินทาง ไม่ให้การบริการซ้อนทับเส้นทางกัน และไม่ให้แต่ละรูปแบบการเดินทางมีการแข่งขันกันหรือแย่งผู้โดยสารกัน

.....

.....

.....

2. กฎหมายและข้อบังคับเกี่ยวกับการจดทะเบียนรถยนต์สี่ล้อเล็กรับจ้าง

2.1 กฎหมายและข้อบังคับที่เกี่ยวข้อง

- กฎหมายและข้อบังคับอะไรบ้างที่เกี่ยวกับการจดทะเบียนรถยนต์สี่ล้อเล็กรับจ้าง

.....

.....

.....

- มีกฎหมายและข้อบังคับที่เกี่ยวกับช่วงเวลาการให้บริการ สภาพรถที่ใช้งาน (เช่น อายุการใช้งาน คุณภาพรถ) และคุณสมบัติของผู้ให้บริการ (คนขับ) หรือไม่ อย่างไร

.....

.....

.....

2.2 ขั้นตอนการจดทะเบียน (รถยนต์ สหกรณ์ หัวหน้าวิน คนขับ)

- กฎหมายหรือข้อบังคับที่ระบุเกี่ยวกับการจดทะเบียนรถและใบขับขี่ของคนขับ (เช่น ทะเบียนรถและใบขับขี่ต้องเป็นประเภทเดียวกันหรือไม่)

.....

.....

.....

2.3 กรมฯ มีหน้าที่ในการตรวจจับ/ตรวจสอบการปฏิบัติตามกฎหมายและข้อบังคับหรือไม่ ถ้ามีหน้าที่ตรวจจับ/ตรวจสอบในขั้นตอนใด ถ้าไม่มี หน่วยงานใดมีหน้าที่ในการตรวจจับ/ตรวจสอบ

.....

.....

.....

2.4 การทบทวนและปรับปรุงกฎหมายและข้อบังคับ

- กรมฯ มีแผนงานหรือแนวทางในการทบทวนและปรับปรุงกฎหมายและข้อบังคับให้เป็นปัจจุบันอย่างไร

.....

.....

.....

3. ปัญหาที่พบในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้าง

- ปัญหาที่พบในการกำกับดูแลรถยนต์สี่ล้อเล็กรับจ้างมีอะไรบ้าง และมีมาตรการจัดการกับปัญหาอย่างไร

.....

.....

.....

4. ข้อคิดเห็นและข้อเสนอแนะต่อระบบการให้บริการรถยนต์สี่ล้อเล็กรับจ้าง

4.1 ประโยชน์และผลกระทบของการให้บริการรถยนต์สี่ล้อเล็กรับจ้าง

- ท่านคิดว่าการให้บริการรถยนต์สี่ล้อเล็กรับจ้างมีประโยชน์อย่างไรบ้าง (เช่น เศรษฐกิจ สิ่งแวดล้อม สังคม/ชุมชน)

.....

.....

.....

- ท่านคิดว่าการให้บริการรถยนต์สี่ล้อเล็กรับจ้างมีผลกระทบอย่างไรบ้าง (เช่น เศรษฐกิจ สิ่งแวดล้อม สังคม/ชุมชน)

.....

.....

.....

4.2 ปัญหาการให้บริการรถยนต์สี่ล้อเล็กรับจ้าง

- ท่านคิดว่าการให้บริการรถยนต์สี่ล้อเล็กรับจ้างในปัจจุบันมีความเหมาะสมหรือไม่ อย่างไร

.....

.....

.....

4.3 การจัดการหรือมาตรการเพื่อให้เกิดความยั่งยืน

- ท่านคิดว่าควรมีการจัดการหรือมาตรการอย่างไรเพื่อให้เกิดความยั่งยืน

.....

.....

.....

- ถ้ามีนโยบายเพื่อสนับสนุนการให้บริการรถสี่ล้อเล็กในด้านต่างๆ เช่น ให้ความรู้เรื่องการซ่อมบำรุงรถ ให้ความรู้เรื่องการขับขี่อย่างปลอดภัย และจัดสิ่งอำนวยความสะดวก (เช่น จุดจอดรถ ท่ารถ) ท่านเห็นด้วยหรือไม่ อย่างไร

.....

.....

.....

- ถ้ามีนโยบายสนับสนุนให้รถสี่ล้อเล็กเป็นระบบเชื่อมต่อกับ BTS/MRT ท่านเห็นด้วยหรือไม่ อย่างไร

.....

.....

.....

4.4 ข้อเสนอแนะเพื่อปรับปรุงการให้บริการรถยนต์สี่ล้อเล็กรับจ้าง

.....

.....

.....

Semi-structured Interview Record Form

Research Topic: Policy for Sustainable Informal Transport: A Case Study of Feeder Services in Bangkok, Thailand

---

Name of Interviewer ..... Date .....

Time ..... Place .....

Name of Interviewee .....

Position ..... Division .....

1. Roles, responsibilities, and policies for SR services

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

2. Laws and regulations on SR services

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

3. Challenges on controlling SR services

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

4. Opinions and recommendations on SR services

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

GLOSSARY

BTS: Bangkok Transit System or Sky-train in Bangkok

Captive: Respondents who have no alternative modes

East BKK: Bangkok area on the east side of Chao Phraya River

MRT: Bangkok Metro or Mass Rapid Transit

Non-user: Respondents who never use Silor

Private driving license: Driving license for drivers who drive private vehicles such as sedan, van, and pick-up

Private vehicle: Vehicles for private use with white-background license plate. For example,

Black text for sedan (not more than 7 passenger seats)

Blue text for microbus, passenger van (over 7 passenger seats)

Green text for pickup

Public driving license: Driving license for drivers who drive public or for-hired vehicles such as taxi, Silor, and tuk-tuk

Public vehicle: Vehicles used for serving passengers with yellow-background license plate. For example,

Black text for taxi (not more than 7 passenger seats)

Blue text for Silor

Green text for tuk-tuk

Songtaew: A modified pick-up truck used as share taxi for passengers travelling in the same direction usually with fixed routes and fares

West BKK: Bangkok area on the west side of Chao Phraya River

VITA

NAME	Chutaporn Amrapala
DATE OF BIRTH	12 August 1984
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	B.Ed. Biology, Faculty of Education, Chulalongkorn University M.Sc. Environmental Science, Graduate School, Chulalongkorn University
AWARD RECEIVED	100th Anniversary Chulalongkorn Universtiy Fund for Doctoral Scholarship and 90th Anniversary of Chulalongkorn University Fund (Ratchadaphiseksomphot Endowment Fund)