การพัฒนาเทคนิค Stated Preference (SP) ในการประเมินคุณภาพ
การให้บริการของรถขนส่งกึ่งสาธารณะ

นายประพัทธ์พงษ์ อุปลา

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิศวกรรมดุษฎีบัณฑิต

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DEVELOPMENT OF STATED PREFERENCE (SP) TECHNIQUE FOR DETERMINING SERVICE QUALITY OF PARATRANSIT

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A Dissertation Submitted in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy Program in Civil Engineering
Department of Civil Engineering
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ประพัทธ์พงษ์ อุปลา : การพัฒนาเทคนิค Stated Preference (SP) ในการประเมินคุณภาพการให้บริการของรถขนส่งกึ่งสาธารณะ. (DEVELOPMENT OF STATED PREFERENCE (SP) TECHNIQUE FOR DETERMINING SERVICE QUALITY OF PARATRANSIT), อ.ที่ปรึกษา : รองศาสตราจารย์ ดร.สรวิศ นฤปิติ, 116 หน้า

การวัดระดับการบริการระบบขนส่งสาธารณะเป็นที่สนใจในการวิจัยเพื่อการวางแผนการขนส่งที่สะท้อนถึงประสิทธิภาพ ประสิทธิผล ผลกระทบทางสังคม ระดับการบริการ และ ความเท่าเทียมกันของการให้บริการรถสาธารณะ เพื่อเพิ่มประสิทธิผลของระเบียบวิธีการวัด การศึกษานี้เสนอระเบียบวิธีการวัดคุณภาพการให้บริการรถขนส่งกึ่งสาธารณะโดยใช้เทคนิค Stated Preference (SP) การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อ (1) ตรวจสอบระเบียบวิธีที่ใช้หาคุณภาพการให้บริการของรถขนส่งสาธารณะที่มีอยู่เพื่อนำไปสู่การพัฒนาระเบียบวิธีสำหรับวัดคุณภาพการให้บริการของรถขนส่งกึ่งสาธารณะ (กรณีศึกษารถตู้โดยสารสาธารณะ) (2) วิเคราะห์ปัจจัยที่มีผลต่อคุณภาพการให้บริการของรถตู้โดยสารสาธารณะ (3) สร้างระเบียบวิธีที่เหมาะสมที่ใช้วัดประสิทธิภาพการให้บริการของรถขนส่งกึ่งสาธารณะ (4) ตรวจสอบลักษณะการให้บริการของรถตู้โดยสารสาธารณะ (5) ประยุกต์ระเบียบวิธีที่สร้างขึ้นกับรถตู้โดยสารสาธารณะเพื่อหาข้อสรุปของคุณภาพการให้บริการ และ (6) อธิบายระเบียบวิธีและความสามารถในการใช้งานจริง การศึกษานี้ประยุกต์ใช้ระเบียบวิธีที่พัฒนาขึ้นกับผู้ใช้บริการรถตู้โดยสารสาธารณะจำนวน 1,200 ชุด โดยเลือกกลุ่มตัวอย่างจากพื้นที่เมืองชั้นใน ชั้นกลาง และชั้นนอก นอกจากนี้ได้สำรวจข้อมูลพิเศษเพิ่มเติมจำนวน 300 ชุด จากพื้นที่เมืองชั้นกลาง เพื่อสร้างแบบจำลองร่วมระหว่างข้อมูล Revealed Preference (RP) และข้อมูล Stated Preference (SP) ผลจากการศึกษาให้ข้อสรุปที่สำคัญของการนำไปใช้งานใน 3 ประเด็นหลัก ได้แก่ (1) การพัฒนาเทคนิค Stated Preference (SP) ในการวัดคุณภาพการให้บริการรถขนส่งสาธารณะ (2) การออกแบบและพัฒนาเทคนิค Stated Preference (SP) ให้สัมพันธ์กับพฤติกรรมการเดินทางของผู้ใช้บริการ (3) การนำไปใช้ประเมินคุณภาพการให้บริการของรถตู้โดยสารสาธารณะ ระเบียบวิธีที่พัฒนานี้สามารถวัดคุณภาพการให้บริการของรถขนส่งกึ่งสาธารณะและยังเป็นวิธีพื้นฐานสำหรับวัดระดับการให้บริการของรถขนส่งสาธารณะทุกประเภท ทั้งยังช่วยให้เกิดความเข้าใจในพฤติกรรมการเลือกรูปแบบการเดินทางภายใต้คุณภาพการให้บริการต่างๆ อีกด้วย

ภาควิชา วิศวกรรมโยธา ลายมือชื่อนิสิต ______
สาขาวิชา วิศวกรรมโยธา ลายมือชื่ออาจารย์ที่ปรึกษา สรวิศ นฤปิติ
ปีการศึกษา 2550

##4571841721: MAJOR CIVIL ENGINEERING
KEY WORD: STATED PREFERENCE TECHNIQUE/ SERVICE QUALITY MEASUREMENT/ PASSENGER VAN

PRAPATPONG UPALA : DEVELOPMENT OF STATED PREFERENCE (SP) TECHNIQUE FOR DETERMINING SERVICE QUALITY OF PARATRANSIT. THESIS ADVISOR : ASSOC. PROF. SORAWIT NARUPITI, Ph.D., 116 pp.

The transit performance measurement has been an important research of transportation planning to measure the cost efficiency, cost effectiveness, social impacts, quality of service, and equity of transit services and operations. To increase the effectiveness of the existing methodology, this study proposed an alternative method of service quality determination using Stated Preference (SP) technique. The objectives of the study were to (1) examine the previous methods of transit service quality measurement to develop an alternative tool for measuring the service quality of paratransit (in this case the passenger vans); (2) identify factors attributing to the service quality of passenger vans; (3) propose an alternative method that could be employed to measure the service quality of paratransit; (4) investigate the characteristics of passenger van services; (5) apply the measurement technique to the case of passenger van in Bangkok to draw conclusion on service quality; and (6) describe the implications of this alternative method to identify its strength and applicability. A sample of 1200 respondents was drawn from three strata pertaining to different spatial locations, specifically Inner-city, Urban-fringe, and Suburban. Moreover, the special survey of 300 respondents was drawn from urban-fringe location to develop the RP-SP models. This study has three key implications. (1) the development of stated preference (SP) technique for determining service quality; (2) the design and development of SP technique-related tools to study travel behaviours in wider aspects (3) the demonstration of the applicability of SP techniques for determining service quality of passenger vans. This developed technique can be applied to measure the service quality of paratransit modes as well as to unify the service quality measurement across public transport modes. This technique also helps situate better understandings on how people select their mode choices due to service quality levels.

Department ....Civil Engineering
Field of Study .....Civil Engineering
Academic year ....2007......

Student's Signature ....
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This work is lovingly and earnestly dedicated to the three most important persons of the author's life; his parents Ajarn Sompong and Ajarn Pranom, and his one sister Ajarn Kasama.

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CHAPTER I

INTRODUCTION

This chapter begins with a description of general background to situate the foundation for the present study. Next, the problems are outlined in the problem statement section to substantiate the need for the study to be conducted. Then, the objectives of the study are delineated. The delimitation is discussed in the scope of the study section and the merits of the study are presented in the expected results section. The chapter ends with a section on definitions of terms.

1.1 GENERAL BACKGROUND

For the more than three decades now that the ‘passenger van’ or ‘private commercial van’ has become a vital form of public transport in mega cities of developing countries such as Rio de Janeiro, Brasilia, Hong Kong, Bangkok, and the developed world such as New York City (Cervero, 2000). This research focuses on the particular case of passenger vans service in Bangkok, where this service emerges as one of the important public transit services. Bangkok is the capital centre of Thailand, with a population of 6.5 million in the central area of 1,568 km^2. A total of 22 million person-trips occur daily, in which 9 million person-trips take place on public transport systems (Office of Transport and Traffic Policy and Planning (OTP), 2006). Whilst the mass rapid transit (BTS sky train and Mass Rapid Transit (MRT) subway) is gaining in popularity but buses (microbus, mini bus, conventional bus, and air-conditioned bus) remain - at least for the moment - the most popular mode. Bus patronage is however in decline, due largely to severe traffic congestion, and the poor level of service that comes as a consequence. The growing popularity of paratransit can be attributed to a relative advantage over buses in terms of both service level and service area. The major modes of paratransit in Bangkok include taxis and passenger vans. This research considers the case of passenger van, which was formerly a form of informal transport modes but the government authority has regulated the licensed routes since 1999. A majority of passenger vans offers point-to-point (shuttle-like) service with possible minor alteration in time and route, as well as stops. This service focuses mainly on the market related to the commuting and school trips. A number of policy issues arise, relating in particular to its complementary to, and competition with, more conventional public transit modes in Bangkok. In comparison to buses, passenger vans offer shorter journey time, increased frequencies, improved reliability, higher levels of comfort, less frequent stopping, guaranteed seating and air conditioning (Sudsanguan, 1995; Kunasol, 2000; Eamsupawat, 2002; Chaisri, 2003; Nontasiri, 2003; and Upala and Narupiti 2004). Equipped with such advantages, it is unsurprising that the advent of passenger van has provoked noticeable changes in the travel behaviour of Bangkok commuters. The shortcomings of these studies are discussed in the Problem Statement section to underpin the need for the present research.

1.2 STATEMENT OF THE PROBLEM

For four decades, the transit performance measurement have been an important topic of research in transportation planning to measure the cost efficiency, cost effectiveness, social impacts, quality of service, and equity of transit services and operations (Alter, 1976; Dajani and Gormam, 1978; Fieldling et al, 1978; Guenther and Sinha, 1982; Talley and Beeker, 1982; Talley, 1986; and Sulek and Lind, 2000). From above studies, it could be summarised that the evaluation of transit performance are very difficult and costly for collecting comprehensive data. For more than three decades, the issues dealing with service quality measurement have been the interest of researchers especially those in the field of travel behaviour (Ben-Akiva and Morikawa, 1991; Bradley and Daly, 1997; Hensher, 1994; McFadden, 1973; and Ortuzar, 2000). Therefore, this research considers the particular case of service quality or quality of service, which is based on the customer's point of view, that assesses the degree of goodness of the service. Service quality is the one of key success indicators for transit service management, in which it is especially useful for deciding where, how often, how long, and the kind of transit service that should be provided within the constraints of transit agency budget.

In 1999, the first comprehensive study of service quality measurement, Transit Capacity and Quality of Service Manual (TCQSM), was published and four years later Transportation Research Board (TRB) improved it in the second edition. TRB (2003) categorized the measurement of service quality of public transport under the two main types: quantitative and qualitative. On one hand, the quantitative measures, including Level of Service (LOS) and Indexes technique, aim to assess the things that are directly observable about transit service. On the other hand, the qualitative measures, including customer satisfaction surveys and passenger environment surveys, are used for identifying aspects of service quality that are difficult or impossible to measure directly. Although the previous methods would be useful for measuring service quality, applying these concepts is impractical and inappropriate in the context of the present study. This is because there are still four major problems to measure service quality of passenger vans. Firstly, the passenger van services cannot be compared to conventional LOS standards of the fixed-route service and the demand-responsive service because their services are fundamentally different. Secondly, an Index technique is valuable for reporting; however, the impacts of changes in individual index components are hidden. Thirdly, the measuring of conventional service quality method focuses only on the quantitative data, in fact; it is short of combining both of the quantitative and the qualitative data. Lastly, although the implication of customer satisfaction surveys and passenger environment surveys could justify the degree of passenger satisfaction, or dissatisfaction as well as the greatest impact on customer satisfaction that are helpful for operating and improving transit service, these surveys cannot examine the users' preference and forecasting demand when the transit changes its services.

To increase the applicability of the previous methodology as aforementioned and fill the gaps of measuring service quality concepts, this study therefore turns to put more attention to apply in the economics and behavioural method, Stated Preference (SP) technique, in service quality measurement. In accordance with the informal transport study by Cervero (2000), his study suggested that discrete-choice (logit) analyses could be a typical technique for gauging the utility and perceived value of informal service features more than other traditional methods. SP techniques are well known and widely used in transport studies for over three decades (Bateman et al, 2002, Ben-Akiva and Lerman, 1985; Bradley and Daly, 1997; Hensher, 1994; Louviere et al, 2000; McFadden, 1973; and Ortuzar, 2000; and Pearmain and Kroes, 1990), but they have just been applied in some transport matters, especially mode choice. SP techniques are especially useful for studying non-existing market situations, such as building new light rail line, building new motorway and implementing road pricing. They have been used to evaluate the effects of relevant attributes (attribute valuation) of a system on individuals' responses and to provide forecast of changes in demand and travel behaviour. A procedure of SP study includes the problem identification, questionnaire and experimental design, data collection, and data analysis with an awareness of individuals' decision-making. In order to forecast transport demand and produce conclusion about people's willingness to pay, the questionnaire and experimental design is the heart of SP procedure. The design experiments are formulated from the scenario sets of hypothetical situations and payment scenarios for either specific aspects or the entirety of goods, services or other things that are relevant to decision (Pearmain and Kroes, 1990; Hensher, 1994; and Bateman et al, 2002). To effectively apply SP techniques, Jaensirisak and Upala (2006) suggested that six key issues should be considered: (1) SP experiment design, (2) measurement of attributes, (3) data collection, (4) respondents' understanding of new scenarios, (5) captive sample, and (6) current situations.

As passenger van has become the important mode of paratransit in Bangkok, a number of Thai researchers in the field of travel behaviour have recognized the importance to measure the service quality of passenger vans (Upala, 2006). In the 2000s, three Thai researchers in the field of travel behaviour similarly studied factors attributing to the usage of passenger vans. Kunasol (2000) listed seven factors that three groups of participants believed these factors influenced both the usage and the operation of passenger vans in Bangkok metropolitan areas. Seven factors identified by the first group of participants (the passenger vans users) included: (1) travel time, (2) comfort, (3) reliability, (4) safety, (5) accessibility, (6) fare, and (7) crew (van drivers and fare collectors) manners. In particular, these participants admitted that they were more satisfied with the passenger vans than the air-conditioned buses. The second (passenger van operators) and the third (taxi operators) groups of participants had slightly different ideas towards the seven factors that they thought affected their operations. Both of these groups generally agreed that their operations could be influenced by these following seven factors: (1) revenue, (2) cost, (3) safety, (4) convenience, (5) flexible work schedule, (6) admittance, and (7) comfort. On one hand, the level of satisfaction that passenger van operators had towards these factors was rated remarkably high. On the other hand, taxi driver operators' level of satisfaction toward these factors was low. Two years later, Eamsupawat (2002) noted the two factors attributing to the determination of the service routes of passenger vans: (1) demand factors and (2) supply factors. The demand factors included, for example, increasing population and unsystematic suburban expansion. The supply factors were, for example, (1) inefficient public transportation service and (2) the efficiency and high service levels of passenger van services. Moreover, this same study also reported what participants regarded as the negative factors of passenger vans. These negative factors were, for example, (1) lack of safety, (2) high fares (3) lack of proper control from responsible organizations, (4) poor management, and (5) fierce competition between passenger vans and public buses. Regardless of these negative factors, a majority of passengers preferred passenger vans to public buses as passenger vans helped reduce journey time and offered more comfort. Chaisri (2003) offered more or less the same results as those of the two previously mentioned studies (Kunasol and Eamsupawat). In his study on passenger satisfaction towards passenger vans running from two universities (Rangsit to Ramkhamhaeng and vice versa), Chaisri found that the participants were moderately satisfied with the fares, crew (van drivers and fare collectors) manners, safety, comfort, and reliability. However, this same group of participants was less satisfied with travel time and accessibility to van services. One lone Thai researcher examined an increase of illegal passenger vans in Bangkok. An analysis of the data by Punyasuith (2002) concluded that an increase of illegal passenger vans in Bangkok was largely due to the problems of the organizations responsible for passenger van services. These problems were, for example, (1) lack of human resources, (2) budget, (3) equipment, and (4) location. Worse yet, these problems, as Punyasuith noted further, were fumed by political problems. The research findings of the studies dealing with passenger van services in Bangkok could explicate the service quality of passenger vans in Bangkok to some extent. However, as almost all the reviewed studies measured the passenger vans' service quality with conventional measurement tools, their findings could little be used to assess and evaluate the van service quality.

Therefore, the SP survey technique is proposed here for applying it to measure the passenger van performance and its service. Because of the analysis of supply and demand, the SP techniques can identify feasible policies, projects, or strategies from transit performance measures and evaluations. In addition to several studies, the measurement of service quality has since refocused on SP techniques for investigating the role of trade-off scenarios of service quality attributes (Hensher 1991; Ortuzar 1997; Prioni and Hensher, 2000; and Swanson et al 1997, Upala, 2006a; Upala, 2007a, Upala, 2007b). Moreover, the recent study of passenger vans in Bangkok which also applied in SP technique for measuring service quality were found in the empirical works of illegal passenger van (Upala, 2006b) and express passenger vans (Upala, 2006c). To increase the efficiency of SP experiments and to assist transport planners and transit agencies, this study will apply and improve the SP techniques to determine the service quality of passenger vans, which bring about more understanding on the passenger van performance that can further and correctly identify the role of passenger van in the integrated transportation system.

1.3 OBJECTIVES OF THE STUDY

Mindful of the shortcomings generated by previous studies, the present study aims to:

1.3.1 Examine the previous methods of transit service quality measurement to develop an alternative tool for measuring the service quality of paratransit (in this case the passenger vans);

1.3.2 Identify factors attributing to the service quality of passenger vans;

1.3.3 Propose an alternative method that could be employed to measure the service quality of paratransit;

1.3.4 Investigate the characteristics of passenger van services;

1.3.5 Apply the measurement technique to a case of passenger van in Bangkok to draw conclusion on service quality; and

1.3.6 Describe the implications of this alternative method to identify its strength and applicability.

1.4 SCOPE OF THE STUDY

As passenger vans have gradually become a major mode of paratransit in Bangkok, this present study applies the concepts of Stated Preference (SP) Technique to measure the service quality of passenger vans.

Passenger van services in Bangkok are very complicated as different characteristics are based on spatial locations and market segments. Although the developed measurement method can be applied to general public transit, including conventional transit and paratransit and to entire population of transit users, the application of this technique in this study is limited to cover the sample of passenger van of school trips due to research resource. Additionally, the SP techniques themselves still have some limitations and arguments, e.g. the context to use SP techniques, instrument design, and attribute specification. Therefore, this study proposes an alternative method that could be employed to measure the service quality of paratransit (in this case of passenger vans).

1.5 EXPECTED RESULTS

Merits of the development of Stated Preference (SP) technique for determining service quality of paratransit would be divided into two contexts (1) the state of practice in service quality measurement and (2) the state of the art in Stated Preference technique development.

Under the first context, an accurate knowledge of how users evaluate transit performance through service quality attributes can be obtained. The research brings about a better measurement technique that could give the degree of service quality attributes, the greatest impact on service quality attributes, utility of mode choice, preference of transit service, attribute valuation, and policy responsive. The "comprehensive" understandings could provide transport planners and transit agencies to access to useful information for defining service quality with appropriate and competitive characteristics to serve market, and to increase their profits and market shares. With enriched knowledge of preference, the transport planners and transit agencies – both passenger van operators and Bangkok Metropolitan Transit Authority (BMTA) – could be much more confident with their better understandings on how individuals respond to the modified service characteristics. This detail is presented in Figure 1.1.

Moreover, this study would disclose a detailed methodology on the "indicator" development for formulating multi-attributes in the experimental design and eliminating the bias of data, the "scaling" development for improving the reliability of data, the "benchmarking" development for comparing the various of passenger van services, the "willingness-to-pay" evaluation for understanding on travel decision on various scenarios, and the applicability of SP experimental design and surveying in developing countries.

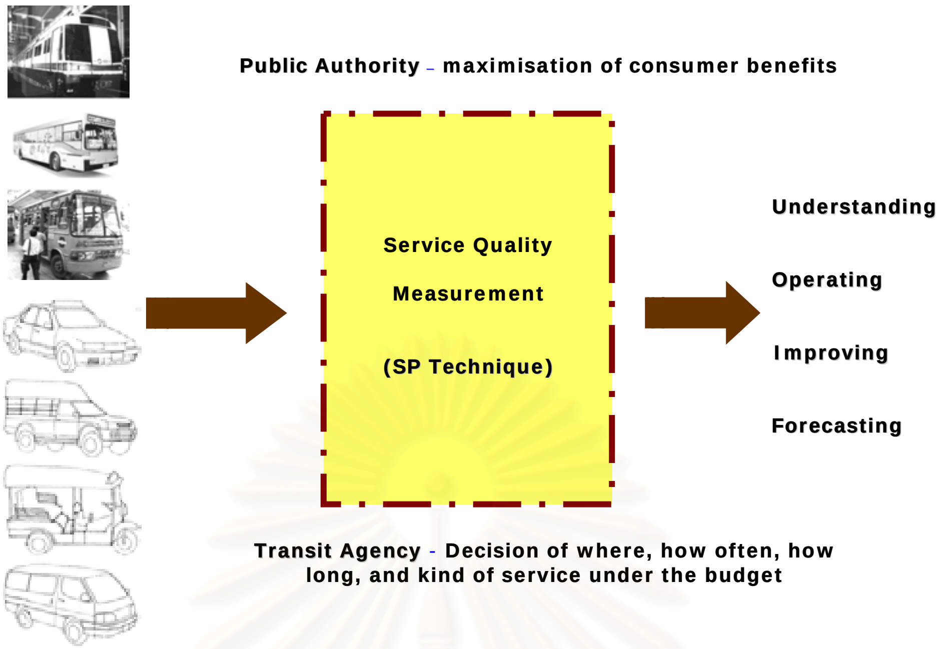

Figure 1.1 Expected results of service quality measures based on SP technique

1.6 DEFINITIONS

1.6.1 *Service Quality* is the overall measured or perceived performance of transit service from the passenger's point of view.

1.6.2 *Passenger Van* is a small-medium transit service that found in the mega city, e.g., Rio de Janeiro, Brasilia, Hong Kong, Bangkok, and New York City.

1.6.3 *Stated Preference (SP)* is a statement by an individual of his or her liking for one alternative over another.

1.6.4 *Revealed Preference (RP)* is an observation of the way an individual expresses his or her linking for one alternative over another, as revealed in their life behaviour.

1.6.5 *Respondent* is an individual who participates in a stated preference exercise and provides responses to the hypothetical situations.

1.6.6 *Attribute* is a characteristic of a goods or service (e.g., travel time, fare, comfort).

1.6.7 *Fractional factorial design* is an experimental design which only uses some of the combinations from a full factorial design but maintains the orthogonality.

CHAPTER II

LITERATURE REVIEW

In order to develop the SP technique for determining service quality of passenger vans, the theoretical frameworks of the present study are reviewed and presented into three main parts: (1) service quality measurement, (2) Stated Preference (SP) techniques, and (3) Passenger van service in Bangkok. The first part of this chapter describes the principles of service quality measurement, service quality definition, and pervious methods for measuring service quality to investigate their concept development, benefits and limitations, techniques, and attributes. Next, the Stated Preference (SP) techniques are summarised. The SP is the developed technique that is used as the alternative method for determining service quality in this study. This section reviews general background of this technique, process of experimental design, analysis methods, applications in service quality measurement, and service quality attributes. The chapter ends with the description on the operational characteristics of passenger van services in Bangkok and the previous study of passenger vans to consider selection of appropriate service quality attributes for development of adaptive SP technique for passenger vans. The overall theoretical frameworks reviewed in this chapter are shown in Figure 2.1.

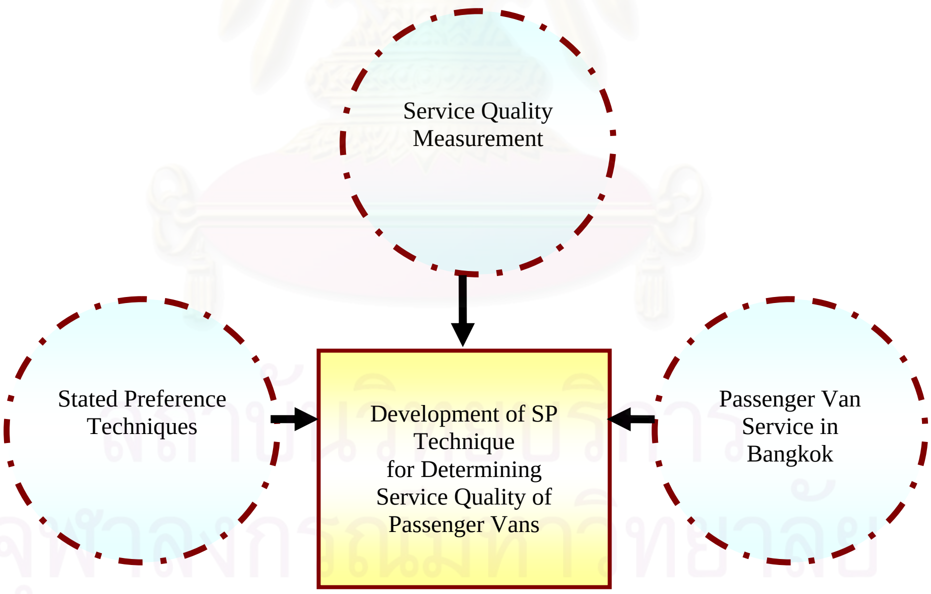

Figure 2.1 Theoretical frameworks of the study

2.1 SERVICE QUALITY MEASUREMENT

The aim of this part is to investigate the general concept development, benefits and limitations, techniques, and attributes for determining an appropriate tool to measure the service quality of passenger vans. The section organisation of this part is divided three sections: (1) general background, (2) service quality definition, and (3) methods of service quality measurement. The first section is a brief description of the general background and the concept development of service quality measurement. Next, the section is the transit service definitions that enlighten the meaning of service quality and its related technical terms. The last section gives details of the methods (objectives, and measurement techniques) that would be employed to measure service quality.

2.1.1 GENERAL BACKGROUND

In 1958, the development of transit performance evaluation and performance indicators first appeared in the U.S National Committee on Urban Transportation in a series of comprehensive reports, specifically service standards, objectives, and measurement techniques. Later, studies on transit performance evaluation extended to cover the consideration by several transit stakeholders, for example, Tomazinis (1975) measured and evaluated transit performance from four points of view: (1) operator, (2) users, (3) society, and (4) government. The researchers developed various concepts and techniques in transit performance measurement during the past thirty years (Alter, 1976; Dajani and Gormam, 1978; Fieldling et al, 1978; Guenther and Sinha, 1982; Talley and Beeker 1982; and Talley 1986). The dimensions of transit performance measurement from the previous studies could generally be summarised into five main categories: (1) cost efficiency, (2) cost effectiveness, (3) social impacts, (4) quality of service, and (5) equity. The finding of those studies indicated that the transit performance evaluation was very difficult and costly to collect comprehensive data.

Recently, the first comprehensive study of service quality measurement was the Transit Capacity and Quality of Service Manual (TCQSM) in 1999. This manual can be used for identifying how well service is provided to their customers, the areas where improvement may be needed, and the effects of action taken to improve performance, as well as the performance is forecast in the future. Four years later, Transportation Research Board (TRB) improved the TCQSM in the second edition. To monitor progress towards policy goals and objectives, TRB (2003) divided the transit performance measures into four main points of view including customer, community, agency, and driver/vehicle. Details of the points of view are presented in Figure 2.2. Nowadays, the service quality measurement, which is a customer’s point of view, has currently emerged as a vital approach for measuring effectiveness indicator and for transit service development.

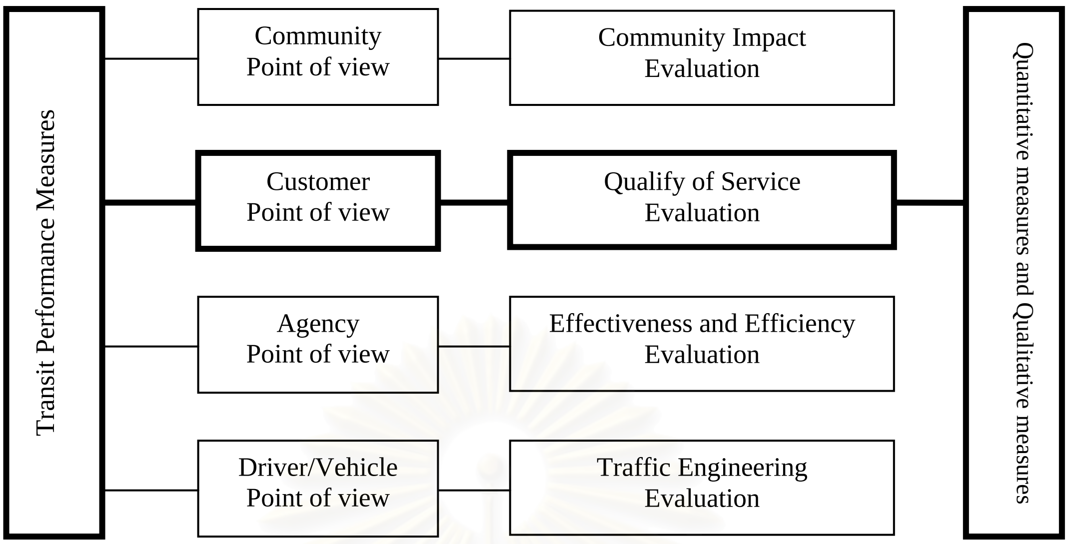

Figure 2.2 Points of view of transit performance measures (TRB, 2003)

2.1.2 SERVICE QUALITY DEFINITION

TRB (2003) defined the meanings of service quality, transit performance measure, transit service measure, and level of service in the TCQSM second editions to provide transportation practitioners with understanding on technical terms of transit service and these definitions are described as below:

(1) Service quality: the overall measured or perceived performance of transit service from the passenger's point of view.

(2) Transit performance measure: a quantitative or qualitative factor used to evaluate a particular aspect of transit service.

(3) Transit service measure: a quantitative performance measure that best describes a particular aspect of transit service and represents the passenger's point of view. It is also known elsewhere as a *measure of effectiveness.*

(4) Level of Service (LOS): designated ranges of values for a particular service measure, graded from "A" (highest) to "F" (lowest) based on a transit passenger's perception of a particular aspect of transit service.

2.1.3 METHODS OF SERVICE QUALITY MEASUREMENT

Before the first TCQSM was published in 1999, the previous methods for measuring service quality were depended on two main approaches: (1) customer satisfaction surveys and (2) level of service (LOS). The good applications of LOS are Botzow's (1974) study and Alter's (1974) study. Botzow measured the service quality in terms of speed, delay, and comfort factors related with the vehicle including density, acceleration, temperature, airflow, and noise. His study classified LOS into six levels. Besides, Alter developed LOS model by six indicators: (1) accessibility, (2) travel time, (3) reliability, (4) directness of service, (4) frequency of service, and (5) passenger density.

In 1999, the first comprehensive study of service quality measurement was published, entitled Transit Capacity and Quality of Service Manual (TCQSM), and four years later Transportation Research Board (TRB) improved this manual. In the new editions, TRB (2003) divided service quality measurement into two types: quantitative measures and qualitative measures and details are described as below:

2.1.3.1 Quantitative measures

Quantitative measures attempt to measure service aspects that can directly be quantified. To interpret the transit performance, the results from the empirical study need to be compared to the fixed (preset) standard or the past relative performances in terms of *Level of service* or *Index*.

Level of service (LOS)

In 1965, TRB developed the concept of LOS in the Highway Capacity Manual. Under this concept, the six ranges of the potential values of the service performance presented on “A” (highest quality) to “F” (lowest quality). Later, the concept of LOS transit performance was developed from the concept of LOS of highways. TRB (1999) explained that the three main reasons to adopt transit LOS are as follow:

(1) Many planning organizations and decision-making bodies are already familiar with LOS letter grades as they are applied to highways;

(2) To share a common language on how quality of service is measured, adopting a similar system for fixed-route transit or all other transportation modes; and

(3) To ease the learning curves for planners and decision-makers who may be less familiar with transit operations than with roadway operations.

Additionally, TRB’s (2003) edition presented the indicators and attributes to measure LOS transit performance for the fixed-route service (A-F numerical scale) and the demand responsive service (1-8 numerical scale) and details are illustrated in Table 2.1

Table 2.1 Transit performance indicator (TRB, 2003)

Mode	Indicator	Transit Stop Measure	Route Segment Measure	System Measure
Fixed-route service	Availability	Frequency	Hours of Service	Service Coverage
	Comfort and Convenience	Passenger Load	Reliability	Transit-Auto Travel time
Demand Responsive service	Availability	Response Time	Span of service	
	Comfort and Convenience	On-time performance	Trips not service	DRT-Auto Travel time

Indexes

This measure quantifies several aspects of transit performance into a single value (index), while maximizing the number of quality of service factors measured. An index could contain the several different performance measures, and each component could be assigned a weight reflecting its relative importance. The index form is typically expressed as follow:

$$i = c_n (w_1 p_1 + w_2 p_2 + .. + w_x p_x) \quad (2.1)$$

Where

i	=	index value;
c_n	=	constant to normalize the maximum index value to a particular value;
w_x	=	weight of performance measure x; and
p_x	=	value of performance measure x (both quantitative and qualitative factors).

2.1.3.2 Qualitative measures

Quantitative measures assess the service directly using the scales of quantitative aspects perceived by transit users. On the contrary, qualitative measures assess passenger's perceptions. The latter measures normally lie in identifying aspects of service quality that are difficult or impossible to measure directly, such as security, staff courtesy, and safety. Transit agencies use the customer satisfaction surveys and passenger environment surveys to identify a problem before it becomes serious enough to make many complaints. Details of these methods are described below:

Customer satisfaction surveys

Customer surveys assist transit operators in identifying the greatest importance factors of service quality to their customers. This technique can be employed to help prioritize future quality of service improvement initiative, measure the degree of success of past initiative, and track changes in service quality over time. Surveys could be conducted to yield not only areas of existing passenger satisfaction or dissatisfaction, but also the degree to which particular factors influence customer satisfaction (for instance, each attributes rated on a 1 to 5 or 1 to 10 scale). In addition to the efficiency of this method, TRB (1999) proposed the "impact score" method using quadrant analysis technique (including gap score, occurrence rate, and impact score process) to identify the importance and seriousness of each service factors. The results of this analysis could provide four dimensions: (1) very important factors, (2) very satisfied factors, (3) not at all important factors, and (4) not at all satisfied factor (TCRP report 47 [TRB, 1999]). Details are illustrated in Figure 2.3.

Figure 2.3 Quadrant analysis from customer satisfaction survey (TRB, 1999)

Passenger Environment Surveys

Similar to customer satisfaction surveys, the passenger environment survey uses a "secret shopper" technique, in which trained checkers travel through the transit system. Generally, the trained checkers have to evaluate the qualitative factors (numerical rating scale) that they perceive on the transit services.

The findings of this part indicate the concept development of service quality based on TCQSM since 1999 (TRB, 1999 and TRB, 2003). These conventional tools for measuring service quality are LOS, Indexes, customer satisfaction surveys, and passenger environment surveys. Although these conventional methods have more benefits for transit agencies and public authority to deal with their service improvement, an alternative method that could understand on users' preference and forecast demand is needed to provide addition conclusion.

2.2 STATED PREFERENCE TECHNIQUES

The aim of this part is to introduce an alternative technique, Stated Preference (SP), that will be employed as an alternative method of service quality measurement in this study for understanding on the concept development, benefits and limitations, and attribute selection. The section is organised into five sections: (1) general background, (2) SP experimental design, (3) SP analysis, (4) SP applications in service quality measurement, and (5) service quality attributes. The first section is a brief description of the general background and the concept development of Stated Preference (SP) techniques. Next, the sections of SP experimental design and SP analysis describe methodological approach of SP techniques. Then, the SP application is presented focusing on service quality measurement of public transit. The last section summarises details of the service quality attributes from the previous study and these chosen list of service attributes will be used as the attributes in this study.

2.2.1 GENERAL BACKGROUND

The SP techniques aim to ask people hypothetical questions for determining people responses from choice scenarios and to estimate money value in term of Willingness-To-Pay (WTP) or Willingness-To-Accepts (WTA). On the contrary, the Revealed Preference (RP) analysis aims to deduce people's willingness to pay from observed evidence in the face of real choices. Although both RP and SP techniques have the strengths and weaknesses, SP is more flexible than RP for applying in almost any valuation context (Bradley and Daly, 1997; Morikawa, 1994; and Pearce, 2002). Because of SP benefits on attributing valuation and forecasting demand, SP techniques are widely used in the filed of travel behaviour. Several evidences have found that SP studies are especially useful for studying non-existing market situations, such as improving public transport services, building new light rail line, building new motorway, and implementing road pricing (Bates, 1998; Louviere et al, 2000; Ortuzar, 2000). Moreover, this section introduces some methodological issues of SP techniques that will be applied in the present study, including combining RP and SP data, adaptive SP techniques with Simulation, and Jackknife estimation.

2.2.1.1 Combining RP and SP data

The combining RP and SP data is one of the recent methodological developments in SP design. A principle of the combining RP and SP data follows Ben-Akiva and Morikawa (1991). The advantage of combining approach is essentially that the two data types are complementary; that is, the strengths of the one cover the weaknesses of the other, particularly the credibility and realism of the RP data combines well with the efficiency and flexibility of SP data. Six year later, Bradley and Daly (1997) developed the simultaneous estimation approach, which has been employed as a feature of ALOGIT software to postulate a single element nested logit model. This approach is applicable by defining a series of subsets of alternatives with the multinomial model within. Then, a multi-level tree structure exploits the choice modelling from the choice subsets (Hague Consulting Group, 2000). The tree logit model fulfils the limitation of the probit approach (Ben-Akiva and Morikawa, 1991) and the sequential approach (Swait and Louviere, 1993), although they are unsuitable for the large-scale modelling under the tight time and cost constraints of practical studies. Nowadays, the SP modellers have accepted the effectiveness in practices and applications of the artificial tree logit approach, especially exploited both of the simplicity and the complexity choice models.

2.2.1.2 Adaptive SP techniques with Simulation

Adaptive SP technique is an advanced procedure to increase reliability of SP estimation. The notable work is Fowkes and Shinghal (2002). Their work devised an SP procedure, called the Leeds Adaptive Stated Preference (LASP) method, which combined pivot and SP-off-RP concepts. The chosen RP alternative was used as a base, like pivoted experiments. A sequence of SP experiments was administered where an alternative, which was favoured in a previous experiment, was made worse and/or an alternative, which was disfavoured in a previous experiment, was improved. This adaptation used the concept of SP-off-RP questions and applied it to each SP experiment based on previous experiments. The empirical study of Richardson (2001) applied an Adaptive Stated Preference (ASP) in the Singapore value of time study. His study concluded that the ASP surveys differed from conventional SP survey in four major ways. Firstly, the options presented to the respondent in an ASP game depended on the response given by the respondent to previous game. Secondly, the individual ASP games generally had fewer options and fewer attributes presented to the respondent in one question than in those of conventional SP games. Thirdly, the respondents were often presented with more games in ASP survey than in a conventional SP survey. Lastly, it was possible to obtain estimates of the parameters of interest for each individual. Conventional SP surveys required that data from many respondents should be aggregated and the parameters were estimated as the result of a model-fitting process. (Fowkes and Shinghal, 2002; Richardson, 2001; Bradley and Daly, 2000; Train, 2003; and Train, 2006)

2.2.1.3 Jackknife estimation

Jackknife method is one of approaches to eliminate bias due to the repeated measurements problem in the same data. A Jackknife procedure can be applied in the final model specification stage to reduce potential biases from the SP repeat observations. The Jackknife takes samples, which are much closer to the original sample, but perturbs it by deleting one or more data points (elements of the population). Moreover, Jackknife tests the sensitivity of the parameter estimate on various (groups of) points of the data set (Hague Consulting Group, 2000 and Bradley and Daly, 2000).

2.2.2 SP EXEPERIMENTAL DESIGN

Good guidelines for SP experimental design can be found in the work of Bradley (1988), Fowkes and Wardman (1988), Hensher (1994), Louviere et al (2000), and Pearmain and Kroes (1990). Stated preference techniques are based on the presentation of hypothetical scenarios to respondents. These scenarios need to be plausible and realistic for respondents. Each scenario represents a package of different attributes. Jaensririsak and Upala (2006) summarised the general design process of a SP experiment in four steps:

(1) *Selection of a set of attributes.* Attributes, which influence users' preferences, representing the characteristics of the hypothetical scenarios. The SP study could select attributes from a preliminary survey (e.g. pilot survey or focus group) and a literature review of previous studies, and factors that are the interested researchers.

(2) *Specification of the number and magnitude of attribute levels.* If there are too many attributes in a SP exercise, individuals may ignore some attributes to simplify the task. This examination is described in Fowkes and Wardman (1988), Pearmain and Kroes (1990), and Bates (1998). Pearmain and Kroes (1990) suggested that SP exercise attributes should be limited at six or seven per alternative and should be the least if it included unfamiliar variables. Furthermore, variations of attribute values across scenarios needed to be large enough for respondents to trade-off otherwise they might be ignored.

(3) *Experimental design: combination of the attribute levels.* An experimental design is usually fractional factorial rather than complete (full) factorial. A complete factorial design contains all possible combinations of attribute levels. Nonetheless, a great advantage of the fractional factorial design is that the number of scenarios can be dramatically reduced from the full factorial design, while it still ensures that the main effects of attributes are independent from the significant interaction effects, so that the main effects can be estimated efficiently.

(4) *Design of response measurement.* SP Questionnaire asks respondents to state their preferences towards each scenario by ranking, rating, or choice. These responses are able to provide information on how individuals evaluate the attributes in the designed scenarios. A ranking response requires respondents to order preferences of the hypothetical options presented. It is some issues dealing with respondents face in real life (Pearmain and Kroes, 1990) and reliability (Ortuzar and Garrido, 1991). A rating response requires respondents to express their degree of preference on a scale (e.g. 5, 10 or 100 point scale). This provides the richest form of data. However, a binary choice response is the most realistic and simplest in making decision, the simplest in data analysis and use for prediction, and the most widely used in SP studies. It requires respondents to choose the best one out of two or more options.

In addition to the SP experiment, other components are also needed in a survey, e.g. questions gathering individuals' actual travel situations, which are relevant to the study context, questions about the attributes of existing choice alternatives, questions about attitudes to alternatives and personal details (Bradley and Kroes, 1992). These additional data are useful in analysing of SP data and explaining of the behavioural responses. At least one pilot survey is necessary; not only for testing the design, but also for guiding how individuals respond to the survey as a whole (e.g. format, questioning, presentation, survey conducting, and response rate).

2.2.3 STATED PREFERENCE ANALYSIS

This section introduces the State Preference (SP) analytical method and result interpretation. The important issues of SP analysis could be summarised into four main subsections: (1) SP data analysis, (2) RP/SP data analysis, (3) bias elimination, and (4) SP estimation and SP interpretation.

2.2.3.1 SP data analysis

Good guidelines for SP experimental design can be found in the work of Ben-Akiva and Lerman (1985), Ortuzar and Willumsen (2001), and the most recent and comprehensive details in Louviere et al (2000).

Upala (2006) explained that the SP analysis in most SP study (including this study), were based on the behavioural principle (random utility theory, RUM). The critical assumption is that travellers will choose the mode that yields greatest satisfaction or 'utility' for the present study, utility,here, means the degree of service quality of public transit (passenger vans). Utility, U_{ni}, is postulated to be a function of both observable (or deterministic) utility and unobservable (or random) utility. Specifically:

$$U_{ni} = V_{ni} + \varepsilon_{ni} \qquad (2.2)$$

Where V_{ni} is the deterministic utility derived from alternative *i* by decision-maker *n,* and ε_{ni} is the associated random utility. In a case of logit-type modelling (i.e. this present study), ε_{ni} is assumed to be independently and identically Gumbell distributed (IID assumption) and the ratio of the choice probability for the traveller is unaffected by the systematic utilities of all other alternatives (independence from irrelevant alternatives, IIA, property). The binary logit model or multinomial logit model (MNL) is applied in to model the travellers' behaviour that relates probability of choice to utility as follows:

$$P_{ni} = \frac{e^{\mu V_{ni}}}{\sum_{ni' \in J} e^{\mu V_{ni}}} \qquad (2.3)$$

Where P_{ni} represents the probability of the traveller *n* to choose the option *i.* An important practical issue is the specification of V_{ni}, which is typically represented as a function of observed variables relating to the alternative. The variables (attributes), chosen to be included in the model, in this research are strictly service quality attributes, and μ is a strictly positive scale parameter and is model coefficient to be calibrated.

2.2.3.2 RP/SP data analysis

To combine RP and SP data consideration, the choice models, used in this study, can be based on the tree logit assumption. The initial notation is similar to Morikawa (1994) approach. Following the (latent) utility maximised by a traveller in their revealed preference, U^{RP}, and stated preference, U^{SP}, for a given traveller, for a given alternative, is given by:

$$U^{RP} = \beta.X^{RP} + \alpha.Y + \phi \quad (2.4)$$
$$U^{SP} = \beta.X^{SP} + \gamma.Z + \varphi \quad (2.5)$$

Where:

X^{RP}, Y, X^{SP}, Z are vectors of the measured variable influencing the RP and SP decision;
β, α, γ are vectors of unknown parameters (to be estimated);
ϕ, φ represent the sum of the unmeasured utility components of utility influencing the RP and SP decision.

The joint-estimation approach lies in the variables, X, that appear in Equation (2.4) and (2.5). The coefficients, β, can be estimated using the information from both RP and SP surveys within the assumption that the mean value of the unmeasured component ϕ and φ is zero for each alternative.

Within "Gumbell" or "Weibull" assumption, ψ^2 is defined to be the ratio of the RP-SP variances, and then the SP utility can be scaled by ψ:

$$\psi^2 = \mathrm{var}(\phi) / \mathrm{var}(\varphi) \quad (2.6)$$
$$\psi.U^{SP} = (\psi.\beta).X^{SP} + (\psi.\gamma).Z + (\psi.\varphi) \quad (2.7)$$

The above equation is suitable for model calibration when the random variable in the new SP utility form has a variance equal to the RP utility form.

The mean utility of each of the "dummy" alternative is composed, as usual, in a tree logit model for SP observations

$$V^{COMP} = \psi.\log(\sum \exp(V^{SP})) \quad (2.8)$$

In Equation (2.8), the sum is taken over all of the alternatives in the nest corresponding to the composite alternative. It is simply the measured part of the SP utility. Then, because each "nest" contains only one alternative in this specification:

$$V^{COMP} = \psi.U^{SP} = (\psi.\beta).X^{SP} + (\psi.\gamma).Z \quad (2.9)$$

Afterward the calibration can be performed easily from this creation of the artificial tree-logit structure. The RP alternatives are placed just below the root of the tree, while the SP alternatives are each placed in a single-alternative nest. Figure 2.4 presents the artificial tree structure for simultaneous mixed RP/SP estimation.

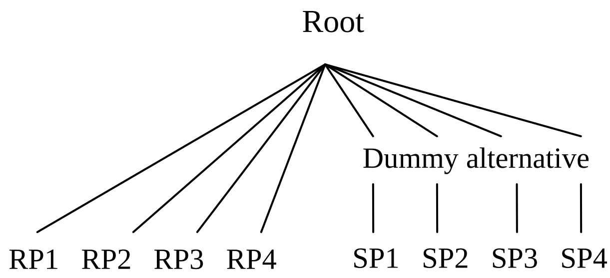

Figure 2.4 Artificial tree structure for simultaneous mixed RP/SP estimation

2.2.3.3 Bias elimination

Bradley and Daly (2000) examined the two main methods to reduce SP bias from the nature of SP data: Bootstrap and Jackknife. This study concluded that Jackknife procedure was effective for applying in the final model specification stage of SP estimation.

To eliminate bias due to the repeated measurements problem in the same data, the Jackknife uses re-sampling vectors like:

$$P_i = (\frac{1}{n-1}, \frac{1}{n-1}, ..., 0, \frac{1}{n-1}, ..., \frac{1}{n-1}) \quad (2.10)$$

Where the *i*th data point is omitted. With the "delete-k" Jackknife, k data points at a time are omitted. The Jackknife variance estimator is

$$\sigma^2_{JACK}\left(\hat{\theta}\right) = \frac{n-1}{n}\sum_{i=1}^{n}\left(\hat{\theta}_{(i)} - \hat{\theta}_{(.)}\right)^2 \quad (2.11)$$

with $\hat{\theta}_{(.)} = \sum_{i=1}^{n}\frac{\theta_{(i)}}{n}$, and $\hat{\theta}_{(.)}$ the re-sample estimate.

2.2.3.4 SP estimation and SP interpretation

An objective of the SP estimation process is to explain the travel behaviour using the discrete choice analysis with random utility theory (RUM) (Domencich and McFadden, 1975). Then, the last process of SP techniques is SP interpretation. The results of discrete choice estimation provide the following outputs:

(1) Coefficient estimates
(2) T-statistics and standard errors
(3) Log-Likelihood measures
(4) Rho Squared goodness of fit.

These results can be estimated using available computer software programmes, for example ALOGIT (Hague Consulting Group, 2000) and LIMDEP (Econometric Software, 1999). As parameters estimated have associated standard errors, each parameter is considered to be significantly different from zero at the 95% confidence level when its corresponding t-ratio (the ratio of the mean parameter to its standard error) has an absolute value greater than 1.96. The overall model goodness-of-fit is indicated by likelihood-ratio index, ρ^2, which is analogous to the R^2 for a linear regression model. The ρ^2 values between 0.2 and 0.4 are considered to indicate an extremely good fit (Louviere et al, 2000). For SP studies, the values around 0.1 are typical.

Attribute valuation can be determined directly after the model calibration. Unless otherwise specified, the choice models is based on linear-in-parameters formulation of the utility functions; this appears adequate for the purpose of this research. This form can be written as follows:

$$V_{ni} = \beta_{fare} \cdot X_{fareni} + \sum_{k} \beta_k \cdot X_{nik} \qquad (2.12)$$

Where the X_{nik} are observations relating to the k^{th} variable (or 'attribute') of traveller n and alternative i, and the β s are associated parameters to be estimated. Whilst X_{fareni} are observations related to the fare attribute of traveller n and alternative i, and the β_{fare} are associated fare parameters.

Under general conditions, any function can be estimated arbitrarily by the linear-in-parameters form. A further attraction of the linear-in-parameters functional form is that by taking ratios of parameter estimates to the estimate of a fare parameter, one can readily infer the marginal rate of substitution with respect to fare (cost), or in other words 'value'. The form of marginal willingness-to-pay or value for any one of the option attributes can be written as follows:

$$\text{Marginal willingness to pay } (MWTP) = \frac{\beta_k}{\beta_{fare}} \qquad (2.13)$$

Where β_{fare} is the coefficient on fare and β_k is the coefficient on service quality attribute k.

2.2.4 SP APPLICATIONS IN SERVICE QUALY MEASUREMENT

The first applications and practices of the choice theory with the transit service quality is found in McFadden (1973). His study used an axiom of choice theory in which it believed that among the available alternatives respondents would choose only the one that maximises utility. This work is the starting point of disaggregate demand forecasting models, and induced change in travel behavioural research. Transit Service Quality is a complex process and dynamic situation in which the transit level of services is changeable according to the inconsistencies of circumstances or people's minds (Sussman, 2000). There are the several transit service quality attributes in the field of transit performance assessment and valuation. Some attributes reflecting transit service quality are normally included in most of mode choice models such as travel cost, in-vehicle time, waiting time, vehicle occupancy and vehicle comfort, frequency, safety and security (Ortuzar et al, 1997 and Sussman, 2000)**.**

A good SP application in service quality measurement is the Prioni and Hensher (2000). Their study proposed the Service Quality Index (SQI) that were based on the combination of SP and RP techniques. The study developed a stated preference model of service quality choice that provided the set of indicators required to measure of user-base service quality. SQI provides an operationally appealing measure of service effectiveness to assist regulators in administering and monitoring a performance assessment regime and operators in improving customer service. SQI has been readily accepted by many bus operators in New South Wales (Australia) as the preferred way of establishing and monitoring the effectiveness of service levels, in contrast to traditional stand-alone satisfaction score based on an independent assessment of each attribute in isolation from the entire service package that passengers actually experience. To obtain value of service quality attributes, a set of three "packages" is given to bus passengers, who are asked to select the preferred package. The example of package is shown in Figure 2.5.

In addition to recent several studies, the measurement of service quality has since refocused on SP techniques for investigating the role of trade-off scenarios of service quality attributes (Hensher 1991; Ortuzar 1997; Swanson et al 1997; Upala, 2006a; Upala, 2007a; and Upala, 2007b). Moreover, the recent studies of passenger vans in Bangkok, which also applied SP technique for measuring service quality were found in the empirical works of illegal passenger van (Upala, 2006b) and express passenger vans (Upala, 2006c).

BUS SCENARIOS

Bus Operators try to provide a package of services, which appeals to passengers, but recognize that there will be trade-offs in order to be able to justify the cost of the service. Please compare the two bus service packages offered by the Bus Companies A and B with the trip service level of the current Bus Company and choose which of the three service packages you most prefer. Indicate also which of the two new packages is the most preferred. [*SET1*]

SCENARIO 1

SERVICE FEATURE	BUS PACKAGE OF THE BUS COMPANY A	BUS PACKAGE OF THE BUS COMPANY B
Reliability	10 minutes late	on time
One-way fare	same as now	same as now
Walking distance to the bus stop	5 minutes more than now	5 minutes more than now
Personal Safety at the bus stop	reasonably unsafe	reasonably safe
Travel Time	25% longer than the current travel time	25% quicker than the current travel time
Bus stop facilities	No shelter or seats at all	Seats only
Air conditioning	Available with a surcharge of 20% on existing one-way fare	Available with a surcharge of 20% on existing one-way fare
Information at the bus stop	Timetable but no map	Timetable but no map
Frequency	Every 15 minutes	Every 30 minutes
Safety on board	The ride is jerky; sudden braking occurs often	The ride is jerky; sudden braking occurs often
Cleanliness of seats	Clean enough	Clean enough
Ease of access to the bus	Wide entry with no steps inside the bus	Wide entry with 2 steps inside the bus
Driver behaviour	Friendly enough	Very friendly

32. **Which bus service would you use, if the BUS PACKAGES of the Bus Companies A and B were both available today for your journey?**

☐ BUS PACKAGE of the Bus Company A ☐ BUS PACKAGE of the Bus Company B ☐ BUS PACKAGE OF YOUR CURRENT BUS COMPANY

33. **If <u>ONLY</u> the BUS PACKAGES of the Bus Companies A and B were available today for your journey, which bus service would you use?**

☐ BUS PACKAGE of the Bus Company A ☐ BUS PACKAGE of the Bus Company B

Figure 2.5 Service Quality Index "Package" of Transit Service (Richardson, 2001)

2.2.5 SERVICE QUALITY ATTRIBUTES

This section describes sets of attributes in the service quality research to identify the appropriate attributes for employing in the SP experimental design in this study.

Pagano and McKnight (1984) investigated a quality of service in special service paratransit with eight aspects: (1) reliability and on-time performance, (2) comfort, (3) convenience, (4) extent of service, (5) vehicle access, (6) safety, (7) driver characteristics, and (8) responsiveness to the individual. The questionnaire results were analysed using psychometric scaling techniques. The results of the analysis indicated that not all types of users placed the same importance on different characteristics of these services.

Ortuzar et al (1997) identified the user perception of public transport in SP techniques with twelve LOS variables: (1) accident risk, (2) alternative use of the time while travelling, (3) bus driver appearance and behaviour, (4) bus occupancy (associated with comfort), (5) in-vehicle travel time, (6) possibility of travelling seated, (7) travel cost, (8) variability of travel time, (9) variable of waiting time, (10) vehicle comfort (seat quality and spacing, dirt, noise, etc.), (11) waiting time, and (12) walking time.

Prioni and Hensher (2000) investigated a set of attributes in the SP experiment to develop Service Quality Index (SQI) for measuring service quality in scheduled bus service with thirteen attributes: (1) reliability, (2) one-way fare, (3) walking distance to bus stop, (4) waiting safety, (5) travel time, (6) bus stop facilities, (7) air conditioning, (8) information at the stop, (9) frequency, (10) safety on board, (11) cleanliness of seats, (12) ease of access to bus, and (13) driver attitude.

Hensher et al (2001) proposed a set of attributes in the SP experiment to develop the Service Quality Index (SQI) in the provision of bus service contracts. The thirteen attributes included (1) bus travel time, (2) bus fare, (3) ticket type, (4) buses per hour at this bus stop (i.e. frequency), (5) time of arrival at bus stop, (6) time walking to bus stop, (7) seat availability on bus, (8) information at bus stop, (9) access to bus, (10) bus stop facilities, (11) temperature on bus, (12) driver attitude, and (13) general cleanliness on board.

Batley and Fowkes (2002) summarised the appropriate attribute sets and alternative sets for route choice and departure time choice including (1) travel time in congestion, (2) travel time not in congestion, (3) trip distance, (4) petrol cost, (5) toll cost, (6) parking cost, and (7) quality improvements. Moreover, their study suggested the attributes for departure time choice included (1) departure time, (2) travel time, (3) travel time variability, (4) parking cost, and (5) late penalty. Their study also identified the set of attributes to be included in the SP design as follows: (1) departure time, (2) travel time, (3) travel time variability, (4) route, and (5) distance.

Moreover, TCRP report 47 (TRB, 1999) summarised the example of transit service attributes. Details of attributes are presented in Table 2.2.

Table 2.2 Examples of Transit Service Attributes (TRB, 2003)

Absence of graffiti	Frequency of service on Saturday/Sundays
Absence of offensive odours	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 announcement of delays	Temperature on train/bus-not hot/cold
Fairness/consistency of fare structure	The train/bus travelling at a safe speed
Freedom from nuisance behaviours of riders	Trains/buses that are not overcrowded
Frequency of delays from breakdowns/emergencies	Transit personnel who know system

Upala (2004 and 2005) applied the service quality concept to evaluate customer satisfaction of mass rapid transit: MRT subway in Bangkok. The six attributes of service quality of this study included (1) safety, (2) comfort, (3) convenience, (4) reliability, (5) fare, and (6) total satisfaction.

Upala and Narupiti (2004) applied characteristics approach to assess passenger vans in Bangkok. Their study investigated thirteen social attributes including greater capacity, coverage area, energy efficiency, air pollution, noise pollution, visual pollution, sustainability of system, risk of terror, risk of accident, congestion, public expense, competitive with public transit, and total performance for society. The twelve individual attributes examined included fare, flexible time, flexible route, frequency, punctuality, convenience, comfort, easy to reroute, suitable for short trips, suitable for medium trips, suitable for long trips, and total performance for individual.

The findings from this part have indicated that SP techniques are widely used in the filed of travel behaviour. The results of SP analysis could provide information for managing transit agencies and public authorities on attributing valuations and forecasting demand from users' preference approach. The present study would concern the SP experimental design, SP analysis, and the previous SP applications in the service quality measurement. Moreover, this section could summarise and classify the appropriate attributes for measuring service quality of passenger vans into six main groups: (1) Cost variables, (2) Accessibility variables, (3) Reliability variables, (4) Comfort and convenience variables, (5) Travel time variables, and (6) Safety and security variables.

2.3 PASSENGER VAN SERIVCES IN BANGKOK

The aim of this part is to examine passenger van situations and lessons learned from the previous studies of passenger van services in Bangkok. The section is divided into two sections: (1) general background, and (2) overview of passenger van research in Bangkok. The first section is a brief description of the general background, the establishment of passenger vans in Bangkok, and the roles of passenger van services in Bangkok. The last section is the chronology of passenger van research in Bangkok that aims to examine an interest of researchers, their findings, and the research gap.

2.3.1 GENERAL BACKGROUND

The establishment of the passenger van in Bangkok is based on two main factors: demand-side and supply-side factors. Demand-side factors are the increasing population and the unsystematic suburban expansion, whereas supply-side factors are the inefficient public transportation service and the efficiency and high service level of passenger van (Eamsupawat, 2002). Thus, the passenger van is viewed as an alternative mode of paratransit that fits requirements of a group of new demand, ex-bus riders, and shifted private vehicle users and that offers services in addition to the current public transport services. In 1999, the government decided to regulate the passenger van services in Bangkok to provide safe ride to commuters, to reduce competition between passenger vans and conventional buses and to eliminate the influential figures from the passenger van business. Although the passenger van services have been regulated, there has been a large number of illegal van duplicating services on the licensed routes (Upala, 2006). Passenger van offers point-to-point service with possible minor alteration in time and route (including stops). The service focuses mainly on the market related to the commuting and school trips in which it offers some superiority to buses, especially in terms of convenience and comfort. Individuals or private groups (“Win”) are the passenger van ownership and operation of passenger van’s route service. With their operational characteristics, passenger vans provide special services for users in Bangkok, especially seven attributes of service quality: (1) fare, (2) waiting time, (3) walking distance, (4) vehicle comfort, (5) in-vehicle time, (6) number of stops, and (7) safety. The passenger van’s fare system, which is a flat rate or distance-based system, is averaged at 10-60 Baht/route. Service headways are flexible time depending on the full users. Users can access easily to use passenger van with guaranteed seating and air-conditioned. Some passenger van routes use Toll ways or special routes for reducing in-vehicle travel time and the number of passenger van stops of some passenger van routes.

2.3.2 OVERVIEW OF PASSNEGER VAN RESEARCH IN BANGKOK

The research of passenger vans in Bangkok has appeared in the last decades. This section presents the significant pieces of research chronologically and details of the previous studies and the results are described as follows:

Sudsanguan (1995) investigated that the private van as a supplement service to the state public transport on a case study: the route on Highway between Pinklao Bridge and Mahidol Unviversity Salaya area. His study found that the private van had the carrying ability of 35.2% of supplementary service to the state transportation systems while the state systems had the carrying the ability 64.8% of the total service in the study area. The quantitative forecasting of the travellers in study area found 3.46% of the extending rate per year (limited time for five years). The passengers had more satisfaction on the private van services than the state transportation services. Both drivers and administrators were satisfied with this system, especially the profit from the operation. However, these problems were the out-law and non-legal operational service. They would like their service systems to become a legal enterprise of the public transportation service.

Kunasol (2000) analysed the factors affecting passenger van operation and usage in Bangkok Metropolitan Area. His study found that commuters using van transit and air conditioned bus selected their mode according to these factors in the order of priority; travel time, comfort, reliability, safety, accessibility, fare and crew manner. Furthermore, the level of satisfaction of van transit users was rated high for the factor users considered important while the level of satisfaction of air-conditioned bus was rated low for the factors that users considered important. The most important factors of van and taxi service providers were revenue, cost, safety, convenience, flexibility of work, admittance, and comfortable. Otherwise, van pratransit providers had a middle level of satisfaction on the most important factor while taxi providers had low level of satisfaction on the most important factor.

Punyasuith (2002) examined the fixed route van regulation in Bangkok and peripheral area. Her study found that the regulation policy of fixed route van Bangkok and peripheral area had not been reached its objective yet as it could not control those fixed route van to comply with the regulation policy. Moreover, numbers of illegal vans were inclined. Many difficulties in the policy application were happened due to many weaknesses within the organizational administration. They were lack of human resources, budget, equipment, and the location. The application process was, therefore, time consuming and far behind the target. Furthermore, the political problem often interfered in the administration to worsen the policy application accordingly.

Eamsupawat (2002) investigated the factors affecting the transportation pattern of vanpooling in Northern Bangkok Metropolis. The result indicated that the influencing factors were found in both demand and supply sides. The demand side factors included increasing population and unsystematic suburban expansion. Supply side factors were inefficient public transportation service and the efficiency and high service levels of van services. Most services routes linked urban and suburban areas of Bangkok, and the advantages of van services line were their speed and availability of seats. According to the survey result, most van passengers lived in suburban areas. Average time spent in the van was 41 minutes, while the average expenditure was 49 baht per day. The most popular transportation pattern after using van service was walking. Most passengers were not captive riders; they could choose other modes of transportation, mostly buses. However, due to speed and comfort ability, these people chose van services. Negative factors about van services included the lack of safety and high fare levels. Lack of proper controls and management by responsible authorities and fierce competition between van and bus service were important problems. The fare was fixed between 20-25 baht for 15-20 kilometres. Van terminals were located at transportation nodes so as to facilitate inter-modal transfer ability. Service standard would also be set up; for instance, vehicle types and maximum number of passengers per van.

Chaisri (2003) investigated the passenger satisfaction of bus van on the route of the Rangsit-Ramkhamhaeng University. His study concluded that passenger generally felt satisfactory moderate to less on the fare, crew manner, safety, comfortable, and reliability except travel time and accessibility to service which were less satisfactory. The relationship between personal factors and satisfaction on service of bus van was influenced by gender and educational level, and the relationship between travelling factors and satisfaction could be indicated by the frequency of the service and the waiting time.

The research findings of the studies dealing with passenger van services in Bangkok could explicate the service quality of passenger vans in Bangkok to some extent. However, as almost all the reviewed studies measured the passenger vans' service quality with conventional measurement tools, their findings could little be used to assess and evaluate the van service quality.

CHAPTER III

RESEARCH FRAMEWORK FOR DETERMINING SERVICE QUALITY OF PASSENGER VANS

This chapter describes the development of research framework for determining service quality of public transit, especially passenger van. The chapter is organised into two main parts: (1) research gaps and alternative method and (2) research methodology. The first part of this chapter begins with a summary of concept development, benefits and limitations, techniques, and attributes of service quality measurements to find the research gaps while an alternative method, which is Stated Preference (SP) technique, is proposed for determining service quality of passenger vans. The chapter ends with a research methodology part that includes research design, data collection, data analysis, and interpretation section is developed for dealing with the research framework of the present study.

3.1 RESEARCH GAPS AND ALTERNATIVE METHOD

A review of the measuring methods of service quality from the previous chapter shows that the service quality is measured under the two main measures: quantitative and qualitative. The first measures aim to assess the transit services that are directly observable. According to TRB (2003), the important methods are Level of Service (LOS) and Indexes. LOS presents the potential values of transit performance that are divided the range from the highest level to the lowest level of service quality, such as “A” to “F” for fixed-route service and “1” to “8” for demand-responsive service. To minimize the number of measures reported, Indexes technique is used to explain an overall measure of service quality. The latter measures are used to identify aspects of service quality that are difficult to measure directly. Customer satisfaction surveys and passenger environment surveys are two important methods of qualitative measures used by transit agencies to identify problems before they become serious and generate many complaints.

Although the previous methods are useful for measuring service quality, applying these concepts is impractical and inappropriate in the context of this study. This is because there are still four major problems to measure service quality of passenger vans. Firstly, the passenger van service cannot be compared to conventional LOS standards of the fixed-route service and the demand-responsive service because their services have different fundamentals. Secondly, the Indexes technique is valuable for reporting; however, the impacts of changes in individual index components are hidden. Thirdly, the measuring of conventional service quality method focuses only on the one aspect of data, in fact; it would be better when combining both of the quantitative and the qualitative data. Lastly, the implication of customer satisfaction surveys and passenger environment surveys could justify the degree of passenger satisfaction or dissatisfaction as well as the greatest impact on customer satisfaction and these results are helpful for operating and improving transit service; however, these surveys cannot examine the users’ preference and forecasting demand when the transit changes in its services.

To increase the applicability of the previous methodology as aforementioned and fill the gaps of measuring quality of service concepts, the present study puts more attention to employ economics and behavioural methods like Stated Preference (SP) technique for evaluating the transit service quality. SP techniques is widely and popularly used in travel behavioural research and practices for providing data on attributing valuations and assisting with demanding modelling in the past decades. In accordance with the informal transport study by Cervero (2000), discrete choice (logit) analyses could be a typical technique used to gauge the utility and perceived value of informal service features better than any other traditional methods. The SP survey technique, therefore, is chosen to the present study for applying to evaluate passenger van performance and van services.

However, the SP techniques which are currently applied to similar existing work still have some limitations and arguments, e.g. context to use SP techniques, instrument design, and attribute specification. Therefore, to increase the efficiency of SP experiments and to assist transport planners and transit agencies on using these measures for understanding, operating, improving, and forecasting the transit system and its services, the present study aims to improve the SP procedures to determine service quality of passenger van service which brings about more understanding on the passenger van performance that can further and correctly identify the role of passenger van in the integrated transportation system. Moreover, this research is expected to advance the understanding on service quality of passenger van in Bangkok, where only customer's satisfaction survey is available. All of the concepts and assumptions, benefits and limitations and examples of attributes for measuring service quality are illustrated in Table 3.1.

With regard to the literature review, this research deals with the SP experiment in two issues (1) the principle state of practice in service quality of passenger van and (2) a number of improvements to this state of practice.

Under the first issue, these various elements should cover: (1) An assumption of the mode choice models would base on the behavioural principle that a traveller will choose the mode that yields greatest satisfaction or 'utility' of transit services quality of passenger vans; (2) The data would come from contextual, highly customized (hypothetical alternatives for a typical transport system service based on actual attribute levels) SP interviews with the various segments and different spatial locations of passenger van users who are asked to compare pairs of alternatives; (3) A set of attributes would be selected both of quantitative attributes and qualitative attributes in terms of the service quality (e.g., fare, waiting time, walking distance, vehicle comfort, in-vehicle time, number of stops, and safety); and (4) An analysis would exploit logit models with linear-in-parameters utility functions.

For the second issue, the elements cover included: (1) The within-mode choice models of passenger van would be exploited for improving passenger van services; (2) The between-mode choice models of passenger van and competitive mode (bus) would be applied for investigating transit service benchmarking; (3) The joint revealed preference (RP) and stated preference (SP) data would be employed to improve the SP scaling and the reliability of data; (4) The use of service quality valuation in terms of monetary (Willingness-To-Pay) would be developed from model results based on the fare attribute; and (5)The Jackknife method would be employed to reduce SP bias to get more reliable estimate on coefficients for the *t*-ratios.

Table 3.1 Measuring methods of service quality

Measuring Service Quality	Approach	Concept and Assumption	Benefit and limitations	Example of Attributes
Quantitative Measures	LOS	To build up the service ranges (highest to lowest) of transit performance	Easy for transport planner and agency who familiar with HCM concept, but it have to compare with LOS standard	Frequency, hours of service, service coverage, passenger load, reliability, transit-auto travel time, response time, span of service, on-time performance, trips not service, DRT-auto travel time (TRB, 2003)
	Indexes	To minimize the number of measured, while maximizing the number of quality of service factors measured	Easy for presentation and result report, but the impacts of changes in individual index components are hidden	Frequency, hours of service, service coverage, passenger load, reliability, transit-auto travel time, response time, span of service, on-time performance, trips not service, DRT-auto travel time (TRB, 2003)
Qualitative Measures	Customer satisfaction surveys	To identify the quality factors of greatest importance to their customers	Helpful for operating and improving transit service by identifying the degree of passenger satisfaction or dissatisfaction as well as the greatest impact on customer satisfaction	See Table 2.2
	Passenger environment surveys	To provide a quantitative evaluation of factors that passenger would express qualitatively	Helpful for operating and improving transit service by identifying the degree of passenger satisfaction or dissatisfaction as well as the greatest impact on customer satisfaction	Cleanliness and appearance, customer information, equipment, operators, station agents (TRB, 2003)
User's Preference Measures	Psychology	To investigate the reasons of an individual's travel decision	Helpful for understanding the traveller's behaviour and the reason of preference	See Table 2.2
	Microeconomics (SP techniques)	To predict an individual's travel decision based on characteristics of the alternative available of them	Helpful for understanding the users' preference and forecasting demand as well as the benefits of Customer satisfaction surveys, but it is still the problem of SP design	Travel time and Travel cost (Ben-Akiva and Lerman, 1985)
Adaptive User's Preference Measure	Microeconomics (SP techniques)	To value and Predict an individual's travel decision based on transit service quality	Apply the Service quality concept, elimination of bias of SP design (simulation and Jackknife) , improve service (within mode model), compare service (between mode model), combine Qualitative and Quantitative data, and SP Scaling	Fare, waiting time, walking distance, vehicle comfort, in-vehicle time, number of stops, safety

3.2. RESEARCH METHODOLOGY

This part describes the process of SP technique for determining service quality of passenger vans. This study elaborates the SP methodology framework into four main sections: (1) research design process, (2) experimental design process, (3) data analysis process, and (4) interpretation process. Details of research methodology are shown in Figure 3.1.

3.2.1 RESEARCH DESIGN

This section explains the process of SP research design in which the five basic components need to be determined when the SP technique is applied for measuring service quality of passenger vans:

(1) Initial research

The objective of the present study is to employ SP technique for measuring service quality of passenger van that the service quality modelling would be exploited for improving passenger van services and investigating passenger van service benchmarking. Therefore, the present study applies an assumption of the conventional mode choice models, a traveller would choose the mode that yields greatest satisfaction or 'utility' of transit services quality. The preferences of passenger van users are investigated towards service quality attributes that are represented by Stated Preference (SP) questionnaire survey. In the final process, the economic valuation (Willingness-To-Pay) of attributes is analysed using the full econometric analysis (discrete choice analysis) that is concerned with the various choice models of passenger van services.

(2) Experimental design

From the study of service quality attributes in the previous chapter, the findings could be summarised and could give the appropriate attributes for measuring service quality of public transit into six main groups: (1) Cost variables, (2) Accessibility variables, (3) Reliability variables, (4) Comfort and convenience variables, (5) Travel time variables, and (6) Safety and security variables. The selection of attribute in the experimental design must consider the operational characteristics of modes under consideration. Then, the levels of each attribute are determined from hypothetical services, the optimum SP experimental design would employ the hypothetical scenarios with the fractional factorial design. In addition to the previous chapter, the findings indicate that the fractional factorial design could reduce the number of scenarios from the full factorial design. In general, the SP questions can get three types of responses from respondents: ranking based, rating based, or choice based. The choice response is the most realistic and simplest in making decisions, and data analysis, and thus suitable for the kind of research.

(3) Questionnaire design

The service quality of passenger vans could be examined using SP questionnaire surveys that consist of four main sections: (1) Respondent characteristics (e.g., gender, age, occupation, income, car ownership, and location), (2) Travel behaviour (e.g., frequency, access mode, and egress mode), (3) Respondents' opinions on the service of passenger vans (e.g., reason to use, level of service, satisfaction), and (4) Mode choice scenarios (for improving passenger van services and for investigating passenger van service benchmarking).

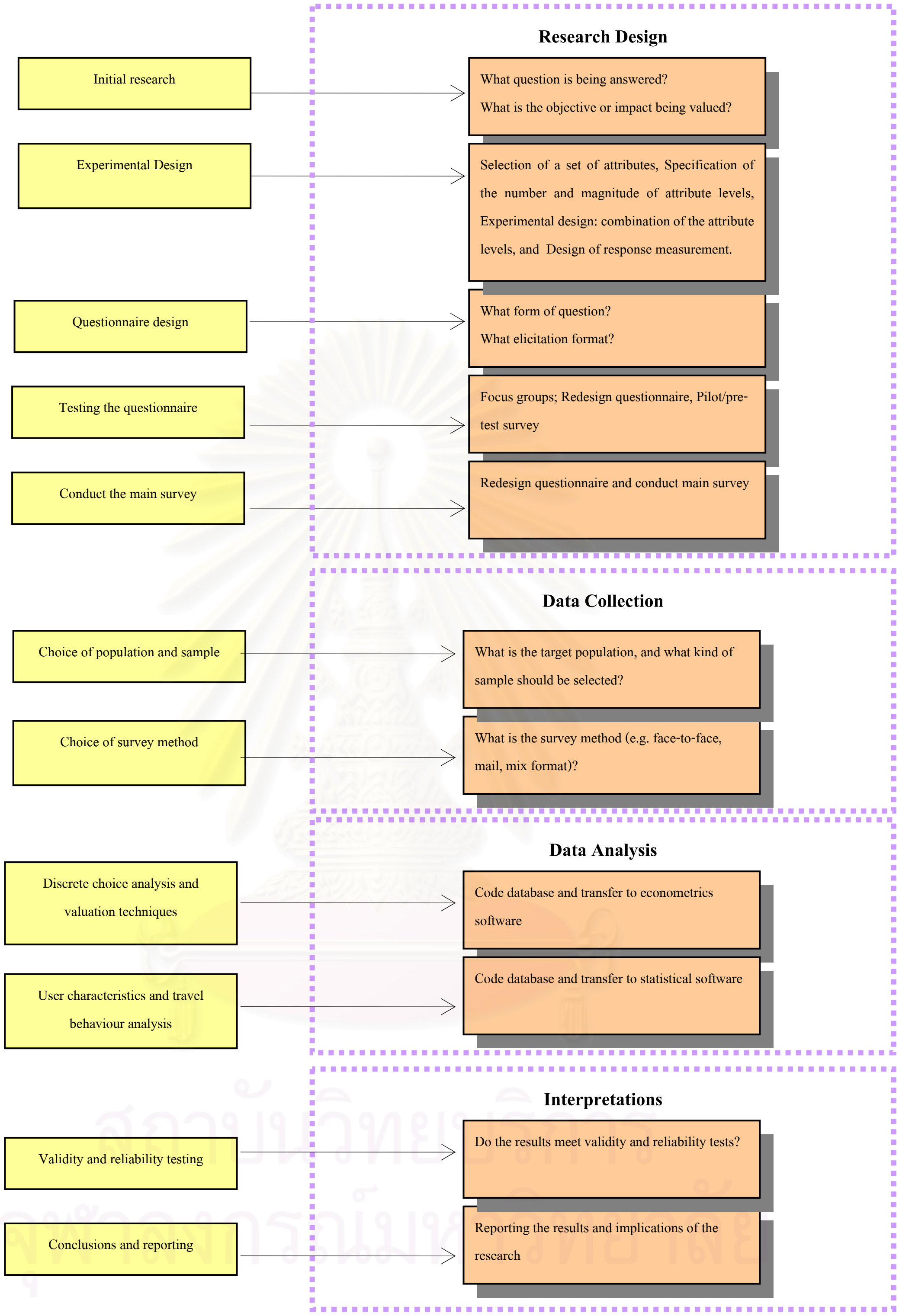

Figure 3.1 Process of SP technique for determining service quality of passenger vans

(4) Testing the questionnaire

The testing of designed questionnaire can be conducted on a focus group to assess the first draft of the questionnaire survey (e.g. whether the issues are understand, wording is clear, or questions are sensible) and to get insights into some issues of the surveys. Then, the questionnaire design could be revised in the light of responses to eliminate any problems and to maximise the amount of information that could be gathered. After test on focus group, the questionnaire is pilot-tested. The size of pilot sample should be 20-100 respondents depending on the full sample size envisaged and the complexity of design (Pearce, 2002). Prior to the collection data process, the SP simulation would be performed for adapting the choice experiments. Ideally, the data simulation and the pilot survey would be used for testing the SP experimental design. The simulated SP data, which use a spreadsheet with random numbers, could be examined to yield the reliability and the accuracy of the SP design. This study proposes an adaptive SP design to improve SP experiments into ten steps including (1) a selection of the number of attributes and their levels, (2) a formulation of the orthogonal design, (3) a transformation of the design code to the attribute levels, (4) the design of the boundary value, (5) a verification of the boundary value, (6) the design of the attributes and their levels for simulated data, (7) the selection of the first loop of the coefficient (literature review/pilot study), (8) the testing on the coefficients based on various scenarios, (9) the checking on the standard deviation, and (10) the conclusion of high-quality of SP questionnaire design for the main survey. Details are shown in Figure 3.2.

(5) Conduct the main survey

The questionnaire could then be revised again after the pilot test, and the number of revision depends on how much is learnt in each round. The final version of the questionnaire is applied to the full sample. Typical the full sample sizes are 250-500 for open-ended elicitation format and 500-1000 for close ended formats (dichotomous choice, payment cards). If the sample needs to be split to take account of different valuation scenarios or population groups, the number of full sample sizes needs to be increased (Pearce, 2002).

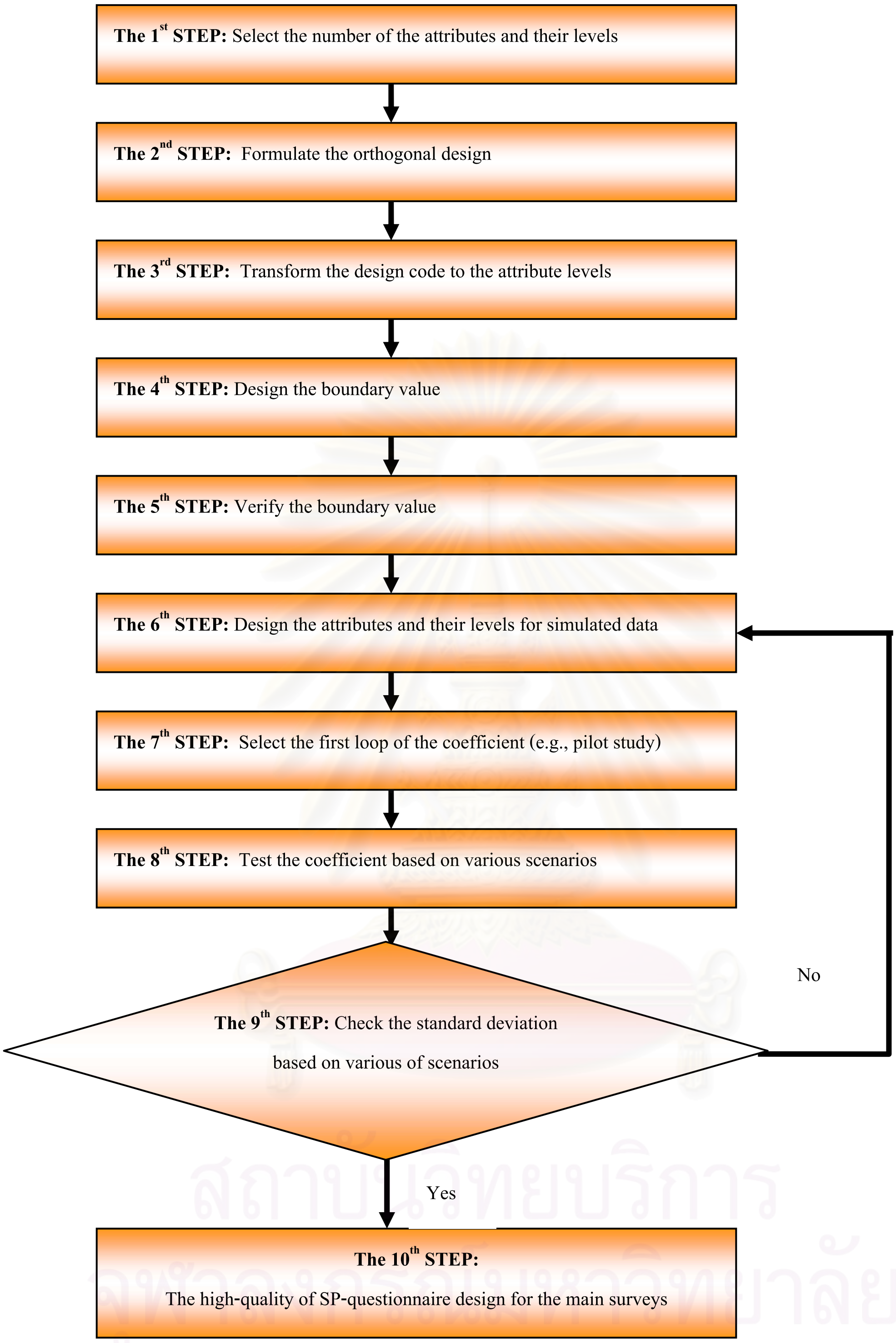

Figure 3.2 Ten steps of adaptive SP design

3.2.2 DATA COLLECTION

In the data collection section, two main issues should be concerned: (1) Choice of population and sample and (2) Choice of survey method.

(1) Choice of population and sample

Generally, the data collection is designed to capture the whole range of travel behaviours and possible responses. At least, it is important to cover the heterogeneity due to spatial locations and various segments. Moreover, a sample frame would be based on a one of probability sampling theories: simple random, systematic, stratified, cluster, or multi-stage.

(2) Choice of survey method

To consider for selecting the method of surveying, the efficiency factors (e.g., cost, time, and response rates) are highlighted to show that the higher the quality of the survey, the higher the cost is likely to be. Moreover, the survey methods would be selected in regards with characteristics of respondents and their spatial locations.

3.2.3 DATA ANALYSIS

Regarding the previous chapter, the summary focuses on the four important issues of SP analysis: (1) SP data analysis, (2) RP/SP data analysis, (3) bias elimination, and (4) SP estimation and SP interpretation. To estimate and describe the SP experiment, this study would analyse data from surveys on two main subjects:

(1) User characteristics and travel behaviour analysis

The user characteristics and travel behaviour analysis could be statistically analysed on available software package e.g., SPSS and SAT.

(2) Discrete choice analysis and valuation techniques

The estimation results of mean, standard deviation of random coefficients, and individuals' specific coefficients could be obtained using appropriate computer software e.g. LIMDEP and ALOGIT. The results of discrete choice estimation provide four main outputs: (1) Coefficient estimates, (2) T-statistics and standard errors, (3) Log-Likelihood measures, and (4) Rho Squared goodness of fit.

3.2.4 INTERPRETATION

The last section of research methodology is the data interpretation. The results of the modelling exercise can be concluded by these two principles:

(1) Validity and reliability

Validity refers to the degree to which a study succeeds in measuring the intended quantity. That is, to what extent has the survey instrument overcome issues of bias and hypothetical nature of the exercise to arrive at respondents' actual values. Details of type of validity tests are shown in Figure 3.3. Reliability refers to the degree of replication of a measurement. It is the test to capture if a survey instrument can be relied upon to provide the same value if the survey is administered repeatedly under controlled conditions. Reliability exercise typically entails the repetition of studies at different points in time and so is not considered to be a reasonable requirement for each individual study. The literature to date is on the whole supportive of the temporal reliability of SP results.

(2) Conclusions and reporting

Reporting should summarise the objectives of the study, the review of any previous relevant valuation studies, the description of the process of survey design, the description of survey administration procedure, the summary of data, the detail of the data analyses, and the tests of validation

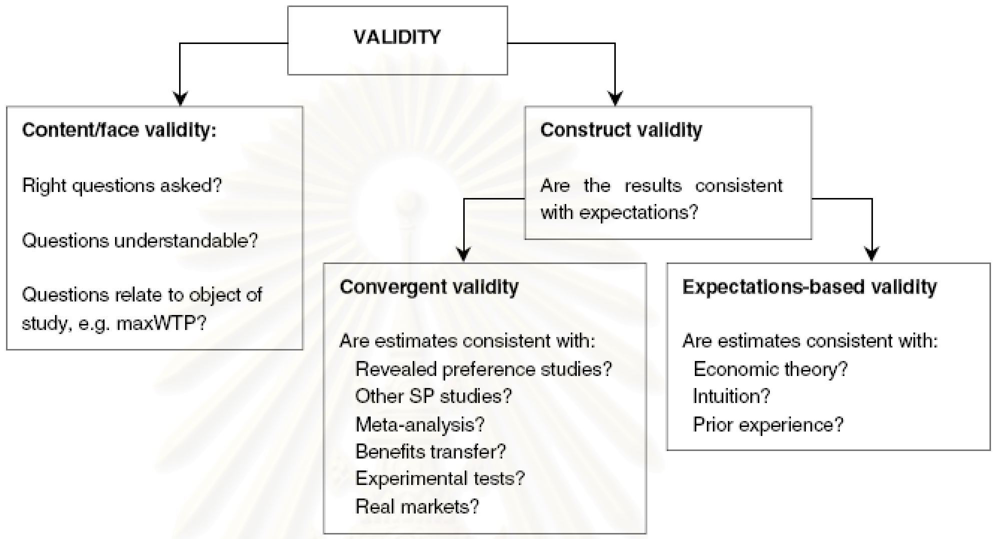

Figure 3.3 Types of validity tests (Pearmain, 2002)

CHAPTER IV

APPLICATIONS OF THE ALTERNATIVE METHOD FOR DETERMINING SERVICE QUALITY OF PASSENGER VANS IN BANGKOK

This chapter presents the applications of the alternative method for determining service quality of passenger vans in Bangkok following research design, data collection, data analysis, and interpretation from the research framework in the previous chapter.

4.1 RESEARCH DESIGN

This part explains the process of SP research design into the five basic components; initial research, experimental design, questionnaire design, testing the questionnaire and conducting the main survey and special survey.

4.1.1 INITIAL RESEARCH

The principal survey tool was a questionnaire Stated Preference (SP) data collection. The survey plan was divided into three surveys. Firstly, the pilot survey, the passenger van users (150 respondents) were provided with ranking-based and choice-based questionnaires. The purpose of the pilot study was to confirm a proper measurement method for the main survey response. Secondly, the main survey, the passenger van users (1200 respondents) were conducted using choice-based questionnaire. The purpose of the main survey was to estimate the discrete choice modelling and attribute valuation. Finally, the special survey, the passenger van users (300 respondents) were interviewed with another choice-based questionnaire to yield Revealed Preference (RP) and Stated Preference (SP) data. The purpose of the special survey was to estimate the discrete choice modelling and attribute valuation using both of the RP and SP data to confirm reliability and to determine the effect of scaling in the model construction. The framework of SP technique for determining service quality of passenger van in Bangkok was developed and shown in Figure 4.1.

4.1.2 EXPERIMENTAL DESIGN

Service quality (SP) attributes were considered for the public transit modes: passenger vans and buses. To present the operational characteristics of transit mode and its services, seven attributes (fare, walking distance, number of stops, waiting time, comfort and convenience from vehicle characteristics, in-vehicle time, and safety from driver behaviour) were identified and employed in the SP experiments. The optimal level of each parameter, here, was determined using the non-linear effect that was ‘Taguchi’s L_9’ methods for the three-level (3^4) fractional-factorial design (Taguchi and Konishi, 1987). The Taguchi’s L_9 is the cookbook for designing experiment. The method designed the four columns and nine treatment combinations, allowing study for up to four factors. Each main effect of a factor involved three levels making up two degrees of freedom that each column was corresponding to one factor or an interaction (Berger and Maurer, 2002). Then, the numbers 1, 2, and 3, respectively represented the attribute levels (low, medium, and high) in the table. The L_9 was shown in Table 4.1.

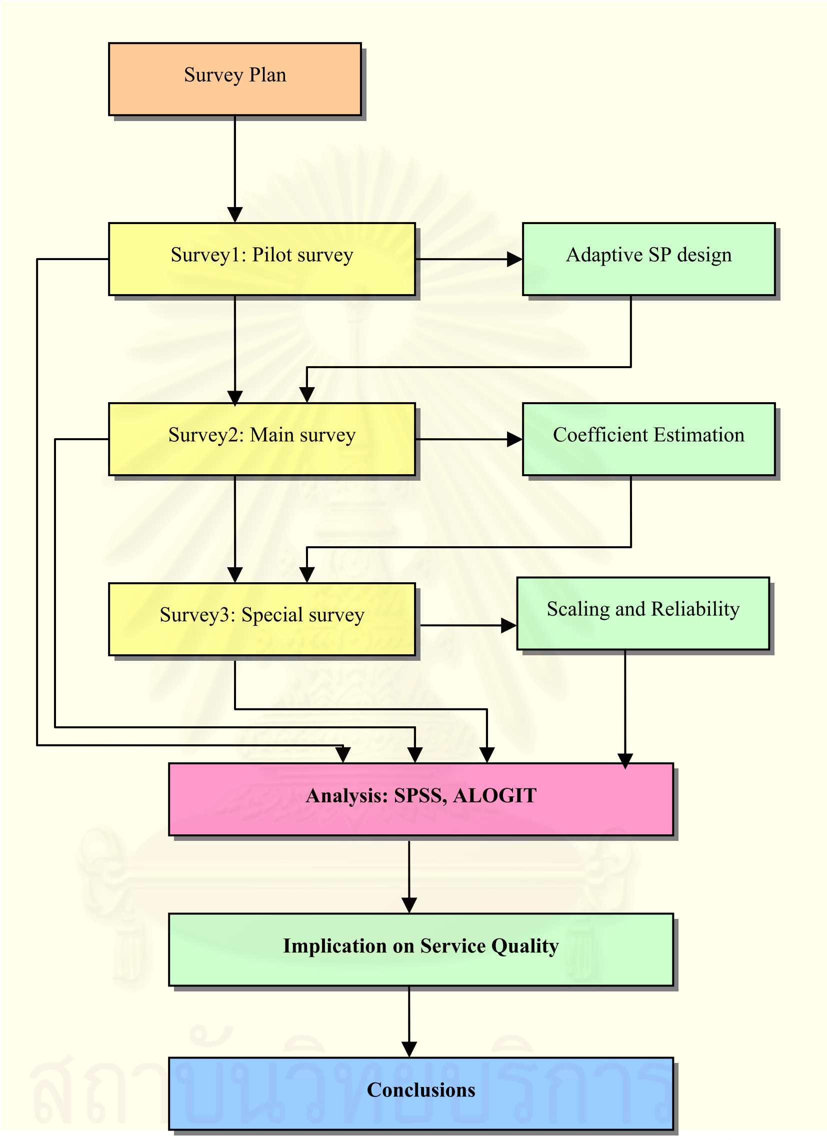

Figure 4.1 Framework of the SP technique for determining service quality of passenger van in Bangkok

Table 4.1 Taguchi's L_9

Experiment No.	Factor 1	Factor 2	Factor 3	Factor 4
1	1	1	1	1
2	1	2	2	2
3	1	3	3	3
4	2	1	2	3
5	2	2	3	1
6	2	3	1	2
7	3	1	3	2
8	3	2	1	3
9	3	3	2	1

4.1.3 QUESTIONNAIRE DESIGN

A questionnaire design of all SP surveys (the pilot survey, the main survey, and the special survey) was divided into five main issues:

(1) Respondent characteristics (e.g., gender, age, occupation, income, car ownership, and location);

(2) Travel behaviour (e.g., frequency, access mode, and egress mode);

(3) Respondents' opinions on the service of passenger vans (e.g., reason to use, level of service, satisfaction);

(4) The current situations of passenger van services (fare, walking distance, waiting time, vehicle comfort, in-vehicle time, number of stops, safety); and

(5) Mode choice scenarios (for improving passenger van services and for investigating passenger van service benchmarking).

Details of variables, operational definitions and levels of measurement were shown in Table 4.2

Table 4.2 Variable, operational definition and level of measurement

Variables	Operational definitions	Levels of measurement
Gender	Male Female	Nominal
Age	Age (years)	Ratio
Respondent income	Income (Thai Baht/month)	Ratio
Household income	Income(Thai Baht/month)	Ratio
Car ownership	Car (vehicles/household)	Ratio
Frequency of passenger van usage	Frequency (times/week)	Ratio
Access mode	Walking Conventional Bus Air-conditioned Bus Motorcycle Taxi Other modes	Nominal
Egress mode	Walking Conventional Bus Air-conditioned Bus Motorcycle Taxi Other modes	Nominal
Main reason for using passenger van	Faster Reliability Comfort Convenience Safety Cheaper	Nominal
Level of service of passenger van	Level of satisfaction	Interval
Fare	Thai Baht	Ratio
Walking distance	Meters	Ratio
Number of stops	Points	Ratio
Waiting time	Minutes	Ratio
Vehicle comfort	Level of comfort	Nominal
In-vehicle travel time	Minutes	Ratio
Safety from driver behaviour	Level of safety	Nominal

In the present study, the survey involved two basic SP experiments: (1) a within-mode choice between two alternative passenger van services and (2) a between-mode choice experiment considering the public transit modes of passenger van and bus. Both choice experiments were further separated into two, each part containing a different subset of service quality attributes, but those two parts included the common attribute of fare to permit subsequent merger. The first part focused on walking distance, waiting time, and vehicle comfort that was representing before passenger van usage. Whilst the second part was in-vehicle time, number of stops and safety from driver behaviour that representing after passenger van usage. With the design of level of attributes process, this study considered the current situations of passenger van services and bus services. The concept of choice experimental design was shown in Figure 4.2.

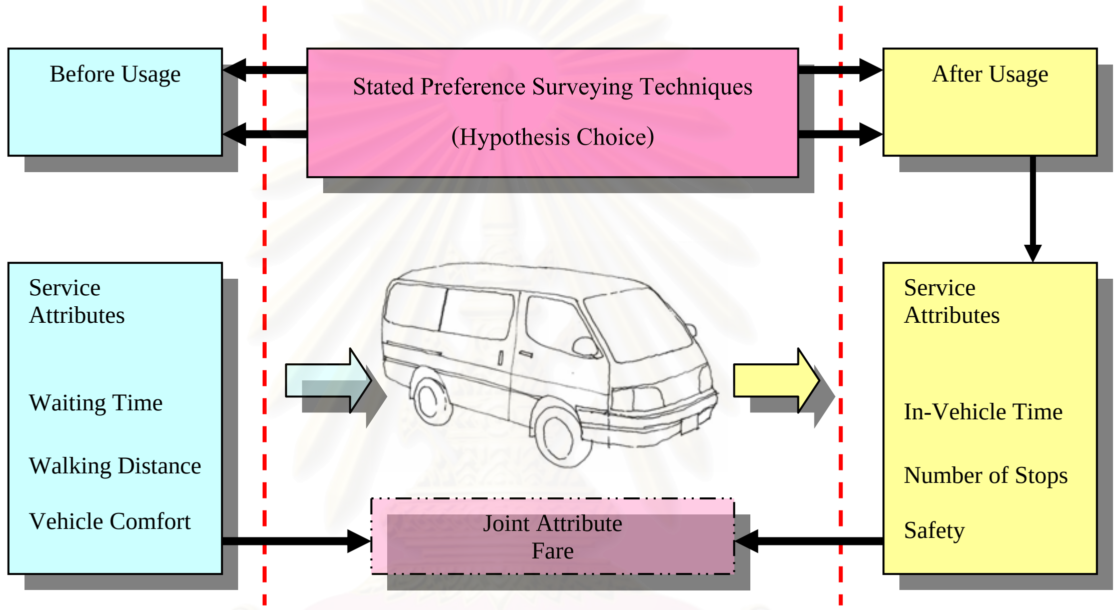

Figure 4.2 Concept of the choice experimental design

Therefore, the design of SP games was separated into four games:

(1) SP Game1 presented travelling conditions before using passenger van through within-mode (passenger van service type1 (PV-1) and passenger van service type2 (PV-2) that were the hypothetical service of passenger vans with improvement of its services in the future);

(2) SP Game2 presented travelling conditions after using passenger van through within-mode (passenger van service type1 and passenger van service type2);

(3) SP Game3 presented travelling conditions before using passenger van through between-mode (passenger van service and bus service); and

(4) SP Game4 presented travelling conditions after using passenger van service though between-mode (passenger van service and bus service).

4.1.4 TESTING THE QUESTIONNAIRE

For testing on the questionnaire design with understanding, wording, and reasonable, the questionnaire was pilot-tested with a focus group of transport professionals (Master's and Ph.D. Student of Department of Civil Engineering, Chulalongkorn Univeristy, Thailand and Ph.D. Student and Economics Behavioural

Modelling Group of Institute for Transport Studies, University of Leeds, UK). Then, the questionnaire was revised in the light of response, to eliminate any problems and maximise the amount of information that could be gathered. Especially the pilot study, the passenger van users -150 respondents- provided information based on how individuals evaluated the attributes in the designed scenarios by a ranking response and choice response. The results thus far confirmed the significance of the service quality attributes, and provided reassurance concerning the suitability of the chosen survey tool. The pilot results showed that the binary choice response was the most realistic and simplest in making decisions for passenger van users.

4.1.5 CONDUCT THE MAIN SURVEY AND SPECIAL SURVEY

The questionnaire was often revised again after each pilot, and the number of interactions depended on how much was learnt in each round. The final version of the questionnaire was applied to the full sample. To confirm the selected main choice modelling approaches, this study adopted choice experiments and contingent ranking questionnaire in pilot survey. The results confirmed that the choice experiments would be used in the main survey. Moreover, the study used the SP simulation to adapt the choice experiments before collecting data for the main survey (Fowkes, 2000; Bradley and Daly, 2000). Further, the nine SP scenarios from Taguchi's L_9 designed had to be divided into two sets (each five SP scenarios) for reducing the respondent error from boring responses.

4.2 DATA COLLECTION

This part explains the process of data collection into the two main sections: (1) Choice of population and sample and (2) Choice of survey method.

4.2.1 CHOICE OF POPULATION AND SAMPLE

In Bangkok, passenger van services are very complicated as different characteristics depend on the spatial locations and market segments. The main survey was based largely on responses from university students, because they were accounted for the largest segment of passenger van users (Cervero, 2000; Eamsupawat, 2002; Chaisri, 2003; and Nontasiri, 2003;), they were obviously trip purpose; and they could select more than one choice, e.g., passenger van services, passenger car, bus, and air-conditioned bus. Moreover, the stations/terminals of passenger van at university could be calculated at 12.59 % of all trip-ends of passenger van service (BMTA, 2004) and the locations of universities were scattered over all Bangkok area.

In the main survey, a sample of 1200 users was drawn from three strata pertaining to different spatial locations during August 2005 to October 2005. The Inner-city was represented by University of the Thai Chamber of Commerce (UTCC), Ramkhamhang University (RU) was a sample of the Urban-fringe, and King Mongkut's Institute of Technology Ladkrabang (KMITL) represented the Suburban as shown in Figure 4.3. Specifically, the selected route for the Inner-city was the routes of UTCC-Victory Monument and UTCC-Central Ladprao shopping centre. Whilst the route at the Urban-fringe included RU-Future Park Rangsit route and RU-RU2 (Bang-Na Campus) route and the route of the Suburban was KMITL-the Mall

Bangkrapi route and KMITL-Victory Monument route. Details of characteristics of selected passenger van routes were presented in Table 4.3 and Figure 4.3.

Moreover, the special sample of 300 users was drawn during December 2005 from urban-fringe to develop the RP-SP models using the joint revealed preference (RP) and stated preference (SP) data, for testing model scaling and reliability.

Table 4.3 Characteristics of selected passenger van routes

Service characteristics	Inner-city		Urban-fringe		Suburban	
Name	Route11	Route12	Route21	Route22	Route31	Route32
Origin	Central Lardprao	Victory Monument	RU2	Future Rangsit	The Mall Bangkrapi	Victory Monument
Designation	UTCC	UTCC	RU	RU	KMITL	KMITL
Fare (Baht)	12	12	25	20	20	35
Expressway Usage	NO	NO	NO	NO	NO	YES
Headways (peak hour)	Full Users	Full Users	Full Users/ 5-10 mins	Full Users/ 5-10 mins	Full Users/ 5-10 mins	Full Users/ 20 mins
Headways (off-peak hour)	Full Users	Full Users	Full Users/ 15-20 mins	Full Users/ 15-20 mins	Full Users/ 15 mins	Full Users/ 20 mins
Service hours beginning	06:00	06:00	04:00	04:20	04:30	05:00
Service hours ending	20:00	20:00	22:00	21:45	22:00	21:00

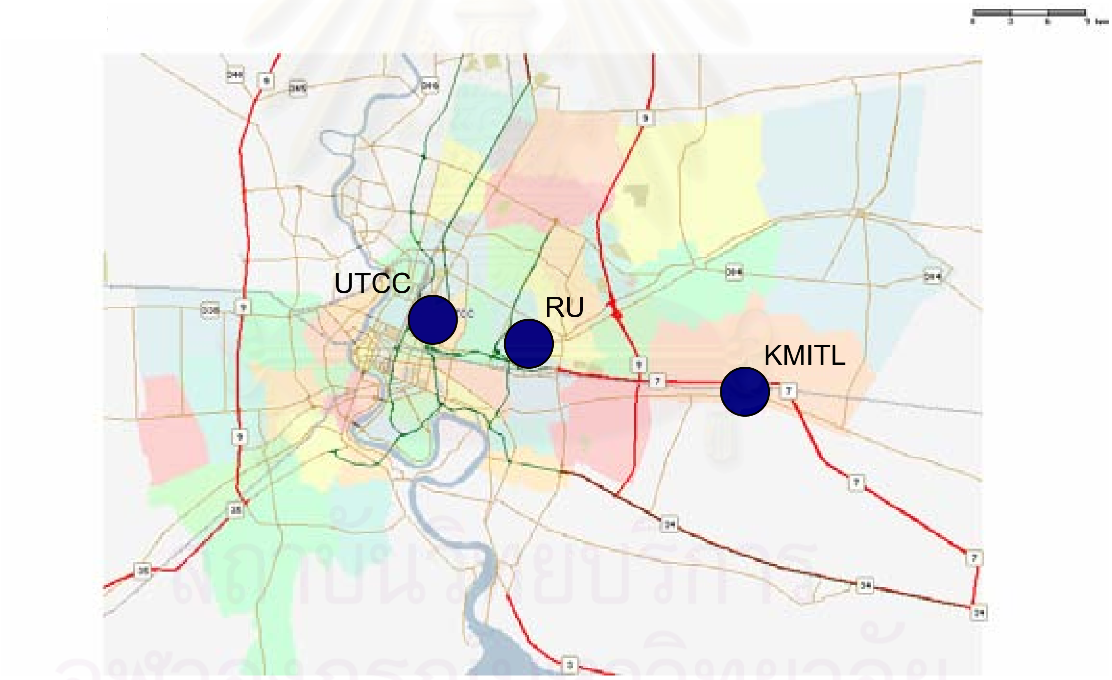

Figure 4.3 Spatial locations of the survey sites

4.2.2 CHOICE OF SURVEY METHOD

The face-to-face interview was selected for this study because it provided the benefits in highly flexible, complex questions and questionnaire structures, permit probing and clarification, larger quantity of data can be collected, potential for extensive use of visual and demonstration aids, and high response rate (expectedly over 70%). Moreover, the sampling strategy of the present study was the systematic random sampling (every tenth permitting passenger van).

4.3 DATA ANALYSIS

To estimate and describe the SP experimental this study analysed data from surveys on two main sections:

4.3.1 USER CHARACTERISTICS AND TRAVEL BEHAVIOURS

The user characteristics and travel behaviour analysis was the process after the data collection process. The present study used the Statistical Procedure for Social Science (SPSS) computer software for analysing the frequency, percent, mean, and standard deviation based on the level of measurement that include (See details in Chapter V and VI):

(1) User's characteristics;
(2) Passenger van level of service;
(3) Access and egress mode;
(4) Reason to use passenger van; and
(5) Current situations of passenger van service.

4.3.2 DISCRETE CHOICE AND ATTRIBUTE VALUATION

The SP and RP data was checked and cleaned of non-response i.e. missing or incomplete response from the all surveys. Following this process, 1200 respondents from 1500 respondents of the main survey and 300 respondents from 350 respondents of the special survey were selected.

The main survey, that was drawn from three spatial location, could be calibrated the parameter estimation and the attribute valuation could be calculated into the six forms of the models, including (See details in Chapter V)

(1) Within-mode model;
(2) Between-mode model;
(3) Within-mode model with Jackknife estimation;
(4) Between-mode model with Jackknife estimation;
(5) Merging (Within-mode and Between-mode) model; and
(6) All of spatial location model.

Whilst, the special survey, that was drawn from the Urban-fringe, could be calibrated the parameter estimation and the attribute valuation could be calculated into the ten forms of the models including (See details in Chapter VI)

(1) SP Within-mode model;
(2) SP Between-mode model;
(3) SP Within-mode model with Jackknife estimation;
(4) SP Between-mode model with Jackknife estimation;
(5) RP-SP Within-mode model;
(6) RP-SP Between-mode model;
(7) RP-SP Within-mode model with Jackknife estimation;
(8) RP-SP Between-mode model with Jackknife estimation;
(9) Merging SP (Within-mode and Between-mode) model; and
(10) Merging RP-SP (Within-mode and Between-mode) model.

4.4 INTERPRETATION

The last part of this chapter is the data interpretation. This study can be concluded from these two principles:

4.4.1 VALIDITY AND RELIABILITY

Content/Face Validity and Construction Validity. The questionnaires of SP survey were tested the understanding, wording, and rationality by transport professional groups and the pilot survey as the same spatial location as the main survey. Furthermore, the study used the SP simulation to adapt the choice experiments before collecting data from the main survey. Moreover, the 20 samples of Jackknife procedure were applied in the final model specification to eliminate of SP bias (See details in Chapter V and VI).

Reliability. The use of joint revealed preference (RP) and stated preference (SP) data in the special survey might improve the SP scaling and the reliability of data (See details in Chapter V and VI).

4.4.2 CONCLUSIONS AND REPORTING

The results of SP estimation from the discrete choice modelling could be interpreted using attribute valuation and implication (See details in Chapter VII); for example, if the results of the between-mode model that was value-of-time of 0.30. That was, hence individual with values-of-time greater than 0.30 baht/minute would choose the quicker/dearer alternative (passenger van service), while those with lower value of time would choose the slower/cheaper alternative (bus service).

CHAPTER V

RESULTS OF SP MAIN SURVEY

This chapter presents the empirical results of the main survey including users' characteristics, travel behaviours, respondents' opinions analysis, and discrete choice modelling. Users' characteristics, travel behaviours, and respondents' opinions were analysed by the SPSS for Windows software (SPSS, 2002) whilst the estimation of the SP models (discrete choice modelling) were performed using the ALOGIT software (HCG, 2000). The discrete choice modelling was based on the random utility theory and the binary logit model, while an attribute valuation analysis was based on willingness to pay approach.

5.1 USERS' CHARATERISTICS, TRAVEL BEHAVIOURS, AND OPINIONS

Table 5.1-5.2 displayed the users' characteristics, travel behaviours, and opinions, while Table 5.3 illustrated the revealed preference data of passenger van services from the main survey.

Table 5.1 Users' characteristics, travel behaviours, and opinions from the main survey (1)

Variable	Inner city Mean (S.D)	Urban Fringe Mean (S.D)	Suburban Mean (S.D)	Total Mean (S.D)
Age (years)	20.2 (1.4)	22.0 (2.3)	20.5 (1.0)	20.9 (1.8)
Respondent income (baht/month)	5,312 (2,257)	5,601 (3,111)	5,137 (1,895)	5,357 (2,491)
Household income (baht/month)	48,727 (47,588)	19,252 (11,750)	38,263 (27,441)	34,020 (33,322)
Car ownership (vehicles/household)	1.6 (1.2)	1.0 (1.0)	1.6 (1.1)	1.4 (1.1)
Frequency (times/week)	4.3 (3.0)	2.1 (1.8)	2.6 (2.2)	3.0 (2.6)
Level of service of passenger van	4.5 (1.0)	4.1 (1.2)	4.2 (1.0)	4.3 (1.1)

Table 5.2 Users' characteristics, travel behaviours, and opinions from the main survey (2)

Variable	Inner city Frequency (%)	Urban Fringe Frequency (%)	Suburban Frequency (%)	Total Frequency (%)
Gender				
Male	110 (27.5)	171 (42.8)	203 (50.8)	484 (40.3)
Female	290 (72.5)	229 (57.3)	197 (49.3)	716 (59.7)
Access mode				
Walking	119 (29.8)	110 (27.5)	116 (29.0)	345 (28.8)
Conventional bus	85 (21.3)	159 (39.8)	92 (23.0)	336(28..0)
Air-conditioned bus	127 (31.8)	86 (21.5)	101 (25.3)	314 (26.2)
Motorcycle taxi	11 (2.8)	36 (9.0)	66 (16.5)	113 (9.4)
Other modes	58 (14.5)	9 (2.3)	25 (6.3)	92 (7.7)
Egress mode				
Walking	148 (37.0)	141 (35.3)	129 (32.3)	418 (34.8)
Conventional bus	81 (20.3)	119 (29.8)	79 (19.8)	279 (23.3)
Air-conditioned bus	110 (27.5)	94 (23.5)	90 (22.5)	294 (24.5)
Motorcycle taxi	20 (5.0)	38 (9.5)	68 (17.0)	126 (10.5)
Other modes	41(10.3)	8 (2.0)	34 (8.5)	83(6.9)
Main reason to use passenger van				
Faster	160 (40.0)	283 (70.8)	221 (55.3)	664 (55.3)
Reliability	15 (3.8)	11 (2.8)	16 (4.0)	42 (3.5)
Comfort	49 (12.3)	33 (8.3)	58 (14.5)	140 (11.7)
Convenience	161 (40.3)	64 (16.0)	91 (22.8)	316 (26.3)
Safety	6 (1.5)	3 (0.8)	7 (1.8)	16 (1.3)
Cheaper	9 (2.3)	6 (1.5)	7 (1.8)	22 (1.8)

Table 5.3 Revealed preference data of passenger van services from the main survey

Variable	Inner city Mean (S.D)	Urban Fringe Mean (S.D)	Suburban Mean (S.D)	Total Mean (S.D)
Fare (baht/trip)	12.0 (0.00)	22.6 (2.6)	27.5 (7.5)	20.7 (7.9)
Waiting time(minutes/trip)	14.0 (8.11)	16.4 (9.3)	14.4 (7.7)	14.9 (8.5)
Walking Distance (meters/trip)	170.5 (179.17)	393.0 (487.1)	395.4 (382.5)	318.9 (386.1)
Vehicle comfort (level/trip)	2.0 (0.46)	1.9 (0.5)	2.0 (0.5)	1.9 (0.5)
In-vehicle time (minutes/trip)	21.5 (10.56)	36.6 (21.8)	33.1 (11.4)	30.4 (16.7)
Number of stops (points/trip)	2.6 (4.16)	6.6 (6.5)	6.0 (6.2)	5.1 (6.0)
Safety (level/trip)	2.0 (0.51)	1.8 (0.5)	2.0 (0.5)	1.9 (0.5)

(1) Users' characteristics

The results in Table 5.1-5.2 show that, out of the entire sample, most respondents were female (59.7%), average age of 21 years old, average respondent income of 5,357 baht/month, average household income of 34,020 baht/month, average car ownership of 1.4 vehicles/household, and average frequency of passenger van usage of 3 times/week. In addition, the results of the Inner-city indicate that the proportion of respondents was female over male. The household income and frequency of passenger van usage at the Inner-city was the highest comparing with the other locations. The respondent income of the Urban-fringe was the highest comparing with the other locations whilst the household income was the lowest. The proportion of gender was significantly different among these locations.

(2) Passenger van level of service (LOS)

The results in Table 5.1 shows that the rating score of passenger van level of service (LOS) was 4.3 score level. This result was medium to high level ('1' was the lowest level of service and '7' was the highest level of service). In comparison to spatial location, the order from high to low of passenger van level of service (LOS) was at the Inner-city, the Suburban, and the Urban-fringe, respectively.

(3) Access and egress mode

From Table 5.2, most respondents took a walk (28.8%), conventional bus (28.0%), air-conditioned bus (26.2%), and motorcycle taxi (9.4%) in order to access passenger van service. Whilst the mode for egress to the destination was walking (34.8%), air-conditioned bus (24.5%), conventional bus (23.3%), and motorcycle taxi (10.5%), respectively. In comparison to spatial locations, the largest mode-sharing of walking occurred at the Inner-city, using conventional bus and air-conditioned bus at the Urban-fringe, and using motorcycle taxi at the Suburban to access the passenger van, respectively. Whilst walking was the largest proportion mode-sharing at all locations, the second largest mode-sharing, in percentage, were using air-conditioned bus at the Inner-city, using conventional bus at urban-fringe, and using motorcycle taxi at the Suburban in order to egress the passenger van.

(4) Reason to use passenger van

The results in Table 5.2 show that, most respondents preferred to use the passenger van service because it was faster (55.3%), convenience (26.3%), comfort (11.7%), reliability (3.5%), less cost (1.8%), and safety (1.3%). In comparison to spatial locations, the greatest preference was on convenience and less cost at the Inner-city; faster at the Urban-fringe, and reliability, comfort, and safety at the Suburban.

(5) Revealed preference data

From Table 5.3, passenger van services in Bangkok had an average fare of 20.7 baht/trip, average waiting time of 14.9 minutes/trip, average walking distance of

318.9 meters/trip, average vehicle comfort of 1.9 levels/trip, average in-vehicle time of 30.4 minutes/trip, number of stops of 5.1 points/trip, and average safety of 1.9 levels/trip. In addition, the safety from driver behaviour and vehicle comfort were the highest at the Inner-city comparing with the other locations. Whilst waiting time, in-vehicle time, and number of stops of the Urban-fringe were the highest and the Suburban had the highest fare, walking distance, and vehicle comfort.

5.2 DISCRETE CHOICE MODELLINGS

This part includes two main sections: (1) the estimation results of the SP models and (2) the attribute valuation. The coefficient estimation was calculated from the six main models: (1) Within-mode model, (2) Between-mode model, (3) Within-mode model with jackknife estimation, (4) Between-mode model with jackknife estimation, (5) Merging (Within-mode and Between-mode) model, and (6) All of spatial location model. Moreover, the attribute valuation was calculated and presented in the last section following these SP models.

5.2.1 ESTIMATION RESULTS OF THE SP MODELS

Table 5.4 illustrated the estimation results of the within-mode, between-mode, and merging model from the main survey.

(1) Within-mode model

In the Inner-city model, five of seven attributes (fare, walking distance, vehicle comfort, in-vehicle time, and safety from driver behaviour) were significant at 5% level of significance, each with the expected reasonable sign. The ρ^2 value was 0.1588 that was the typical of SP studies (The ρ^2 value between 0.2 and 0.4 were considered to indicate an extremely good fit and the values around 0.1 were typical for SP studies (Louviere et al, 2000)). Whilst, the Urban-fringe model showed that waiting time and in-vehicle time were insignificant at 5% level of significance with the ρ^2 value was 0.1941. In the Suburban model, waiting time and walking distance were insignificant at 5% level of significance and the ρ^2 value was 0.1424.

(2) Between-mode model

In the Inner-city model, six of seven attributes (fare, waiting time, walking distance, vehicle comfort, in-vehicle time, and safety from driver behaviour) were significant at 5% level of significance, each with the expected reasonable sign. The ρ^2 value was 0.3100 that was an extremely good fit. Whilst, in the Urban-fringe and the Suburban models, walking distance and number of stops were insignificant at 5% level of significance. The ρ^2 value was 0.1960, and 0.1154, respectively.

(3) Merging model

In the Inner-city model, five of seven attributes (fare, waiting time, comfort and convenience, in-vehicle time, and safety from driver behaviour) were significant at 5% level of significance, each with the expected reasonable sign. Whilst, the Urban-fringe model showed that waiting time and walking distance was insignificant at 5% level of significance, and walking distance were insignificant at 5% level of significance in the Suburban model. The ρ^2 values were 0.6138, 0.5905, and 0.5583 that was the extremely good fit, respectively.

Table 5.4 Estimation results of within-mode, between-mode, and merging model from the main survey

Attribute	Inner city Parameters (t-value)		Urban Fringe Parameters (t-value)		Suburban Parameters (t-value)	
	Original	Jackknife	Original	Jackknife	Original	Jackknife
Within-mode model						
ASC (PV-2)	-0.6868(-3.7)***	-0.6825(-3.9)***	-0.7515(-4.0)***	-0.7465(-3.6)***	-0.4607(-2.6)***	-0.4545(-2.4)**
Fare	-0.1236(-12.9)***	-0.1233(-9.3)***	-0.1482(-15.0)***	-0.1476(-12.3)***	-0.1244(-13.4)***	-0.1241(-9.7)***
Waiting Time	-0.0078(-0.3)	-0.0082(-0.8)	0.0273(1.1)	0.0271(1.1)	-0.0176(-0.7)	-0.0182(-0.8)
Walking Distance	-0.0042(-3.4)***	-0.0041(-5.2)***	-0.0051(-4.0)***	-0.0051(-3.9)***	-0.0015(-1.3)	-0.0015(-1.4)
Vehicle Comfort	0.9500(15.4)***	0.9486(13.8)***	1.0689(16.9)***	1.0664(14.9)***	0.7589(12.8)***	0.7583(17.1)***
In-vehicle Time	-0.0208(-2.4)**	-0.0209(-2.6)***	-0.0169(-1.9)*	-0.0169(-1.8)*	-0.0326(-3.8)***	-0.0327(-3.8)***
No. of Stops	-0.0193(-1.5)	-0.0194(-1.8)*	-0.0293(-2.2)**	-0.0291(-2.4)**	0.0306(2.4)**	0.0302(2.9)***
Safety	1.2352(18.3)***	1.2316(19.5)***	1.3991(20.0)***	1.3932(15.1)***	1.1612(17.5)***	1.1576(12.9)***
ρ^2 w.r.t. Zero	0.1588		0.1941		0.1424	
Likelihood	-2332.1855		-2234.3224		-2377.7754	
Chosen (PV-1)	2158		1970		2081	
Chosen (PV-2)	1842		2030		1919	
No. of observations	4000		4000		4000	
Between-mode model						
ASC (Bus)	-0.7452(-3.3)***	-0.7589(-3.6)***	-0.5240(-3.1)***	-0.5208(-2.4)**	-0.3846(-3.0)***	-0.3853(-2.6)***
Fare	-0.0438(-4.0)***	-0.0430(-2.9)***	-0.0519(-6.4)***	-0.0519(-5.1)***	-0.0305(-6.0)***	-0.0305(-5.6)***
Waiting Time	-0.0446(-3.7)***	-0.0435(-3.6)***	-0.0380(-4.0)***	-0.0381(-3.2)***	-0.0238(-3.4)***	-0.0237(-3.1)***
Walking Distance	-0.0056(-2.9)***	-0.0045(-3.2)***	-0.0020(-1.6)	-0.0020(-1.8)*	-0.0018(-1.6)	-0.0018(-1.6)
Vehicle Comfort	0.9332(10.9)***	0.9230(10.2)***	0.9280(13.6)***	0.9256(14.1)***	0.6005(10.1)***	0.6002(12.1)***
In-vehicle Time	-0.0356(-3.1)***	-0.0346(-2.9)***	-0.0386(-5.1)***	-0.0385(-5.0)***	-0.0109(-5.9)***	-0.0108(-3.9)***
No. of Stops	-0.0064(-0.4)	-0.0057(-0.6)	-0.0005(-0.0)	-0.0006(-0.1)	-0.0203(-1.9)*	-0.0201(-2.5)**
Safety	1.1350(13.9)***	1.1276(12.7)***	1.3285(17.9)***	1.3245(12.2)***	0.9896(15.0)***	0.9863(15.4)***
ρ^2 w.r.t. Zero	0.3100		0.1960		0.1154	
Likelihood	-1913.0518		-2229.1296		-2452.6804	
Chosen (PV)	3106		2631		2481	
Chosen (Bus)	894		1369		1519	
No. of observations	4000		4000		4000	
Merging model						
ASC (Van)	1.469 (11.8)***		1.413 (10.3)***		1.372 (9.5)***	
ASC (PV-1)	1.009 (6.9)***		0.9490 (6.3)***		1.286 (7.4)***	
ASC (PV-2)	0.5286 (4.8)***		0.6852 (6.6)***		0.9242 (6.5)***	
Fare	-0.068(-10.1)***		-0.058 (-11.5)***		-0.041 (-12.4)***	
Waiting Time	-0.010 (-2.1)**		0.004 (0.8)		0. 015 (2.8)***	
Walking Distance	-0.001 (-1.5)		-0.001 (-1.5)		-0. 000(-0.2)	
Vehicle Comfort	1.006 (18.7)***		1.075 (20.8)***		0.804 (16.4)***	
In-vehicle Time	-0.014 (-5.2)***		-.0.015 (-6.5)***		-0. 012 (-7.2)***	
No. of Stops	-0.009 (-1.0)		0.020 (3.2)***		0. 038 (4.6)***	
Safety	1.286 (21.4)***		1.433 (24.7)***		1.223 (20.8)***	
Nest Coefficient 1	0.8742 (14.5)***		0.888 (17.2)***		0.732 (14.1)***	
Nest Coefficient 2	170.8(2.2)**		166.3 (2.2)**		170.3 (2.2)**	
ρ^2 w.r.t. Zero	0.6138		0.5905		0.5583	
Likelihood	-4282.9166		-4540.9475		-4898.6899	
Chosen (PV-1)	2158		1970		2081	
Chosen (PV-2)	1842		2030		1919	
Chosen (Van)	3106		2631		2481	
Chosen (Bus)	894		1369		1519	
No. of observations	8000		8000		8000	

*90 % confidence level (t-value > 1.645)
**95 % confidence level (t-value > 1.960)
***99 % confidence level (t-value > 2.575)

ASC = Alternative-specific constants
ρ^2 w.r.t. Zero = Rho-squared w.r.t. Zero
Chosen (PV-1) = Chosen passenger van service type-1

Chosen (PV-2) = Chosen passenger van service type-2
Chosen (Van) = Chosen passenger van service
Chosen (Bus) = Chosen bus service

(4) All of spatial location model

Table 5.5 displayed the estimation results of the within-mode and between-mode model by all of spatial locations.

In the within-mode model, four of seven attributes (fare, vehicle comfort, in-vehicle time, and safety from driver behaviour) were significant at 5% level of significance, each with the expected reasonable sign. Whilst, the between-mode model indicated that five of seven attributes (fare, waiting time, vehicle comfort, in-vehicle time, and safety from driver behaviour) were significant at 5% level of significance, each with the expected reasonable sign. The ρ^2 values were 0.1650 and 0.2070 that were the good to extremely good fit, respectively.

Table 5.5 Estimation results of within-mode and the between-mode model by all of spatial locations

Attribute	All of special locations	
	Within-mode model Parameters (t-value)	Between-mode model Parameters (t-value)
ASC (PV-2)	-0.630 (-5.9)***	
ASC (Bus)		-0.489 (-5.2)***
Fare (Inner-city)	-0.123 (-13.4)***	-0.048 (-4.6)***
Fare (Urban-fringe)	-0.146 (-15.3)***	-0.052 (-6.4)***
Fare (Suburban)	-0.127 (-14.3)***	-0.031 (-6.1)***
Waiting Time (Inner-city)	-0.015 (-0.9)	-0.058 (-9.5)***
Waiting Time (Urban-fringe)	0.012 (0.8)	-0.040 (-6.3)***
Waiting Time (Suburban)	0.003 (0.2)	-0.019 (-3.3)***
Walking Distance (Inner-city)	-0.004 (-3.4)***	-0.005 (-3.7)***
Walking Distance (Urban-fringe)	-0.005 (-4.1)***	-0.002 (-1.7)*
Walking Distance (Suburban)	-0.001 (-1.2)	-0.002 (-1.5)
Vehicle Comfort (Inner-city)	0.950 (15.4)***	0.949 (11.1)***
Vehicle Comfort (Urban-fringe)	1.070 (16.9)***	0.928 (13.6)***
Vehicle Comfort (Suburban)	0.759 (12.8)***	0.603 (10.1)***
In Vehicle Time (Inner-city)	-0.023 (-4.1)***	-0.048 (-8.4)***
In Vehicle Time (Urban-fringe)	-0.022 (-3.8)***	-0.040 (-6.2)***
In Vehicle Time (Suburban)	-0.025 (-4.4)***	-0.010 (-5.8)***
No. of Stops (Inner-city)	-0.020 (-1.6)	-0.012 (-0.9)
No. of Stops (Urban-fringe)	-0.031 (-2.3)***	-0.002 (-0.2)
No. of Stops (Suburban)	0.033 (2.6)***	-0.014 (-1.5)
Safety from Driver Behaviour (Inner-city)	1.232 (18.4)***	1.135 (13.9)***
Safety from Driver Behaviour (Urban-fringe)	1.392 (20.1)***	1.329 (17.9)***
Safety from Driver Behaviour (Suburban)	1.173 (17.8)***	0.988 (14.9)***
ρ^2 w.r.t zero	0.1650	0.2070
Likelihood	-6944.9773	-6595.8696
Chosen (PV-1)	6209	
Chosen (PV-2)	5791	
Chosen (Van)		8218
Chosen (Bus)		3782
No. of observations	12000	12000

*90 % confidence level (t-value > 1.645)
**95 % confidence level (t-value > 1.960)
***99 % confidence level (t-value > 2.575)

ASC = Alternative-specific constants
ρ^2 w.r.t. Zero = Rho-squared w.r.t. Zero
Chosen (PV-1) = Chosen passenger van service type-1

Chosen (PV-2) = Chosen passenger van service type-2
Chosen (Van) = Chosen passenger van service
Chosen (Bus) = Chosen bus service

(6) Results discussion

From Table 5.4, the estimation results of the within-mode model show that the t-values of some attributes were insignificant at 5% level of significance (t-value < 1.96), especially waiting time of all spatial locations, number of stops of the Inner-city, in-vehicle time of the Urban-fringe, and walking distance of the Suburban. It might imply that respondents valued these service quality attributes indifferently between the SP experiments of passenger van service type-1 and type-2.

The estimation results of the between-mode model show that t-values of some attributes were insignificant at 5% level of significance, particularly number of stops of the Inner-city, walking distance and number of stops of the Urban-fringe, and walking distance of the Suburban. Moreover, the Jackknife estimate could confirm the power of coefficient estimation; for example, the t-value of number of stops in the Suburban altered from 1.9 to 2.5 (coefficient estimation from -0.0203 to -0.0201). It might imply that respondents valued these service quality attributes indifferently between the SP experiments of passenger van service and bus service.

The estimation results of the merging model show that the t-values of some attributes were insignificant at 5% level of significance; particularly walking distance of all spatial locations, number of stops of the Inner-city, waiting time of the Suburban. It was inferred that the merging model of within-mode and between-mode increased the power of model estimation as indicated by the ρ^2 value of 0.6138 in the Inner-city, 0.5905 in the Urban-fringe, and 0.5583 in the Suburban, respectively.

From Table 5.5, the estimation results of the all of spatial location model show that the t-values of some attributes of the within-mode model were insignificant at 5% level of significance, particularly waiting time of all spatial location, walking distance of the Suburban, and number of stops of the Suburban. Whilst, the t-values of some attributes of the between-mode model were insignificant at 5% level of significance, particularly number of stops of all spatial locations, and walking distance of the Urban-fringe and the Suburban.

The signs of parameters were checked to test the realism of each service quality attributes. In this study, the signs of service quality attributes was expected that (1) fare would have negative sign because the utility is decreasing if the value of fare increases, (2) waiting time would be negative sign because the utility is decreasing if the value of waiting time increases, (3) walking distance because the utility is decreasing if the value of walking distance increases, (4) vehicle comfort would have positive sign because the utility is increasing if the value of vehicle comfort increases, (5) in-vehicle time would have negative sign because the utility is decreasing if the value of in-vehicle time increases (6) number of stops would be negative sign because the utility is decreasing if the value of number of stops increases, and (7) safety from driver behaviour would have positive sign because the utility is increasing if the value of safety from driver behaviour increases. From Table 5.4-5.5, the results show that the signs of parameters in most models have reasonable signs following above assumptions; however, some attributes do not have reasonable signs (including, waiting time of the Urban-fringe and number of stops of the Suburban in the within-mode model, waiting time (the Urban-fringe and the Suburban) and number of stops (the Suburban) in all of spatial locations model). According to the significance test, these service attributes do not have high significance. Thus, it might imply that the respondents in the Urban-fringe and the Suburban may be not concerned with these attributes, the contribution of the unreasonable sign attributes to the utility is quite small.

For example, the within-mode model of passenger van service type-1 and passenger van service type 2 in the Urban-fringe:

If an individual experiences the following passenger van service type-1,

Fare	= 20 baht
Waiting Time	= 20 minutes
Walking Distance	= 200 metres
Vehicle Comfort	= 3 out of 3 scale
In-Vehicle Time	= 60 minutes
Number of Stops	= 5 points
Safety	= 3 out of 3 scale.

The contribution of each attribute to the overall service quality of this passenger van service type-1 is expressed as absolute value and percentage of utility value (in parenthesis),

Fare	= 2.96 (22.6)
Waiting Time	= 0.55 (4.2)
Walking Distance	= 1.02 (7.8)
Vehicle Comfort	= 3.20 (24.5)
In-Vehicle Time	= 1.01 (7.7)
Number of Stops	= 0.15 (1.1)
Safety	= 4.19 (32.0)

From the example, the variables that have wrong signs and insignificance (number of stops and waiting time) have the least contribution effect to the overall utility. Although the contributions by these factors vary by individual travelers, it can be expected that the contribution by these factors would be minimal.

Thus, this study would like to present all effects of service quality attributes in the models more than the power of models calibration. This is to show the generalization of the service quality variables for various paratransit modes (and even across all public transit modes). These variables were then decided to be kept in the models. All variables including the insignificant ones mentioned above would be introduce in the models for further analyses.

5.2.2 ATTRIBUTE VALUATION

Table 5.6 illustrated the valuation of the within-mode, between-mode, and merging models by types of spatial locations.

Table 5.6 Valuation of within-mode, between-mode, and merging model from the main survey

Attribute	Inner city Valuation		Urban Fringe Valuation		Suburban Valuation	
	Original	Jackknife	Original	Jackknife	Original	Jackknife
Within- mode						
ASC (PV-2)	5.56	5.54	5.07	5.06	3.70	3.66
Waiting Time	0.06	0.07	-0.18	-0.18	0.14	0.15
Walking Distance	0.03	0.03	0.03	0.04	0.01	0.01
Vehicle Comfort	-7.69	-7.69	-7.21	-7.23	-6.10	-6.11
In-vehicle Time	0.17	0.17	0.11	0.11	0.26	0.26
No. of Stops	0.16	0.16	0.20	0.20	-0.25	-0.24
Safety	-9.99	-9.99	-9.44	-9.44	-9.33	-9.33
Between-mode						
ASC (Bus)	17.01	17.65	10.10	10.04	12.61	12.63
Waiting Time	1.02	1.01	0.73	0.73	0.78	0.78
Walking Distance	0.13	0.11	0.04	0.040	0.06	0.06
Vehicle Comfort	-21.31	-21.47	-17.88	-17.83	-19.69	-19.68
In-vehicle Time	0.81	0.81	0.74	0.74	0.36	0.35
No. of Stops	0.15	0.13	0.01	0.01	0.67	0.66
Safety	-25.91	-26.22	-25.60	-25.52	-32.45	-32.34
Merging model						
ASC (Van)	-21.60		-24.42		-33.87	
ASC (PV-1)	-14.84		-16.40		-31.75	
ASC (PV-2)	-7.77		-11.84		-22.81	
Waiting Time	0.15		-0.07		-0.36	
Walking Distance	0.02		0.02		0.00	
Vehicle Comfort	-14.79		-18.58		-19.85	
In-vehicle Time	0.21		0.26		0.29	
No. of Stops	0.13		-0.36		-0.95	
Safety	-18.91		-24.76		-30.19	

(1) Valuation of within-mode model

In the Inner-city, it was inferred that respondents demonstrated an alternative-specific preference of 5.56 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attributes, walking distance was valued at 0.03 baht/meter, vehicle comfort at 7.69 baht/level, in-vehicle time at 0.17 baht/minute, and safety from driver behaviour at 9.99 baht/level. The Jackknife estimation gave an alternative-specific preference of 5.54 baht for passenger van service type 1 when comparing this service with passenger van service type 2. Of the generic attributes, walking distance was valued at 0.03 baht/meter, vehicle comfort at 7.69 baht/level, in-vehicle time at 0.17 baht/minute, and safety from driver behaviour at 9.99 baht/level.

In the Urban-fringe, respondents demonstrated an alternative-specific preference of 5.07 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attributes, walking distance was valued at 0.03 baht/meter, vehicle comfort at 7.21 baht/level, in-vehicle time at 0.11 baht/minute, and safety from driver behaviour at 9.44 baht/level. The Jackknife estimation gave an alternative-specific preference of 5.06 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attributes, walking distance was valued at 0.04 baht/meter, vehicle comfort at 7.23 baht/level, in-vehicle time at 0.11 baht/minute, and safety from driver behaviour at 9.44 baht/level.

In the Suburban, respondents demonstrated an alternative-specific preference of 3.70 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attributes, vehicle comfort was valued at 6.10 baht/meter, in-vehicle time at 0.26 baht/minute, and safety from driver behaviour at 9.33 baht/level. The Jackknife estimation gave an alternative-specific preference of 3.66 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attribute, in-vehicle time was valued at 0.26 baht/meter, vehicle comfort at 6.11 baht/level, and safety from driver behaviour at 9.33 baht/level.

(2) Valuation of between-mode model

In the Inner-city, it was inferred that respondents demonstrated an alternative-specific preference of 17.01 baht for passenger van service when comparing this service with bus service. Of the generic attributes, waiting time was valued at 1.02 baht/minute, walking distance at 0.13 baht/meter, vehicle comfort at 21.31 baht/level, in-vehicle time at 0.81 baht/minute, and safety from driver behaviour at 25.91 baht/level. The Jackknife estimation gave an alternative-specific preference of 17.65 baht for passenger van service when comparing this service with bus service. Of the generic attributes, waiting time was valued at 1.01 baht/minute, walking distance at 0.11 baht/meter, vehicle comfort at 21.47 baht/level, in-vehicle time at 0.805 baht/minute, and safety from driver behaviour at 26.22 baht/level.

In the Urban-fringe, respondents demonstrated an alternative-specific preference of 10.096 baht for passenger van service when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.73 baht/minute, vehicle comfort at 17.88 baht/level, in-vehicle time at 0.77 baht/minute, and safety from driver behaviour at 25.60 baht/level. The Jackknife estimation gave an alternative-specific preference of 10.04 baht for passenger van service when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.73 baht/minute, vehicle comfort at 17.83 baht/level, in-vehicle time at 0.77 baht/minute, and safety from driver behaviour at 25.52 baht/level.

In the Suburban, respondents demonstrated an alternative-specific preference of 12.61 baht for passenger van service comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.78 baht/minute, vehicle comfort at 19.69 baht/level, in-vehicle time at 0.36 baht/minute, and safety from driver behaviour at 32.45 baht/level. The Jackknife estimation gave an alternative-specific preference of 12.63 baht for passenger van service when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.78 baht/minute, vehicle comfort at 19.68 baht/level, in-vehicle time at 0.36 baht/minute, and safety from driver behaviour at 32.34 baht/level.

(3) Valuation of merging model

In the Inner-city, it was inferred that respondents demonstrated an alternative-specific preference of 21.60 baht for passenger van service, 14.84 baht for passenger van service type-1, and 7.77 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.15 baht/minute, vehicle comfort at 14.79 baht/level, in-vehicle time at 0.21 baht/minute, and safety from driver behaviour at 18.91 baht/level.

In the Urban-fringe, respondents demonstrated an alternative-specific preference of 24.42 baht for passenger van service, 16.40 baht for passenger service type-1, and 11.84 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, vehicle comfort was valued at 18.58 baht/level, in-vehicle time at 0.26 baht/minute, number of stops at 0.36 baht/stop, and safety from driver behaviour at 24.76 baht/level.

In the Suburban, respondents demonstrated an alternative-specific preference of 33.868 baht for passenger van service, 31.75 baht for passenger service type-1, and 22.81 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.36 baht/minute, vehicle comfort at 19.85 baht/level, in-vehicle time at 0.288 baht/minute, number of stops at 0.95 baht/stop, and safety from driver behaviour at 30.19 baht/level.

Table 5.7 displayed the valuation of the within-mode models and between-mode model by all of spatial locations.

Table 5.7 Valuation of within-mode and between-mode model by all of spatial locations

Attribute	All of special location	
	Within-mode model Valuation	Between-mode model Valuation
ASC (PV-2) (Inner-city)	5.122	
ASC (PV-2) (Urban-fringe)	4.315	
ASC (PV-2) (Suburban)	4.961	
ASC (Bus) (Inner-city)		10.188
ASC (Bus) (Urban-fringe)		9.404
ASC (Bus) (Suburban)		15.774
Waiting Time (Inner-city)	0.122	1.208
Waiting Time (Urban-fringe)	-0.082	0.769
Waiting Time (Suburban)	-0.024	0.613
Walking Distance (Inner-city)	0.033	0.104
Walking Distance (Urban-fringe)	0.034	0.038
Walking Distance (Suburban)	0.008	0.065
Vehicle Comfort (Inner-city)	-7.724	-19.771
Vehicle Comfort (Urban-fringe)	-7.329	-17.846
Vehicle Comfort (Suburban)	-5.976	-19.452
In Vehicle Time (Inner-city)	0.187	1.000
In Vehicle Time (Urban-fringe)	0.151	0.769
In Vehicle Time (Suburban)	0.197	0.323
No. of Stops (Inner-city)	0.163	0.250
No. of Stops (Urban-fringe)	0.212	0.038
No. of Stops (Suburban)	-0.260	0.452
Safety from Driver Behaviour (Inner-city)	-10.016	-23.646
Safety from Driver Behaviour (Urban-fringe)	-9.534	-25.558
Safety from Driver Behaviour (Suburban)	-9.236	-31.871

(4) Valuation of All of Spatial location: Within-mode model

In the Inner-city, it was inferred that respondents demonstrated an alternative-specific preference of 5.12 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attributes, vehicle comfort was valued at 7.72 baht/level, in-vehicle time at 0.19 baht/minute, and safety from driver behaviour at 10.02 baht/level.

In the Urban-fringe, respondents demonstrated an alternative-specific preference of 4.32 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of the generic attributes, vehicle comfort was valued at 7.33 baht/level, in-vehicle time at 0.15 baht/minute, and safety from driver behaviour at 9.53 baht/level.

In the Suburban, respondents demonstrated an alternative-specific preference of 4.96 baht for passenger van service type-1 when comparing this service with passenger van service type-2. Of generic attributes, vehicle comfort was valued at 5.98 baht/level, in-vehicle time at 0.20 baht/minute, and safety from driver behaviour at 9.24 baht/level.

(5) Valuation of All of Spatial location: Between-mode model

In the Inner-city, it was inferred that respondents demonstrated an alternative-specific preference of 10.19 baht for passenger van service when comparing this service with bus service. Of the generic attributes, vehicle comfort was valued at 19.77 baht/level, in-vehicle time at 1.00 baht/minute, and safety from driver behaviour at 23.65 baht/level.

In the Urban-fringe, respondents demonstrated an alternative-specific preference of 9.40 baht for passenger van service when comparing this service bus service. Of the generic attributes, vehicle comfort was valued at 17.85 baht/level, in-vehicle time at 0.77 baht/minute, and safety from driver behaviour at 25.56 baht/level.

In the Suburban, respondents demonstrated an alternative-specific preference of 15.77 baht for passenger van service when comparing this service with bus service. Of the generic attributes, vehicle comfort was valued at 19.45 baht/level, in-vehicle time at 0.32 baht/minute, and safety from driver behaviour at 31.87 baht/level.

CHAPTER VI

RESULTS OF RP-SP SPECIAL SURVEY

This chapter presents the empirical results of the special survey including users' characteristics, travel behaviours, respondents' opinions analysis, and discrete choice modelling. Users' characteristics, travel behaviours, and respondents' opinions were analysed by the SPSS for Windows software (SPSS, 2002) whilst the estimation of the SP models and RP-SP models (discrete choice modelling) were performed using the ALOGIT software (HCG, 2000). The discrete choice modelling was based on the random utility theory and the binary logit model, while an attribute valuation analysis based on willingness to pay approach.

6.1 USERS' CHARATERISTICS, TRAVEL BEHAVIOURS, AND OPINIONS

Table 6.1-6.2 displayed the users' characteristics, travel behaviours, and opinions, while Table 6.3 illustrated the revealed preference data of passenger van services from the special survey.

Table 6.1 Users' characteristics, travel behaviours, and opinions from the special survey (1)

Variable	Mean	Standard Deviation
Age (years)	21.4	2.16
Respondent income (baht/month)	5,296	5,000
Household income (baht/month)	24,643	20,000
Car ownership (vehicles/household)	1.1	1.0
Frequency (times/week)	4.3	3.0
Level of service of passenger van	4.1	1.2

Table 6.2 Users' characteristics, travel behaviours, and opinions from the special survey (2)

Variable	Frequency	Percentage
Gender		
Male	142	47.3
Female	158	52.7
Access mode		
Walking	81	27.0
Conventional bus	122	40.7
Air-conditioned bus	65	21.7
Motorcycle taxi	22	7.3
Other modes	10	3.3
Egress mode		
Walking	107	35.7
Conventional bus	90	30.0
Air-conditioned bus	62	20.7
Motorcycle taxi	28	9.3
Other modes	13	4.3
Main reason to use passenger van		
Faster	183	61.0
Reliability	20	6.7
Comfort	30	10.0
Convenience	55	18.3
Safety	5	1.7
Cheaper	7	2.3

Table 6.3 Revealed preference data of passenger van services from the special survey

Variable	Special survey Mean (S.D)
Fare (baht/trip)	19.1 (2.0)
Waiting time(minute/trip)	17.0 (9.5)
Walking Distance (meter/trip)	384.6 (483.3)
Vehicle comfort (level/trip)	1.9 (0.5)
In-vehicle time (minute/trip)	32.6 (13.3)
Number of stops (point/trip)	3.7 (4.4)
Safety (level/trip)	1.8 (0.5)

(1) Users' characteristics

The results in Table 6.1 show that most respondents were female (51.3%), average age of 21 years old, average respondent income of 5,296 baht/month, average household income of 24,643 baht/month, average car ownership of 1.1 vehicles/household, and frequency of passenger van usage of 4.3 times/week

(2) Passenger van level of service (LOS)

The results in Table 6.1 show that the rating score of passenger van level of service (LOS) at 4.1. This result was medium to high level ('1' was the lowest level of service and '7' was the highest level of service).

(3) Access and egress mode

Table 6.2 shows that most respondents took a conventional bus (40.7%), walking (27.0%), air-conditioned bus (21.7) and motorcycle taxi (7.3%) in order to access passenger van service. Whilst the mode to egress destination was walking (35.7%), conventional bus (30.0%), air-conditioned bus (20.7%), and motorcycle taxi (9.3%), respectively.

(4) Reason to use passenger van and

From Table 6.2, most respondents preferred to use the passenger van service because it was faster (61.0%), convenience (18.3%), comfort (10.0%), reliability (6.7%), less cost (2.3%), and safety (1.7%).

(5) Revealed preference data

From Table 6.3, passenger van service in the special survey was average fare of 19.1 baht/trip, average waiting time of 17.0 minutes/trip, average walking distance of 384.6 meters/trip, average vehicle comfort of 1.9 level/trip, average in-vehicle time of 32.6 minutes/trip, number of stops of 3.7 points/trip, and average safety of 1.8 level/trip.

6.2 DISCRETE CHOICE MODELLINGS

This part includes two main sections: (1) the estimation results of the SP and RP-SP models and (2) the attribute valuation. The coefficient estimation was calculated from ten main models: (1) SP Within-mode model, (2) SP Between-mode model, (3) SP Within-mode model with Jackknife estimation, (4) SP Between-mode model with jackknife estimation, (5) RP-SP Within-mode model, (6) RP-SP Between-mode model, (7) RP-SP Within-mode model with Jackknife estimation, (8) RP-SP Between-mode model with Jackknife estimation, (9) Merging SP (Within-mode and Between-mode) model, and (10) Merging RP-SP (Within-mode and Between-mode) model. Moreover, the attribute valuation was calculated and presented in the last section following these SP models.

6.2.1 ESTIMATION RESULTS OF THE SP AND RP-SP MODELS

(1) Estimation results of the SP model

Table 6.4 displayed the estimation results of the within-mode model and the between-mode model from the special survey.

Table 6.4 Estimation results of SP within-mode and SP between-mode model from the special survey

Attribute	Special survey	
	Original Parameters (t-value)	Jack-knife Parameters (t-value)
SP Within-mode model		
ASC (PV-2)	-0.6528 (-3.0)***	-0.6825(-3.9)***
Fare	-0.1771 (-15.0)***	-0.1767 (-12.4)***
Waiting Time	0.0064 (0.2)	0.0063 (0.2)
Walking Distance	-0.0061 (-4.0)***	-0.0061 (-4.3)***
Vehicle Comfort	1.0755 (14.6)***	1.0736 (14.6)***
In-vehicle Time	-0.0334 (-3.2)***	-0.0333 (-2.7)***
No. of Stops	-0.0363 (-2.2)**	-0.0360 (-2.1)**
Safety	1.4969 (17.7)***	1.4909 (12.4)***
ρ^2 w.r.t. Zero	0.2209	
Likelihood	-1620.1269	
Chosen (PV-1)	1473	
Chosen (PV-2)	1527	
No. of observations	3000	
SP Between-mode model		
ASC (Bus)	-0.6574 (-3.0)***	-0.6622 (-2.7)***
Fare	-0.0644 (-7.0)***	-0.0685 (-4.1)***
Waiting Time	-0.0309 (-3.0)***	-0.0358 (-2.4)**
Walking Distance	-0.0020 (-1.7)*	-0.0026 (-1.6)
Vehicle Comfort	1.0522 (12.2)***	1.0107 (11.4)***
In-vehicle Time	-0.0256 (-2.6)***	-0.0324 (-2.4)***
No. of Stops	-0.0048 (-0.4)	-0.0043 (-0.3)
Safety	1.2597 (15.0)***	1.2522 (12.8)***
ρ^2 w.r.t. Zero	0.2045	
Likelihood	-1654.1900	
Chosen (PV)	1989	
Chosen (Bus)	1011	
No. of observations	3000	

*90 % confidence level (t-value > 1.645)
**95 % confidence level (t-value > 1.960)
***99 % confidence level (t-value > 2.575)
ASC = Alternative-specific constants
ρ^2 w.r.t. Zero = Rho-squared w.r.t. Zero
Chosen (PV-1) = Chosen passenger van service type-1
Chosen (PV-2) = Chosen passenger van service type-2
Chosen (Van) = Chosen passenger van service
Chosen (Bus) = Chosen bus service

Within-mode model - six of all seven attributes (fare, walking distance, vehicle comfort, in-vehicle time, number of stops, and safety from driver behaviour) were significant at 5% level of significance, each with the expected sign. The ρ^2 value was 0.2209 that was an extremely good fit.

Between-mode model - five of all seven attributes (fare, waiting time, vehicle comfort, in-vehicle time, and safety from driver behaviour) were significant at 5% level of significance, each with the expected sign. The ρ^2 value was 0.2045 considered good fit.

(2) Estimation results of the RP-SP model

Table 6.5 displayed the estimation results of the RP-SP within-mode and RP-SP between-mode model from the special survey.

Table 6.5 Estimation results of RP-SP within-mode and RP-SP between-mode model from the special survey

Attribute	Special survey Within-mode		Special survey Between-mode	
	Original Parameters (t-value)	Jack-knife Parameters (t-value)	Original Parameters (t-value)	Jack-knife Parameters (t-value)
2 choice (RP and SP)				
ASC (RP)	-2.3639(-16.7)***	-2.3262(-7.5)***	-2.5805(-18.9)***	-2.5252(-8.2)***
Fare	-0.0273(-2.2)*	-0.0259(-1.1)	0.0041 (0.5)	0.0034 (0.3)
Waiting Time	0.0038(0.8)	0.0035(0.4)	-0.0140 (-3.2)***	-0.0142 (-2.0)**
Walking Distance	0.0001(0.7)	0.0001(0.4)	0.0002 (1.5)	0.0002 (0.8)
Vehicle Comfort	0.5984(8.2)**	0.5916(5.9)***	0.7789 (11.0)***	0.7609 (5.6)***
In-vehicle Time	-0.0020(-0.8)	-0.0015(-0.3)	0.0016 (0.6)	0.0010 (0.2)
No. of Stops	-0.0057(-0.9)	-0.0061(-0.7)	0.0035 (0.7)	0.0063 (0.5)
Safety	0.3536 (5.2)***	0.3372(3.1)***	0.4779 (7.2)***	0.4599 (3.5)***
ρ^2 w.r.t. Zero	0.3300		0.3334	
Likelihood	-1393.18		-1386.19	
Chosen (SP)	2432		2422	
Chosen (RP)	568		578	
No. of observations	3000		3000	
3 choice (RP, VAN, and Bus)				
ASC (RP)	-2.9574 (-21.0)***	-2.9005 (-6.4)***	-2.9031 (-20.5)***	-2.8664 (-8.6)***
ASC (PV-2)	-0.5357 (-7.3) ***	-0.5256 (-3.5)***	(BUS)-0.6628(-8.8)***	-0.6588 (-5.8)***
Fare	-0.1188(-12.2)***	-0.1170 (-6.8)***	-0.0596 (-6.2)***	-0.0584 (-4.8)***
Waiting Time	0.0162(3.3)***	0.0155 (1.3)	-0.0031 (-0.6)	-0.0036 (-0.4)
Walking Distance	0.0002(1.7)*	0.0002 (0.9)	0.0002 (2.2)**	0.0003 (1.0)
Vehicle Comfort	0.8719(16.3)***	0.8597 (10.0)***	1.0393 (18.4)***	1.0266 (10.4)***
In-vehicle Time	-0.0105(-4.3)***	-0.0102 (-1.7)*	0.0043 (1.8)*	0.0040 (1.2)
No. of Stops	-0.0122(-2.0)**	-0.0122 (-1.3)	0.0142 (2.7)***	0.0159 (1.4)
Safety	0.9290(17.1)***	0.9129 (8.1)***	0.8095 (15.0)***	0.7944 (7.3)***
ρ^2 w.r.t. Zero	0.1551		0.1848	
Likelihood	-2784.52		-2686.79	
Chosen (PV-1)	1189		(VAN), 1664	
Chosen (PV-2)	1243		(BUS), 758	
Chosen (RP)	568		(RP), 578	
No. of observations	3000		3000	

*90 % confidence level (t-value > 1.645)
**95 % confidence level (t-value > 1.960)
***99 % confidence level (t-value > 2.575)
ASC = Alternative-specific constants
ρ^2 w.r.t. Zero = Rho-squared w.r.t. Zero
Chosen (PV-1) = Chosen passenger van service type-1
Chosen (PV-2) = Chosen passenger van service type-2
Chosen (Van) = Chosen passenger van service
Chosen (Bus) = Chosen bus service

For the analysis of RP-SP model, the exploitation of RP-SP models includes two models: 2-choices (RP choice and SP choice) and 3-choices (RP choice and 2-SP choices). Comparing the two models on the significance and expected sign, the 3-choice model was better than 2-choice model, both of within-mode model and between-mode model.

Within-mode model - the results indicated that six of all seven attributes (fare, walking distance, vehicle comfort, in-vehicle time, number of stops, and safety from driver behaviour) were significant at 5% level of significance, each with the expected sign. The ρ^2 value was 0.1551 that was the typical for SP studies.

Between-mode model - the results indicated that six of all seven attributes (fare, walking distance, vehicle comfort, in-vehicle time, number of stops, and safety from driver behaviour) were significant at 5% level of significance, each with the expected sign. The ρ^2 value was 0.1848.

(3) Estimation results of the Merging SP and Merging RP-SP model

Figure 6.1 illustrated the artificial tree structures for Merging SP and Merging RP-SP model and Table 6.6 displayed the estimation results of the RP-SP within-mode and RP-SP between-mode model from the special survey.

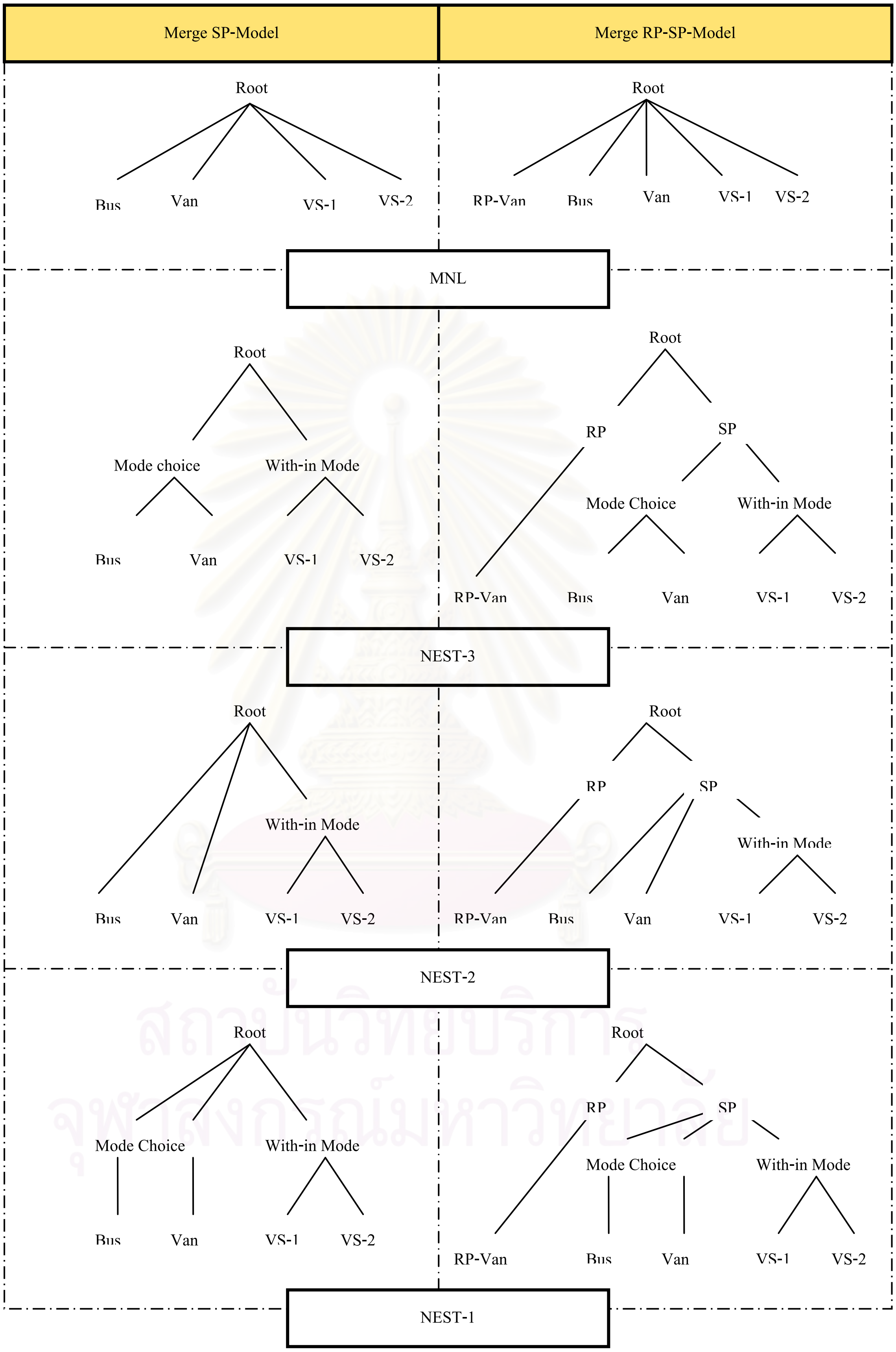

Figure 6.1 Artificial tree structures for Merging SP and Merging RP-SP model

Table 6.6 Estimation results of Merging SP and Merging RP-SP model from special survey

Attribute	MNL Parameters (t-value)	NL- 1 Parameters (t-value)	NL-2 Parameters (t-value)	NL-3 Parameters (t-value)
Merging SP Model				
ASC (Van)	2.4530 (20.0)***	1.7190 (10.6)***	1.4280 (12.8)***	1.429 (12.9)***
ASC (Van Service1)	2.0480 (12.3)***	1.1770 (6.7)***	-0.6362 (-16.9)***	0.8271(7.7)***
ASC (Van Service2)	1.386 (10.5)***	0.7464 (6.2)***	-0.9705 (-20.8)***	0.4841(7.3)***
Fare	-0. 0063 (-1.2)	-0. 0808 (-11.8)***	-0. 0740 (-13.7)***	-0. 0699 (-13.5)***
Waiting Time	0. 0769 (12.8)***	0. 0140 (2.3)**	0. 0064 (1.2)	0. 0088 (1.7)*
Walking Distance	0. 00474 (5.3)***	-0. 0004 (-0.4)	-0. 0010 (-1.2)	-0. 0054 (-0.6)
Vehicle Comfort	1.2890 (25.7)***	1.128 (18.3)***	1.064 (20.6)***	1.039 (20.2)***
In-vehicle Time	0. 0244 (6.9)***	-0. 0138 (-5.2)***	-0. 0143 (-5.9)***	-0. 0135 (-5.6)***
No. of Stops	0. 0868 (10.2)***	0. 0331 (3.5)***	0. 0262 (3.1)***	0.0269 (3.3)***
Safety from Driver Behaviour	1.495 (26.2)***	1.517 (20.8)***	1.398 (24.5)***	1.390 (24.5)***
Nest coefficient 1		141.8 (15.0)***	62.35 (4.9)***	135.3 (2.3)**
Nest coefficient2		0.8169 (2.4)***		
Likelihood with Zero Coefficients	-8317.7662	-8317.7662	-8317.7662	-8317.7662
Likelihood with Constants only	-8154.9151	-8154.9151	-8154.9151	-8154.9151
Final value of Likelihood	-3673.3588	-3350.7773	-3352.3884	-3355.4921
ρ2 w.r.t. Zero	0.5584	0.5972	0.5970	0.5966
ρ2 w.r.t. Constants	0.5496	0.5891	0.5889	0.5885
Chosen Van Service Type1	1473	1473	1473	1473
Chosen Van Service Type 2	1527	1527	1527	1527
Chosen Van Service	1989	1989	1989	1989
Chosen Bus Service	1011	1011	1011	1011
Observations	6000	6000	6000	6000
Merging RP-SP model				
ASC (RP)	-2.760(-33.3)***	-2.053 (-4.1)***	-2.3870 (-16.6)***	7.004 (4.3)***
ASC (Van)	1.1820 (17.5)***	1.2440 (12.2)***	1.2010 (16.2)***	1.660 (14.0)***
ASC (Van Service1)	0.6821 (7.8)***	0.6444 (5.2)***	-1.1920 (-9.3)***	1.175 (8.8)***
ASC (Van Service2)	0.7083 (9.8)***	0.5126 (5.1)***	-1.133 (-9.7)***	0.9708 (10.0)***
Fare	0.0310 (7.4)***	-0.0045 (-1.2)	0.0152 (3.6)***	-0. 0553 (-10.0)***
Waiting Time	0.0196 (6.8)***	0.0241 (5.9)***	0.0186 (5.9)***	0.0159 (2.9)***
Walking Distance	0.0003 (4.1)***	0.0005 (3.0)***	0.0003 (3.7)***	0.0006 (1.2)
Vehicle Comfort	1.3580 (36.6)***	1.1960 (18.8)***	1.2440 (24.2)***	1.3280 (25.2)***
In-vehicle Time	0. 0080 (4.9)***	0. 0025 (1.1)	0. 0057 (3.6)***	-0. 0140 (-4.9)***
No. of Stops	0. 0213 (6.0)***	0. 0474 (7.8)***	0. 0216 (5.4)***	0. 0579 (7.0)***
Safety from Driver Behaviour	1.050 (27.8)***	0.9852 (15.2)***	0.9794 (20.3)***	1.2950 (23.2)***
Nest coefficient 1		0.3822(11.5)***	0.9394 (19.3)***	0.1187 (6.1)***
Nest coefficient 2		1.7630(17.8)***	1.9980 (18.1)***	6.908 (6.8)***
Likelihood with Zero Coefficients	-9656.6275	-9656.6275	-9656.6275	-9656.6275
Likelihood with Constants only	-9480.8359	-9480.8359	-9480.8359	-9480.8359
Final value of Likelihood	-5930.2399	-5662.4147	-5840.1627	-5417.3354
ρ2 w.r.t. Zero	0.3859	0.4136	0.3952	0.4390
ρ2 w.r.t. Constants	0.3745	0.4028	0.3840	0.4286
Chosen Van Service Type1	1473	1473	1473	1473
Chosen Van Service Type 2	1527	1527	1527	1527
Chosen Van Service	1989	1989	1989	1989
Chosen Bus Service	1011	1011	1011	1011
No. of observations	6000	6000	6000	6000

*90 % confidence level (t-value > 1.645)
**95 % confidence level (t-value > 1.960)
***99 % confidence level (t-value > 2.575)

ASC = Alternative-specific constants
ρ^2 w.r.t. Zero = Rho-squared w.r.t. Zero
Chosen (PV-1) = Chosen passenger van service type-1

Chosen (PV-2) = Chosen passenger van service type-2
Chosen (Van) = Chosen passenger van service
Chosen (Bus) = Chosen bus service

Merging SP models - the exploitation of merge SP models was divided into four model forms including MNL (multinomial logit model), NL-1 (nested logit model), NL-2 (nested logit model), and NL-3(nested logit model). Comparing four merging SP models on the significance and expected sign, the NL-3 model was better than the other models. The results indicate that five of all seven attributes (fare, vehicle comfort, in-vehicle time, number of stops, and safety from driver behaviour) were significant at 5% level of significance, each with the expected sign. The ρ^2 value was 0.5966 that an extremely good fit.

Merging RP-SP models - the exploitation of merge RP-SP models was divided into four model forms including MNL (multinomial logit model), NL-1 (nested logit model), NL-2 (nested logit model), NL-3(nested logit model) (See Figure 6.1). Comparing four models on the significance and expected sign, the NL-3 model was better than the other models. The results indicate that six of all seven attributes (fare, waiting time, vehicle comfort, in-vehicle time, number of stops, and safety from driver behaviour) were significant at 5% level of significance, each with the expected sign. The ρ^2 value was 0.4390 that an extremely good fit.

(4) Results discussion

From Table 6.4, the estimation results of the SP within-mode model indicate that the t-values of some attributes were insignificant at 5% level of significance (t-value < 1.96), particularly waiting time. It might imply that respondents valued this service quality attribute were indifferent between of passenger van service type 1 and type 2. In the SP between-mode model, the number of stops and walking distance had low significance (t-value < 1.96). This might imply that respondents valued these service quality attributes indifferently between the SP experiments of passenger van service and bus service.

From Table 6.5, the estimation results of the RP-SP within-mode model show that the t-values of some attributes were insignificant at 5% level of significance (t-value < 1.96), particularly waiting time. With regard to bias reduction, the Jackknife estimate could confirm the power of coefficient estimation; for example, only waiting time attribute was insignificant at 5% level of significance (t-value < 1.96) of the original estimation but among waiting time, walking distance, in-vehicle time, and number of stops were insignificant at 5% level of significance (t-value < 1.96) of the Jackknife estimation. It might imply that respondents valued these service quality attributes indifferently between the RP-SP experiment of passenger van service type 1 and type 2.

The estimation results of the RP-SP between-mode model show that the t-values of some attributes were insignificant at 5% level of significance (t-value < 1.96), particularly waiting time and in-vehicle time. With regard to bias reduction, the Jackknife estimate could confirm the power of coefficient estimation; for example, waiting time and in-vehicle time attributes were insignificant at 5% level of significance (t-value < 1.96) of the original estimation but among waiting time, walking distance, in-vehicle time, and number of stops were insignificant at 5% level of significance (t-value < 1.96) of the Jackknife estimation. It might imply that respondents valued these service quality attributes indifferently between the RP-SP experiment of passenger van service and bus service.

From Table 6.6, The estimation results of the merging SP model indicate that the t-values of some attributes were insignificant at 5% level of significant (t-value < 1.96), particularly waiting time and walking distance. It might imply that the merging SP model of SP within-mode and SP between-mode increased the power of model estimation as observed from the ρ^2 value of 0.5966. The estimation results of the merging RP-SP model show that the t-values of some attributes was insignificant at 5% level of significance (t-value < 1.96), particularly walking distance. It might imply that the merging RP-SP model of RP-SP within-mode and RP-SP between-mode increased the power of model estimation as seen from the ρ^2 value of 0.4390.

The sign of parameters would be checked to test the realism of each service quality attributes. From Table 6.4-6.6, the results show that the sign of parameters in most models were reasonable sign following above assumptions; however, some attributes did not have reasonable sign (including, waiting time in within-mode of SP model, waiting time and walking distance in within-mode of RP-SP model, walking distance, in-vehicle time, and number of stops in between-mode of RP-SP model). According to the significance test, these service attributes do not have high significance. With the same reason described in Chapter 5, this study would like to present all effects of service quality attributes in the models more than the power of models calibration and thus the models were calibrated with all service quality variables.

6.2.2 ATTRIBUTE VALUATION

(1) Valuation of SP model

Table 6.7 illustrated the valuation of the SP within-mode and SP between-mode model from special survey.

Table 6.7 Valuation of SP within-mode and the SP between-mode model from the special survey

Attribute	Special survey	
	Original valuation	Jack-knife Valuation
SP Within- mode		
ASC (PV-2)	3.69	3.68
Waiting Time	-0.04	-0.04
Walking Distance	0.03	0.04
Vehicle Comfort	-6.07	-6.08
In-vehicle Time	0.19	0.19
No. of Stops	0.21	0.20
Safety	-8.45	-8.44
SP Between-mode		
ASC (Bus)	10.21	9.67
Waiting Time	0.48	0.52
Walking Distance	0.03	0.04
Vehicle Comfort	-16.34	-14.76
In-vehicle Time	0.40	0.47
No. Of Stops	0.08	0.06
Safety	-19.56	-18.28

SP within-mode model - It was inferred that respondents demonstrated an alternative-specific preference of 3.69 baht for passenger van service type-2 when comparing this service with passenger van service type-1. Of the generic attributes, walking distance was valued at 0.03 baht/meter, vehicle comfort at 6.07 baht/level, in-vehicle time at 0.19 baht/minute, number of stops at 0.21 baht/point, and safety from driver behaviour at 8.45 baht/level. The Jackknife estimation gave an alternative-specific preference of 3.68 baht for passenger van service type-2 when comparing this service with passenger van service type-1. Of the generic attributes, walking distance was valued at 0.036 baht/meter, vehicle comfort at 6.07 baht/level, in-vehicle time at 0.19 baht/minute, number of stops at 0.21 baht/point, and safety from driver behaviour at 8.45 baht/level.

SP between-mode model - It was inferred that respondents demonstrated an alternative-specific preference of 10.21 baht for bus service when comparing this service with passenger van service. Of the generic attributes, waiting time was valued at 0.48 baht/minute, vehicle comfort at 16.34 baht/level, in-vehicle time at 0.40 baht/minute, and safety from driver behaviour at 19.56 baht/level. The Jackknife estimation gave an alternative-specific preference of 9.67 baht for bus service when comparing this service with passenger van service. Of the generic attributes, waiting time was valued at 0.52 baht/minute, walking distance at 0.04 baht/meter, vehicle comfort at 14.76 baht/level, in-vehicle time at 0.47 baht/minute, and safety from driver behaviour at 18.28 baht/level.

(2) Valuation of RP-SP model

Table 6.8 illustrated the valuation of the RP-SP within-mode and RP-SP between-mode model from the special survey.

Table 6.8 Valuation of RP-SP within-mode and RP-SP the between-mode model from the special survey

Attribute	Special survey Within-mode		Special survey Between-mode	
	Original valuation	Jack-knife valuation	Original valuation	Jack-knife valuation
2 choice (RP and SP)				
ASC (RP)	86.59	89.82	-629.39	-742.71
Waiting Time	-0.14	-0.14	-3.42	-4.18
Walking Distance	-0.00	-0.00	0.05	0.06
Vehicle Comfort	-21.92	-22.84	189.98	223.79
In-vehicle Time	0.07	0.06	0.39	0.29
No. Of Stops	0.21	0.24	0.85	1.85
Safety	-12.95	-13.02	116.56	135.27
3 choice (RP, VAN, and Bus)				
ASC (RP)	24.89	24.79	48.71	49.08
ASC (PV-2)	4.51	4.49	N/A	N/A
ASC (BUS)	N/A	N/A	11.12	11.28
Waiting Time	-0.14	-0.13	0.05	0.06
Walking Distance	-0.00	-0.00	-0.00	-0.01
Vehicle Comfort	-7.34	-7.35	-17.44	-17.58
In-vehicle Time	0.09	0.09	-0.07	-0.07
No. of Stops	0.10	0.10	-0.24	-0.27
Safety	-7.82	-7.80	-13.58	-13.60

***Within-mode model* -** In within-mode of the 3-choice model, it was inferred that respondents demonstrated an alternative-specific preference of 24.89 baht for RP van service, and 4.51 baht for passenger van service type-2 when comparing this service with passenger van service type-1. Of the generic attributes, waiting time was valued at 0.17 baht/meter, walking distance was at 0.00 baht/meter, vehicle comfort at 7.34 baht/level, in-vehicle time at 0.09 baht/minute, number of stops at 0.10 baht/point, and safety from driver behaviour at 7.82 baht/level. The Jackknife estimation gave an alternative-specific preference of 24.79 baht for RP van service, and 4.49 baht for passenger van service type-2 when comparing this service with passenger van service type-1. Of the generic attributes, waiting time was valued at 0.13 baht/meter, walking distance was at 0.00 baht/meter, vehicle comfort at 7.35 baht/level, in-vehicle time at 0.09 baht/minute, number of stops at 0.10 baht/point, and safety from driver behaviour at 7.80 baht/level.

Between-mode Model - In between-mode model of the 3-choice model, it was inferred that respondents demonstrated an alternative-specific preference of 48.71 baht for RP-van service, and 11.12 baht for bus service when comparing this service with passenger van service. Of the generic attributes, waiting time was valued at 0.05 baht/meter, walking distance was at 0.00 baht/meter, vehicle comfort at 17.44 baht/level, in-vehicle time at 0.07 baht/minute, number of stops at 0.24 baht/point, and safety from driver behaviour at 13.58 baht/level. The Jackknife estimation gave an alternative-specific preference of 49.08 baht for RP van service, and 11.28 baht for bus service when comparing this service with passenger van service. Of the generic attributes, waiting time was valued at 0.06 baht/meter, walking distance was at 0.01 baht/meter, vehicle comfort at 17.58 baht/level, in-vehicle time at 0.07 baht/minute, number of stops at 0.27 baht/point, and safety from driver behaviour at 13.60 baht/level.

(3) Valuation of Merging SP model and Merging RP-SP model

Table 6.9 illustrated the valuation of the Merging SP and Merging RP-SP models from the special survey.

Table 6.9 Valuation of Merging SP and Merging RP-SP model from the special survey

Attribute	MNL Valuation	NL- 1 Valuation	NL-2 Valuation	NL-3 Valuation
Merging SP Model				
ASC (Van)	-389.37	-21.28	-19.30	-20.44
ASC (Van-1)	-325.08	-14.57	8.60	-11.83
ASC (Van-2)	-220.00	-9.24	13.12	-6.93
Waiting Time	-12.21	-0.17	-0.09	-0.13
Walking Distance	-0.75	0.01	0.01	0.08
Comfort	-204.60	-13.96	-14.38	-14.86
In-vehicle Time	-3.87	0.17	0.19	0.19
No. of Stops	-13.78	-0.41	-0.35	-0.39
Safety	-237.30	-18.78	-18.89	-19.89
Merging RP-SP Model				
ASC (RP)	-89.03	456.22	-157.04	-126.66
ASC (Van)	38.13	-276.44	79.01	-30.02
ASC (Van-1)	22.00	-143.20	-78.42	-21.25
ASC (Van -2)	22.85	-113.91	-74.54	-17.56
Waiting Time	0.63	-5.36	1.22	-0.29
Walking Distance	0.01	-0.11	0.02	-0.01
Comfort	43.81	-265.78	81.84	-24.01
In-vehicle Time	0.26	-0.56	0.38	0.25
No. of Stops	0.69	-10.53	1.42	-1.05
Safety	33.87	-218.93	64.43	-23.42

Merging SP model- It was inferred that respondents demonstrated an alternative-specific preference of 20.44 baht for passenger van service, 11.83 baht for passenger service type-1, and 6.93 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.13 baht/minute, walking distance at 0.08 baht/meter, vehicle comfort at 14.86 baht/level, in-vehicle time at 0.19 baht/minute, number of stops at 0.39 baht/point and safety from driver behaviour at 18.28 baht/level.

Merging RP-SP model - It was inferred that respondents demonstrated an alternative-specific preference of 126.66 baht for RP illegal van service, 30.02 baht for passenger service, 21.25 baht for passenger service type-1, and 17.56 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, waiting time was valued at 0.288 baht/minute, walking distance at 0.01 baht/meter, vehicle comfort at 24.01 baht/level, in-vehicle time at 0.25 baht/minute, number of stops at 1.05 baht/point and safety from driver behaviour at 23.42 baht/level.

CHAPTER VII

IMPLICATIONS

This chapter presents the implications from the development of the stated preference (SP) technique to determine service quality measurement of passenger vans. The implications of this study could be summarised into three main contexts including service quality measurement, stated preference (SP) techniques, and applicability of SP techniques for determining service quality of passenger vans.

7.1 CONTEXT OF SERVICE QUALITY MEASUREMENT

The conventional methods of service quality measurement were LOS, Index, Customer Satisfaction, and Passenger Environmental Survey. For the last decades, Stated Preference (SP) technique has been accepted as the new approach for measuring service quality of urban public transport. In comparison to the LOS, Index, Customer Satisfaction, and Passenger Environmental Survey, the SP technique provided the similarity to the mentioned in which it could provide a measure of service quality. The SP technique offers a medium to overcome some issues. The benefits of SP technique in the context of service quality measurement could be categorised into six issues: (1) the degree of service quality attributes, (2) the greatest impact on service quality attributes, (3) the utility of service choice, (4) the preference of transit service (service quality selection), (5) the attribute valuation (willingness-to-pay), and (6) the policy responsive (elasticity). Details of the comparison in the methods of service quality measurement were shown in Table 7.1.

Table 7.1 Comparison in the methods of service quality measurement

Benefits of service quality measurement	LOS	Index	Customer Satisfaction	Passenger Environmental	Stated Preference Technique
Degree of service quality attributes (magnitude and sign)	●	●	●	●	●
The greatest impact on service quality attributes		●	●	●	●
Utility of service choice					●
Preference of transit service (service quality selection)					●
Attributes valuation (willingness-to-pay)					●
Policy responsive (elasticity)		●			●

7.1.1 DEGREE OF SERVICE QUALITY ATTRIBUTES

This application of Stated Preference (SP) technique offers the degrees of service quality attributes that are presented by the magnitude of parameters and the sign of parameters from the utility function of service quality model. The determination of the magnitude of parameters is beneficial in that it could present the relative importance on each service quality attribute. The sign of the parameters could imply the effect when service quality attributes decreases or increase (the negative sign of the service quality attribute implies that the utility is decreasing if the value of attribute increases. Whilst, the positive sign implies that the utility is increasing if the value of attributes increases). To test the realism of each service quality attribute, the sign of parameters would be checked if it is reasonable.

From the results of the discrete choice modelling in Chapter V, the main survey could present the magnitude and sign of service quality attributes as summarized in Table 7.2. The special survey in Chapter VI could give the magnitude and sign of service quality attributes as presented in Table 7.3. However, this study found that some attributes did not have reasonable sign, as highlighted in these tables.

The Tables can also be used to justify the strengths of calibration techniques. The comparisons among these models will be elaborated in the Section 7.2.

Table 7.2 Magnitude and sign of service quality attributes from the main survey

Models	ASC (PV-1)	ASC (PV-2)	ASC (VAN)	ASC (BUS)	Fare	Waiting Time	Walking Distance	Vehicle Comfort	In-vehicle Time	No. of Stops	Safety
Within-mode											
Inner-city	N/A	-0.6868	N/A	N/A	-0.1236	-0.0078	-0.0042	0.9500	-0.0208	-0.0193	1.2352
Urban-fringe	N/A	-0.7515	N/A	N/A	-0.1482	0.0273	-0.0051	1.0689	-0.0169	-0.0293	1.3991
Suburban	N/A	-0.4607	N/A	N/A	-0.1244	-0.0176	-0.0015	0.7589	-0.0326	0.0306	1.1612
Within-mode with Jackknife Estimation											
Inner-city	N/A	-0.6825	N/A	N/A	-0.1233	-0.0082	-0.0041	0.9486	-0.0209	-0.0194	1.2316
Urban-fringe	N/A	-0.7465	N/A	N/A	-0.1476	0.0271	-0.0051	1.0664	-0.0169	-0.0291	1.3932
Suburban	N/A	-0.4545	N/A	N/A	-0.1241	-0.0182	-0.0015	0.7583	-0.0327	0.0302	1.1576
Between-mode											
Inner-city	N/A	N/A	N/A	-0.7452	-0.0438	-0.0446	-0.0056	0.9332	-0.0356	-0.0064	1.1350
Urban-fringe	N/A	N/A	N/A	-0.5240	-0.0519	-0.0380	-0.0020	0.9280	-0.0386	-0.0005	1.3285
Suburban	N/A	N/A	N/A	-0.3846	-0.0305	-0.0238	-0.0018	0.6005	-0.0109	-0.0203	0.9896
Between-mode with Jackknife Estimation											
Inner-city	N/A	N/A	N/A	-0.7589	-0.0430	-0.0435	-0.0045	0.9230	-0.0346	-0.0057	1.1276
Urban fringe	N/A	N/A	N/A	-0.5208	-0.0519	-0.0381	-0.0020	0.9256	-0.0385	-0.0006	1.3245
Suburban	N/A	N/A	N/A	-0.3853	-0.0305	-0.0237	-0.0018	0.6002	-0.0108	-0.0201	0.9863
Merging											
Inner-city	1.0090	0.5286	1.4690	N/A	-0.068	-0.0100	-0.0010	1.0060	-0.0140	-0.0090	1.2860
Urban fringe	0.9490	0.6852	1.4130	N/A	-0.058	0.0040	-0.0010	1.0750	-0.0150	0.0200	1.4330
Suburban	1.2860	0.9242	1.3720	N/A	-0.041	0.0150	-0. 0000	0.8040	-0. 0120	0.0380	1.2230

Remark: x.xxxx = the sign is not reasonable

Table 7.3 Magnitude and sign of service quality attributes from the special survey

Models	ASC (RP)	ASC (PV-1)	ASC (PV-2)	ASC (VAN)	ASC (BUS)	Fare	Waiting Time	Walking Distance	Vehicle Comfort	In-vehicle Time	No. of Stops	Safety
SP-model												
Within-mode	N/A	N/A	-0.6528	N/A	N/A	-0.1771	0.0064	-0.0061	1.0755	-0.0334	-0.0363	1.4969
Between mode	N/A	N/A	N/A	N/A	-0.6574	-0.0644	-0.0309	-0.0020	1.0522	-0.0256	-0.0048	1.2597
SP-model with Jackknife Estimation												
Within-mode	N/A	N/A	-0.6825	N/A	N/A	-0.1767	0.0063	-0.0061	1.0736	-0.0333	-0.0360	1.4909
Between mode	N/A	N/A	N/A	N/A	-0.6622	-0.0685	0.0358	-0.0026	1.0107	-0.0324	-0.0043	1.2522
RP-SP-model												
Within-mode	-2.9574	N/A	-0.5357	N/A	N/A	-0.1188	0.0162	0.0002	0.8719	-0.0105	-0.0122	0.9290
Between mode	-2.9031	N/A	N/A	N/A	-0.6628	-0.0596	-0.0031	0.0002	1.0393	0.0043	0.0142	0.8095
RP-SP-model with Jackknife Estimation												
Within-mode	-2.9005	N/A	-0.5256	N/A	N/A	-0.1170	0.0155	0.0002	0.8597	-0.0102	-0.0122	0.9129
Between-mode	-2.8664	N/A	N/A	N/A	-0.6588	-0.0584	-0.0036	0.0003	1.0266	0.0040	0.0159	0.7944
Merging model												
Merging SP	N/A	0.8271	0.4841	1.4290	N/A	-0.0699	0. 0088	-0.0054	1.0390	-0.0135	0.0269	1.3900
Merging RP-SP	7.0040	1.1750	0.9708	1.6600	N/A	-0.0553	0.0159	0.0006	1.3280	-0.0140	0.0579	1.2950

Remark: x.xxxx = the sign is not reasonable

Since these service quality attributes form a utility function, the relative importance can be obtained from the magnitude of each coefficient. However, this magnitude is subject to measurement unit of each variable. Therefore, the magnitude of each attribute must be considered with the unit of attribute measurement. The utility function implies the combination of these attributes to form the overall service quality level of the passenger van service. The degree of service quality attributes is then used to observe the contribution of each attribute to the overall service performance. The degree of service quality attributes is used to find the equivalent effect due to a change in service quality levels of one or more service attributes. It is suggested that the magnitude of each attribute should not be considered individually for comparing the service quality across locations (routes). The comparison should be considered from Service Quality Index (SQI) which will be described in Section 7.2.5.

For example

The between-mode model of passenger van service and bus service in chapter V illustrates the benefits of SP technique in the context of service quality measurement. The general form of the utility function of the service quality could be written as follows:

$$U_{van} = B_1 * Fare_{van} + B_2 * Waiting\ Time_{van} + B_3 * Walking\ Distance_{van} + B_4 * Vehicle\ Comfort_{van} + B_5 * In\text{-}Vehicle\ Time_{van} + B_6 * Number\ of\ Stops_{van} + B_7 * Safety_{van} \quad (7.1)$$

$$U_{bus} = ASC + B_1 * Fare_{bus} + B_2 * Waiting\ Time_{bus} + B_3 * Walking\ Distance_{bus} + B_4 * Vehicle\ Comfort_{bus} + B_5 * In\text{-}Vehicle\ Time_{bus} + B_6 * Number\ of\ Stops_{bus} + B_7 * Safety_{bus} \quad (7.2)$$

The results of the utility function of between-mode model for the Suburban from the main survey (See Table 7.2) could be written as:

Suburban model

$$U_{van} = - 0.0305 * Fare - 0.0238 * Waiting\ Time - 0.0018 * Walking\ Distance + 0.6005 * Vehicle\ Comfort - 0.0109 * In\text{-}Vehicle\ Time - 0.0203 * Number\ of\ Stop + 0.9896 * Safety \quad (7.3)$$

$$U_{bus} = -0.3846 - 0.0305 * Fare - 0.0238 * Waiting\ Time - 0.0018 * Walking\ Distance + 0.6005 * Vehicle\ Comfort - 0.0109 * In\text{-}Vehicle\ Time - 0.0203 * Number\ of\ Stop + 0.9896 * Safety \quad (7.4)$$

From Equation (7.3) and Equation (7.4), the parameters present the degrees of service quality attributes. Fare attribute is at a degree of 0.0305, waiting time at 0.0238, walking distance at 0.0018, vehicle comfort at 0.6005, in-vehicle time at 0.0109, number of stops at 0.0203, and safety at 0.986. The negative sign of fare, waiting time, walking distance, and in-vehicle time attribute implies that the utility is decreasing if the value of attribute increases whilst the positive sign of vehicle comfort and safety implies that the utility is increasing if the values of attributes increase.

The relative effect due to change in one degree of service quality attribute can be directly observed from the ratio of the coefficient. For instance, the improvement to satisfy one more level of the safety attribute is equivalent to 0.9896/0.0109 times or 90.8 unit of change in In-vehicle time attribute, regardless of the level of service provided.

7.1.2 THE GREATEST IMPACT (service quality attributes)

This application of Stated Preference (SP) technique offers the understanding on the importance of service quality attribute in justifying the overall service quality. The impact of the service quality attributes can be determined from the product of degree of service quality attribute (coefficient of the attribute in the utility function) and the perceived service value. The impacts by all seven service quality attributes can then be ranked to observe the order of importance as well as the greatest impact to the overall service quality. This finding is beneficial in that the analysts could learn the contributing factor, of each attribute, to the overall preference by an individual, at the level of existing transit service environments. The greatest impact and the order of importance is determined as illustrated below:

For example, the between-mode model of passenger van service and bus service in chapter V and equation (7.1) through (7.4):

If an individual experiences the following passenger van service,

Fare	= 30 baht
Waiting Time	= 20 minutes
Walking Distance	= 100 metres
Vehicle Comfort	= 3 out of 3 scale
In-Vehicle Time	= 60 minutes
Number of Stops	= 5 points
Safety	= 3 out of 3 scale.

The contribution of each attribute to the overall service quality of this passenger van service is expressed as (Absolute value),

Fare	= 0.92
Waiting Time	= 0.48
Walking Distance	= 0.18
Vehicle Comfort	= 1.80
In-Vehicle Time	= 0.65
Number of Stops	= 0.10
Safety	= 2.97.

The order of the importance of the attributes can be written as safety, vehicle comfort, fare, in-vehicle time, waiting time, walking distance, and number of stops, respectively. In this instance, safety has the greatest impact.

It is remarked that the order of importance can be determined on individual traveller's as well as route (location) basis. In reality, even at the same passenger van service location (route), all travellers may experience different passenger van service environments. The order of importance as well as the greatest impact attribute for one location (route) can be determined by the aggregation of these values from all travellers.

7.1.3 UTILITY OF SERVICE CHOICE

This application of Stated Preference (SP) technique offers the understanding on the preference of service mode or service choice from the utility function. The utility of service choice can be determined from an Alternative Specific Constant (ASC). The ASC represents the additional preference to this mode compared with the competing mode, since the value is considered when other variables are held constant, regardless of the level of service provided; for example, the between-mode model for the Suburban from the main survey. Equation (7.4), a unit of alternative-specific constant was 0.3846 (negative) for passenger van service when comparing this service with bus service, ceteris paribus. That is, a unit of alternative-specific preference of bus has a disutility of 0.3846 times the higher than a unit of alternative-specific preference of passenger van. Thus, the negative value for ASC indicates that respondents are favourable toward hypothetical service scenarios of passenger van services more than bus services.

The utility of service choice (ASC) for the main survey is presented in Table 7.2 and the utility of service choice (ASC) for the special survey is presented in Table 7.3. However, the utility of service choice is used to find the preference equivalence between two competing modes by holding other variables constant. It is suggested that the magnitude of ASC should not be considered individually for comparing the preference of service quality across locations (routes).

7.1.4 PREFERENCE OF TRANSIT SERVICE (service quality selection)

This application of Stated Preference (SP) technique offers preference of transit service or service quality selection. This finding could identify the preference of each transit service choice observed directly from the decision on mode selection from the users' responses of various SP scenarios. The advantage of this consideration is that the resulting mode choice decision comes directly from the survey with the standardised service scenarios. It means that the mode preference by travellers can directly be compared across locations (routes). The preference of transit service (service quality selection) for the main survey and for the special survey was presented in Table 7.4.

For example, from all 4000 responses of between-mode choice model for the Suburban from the main survey. The results show that 2481 responses (62.0%) selected the passenger van services, whilst 1519 responses (38.0%) selected the bus service. At Inner-city, 3106 responses (77.7%) selected the passenger van services, whilst 894 responses (22.4%) selected the bus service. It can be observed that the travellers at Inner-city prefer van to bus in a greater degree than travellers at Suburban, although the two locations have different existing passenger van and bus services.

Table 7.4 Service sharing by types of model

Models	Chosen (RP)	Chosen (PV-1)	Chosen (PV-2)	Chosen (VAN)	Chosen (BUS)	Total
Main Survey: Within-mode						
Inner-city	N/A	2158(54.0%)	1842(46.1%)	N/A	N/A	4000(100.0%)
Urban-fringe	N/A	1970(49.3%)	2030(50.8%)	N/A	N/A	4000(100.0%)
Suburban	N/A	2081(52.0%)	1919(48.0%)	N/A	N/A	4000(100.0%)
Main Survey: Between-mode						
Inner-city	N/A	N/A	N/A	3106 (77.7%)	894(22.4%)	4000(100.0%)
Urban-fringe	N/A	N/A	N/A	2631(65.8%)	1369(34.2%)	4000(100.0%)
Suburban	N/A	N/A	N/A	2481(62.0%)	1519(38.0%)	4000(100.0%)
Main Survey: Merging						
Inner-city	N/A	2158(27.0%)	1842(23.0%)	3106(38.8%)	894(11.2%)	8000(100.0%)
Urban-fringe	N/A	1970(24.6%)	2030(25.4%)	2631(32.9%)	1369(17.1%)	8000(100.0%)
Suburban	N/A	2081(26.0%)	1919(24.0%)	2481(31.0%)	1519(19.0%)	8000(100.0%)
Special Survey: SP-model						
Within-mode	N/A	1473(49.1%)	1527(50.9%)	N/A	N/A	3000(100.0%)
Between mode	N/A	1989(66.3%)	1011(33.7%)	N/A	N/A	3000(100.0%)
Special Survey: RP-SP-model						
Within-mode	568(18.9%)	1189(39.6%)	1243(41.4%)			3000(100.0%)
Between mode	578(19.3%)			1664(55.5%)	758(25.3%)	3000(100.0%)
Merging model						
Merging SP	N/A	1473(24.6%)	1527(25.5%)	1989(33.2%)	1011(16.9%)	6000(100.0%)
Merging RP-SP	N/A	1473(24.6%)	1527(25.5%)	1989(33.2%)	1011(16.9%)	6000(100.0%)

It is noted that the ranking of locations by mode preference from Table 7.4 may be different from the ranking of locations by the direct answers of rating score of passenger van level of service. From the main survey in Chapter V, the order from high to low of passenger van level of service (LOS) is at the Inner-city, the Suburban, and the Urban-fringe, respectively. Whilst the order from high to low of mode preference obtained from Table 7.4 is Inner-city, the Urban-fringe, and the Suburban.

Thus, it is believed that the ranking of the mode preference in Table 7.4 is more convincing since it is based on behaviours of travellers in considering all service quality attributes in their decision.

7.1.5 ATTRIBUTE VALUATION (willingness-to-pay)

This application of Stated Preference (SP) technique offers the attribute valuation in terms of willingness-to-pay. This consideration could give understanding on traveller's decision on various scenarios (attributes) in terms of monetary value. From section 7.1.1, the degrees of service quality give the relative importance of each service quality attributes, whilst the attribute valuation in this section could give the absolute importance of each service quality attribute in the same unit (fare). The ratio of each coefficient estimate to the estimate of a fare parameter from the SP model can represent the willingness-to-pay of a service quality attribute. The valuation of an attribute can give a behavioural implication. Assume, if the value of time from the between-mode model (passenger van and bus) is 0.21 baht/minute. It implies that an individual with values-of-time greater than 0.21 baht/minute will choose the quicker/dearer alternative (passenger van), while those with lower value-of-time will choose the slower/cheaper alternative (bus).

The attribute valuation give the generalised values across service quality attributes, thus the impacts of the service quality attributes can be directly compared. For example, in the between-mode model for the Suburban from the main survey, an alternative-specific preference is valued at 12.61 baht for passenger van service when comparing this service with bus service. Of the generic attributes, waiting time is valued at 0.780 baht/minute, vehicle comfort at 19.69 baht/level, in-vehicle time at 0.36 baht/minute, and safety from driver behaviour at 32.45 baht/level. The value of safety is higher than the value of vehicle comfort, considering one unit of change in the service.

Because the results of the main survey and special survey display that, of all service quality attributes, some attributes are statistically insignificant, i.e. waiting time, walking distance, and number of stops, as indicated by their t-values, the present study considers the particular terms of the value-of-time, value-of-comfort, and value-of-safety.

Figure 7.1-7.3 present the value-of-time, the value-of-comfort, and the value-of-safety by spatial locations (1200 respondents from the main survey).

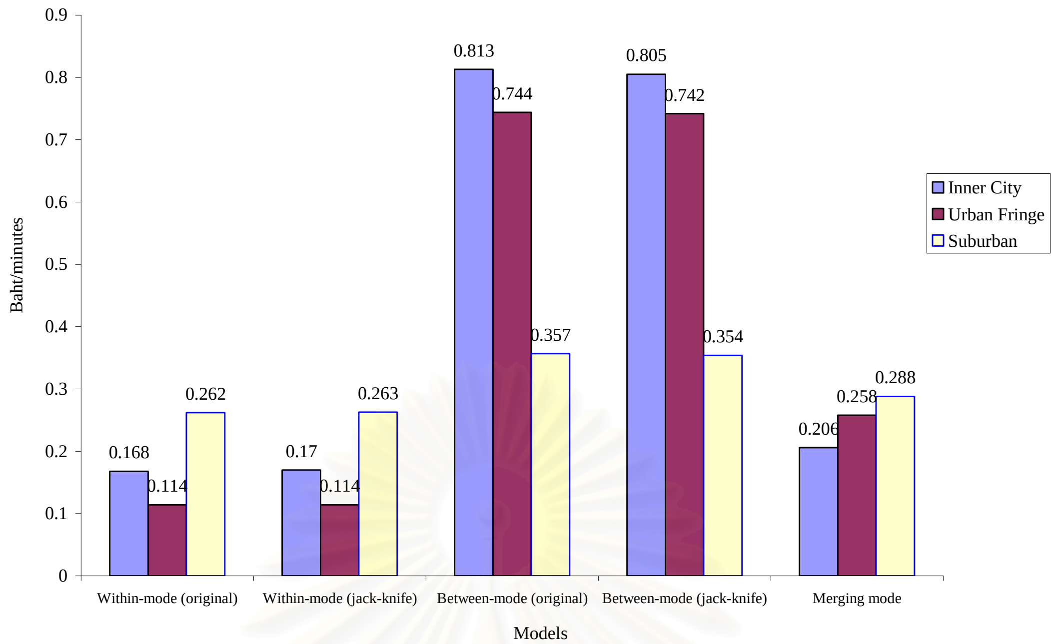

Figure 7.1 Value-of-time from the main survey

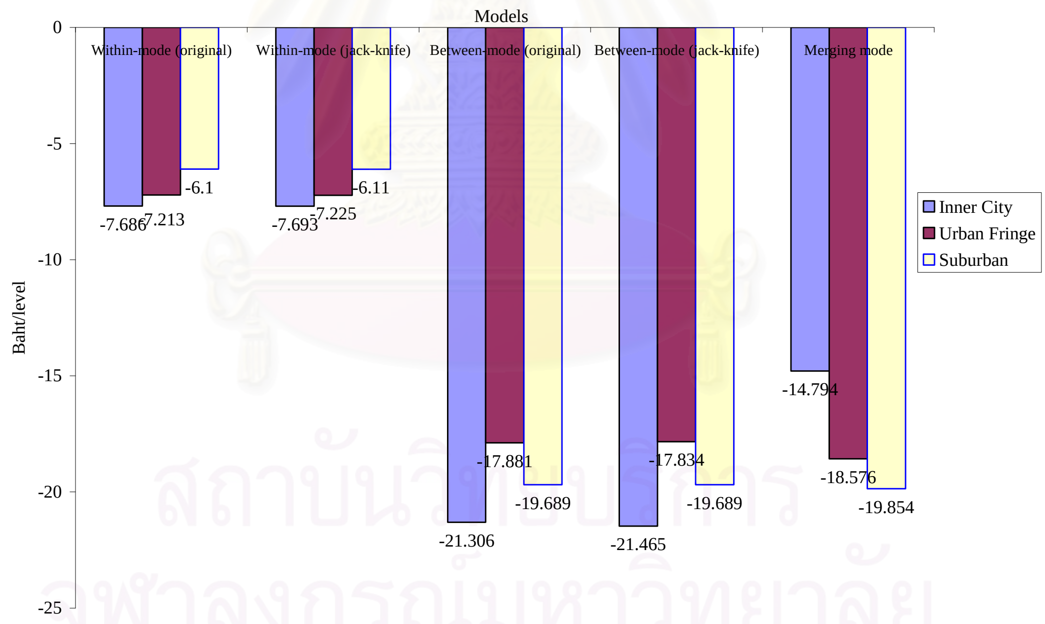

Figure 7.2 Value-of-vehicle comfort from the main survey

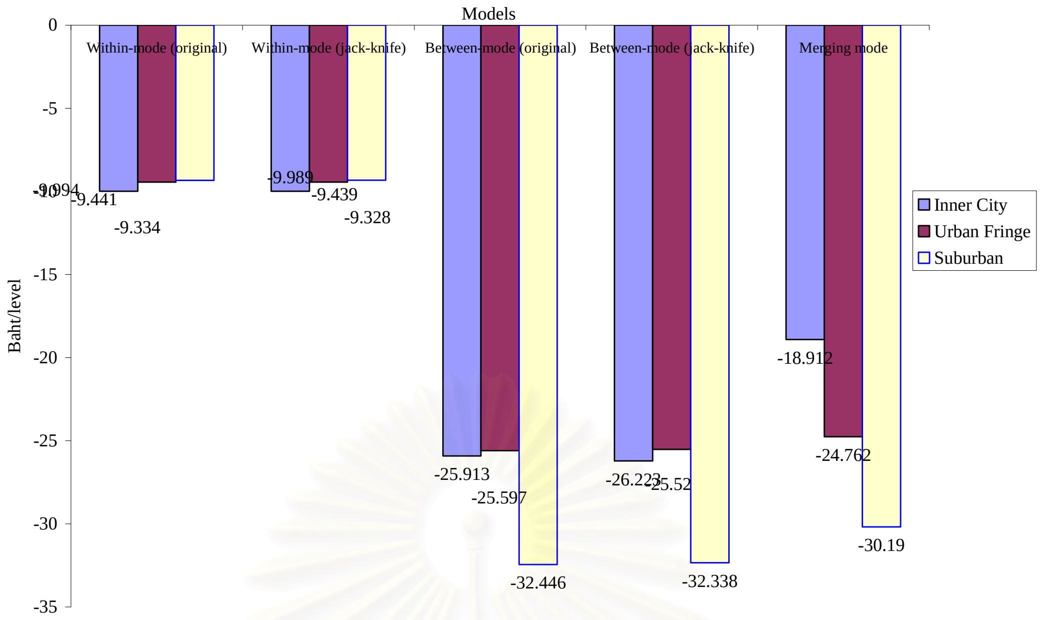

Figure 7.3 Value-of-safety from the main survey

The attribute valuation from the main survey

(1) Inner-city

The results of the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-time were 0.17, 0.17, 0.81, 0.81, and 0.21 baht/minute, respectively. The value-of-vehicle comfort was 7.69, 7.69, 21.31, 21.47, and 14.77 baht/level respectively. The value-of-safety was 9.99, 9.99, 25.91, 26.22, and 18.91 baht/level, respectively.

(2) Urban-fringe

The results of the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-time were 0.11, 0.11, 0.74, 0.74, and 0.26 baht/minute, respectively. The value-of-vehicle comfort was 7.21, 7.23, 17.88, 17.83, and 18.58 baht/level respectively. The value-of-safety was 9.44, 9.44, 25.60, 25.52, and 24.76 baht/level, respectively.

(3) Suburban

The results of the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-time were 0.26, 0.26, 0.36, 0.35, and 0.36 baht/minute, respectively. The value-of-vehicle comfort was 6.10, 6.11, 19.69, 19.68, and 19.85 baht/level respectively. The value-of-safety was 9.33, 9.33, 32.45, 32.34, and 30.19 baht/level, respectively.

Figure 7.4-7.6 presented the value of time, the value of comfort, and the value of safety from the special survey (a sample of 300 respondents from the special survey).

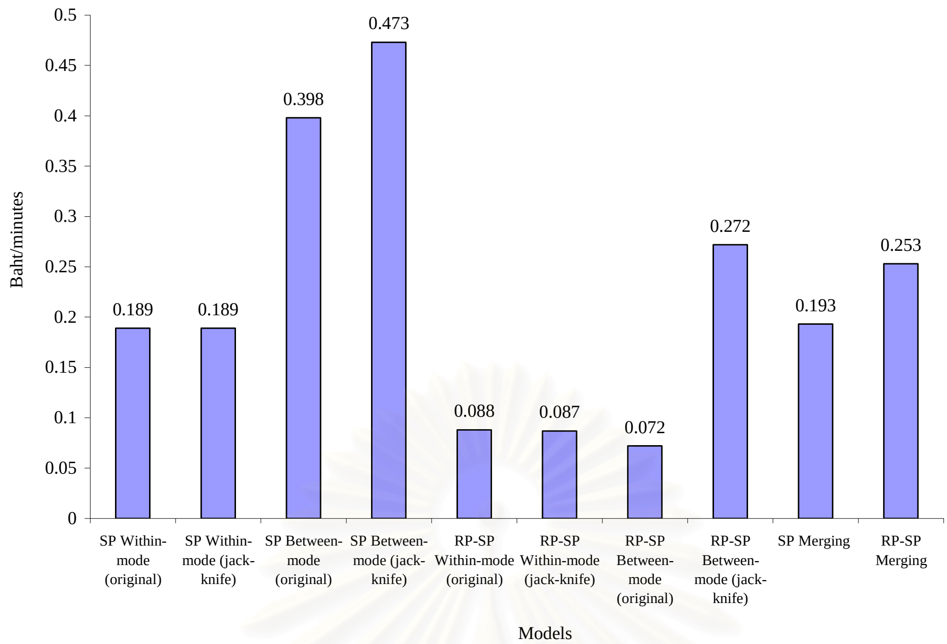

Figure 7.4 Value-of-time from the special survey

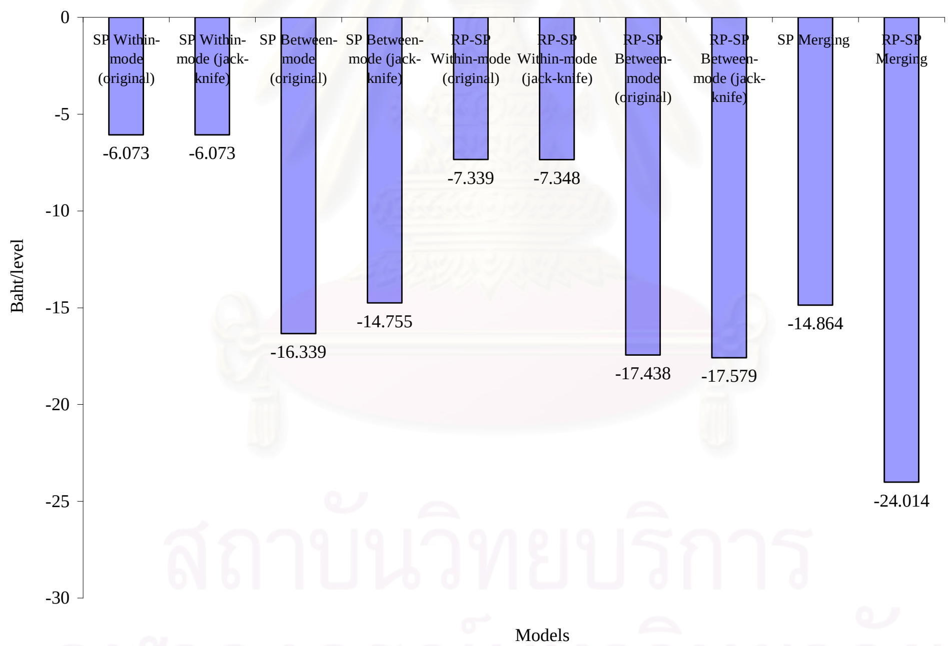

Figure 7.5 Value-of-vehicle comfort from the special survey

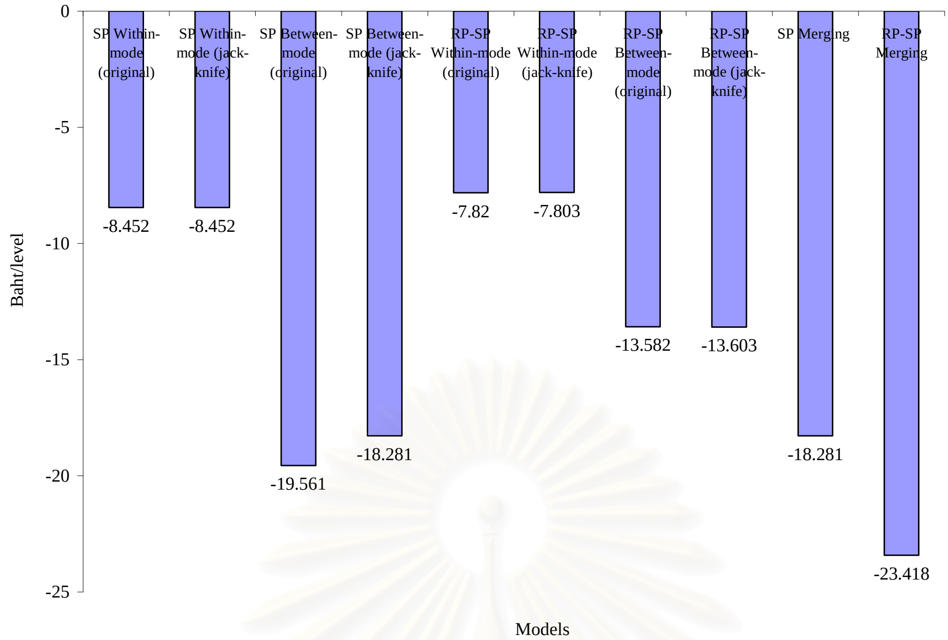

Figure 7.6 Value-of-safety from the special survey

The attribute valuation from the special survey

The results of the SP within-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP, and merging RP-SP model on the value-of-time were 0.19, 0.19, 0.40, 0.47, 0.09, 0.09, 0.07, 0.27, 0.19, and 0.25 baht/minute, respectively. Additionally, the value-of-vehicle comfort were 6.07, 6.07, 16.34, 14.76, 7.34, 7.35, 17.45, 17.58, 14.86, and 24.01 baht/level, respectively. Moreover, the value-of-safety were 8.45, 8.45, 19.56, 18.28, 7.82, 7.80, 13.582 13.60, 18.28, and 23.42 baht/level, respectively.

7.1.6 POLICY RESPONSIVE (elasticity)

The Stated Preference (SP) technique offers the mechanism to test the policy responsiveness in the passenger van service from the exploited elasticity of the utility function to exploit such insights in the planning of future services. For example, using the between-mode model for the Suburban from the main survey, Equation (7.3) and Equation (7.4) can be used to consider a series of scenarios of respondent responsiveness to the change in fare from six scenarios of the passenger van and bus service, specifically:

- Service Quality attributes increase for Passenger Van by 10%
- Service Quality attributes increase for Passenger Van by 5%
- Service Quality attributes increase for Passenger Van and Bus by 10%
- Service Quality attributes increase for Passenger Van and Bus by 5%
- Service Quality attributes increase for Bus by 10%
- Service Quality attributes increase for Bus by 5%

Market share is the amount of a set of service quality chosen by travellers. The measure of elasticity calculated is the arc elasticity of demand, which could be defined as follows:

$$E_{im} = \frac{\ln(S_2 / S_1)}{\ln(X_2 / X_1)} \tag{7.5}$$

Where *S* is the market share of alternate *i*, *X* is the level of service attribute *m*, and *1* and *2* related to the 'before' and 'after' cases respectively.

Table 7.5 Percent change in market shares due to fare elasticity

Fare Scenarios	Suburban Change in Share from base %		Suburban Elasticity of demand	
	Van	Bus	Van	Bus
Passenger van up 10%	-0.1272	0.1556	-0.052	0.073
Passenger van up 5%	-0.1272	0.1556	-0.074	0.105
Both passenger van and bus up 10%	-0.1272	0.1556	-0.052	0.073
Both passenger van and bus 5%	-0.1272	0.1556	-0.074	0.105
Bus up 10%	-0.1272	0.1556	-0.074	0.105
Bus up 5%	-0.1272	0.1556	-0.07	0.105

Fare Elasticity

From Table 7.5, the results show the implication of elasticity of the Suburban that passenger van and bus services have interaction in terms of their response to fare increasing. That is, passenger van operators might loss profit when the fare of passenger van increases, the fares of both of passenger van and bus increase, and the fare of bus increases. The fare elasticity in testing the demand responsiveness is the advantage of the SP method that offers systematic and behavioural ground to forecast the change in demand due to the change of service quality of the passenger van services.

7.2 CONTEXT OF SP TECHNIQUES

From the present study, the lessons learned from the application of SP technique can be presented into six issues: (1) The joint revealed preference (RP) and stated preference (SP) data, (2) The Jackknife estimation, (3) Service benchmarking by comparison with various models, (4) Service benchmarking by comparison with spatial location, (5) external validity test, and (6) Service Quality Index (SQI).

7.2.1 THE JOINT RP AND SP DATA

To improve the SP scaling and the reliability of data, a combination of RP and SP data was employed in the present study. The present study confirms the power of the joint RP and SP data; for example, the estimation results of the RP-SP within-mode model show that the t-values of six of seven attributes were significant at 5% level of significance (t-value < 1.96), excluding walking distance. However, it is quite complicated in the process of questionnaire design and data analysis. Therefore, appropriate software of econometric analysis, such as ALOGIT (Hague Consulting Group, 1995) or LIMDEP (Econometric Software, 1999) must be employed, to exploit the discrete choice modelling (See details of data analysis in Chapter VI).

7.2.2 THE JACKKNIFE ESTIMATION

To estimate the coefficients and their *t* ratios, Jackknife estimation is employed in the present study. The Jackknife estimation based on multiple observations for the same individual to more reliable estimates for the *t* ratios. Therefore, the Jackknife procedure could employ to eliminate bias of the data from the original estimation. The results of study can confirm the power of coefficient estimation; for example, the t-value of number of stops in the Suburban altered from 1.9 to 2.5 (coefficient estimation from -0.0203 to -0.0201). This method is included in the feature of ALOGIT software. (See details of data analysis in Chapter V and Chapter VI).

7.2.3 SERVICE BENCHMARKING (comparison of various models)

To formulate service benchmarking, the values of attributes by various models are compared from the main survey and the special survey.

Table 7.6 displayed the comparison of models (times) by type of various models from the main survey.

Table 7.6 Comparison of model by type of various models from the main survey

Model	Comparison of models (times)				
	within-mode	within-mode with Jackknife estimation	between-mode	Between-mode with Jackknife estimation	merging SP
Value-of-time (Inner-city)	Base	1.01	4.84	4.79	1.23
Value-of-time (Urban-fringe)	Base	1.00	6.53	6.51	2.26
Value-of-time (Suburban)	Base	1.00	1.36	1.35	1.39
Value-of-vehicle comfort (Inner-city)	Base	1.00	2.77	2.79	1.92
Value-of-vehicle comfort (Urban-fringe)	Base	1.00	2.48	2.47	2.58
Value-of-vehicle comfort (Suburban)	Base	1.00	3.23	3.23	3.25
Vale-of-safety (Inner-city)	Base	1.00	2.59	2.62	1.89
Vale-of-safety (Urban-fringe)	Base	1.00	2.71	2.70	2.62
Vale-of-safety (Suburban)	Base	1.00	3.48	3.46	3.23

(1) Value-of-time in the main survey

The value-of-time by various models in the Inner-city could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-time were 0.17, 0.17, 0.81, 0.81, and 0.21 baht/minute, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model was valued at 1.01, 4.84, 4.79, and 1.23 times, respectively.

The value of time by various models in the Urban-fringe could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-time were 0.11, 0.11, 0.74, 0.74, and 0.26 baht/minute, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 6.53, 6.51, and 2.26 times, respectively.

The values of time by various models in the Suburban could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-time were 0.26, 0.26, 0.36, 0.35, and 0.36 baht/minute, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 1.36, 1.35, and 1.39 times, respectively.

(2) Value-of-vehicle comfort in the main survey

The value-of-vehicle comfort by various models in the Inner-city could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode model with Jackknife estimation, and merging SP model on the value-of-vehicle comfort were 7.69 baht/level, 7.69, 21.31, 21.47, and 14.77 baht/level, respectively. In comparison of the within-mode model with the within-mode model with Jackknife estimation, between-mode, the between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 2.77, 2.79, and 1.92 times, respectively.

The value-of-vehicle comfort by various models in the Urban-fringe could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode model, between-mode with Jackknife estimation, and merging SP model on the value-of-vehicle comfort were 7.21, 7.23, 17.88, 17.83, and 18.58 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, the between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 2.48, 2.47, and 2.58 times, respectively.

The value-of-vehicle comfort by various models in the Suburban could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-vehicle comfort were 6.10, 6.11, 19.69, 19.68, and 19.85 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model was value at 1.00, 3.23, 3.23, and 3.25 times, respectively.

(3) Value-of-safety in the main survey

The value-of-safety by various models in the Inner-city could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-safety were 9.99, 9.99, 25.91, 26.22, and 18.91 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 2.59, 2.62, and 1.89 times, respectively.

The value-of-safety by various models in the Urban-fringe could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-safety were 9.44, 9.44, 25.60, 25.52, and 24.76 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode model, between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 2.71, 2.70, and 2.62 times, respectively.

The value-of-safety by various models in the Suburban could be calculated from the within-mode, within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model on the value-of-safety were 9.33, 9.33, 32.45, 32.34, and 30.19 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, between-mode, between-mode with Jackknife estimation, and merging SP model was valued at 1.00, 3.48, 3.46, and 3.23 times, respectively.

Table 7.7 displayed the comparison of models (times) by type of various models in the special survey.

Table 7.7 Comparison of model by type of various models from the special survey

Model	Comparison of models (times)									
	SP within -mode	SP within-mode with Jackknife	SP betwee n-mode	SP between-mode with Jackknife	RP-SP within-mode	RP-SP within-mode with Jackknife	RP-SP between -mode	RP-SP between-mode with Jackknife	merging SP	merging RP-SP
Value-of-time	Base	1.00	2.11	2.50	0.47	0.46	0.38	1.44	1.02	1.34
Value-of-comfort	Base	1.00	2.69	2.43	1.21	1.21	2.87	2.89	2.45	3.95
Vale-of-safety	Base	1.00	2.31	2.16	0.93	0.92	1.61	1.61	2.16	2.77

(4) Value-of-time in the special survey

The results of the SP within-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP model, and merging RP-SP model on the value-of-time were 0.19, 0.19, 0.40, 0.47, 0.09, 0.09, 0.07, 0.27, 0.19, and 0.25 baht/minute, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, SP between-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP model, and merging RP-SP model was valued at 1.00, 2.11, 2.50, 0.47, 0.46, 0.38, 1.44, 1.02, and 1.34 times, respectively.

(5) Value-of-vehicle comfort in the special survey

The results of the SP within-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP model, and merging RP-SP model on the value-of-vehicle comfort were 6.073, 6.073, 16.339, 14.755, 7.339, 7.348, 17.438, 17.579, 14.864, and 24.014 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, SP between-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP model, and merging RP-SP model was valued at 1.00, 2.69, 2.43, 1.21, 1.21, 2.87, 2.89, 2.45, and 3.95 times, respectively.

(6) Value-of-safety in the special survey

The results of the SP within-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP model, and merging RP-SP model on the value-of-safety were 8.45, 8.45, 19.56, 18.28, 7.82, 7.80, 13.58, 13.60, 18.28, and 23.42 baht/level, respectively. In comparison of the within-mode model with the within-mode with Jackknife estimation, SP between-mode, SP within-mode with Jackknife estimation, SP between-mode, SP between-mode with Jackknife estimation, RP-SP within-mode, RP-SP within-mode with Jackknife estimation, RP-SP between-mode, RP-SP between-mode with Jackknife estimation, merging SP model, and merging RP-SP model was valued at 1.00, 2.31, 2.16, 0.93, 0.92, 1.61, 1.61, 2.16, and 2.77 times, respectively

7.2.4 SERVICE BENCHMARKING (comparison of spatial locations)

To formulate service benchmarking, the values of attributes from the main survey by all of spatial location models are compared.

Table 7.8 displayed the comparison of models (times) by all of spatial location and Figure 7.7-7.9 presented values of alternative-specific preferences, the values of time, the values of comfort, and the values of safety in all of spatial location models (a sample of 1200 users in the main survey).

Table 7.8 Comparison of model by all of spatial locations

Model	Comparison of models (times)		
	Inner-city	Urban-fringe	Suburban
ASC (Within-mode)	Base	0.84	0.97
ASC (Between-mode)	Base	0.92	1.55
Value-of-time (Within-mode)	Base	0.81	1.05
Value-of-time (Between-mode)	Base	0.77	0.32
Value-of-vehicle comfort (Within-mode)	Base	0.95	0.77
Value-of-vehicle comfort (Between-mode)	Base	0.90	0.98
Value-of-Safety (Within-mode)	Base	0.95	0.92
Value-of-Safety	Base	1.08	1.35

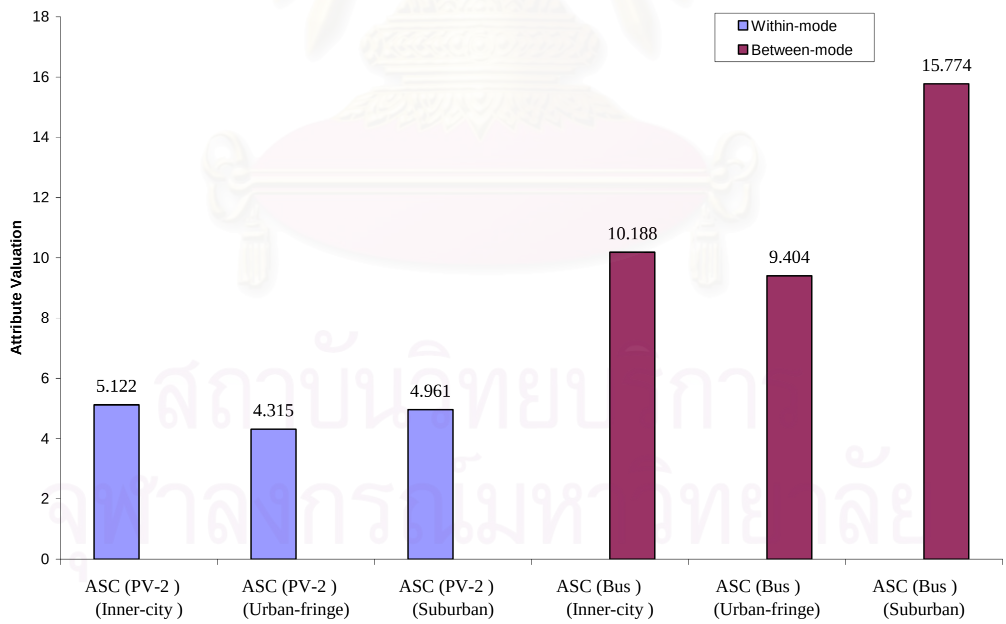

Figure 7.7 Value-of- alternative-specific preferences by all of spatial locations

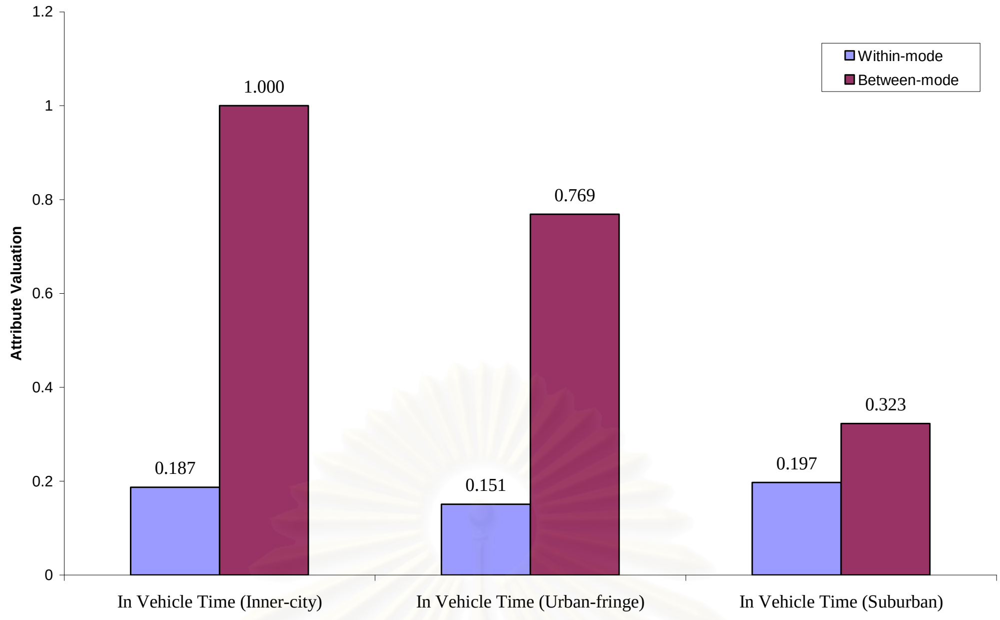

Figure 7.8 Value-of- time by all of spatial locations

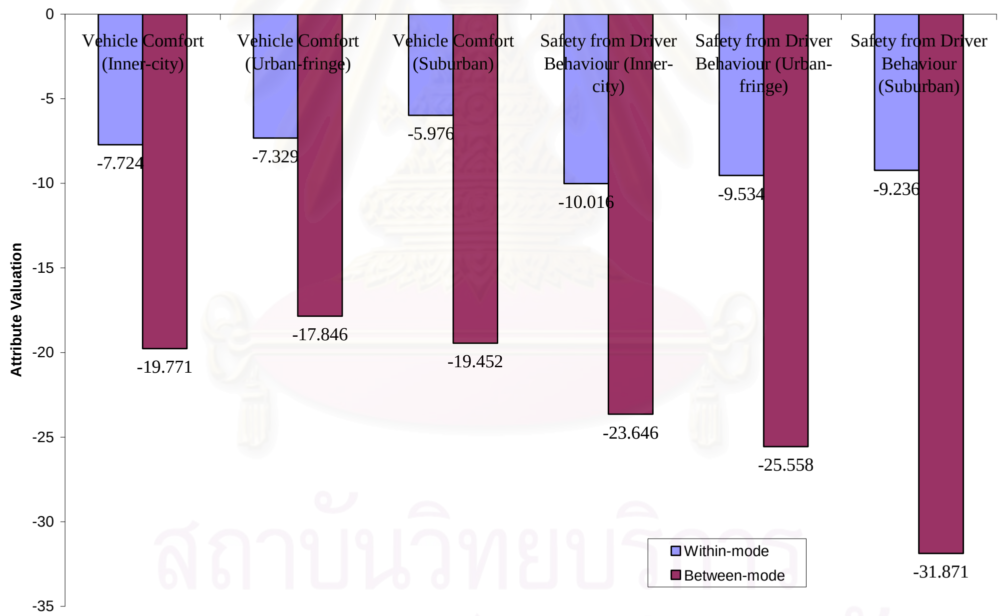

Figure 7.9 Value-of- safety and value-of-vehicle comfort by all of spatial locations

(1) Value-of-alternative-specific preferences

The value-of-alternative specific preference of within-mode model for the Inner-city, the Urban-fringe, and the Suburban that respondent demonstrated an alternative-specific preference of 5.12, 4.32, and 4.96 baht for passenger van service type-1 and against passenger van service type-2 respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban was valued at 0.84 and 0.97 times, respectively.

The value-of-alternative specific preference of within-mode model for the Inner-city, the Urban-fringe, and the Suburban that respondent demonstrated an alternative-specific preference of 10.19, 9.40, and 15.77 baht for passenger service and against bus service respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban was valued at 0.92 and 1.55 times, respectively.

(2) Value-of-time in all of spatial location model

The value-of-time of within-mode model could be calculated from the Inner-city, the Urban-fringe, and the Suburban on the value-of-time were 0.19, 0.15, and 0.20 baht/minute, respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban was valued at 0.81 and 1.05 times, respectively.

The value-of-time of between-mode model could be calculated from the Inner-city, the Urban-fringe, and the Suburban on the value-of-time were 1.00, 0.77, and 0.32 baht/minute, respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban was valued at 0.77 and 0.32 times, respectively.

(3) Value-of-vehicle comfort in all of spatial location model

The value-of-vehicle comfort of within-mode model could be calculated from the Inner-city, the Urban-fringe, and the Suburban in terms of the value-of-time were 7.72, 7.33, and 5.98 baht/level, respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban was valued at 0.95 and 0.77 times, respectively.

The value-of- vehicle comfort of between-mode model could be calculated from the Inner-city, the Urban-fringe, and the Suburban on the value-of-time were 19.77, 17.85, and 19.45 baht/level, respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban found that the Inner-city was valued at 0.90 and 1.35 times, respectively.

(4) Value-of-safety in all of spatial location model

The value-of-safety of within-mode model could be calculated from the Inner-city, the Urban-fringe, and the Suburban in terms of the value-of-time were 10.02, 9.53, and 9.24 baht/level, respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban found that the Inner-city valued at 0.95 and 0.98 times, respectively.

The value-of-safety of between-mode model could be calculated from the Inner-city, the Urban-fringe, and the Suburban on the value-of-time were 23.65, 25.56, and 31.87 baht/level, respectively. In comparison of the Inner-city model with the Urban-fringe, and the Suburban was valued at 1.08 and 1.35 times, respectively.

7.2.5 EXTERNAL VALIDITY TEST

To test the survey instrument overcome issues of bias and hypothetical nature of the exercise to arrive at respondent' actual values, the external validity test was performed on the models from the main survey and the special survey. The results are shown in Table 7.9 to 7.12.

Table 7.9 External validity test between the main survey and the special survey (1)

Variable	Urban Fringe (Main survey) Mean (S.D)	Urban Fringe (Special survey) Mean (S.D)
Age (years)	21.99 (2.3)	21.35 (2.1)
Respondent income (baht/month)	5,601 (3,111)	5,296 (5,000)
Household income (baht/month)	19,252 (11,750)	24,643 (20,000)
Car ownership (vehicles/household)	1.0 (1.0)	1.1 (1.0)
Frequency (times/week)	2.1 (1.8)	4.3 (3.0)
Level of service of passenger van	4.1 (1.2)	4.1 (1.2)

Table 7.10 External validity test between the main survey and the special survey (2)

Variable	Urban Fringe (Main Survey) Frequency (%)	Urban Fringe (Special Survey) Frequency (%)
Gender		
Male	171 (42.8)	142 (47.3)
Female	229 (57.3)	158 (52.7)
Access mode		
Walking	110 (27.5)	81 (27.0)
Conventional bus	159 (39.8)	122 (40.7)
Air-conditioned bus	86 (21.5)	65 (21.7)
Motorcycle taxi	36 (9.0)	22 (7.3)
Other modes	9 (2.3)	10 (3.3)
Egress mode		
Walking	141 (35.3)	107 (35.7)
Conventional bus	119 (29.8)	90 (30.0)
Air-conditioned bus	94 (23.5)	62 (20.7)
Motorcycle taxi	38 (9.5)	28 (9.3)
Other modes	8 (2.0)	13 (4.3)
Main reason to use passenger van		
Faster	283 (70.8)	183 (61.0)
Reliability	11 (2.8)	20 (6.7)
Comfort	33 (8.3)	30 (10.0)
Convenience	64 (16.0)	55 (18.3)
Safety	3 (0.8)	5 (1.7)
Cheaper	6 (1.5)	7 (2.3)

Table 7.11 External validity test between the main survey and the special survey (3)

Attribute	Urban Fringe (main survey) Parameters (t-value)		Urban Fringe (special survey) Parameters (t-value)	
	Original	Jackknife	Original	Jackknife
Within-mode model				
ASC (PV-2)	-0.7515(-4.0)***	-0.7465(-3.6)***	-0.6528 (-3.0)***	-0.6825(-3.9)***
Fare	-0.1482(-15.0)***	-0.1476(-12.3)***	-0.1771 (-15.0)***	-0.1767 (-12.4)***
Waiting Time	0.0273(1.1)	0.0271(1.1)	0.0064 (0.2)	0.0063 (0.2)
Walking Distance	-0.0051(-4.0)***	-0.0051(-3.9)***	-0.0061 (-4.0)***	-0.0061 (-4.3)***
Vehicle Comfort	1.0689(16.9)***	1.0664(14.9)***	1.0755 (14.6)***	1.0736 (14.6)***
In-vehicle Time	-0.0169(-1.9)*	-0.0169(-1.8)*	-0.0334 (-3.2)***	-0.0333 (-2.7)***
No. of Stops	-0.0293(-2.2)**	-0.0291(-2.4)**	-0.0363 (-2.2)**	-0.0360 (-2.1)**
Safety	1.3991(20.0)***	1.3932(15.1)***	1.4969 (17.7)***	1.4909 (12.4)***
ρ^2 w.r.t. Zero	0.1941		0.2209	
Likelihood	-2234.3224		-1620.1269	
Chosen (PV-1)	1970		1473	
Chosen (PV-2)	2030		1527	
No. of observations	4000		3000	
Between-mode model				
ASC (Bus)	-0.5240(-3.1)***	-0.5208(-2.4)**	-0.6574 (-3.0)***	-0.6622 (-2.7)***
Fare	-0.0519(-6.4)***	-0.0519(-5.1)***	-0.0644 (-7.0)***	-0.0685 (-4.1)***
Waiting Time	-0.0380(-4.0)***	-0.0381(-3.2)***	-0.0309 (-3.0)***	-0.0358 (-2.4)**
Walking Distance	-0.0020(-1.6)	-0.0020(-1.8)*	-0.0020 (-1.7)*	-0.0026 (-1.6)
Vehicle Comfort	0.9280(13.6)***	0.9256(14.1)***	1.0522 (12.2)***	1.0107 (11.4)***
In-vehicle Time	-0.0386(-5.1)***	-0.0385(-5.0)***	-0.0256 (-2.6)***	-0.0324 (-2.4)***
No. of Stops	-0.0005(-0.0)	-0.0006(-0.1)	-0.0048 (-0.4)	-0.0043 (-0.3)
Safety	1.3285(17.9)***	1.3245(12.2)***	1.2597 (15.0)***	1.2522 (12.8)***
ρ^2 w.r.t. Zero	0.1960		0.2045	
Likelihood	-2229.1296		-1654.1900	
Chosen (PV)	2631		1989	
Chosen (Bus)	1369		1011	
No. of observations	4000		3000	
Merging model				
ASC (Van)	1.413 (10.3)***		1.429 (12.9)***	
ASC (PV-1)	0.9490 (6.3)***		0.8271(7.7)***	
ASC (PV-2)	0.6852 (6.6)***		0.4841(7.3)***	
Fare	-0.058 (-11.5)***		-0. 0699 (-13.5)***	
Waiting Time	0.004 (0.8)		0. 0088 (1.7)*	
Walking Distance	-0.001 (-1.5)		-0. 0054 (-0.6)	
Vehicle Comfort	1.075 (20.8)***		1.039 (20.2)***	
In-vehicle Time	-.0.015 (-6.5)***		-0. 0135 (-5.6)***	
No. of Stops	0.020 (3.2)***		0.0269 (3.3)***	
Safety	1.433 (24.7)***		1.390 (24.5)***	
ρ^2 w.r.t. Zero	0.5905		0.5966	
Likelihood	-4540.9475		-3355.4921	
Chosen (PV-1)	1970		1473	
Chosen (PV-2)	2030		1527	
Chosen (Van)	2631		1989	
Chosen (Bus)	1369		1011	
No. of observations	8000		6000	

*90 % confidence level (t-value > 1.645)
**95 % confidence level (t-value > 1.960)
***99 % confidence level (t-value > 2.575)

ASC = Alternative-specific constants
ρ^2 w.r.t. Zero = Rho-squared w.r.t. Zero
Chosen (PV-1) = Chosen passenger van service type-1

Chosen (PV-2) = Chosen passenger van service type-2
Chosen (Van) = Chosen passenger van service
Chosen (Bus) = Chosen bus service

Table 7.12 External validity test between the main survey and the special survey (4)

Attribute	Urban Fringe (main survey) Valuation		Urban Fringe (special survey) Valuation	
	Original	Jackknife	Original	Jackknife
Within- mode				
ASC (PV-2)	5.07	5.06	3.69	3.68
Waiting Time	-0.18	-0.18	-0.04	-0.04
Walking Distance	0.03	0.04	0.03	0.04
Vehicle Comfort	-7.21	-7.23	-6.07	-6.08
In-vehicle Time	0.11	0.11	0.19	0.19
No. of Stops	0.20	0.20	0.21	0.20
Safety	-9.44	-9.44	-8.45	-8.44
Between-mode				
ASC (Bus)	10.10	10.04	10.21	9.67
Waiting Time	0.73	0.73	0.48	0.52
Walking Distance	0.04	0.040	0.03	0.04
Vehicle Comfort	-17.88	-17.83	-16.34	-14.76
In-vehicle Time	0.74	0.74	0.40	0.47
No. of Stops	0.01	0.01	0.08	0.06
Safety	-25.60	-25.52	-19.56	-18.28
Merging model				
ASC (Van)	-24.42		-20.44	
ASC (PV-1)	-16.40		-11.83	
ASC (PV-2)	-11.84		-6.93	
Waiting Time	-0.07		-0.13	
Walking Distance	0.02		0.08	
Vehicle Comfort	-18.58		-14.86	
In-vehicle Time	0.26		0.19	
No. of Stops	-0.36		-0.39	
Safety	-24.76		-19.89	

Table 7.9 to 7.12 presented the external validity test by comparison of user's characteristics, travel behaviours, opinions, coefficient estimations, and attribute valuations between the main survey and the special survey of the Urban-fringe. The result of table 7.9, 7.10, 7.11, and 7.12 showed that the proportion of main survey and the special survey are reasonable.

Table 7.13 External validity test between the main survey and the special survey (5)

External validity test	Urban Fringe (main survey)		Urban Fringe (special survey)	
	Original	Jackknife	Original	Jackknife
% Correct of Within-mode model	63.9	63.9	64.1	64.1
% Correct of Between-mode model	67.6	67.6	65.3	65.3
% Correct of Merging model	73.4	73.4	73.8	73.8

To test external validity of the main survey, 3000 responses data from the special survey were used to estimate percent correct of model forecasting. Contradictory, the 3000 responses data from the main survey were used to test external validity of the special survey. Table 7.13 showed that the within-mode, between-mode, merging model of the main survey were valued at 63.9, 67.6, 73.4 of the percent correct, respectively. Whilst, the within-mode, between-mode, and merging model of the special survey were valued at 64.1, 65.3, and 73.8 of the percent correct, respectively. It could be concluded that the model having the highest power and efficiency in forecasting is the merging model, followed by the between-mode model and within-mode model, respectively.

7.2.6 SERVICE QUALITY INDEX (SQI)

Service Quality Index (SQI) is as a way to capture customer perceptions of service quality. SQI is calculated from the SP discrete choice modelling (within-mode with Jackknife estimation, between-mode with Jackknife estimation and merging model) that were estimated to the relative weights attached to the statistically significant attributes, representing the contribution of each service attribute. In order to calculate a SQI for each area (location or route), the SQI measure for each traveller is first calculated using the formula:

$$SQI_n = \sum_{k=1}^{K} \beta_k X_{kn} \tag{7.6}$$

The SQI for user *n* is obtained by multiplying the RP attribute levels, as perceived by user *n*, by the appropriate scaled parameter from Chapter V and summing across the *k* attributes (in this three spatial locations). Then for each geographical segment, *s*, the overall SQI is measured by taking the individual SQI average for the sampled travellers in each area, *m*:

$$SQI_s = \frac{\sum_{n=1}^{m_s} SQI_n}{m_s} \tag{7.7}$$

Table 7.14 SQI of within-mode model with Jackknife estimation from the main survey

Variable	Inner city SQI	Urban Fringe SQI	Suburban SQI
Fare (baht)	-1.48	-3.33	-3.41
Waiting time(minute)	-0.11	0.44*	-0.26
Walking Distance (meter)	-0.70	-2.00	-0.59
Vehicle comfort (level)	1.86	1.98	1.49
In-vehicle time (minute)	-0.45	-0.62	-1.08
Number of stops	-0.05	-0.19	0.18*
Safety (level)	2.46	2.56	2.26
SQI	1.53	-1.15	-1.43
Rank	1	2	3

*****the sign is not reasonable

Table 7.15 SQI of between-mode model with Jackknife estimation from the main survey

Variable	Inner city SQI	Urban Fringe SQI	Suburban SQI
Fare (baht)	-0.52	-1.17	-0.84
Waiting time(minute)	-0.61	-0.62	-0.34
Walking Distance (meter)	-0.77	-0.79	-0.71
Vehicle comfort (level)	1.81	1.73	1.18
In-vehicle time (minute)	-0.74	-1.41	-0.36
Number of stops	-0.01	0.00	-0.12
Safety (level)	2.26	2.44	1.92
SQI	1.41	0.18	0.73
Rank	1	3	2

Table 7.16 SQI of merging model from the main survey

Variable	Inner city SQI	Urban Fringe SQI	Suburban SQI
Fare (baht)	-0.82	-1.31	-1.13
Waiting time(minute)	-0.14	0.07*	0.22*
Walking Distance (meter)	-0.17	-0.39	0.04
Vehicle comfort (level)	1.97	2.00	1.58
In-vehicle time (minute)	-0.30	-0.55	-0.40
Number of stops	-0.02	0.13*	0.23*
Safety (level)	2.57	2.64	2.38
SQI	3.09	2.58	2.92
Rank	1	3	2

*the sign is not reasonable

SQI values of within-mode model with Jackknife estimation in the Inner-city, the Urban-fringe, and the Suburban were 1.53, -1.15, and -1.43, respectively. The ranking order of SQI value was the Inner-city, the Urban-fringe, and the Suburban, respectively. Whilst, SQI values of between-mode model with Jackknife estimation in the Inner-city, the Urban-fringe, and the Suburban were 1.41, 0.18, and 0.73, respectively. The ranking order was the Inner-city, the Suburban, and the Urban-fringe, respectively. Moreover, SQI values of merging model in the Inner-city, the Urban-fringe, and the Suburban were at 3.09, 2.58, and 2.92, respectively. The ranking order was the Inner-city, the Suburban, and the Urban-fringe, respectively.

From the result of the study, the SQI could demonstrate the robustness of the results (ranking) considering the level of significance and contribution (weight) of each service quality variable. In the case of the modelling result in this study, the construction of models included some variables that have either low statistical significance or wrong signs in the SP models. The resulting SQI could still yield the same ranking results, whether these variables are included or not. This shows the strength of the SQI determination technique used in the study that could give robust and reasonable results, as it takes care of the traveller's behavioural effects on each service quality dimensions.

7.3 APPLICABILITY OF SP TECHNIQUES FOR DETERMINING SERVICE QUALITY OF PASSENGER VANS

The development of the SP technique and the implications from the results of models demonstrate the applicability of SP techniques for determining service quality of passenger vans into two main issues: (1) Service quality measurement and (2) Stated preference techniques.

7.3.1 SERVICE QUALITY MEASUREMENT

(1) Ability to study the statistical significance of each service quality attributes

This method of service quality measurement is constructed from the travel behavioural modelling, based on statistical assumptions and methodology. The results from the methods also point out the statistical significance of each service quality attribute. The analyst could understand each dimension of travellers' behaviour and correctly identify the service quality perceived by travellers.

(2) Ability to draw reasonable conclusions from limited data

The use of SP technique reduces the amount of required data, thus allowing the planners and analysts to design a service quality survey that extensively covers wider spectrum of the public transit users. With the limited amount of data, the proposed method could determine statistically-acceptable conclusion on service quality, especially the levels of importance of each service quality attribute and the preference (or captiveness) on each transit service modes. Thus, the measurement technique could obtain the service quality for more extensive stratified group of users and for geographical locations. This would be the advantage over the existing survey technique that could not get the statistically-proof levels of importance among the service quality attributes with a limited amount of data. The technique also allows the authority to get the inferences on service quality for specific characteristics of traveller and areas.

(3) Standardisation across public transit modes through benchmarking Since this survey technique directly measure the decision between (among) various competing modes, it is possible to directly get the unbiased levels of service quality across modes. This is a breakthrough since the existing methods of service quality measurement cannot obtain this generalisation. With this survey technique, the transit authority hence could get generalised level of service across route (or district) of operations as well as the available public transit modes. Through SQI, the authority could benchmark the degree of operations across the districts of operation, thus utilizing the results as the management tools for monitoring the transit services. The design of the technique can utilize the comparisons between two competing modes, and the results could lead to more efficient campaigns and promotions, that would attract the riders from the competing services.

(4) More understanding on travellers' behaviours

The results from the measurements are expressed in terms of standardised quantifiable values, which allow the authority to understand the behaviours of travellers. The existing methods of service quality measurement normally expressed in terms of the levels of service, which are not generalised across the service quality attributes. The weight could directly show the level of concerns (or preferences) by each individual traveller. The attribute valuation also gives meaningful interpretation on each service quality attribute. The authority could use this information to foresee the relevant impacts from the system changes.

(5) More accurate demand forecasting

The proposed technique directly compares the services and traveller's decision across modes (in this instance, passenger vans and buses). The results directly reflect the travellers' decision due to public transit system change. The results ascertain the sensitivity in demand due to the operational changes. This is important since most of service quality measurement focuses on examining the existing operational service without linking the study on demand alteration due to system changes. The implication from the survey could be valuable information for authority, especially elasticity, which can be used for forecasting the future (new) after the system changes. This demand estimation is sensitive to each of service quality attribute. Also, this technique could show the cross-elasticity in demand due to the system change in competing modes. It is believed that this method reflects more accurate traveller's decision due to service improvements and thus could yield more accurate demand prediction.

7.3.2 STATED PREFERENCE TECHNIQUES

(1) Ability to formulate multi-attributes and eliminate bias of data in SP experimental design

The “indicator” development of this study can formulate multi-attributes in the SP experimental design, which is developed for measuring service quality of paratransit, in this case the passenger vans. A preliminary survey (e.g. pilot survey or focus group) and a literature review of previous studies can help identify the appropriate attributes for service quality measurement. The results show that not only quantitative attributes (fare, walking distance, waiting time, in-vehicle time, and number of stops) and qualitative attributes (vehicle comfort and safety from driver behaviour) is applicable for development SP techniques, but also before usage condition and after usage condition is applicable for SP questionnaire design (four attribute per alternative). Moreover, the Jackknife procedure could be employed to eliminate bias of the data from the original estimation. This results of study can confirm the power of coefficient estimation; for example, the t-value of number of stops in the Suburban altered from 1.9 to 2.5 (coefficient estimation from -0.0203 to -0.0201).

(2) Ability to improve reliability of data

The “scaling” development of this study could improve the reliability of data, which is applied by combining Revealed Preference (RP) and Stated Preference (SP) model. The credibility and realism of RP data could combine well with the efficiency and flexibility of SP data. Furthermore, the Adaptive SP design with Simulation could be employed to improve SP experiments into ten steps including (1) a selection of the number of attributes and their levels, (2) a formulation of the orthogonal design, (3) a transformation of the design code to the attribute levels, (4) the design of the boundary value, (5) a verification of the boundary value, (6) the design of the attributes and their levels for simulated data, (7) the selection of the first loop of the coefficient (literature review/pilot study), (8) the testing on the coefficients based on various scenarios, (9) the checking on the standard deviation, and (10) the conclusion of high-quality of SP questionnaire design for the main survey. This Adaptive SP design with Simulation can confirm the reliability of data and SP questionnaire design before data collection process of the questionnaire survey.

(3) Ability to compare various of SP model structure

The several SP model structures of this study could be used to compare the public transit services in the light of traveller’s decision. To improve public transit service, the within-mode choice models could be exploited. To investigate transit service benchmarking, the between-mode choice models of passenger van and competitive mode (bus) could be applied. To improve the SP scaling and the reliability of data, the joint revealed preference (RP) and stated preference (SP) data could be employed. The use of service quality valuation in terms of monetary (Willingness-To-Pay) could be developed from model results that are based on the fare attribute. The Jackknife method could be employed to reduce SP bias that get more reliable estimate on coefficients for the *t* -ratios. Moreover, the comparison of the model structure among the within-mode, between-mode, and merging model. The results of external validity test show that the within-mode, between-mode, and merging model of the special survey are at 64.1, 65.3, and 73.8 of the percent correct, respectively. This could be concluded that the merging model (combined within-mode and between-mode) is the best of the power and efficiency of model forecasting.

Moreover, Service Quality Index (SQI) could be the best way to capture customer perceptions and service benchmarking from the different spatial locations (Inner-city, Urban-fringe, and Suburban) and SP models (within-mode with Jackknife estimation, between-mode with Jackknife estimation and merging model). For example, SQI values of within-mode model with Jackknife estimation in the Inner-city, the Urban-fringe, and the Suburban are at 1.53, -1.15, and -1.43, respectively. This could show that the ranking order of SQI value is the Inner-city, the Urban-fringe, and the Suburban, respectively.

(4) Ability of SP survey in developing countries

Findings from this study show that some main issues should be concerned in applications of the SP techniques. Some guidelines of SP design in developed countries are not appropriate. This is mainly due to that respondents in developing countries may not be familiar with new scenarios (situations) and technologies. These key issues include:

SP experimental design. From the reviews, some studies used six or seven attributes per alternative. In this research, it is recommended that number of attributes should be limited at four per alternative; otherwise individuals may ignore some attributes. If we need more attribute need to separate into several sets of questionnaires.

Measurement of attributes (variables). Some attributes are not easy to be understood by respondents, and not easy to ask respondents to quantify them. These attributes are, for example, travel time, delayed time, walking time, waiting time, comfort, and safety. Moreover, it is also not easy for respondents to understand relative value, e.g. travel time reduction 30% compared to current travel time. It is recommended that the questionnaire should be used the graphical picture and short message.

Data collection method. In developed countries, SP questionnaires are often conducted by mail-back method, or sometimes by telephone. These methods are cheaper than interview. If these methods are used in developing countries, respondents may not be able to provide reliable data. However, if interview method is used, survey staffs need to be well trained. Moreover, stating preferences towards each scenario by choice is likely to be more appropriate than rating or ranking.

Understanding of new scenarios. It is advised that non-existing situations must be well designed to present to respondents; for example, new modes (e.g. BRT), new routes (e.g. motorways), new policies (e.g. road pricing) and service improvement (e.g. increasing reliability). Some descriptions and/or pictures are useful. If respondents misunderstand choices, their stated behaviours would be unreliable.

Captive sample. Some respondents may not consider any alternatives presented to them. They are captive to what they have done or chosen before. They do not trade-off among attributes. These respondents are those who have no choice, those who have personal and family constraints, and those who do not want to change their behaviours (habit). In developing countries, the number of captive respondents is high and very likely to higher than in developed countries. If captive proportion is not considered in the model, predicted results may be wrong.

Current situations in developing countries. Current situations in developing countries are much different from developed countries, e.g. lifestyles of living, infrastructure and transport service. This is likely to affect respondents' behaviours.

CHAPTER VIII

CONCLUSIONS AND FURTHER STUDIES

8.1 CONCLUSIONS

An alternative methodology using Stated Preference (SP) technique has been proposed for determining the service quality of paratransit. The developed technique aims to overcome some weaknesses in existing measurement methods. Moreover, the developed method is applicable for paratransit modes, which has different fundamentals from conventional transit modes.

The objectives of the study were to examine and develop service quality measurement technique that incorporates key service quality attributes and yields unbiased service quality for a particular service. Moreover, the strength and applicability of the developed technique are displayed. This present study considers the particular case of passenger van, which was a form of informal paratransit modes. Passenger van services in Bangkok are very complicated and have different characteristics based on spatial locations and market segments.

The literature on service quality measurement technique indicates that, in comparison to the LOS, Index, Customer Satisfaction, and Passenger Environmental Survey, the SP technique provides the similarity to the mentioned in which it could provide a measure of service quality. The SP technique offers a medium to overcome some issues such as utility of service choice, preference of transit service (service quality selection), attribute valuation (willingness-to-pay), and policy responsive (elasticity). However, the previous SP techniques still have some limitations and arguments, e.g. context to use SP techniques, instrument design, and attribute specification. Therefore, to increase the efficiency of SP experiments and to assist transport planners and transit agencies on using these measures for understanding, operating, improving, and forecasting the transit system and its services.

With regard to the literature review, this research deals with the SP experiment in two issues (1) the principle state of practice in service quality of passenger van and (2) a number of improvements to this state of practice. Under the first issue, these various elements are covered: (1) An assumption of the mode choice models is based on the behavioural principle that a traveller would choose the mode that yields greatest satisfaction or 'utility' of transit services quality of passenger vans; (2) the data come from contextual, highly customized (hypothetical alternatives for a typical transport based on actual attribute levels) SP interviews with the various segment and different spatial locations of passenger van users who are asked to compare pairs of alternatives; (3) A set of attributes is selected from both of quantitative attributes and qualitative attributes in terms of the service quality (e.g., fare, waiting time, walking distance, vehicle comfort, in-vehicle time, number of stops, and safety); and (4) An analysis exploits logit models with linear utility functions. For the second issue, the elements include: (1) The within-mode choice models of passenger van are exploited for improving passenger van services; (2) The between-mode choice models of passenger van and competitive mode (bus) are exploited for investigating transit service benchmarking; (3) The joint revealed preference (RP) and stated preference (SP) data are used to improve the SP scaling and the reliability of data; (4) The use of service quality valuation in terms of monetary (Willingness-To-Pay) is based on the fare attribute; and (5) The Jackknife method is employed to reduce SP bias and to get more reliable estimates on coefficients for *t*-ratios.

The main survey was based on responses from samples of three spatial locations, mainly located near universities; hence the responses were largely drawn from university students who were the largest segment of passenger van users. A sample of 1200 respondents was drawn from three strata pertaining to different spatial locations, specifically Inner-city, Urban-fringe, and Suburban. The survey involved two basic SP experiments: a within-mode choice between two alternative passenger van services, and a between-mode choice experiment considering the public transit modes of passenger van and bus. Moreover, the special survey of 300 respondents was drawn from urban-fringe location to develop the RP-SP models using the joint revealed preference (RP) and stated preference (SP) data for improving the SP scaling and the reliability of data.

The study used SP simulation, a spreadsheet using random numbers, to adapt and to design the choice experiments (main survey and special survey). These experiments were then piloted on 150 respondents. The results gathered from this pilot study were later calculated with SP simulation to assess their reliability and accuracy. The main survey was then administered on 1,200 respondents. A majority of them were female with an average age of 21 years old. Their average monthly income equalled 5,357 baht and their average household income was at 34,020 baht/month. Average car ownership was around 1.4 cars for every household. On average, these respondents used passenger van 3 times/week. Two-third of the respondents used several public modes (e.g., conventional buses and air-conditioned buses) to access the passenger van services. Interestingly, these results affirmed the point-to-point (shuttle-like) services of passenger vans. Furthermore, the analysis of responses given to the personal information section helped identify three reasons explaining why passengers chose to travel with passenger vans. These three reasons included: (1) passenger vans were faster; (2) passenger vans offered more convenience; and (3) passenger vans offered more comfort. The respondents' satisfaction of passenger van level-of-service (LOS) was between medium to high levels.

The special survey was distributed to 300 respondents. The majority of them were female with an average age of 21 years old. The average monthly income was 5,296 baht and the household income was an average of 24,643 baht/month. On average, every household owned 1.1 cars and the respondents' frequency of passenger van usage were 4.3 times/week.

The analyses were conducted on the responses to the *Mode Choice Scenarios* (within mode and between mode). The within mode concentrated on how passenger van service could be improved. On the contrary, the between mode focused on how passenger vans' service benchmarking could be compared and investigated. A commercially available programme – ALOGIT software was employed to analyse these responses to identify factors determining participants' preference for passenger vans and buses. It could be reported that of all seven attributes of service quality (fare, walking distance, waiting time, vehicle comfort, in-vehicle time, number of stops, and safety from driving behaviour), only three (in-vehicle time, vehicle comfort, and safety) were found to be significant within all discrete choice models. Hence, these three attributes of service quality would be explained in greater details in light of the value-of-time, the value-of-vehicle comfort, and the value-of-safety. The significance of these three attributes could be best elaborated within the merging model in which two models (within and between) were combined. Some variables that had wrong signs and insignificance (number of stops and waiting time in the within-mode model from the main survey) had the least contribution effects to the overall utility. Although the contributions by these factors vary by individual travelers, it could be expected that the contribution by these factors would be minimal. Thus, this study presented all effects of service quality attributes in the models more than the power of models calibration. This was to show the generalization of the service quality variables for various paratransit modes (and even across all public transit modes). These variables were then decided to be kept in the models. All variables including the insignificant ones would be incorporated in the models for further analyses.

From the merging SP valuation of the main survey, it was inferred that respondents of the Inner-city demonstrated an alternative-specific preference of 21.60 baht for passenger van service, 14.84 baht for passenger van service type-1, and 7.77 baht for passenger service type-2 when comparing this service with bus service, ceteris paribus. Of the generic attributes, vehicle comfort was valued at 14.79 baht/level, in-vehicle time at 0.21 baht/minute, and safety from driver behaviour at 18.91 baht/level. In the Urban-fringe model, an alternative-specific preference was of 24.42 baht for passenger van service, 16.40 baht for passenger service type-1, and 11.84 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, vehicle comfort was valued at 18.58 baht/level, in-vehicle time at 0.26 baht/minute, and safety from driver behaviour at 24.76 baht/level. Moreover, it is found from the Suburban model that an alternative-specific preference was 33.868 baht for passenger van service, 31.75 baht for passenger service type-1, and 22.81 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, vehicle comfort was valued at 19.85 baht/level, in-vehicle time at 0.288 baht/minute, and safety from driver behaviour at 30.19 baht/level. Whilst, the merging SP valuation of the special survey, It was inferred that an alternative-specific preference was 20.44 baht for passenger van service, and 11.83 baht for passenger service type-1, 6.93 baht for passenger service type-2 when comparing this service with bus service. Of the generic attributes, vehicle comfort was valued at 14.86 baht/level, in-vehicle time at 0.19 baht/minute, and safety from driver behaviour at 18.28 baht/level.

Furthermore, the results indicated that the model with Jackknife estimation could reduce the biases of SP data from the original model. Additionally, the merging model that combined the within-mode choice model (passenger van service type-1 and passenger van service type-2) and the between-mode choice model (passenger van service and bus service) increased the efficiency of model estimation. While the joint revealed preference (RP) and stated preference (SP) data exploited the RP-SP models for improving the SP scaling and the reliability of data.

This interpretation of the modelling can give several dimensions: the degree of service quality attributes; the greatest impact on service quality attributes; utility of service choice; preference of transit service (service quality selection); attribute valuation (willingness-to-pay); and policy responsive (elasticity).

The study also shows some advancement in the application of SP technique. It could be learned from the lessons in six issues: (1) the joint revealed preference (RP) and stated preference (SP) data; (2) the Jackknife estimation; (3) service benchmarking: comparative with various models, (4) service benchmarking: comparative with spatial locations, (5) external validity test; and (6) Service Quality Index (SQI).

Moreover, the development of the SP technique and the implications from the results of models demonstrate the applicability of SP techniques for determining service quality of passenger vans on service quality measurement include: (1) ability to study the statistical significance of each service quality attributes; (2) ability to draw reasonable conclusions from limited data; (3) standardisation across public transit modes through benchmarking; (4) more understanding on travellers' behaviours; and (5) more accurate demand forecasting. While, the applicability of SP techniques for determining service quality of passenger vans on SP techniques include: (1) ability to formulate multi-attributes and eliminate bias of data in SP experimental design; (2) ability to improve reliability of data; (3) ability to compare various SP model structure; and (4) applicability of SP survey in developing countries**.**

8.2 FURTHER STUDIES

Although this application of Stated Preference (SP) technique is useful for determining service quality of paratransit (in this case the passenger vans), there are inevitable some areas where further studies are needed. This section identifies briefly two general areas of activity in which future study efforts might usefully be concentrated.

(1) Study areas of service quality measurement. This present study is the preliminary investigation of the application of Stated Preference (SP) techniques for measuring service quality of passenger vans. However, this study can be viewed as a starting point to develop a comprehensive service quality measurement that covers the other paratransit (e.g., Pick up: Song-Taeo, Tuk Tuk, Silor leks, and Taxi) and conventional public transit (Buses and Mass Transits). The areas of studies that could be furthered include:

Service quality attributes

The further study would identify the important attributes of service quality attributes for measuring service quality of all public transport modes; paratransit or conventional public transit, in both of quantitative attributes (e.g., fare, walking distance, waiting time, in-vehicle time, and number of stops) and qualitative attributes (e.g., vehicle comfort and safety from driver behaviour). This SP analysis could give understanding on travellers' behaviour and correctly identify the service quality perceived by travellers.

Travellers and areas

The SP measurement has the advantage over the existing survey technique that could not get the statistically-proof levels of importance among the service quality attributes with a limited amount of data. The technique also allows the authority to get the inferences on service quality for specific characteristics of travellers and areas. Thus, the future study of SP application would consider the service quality for more extensive stratified groups of users and for geographical locations to confirm reliability of SP development and its applicability. Moreover, this SP application would be employed to develop the complexity of the travel behaviours to yield understanding on various trip purposes (e.g., work trips, business trips, shopping trips, or trip-chain) and target groups (e.g., alternative users and captive users). Thus, the new market segments (e.g., business, commuting, and leisure) would be examined by repeating the set of service quality of this study to check the reliability of this measurement.

Service benchmarking

With this SP survey technique, the transit authority could hence get generalised level of service across routes (or districts) of operations as well as the available public transit modes. Through SQI, the authority could benchmark the degree of operations across the districts of operation, thus utilizing the results as the management tools for monitoring the transit services. The design of the technique can utilize the comparisons between two competing modes, and the results could lead to more efficient campaigns and promotions, that would attract the riders from the competing services in the present and in the future.

Traveller's behaviours

The results from the measurements are expressed in terms of standardised quantifiable values, which allow the authority to understand the behaviours of travellers. The weights (coefficients of service attributes in the utility function) could directly show the level of concerns (or preferences) by each individual traveller. The attribute valuation also gives meaningful interpretation on each service quality attribute. The authority could use this information to foresee the relevant impacts from the system changes. Moreover, the SP design would be concerned with the traveller's behaviours; for example, before usage condition (e.g., fare, walking distance, waiting time, and vehicle comfort) and after usage condition (e.g., fare, in-vehicle time, number of stops, and safety from driver behaviour). The future study can utilize the knowledge on traveller's behaviours in constructing a more effective campaign on public transit promotions.

Demand forecasting

The implication from the SP survey could be valuable information for authority, especially elasticity, which can be used for forecasting the future (new) after the system changes. This demand estimation is sensitive to each of service quality attribute. Also, this technique could show the cross-elasticity in demand due to the system change in competing mode services. It is believed that this method reflects more accurate traveller's decision due to service improvements and thus could yield more accurate demand prediction. The further study should examine the policy responsiveness in the other public transport modes from the exploited elasticity of the utility function to exploit such insights in the planning of future transit services.

(2) Study areas of Stated Preference (SP) techniques. The further study of SP techniques would require some of key issues in developments and applications for measuring service quality of other paratransits (e.g., Pick up: Song-Taeo, Tuk Tuk, Silor leks, and Taxi) and conventional public transit (Buses and Mass Transits). Moreover, the further study would examine the relative importance of the factors influencing the validity of SP data and model to more understanding on SP situations. The areas of studies that could be furthered include:

Multi-attributes and bias of data in SP experimental design

The further study would examine multi-attributes effects (e.g., orthogonal versus non-orthogonal, two attributes per alternative versus three attributes per alternative, quantitative data versus qualitative data, etc.) and bias of data in SP experimental design (e.g., Jackknife procedure versus original procedure, etc.).

Reliability of data

The further study would examine reliability of data effects (e.g., RP data versus SP data, RP-SP data versus RP data, RP-SP data versus SP data, Adaptive SP design versus conventional SP design).

SP model structure

The further study would examine SP model structure effects (e.g., Specific Model (GEV, Probit, Mixed Logit, versus Logit), application model (Within-mode, Between-mode, versus Merging), etc.).

Presentation and response scale

The further study would examine presentation and response scale (e.g., ranking scale, rating scale, versus pairwise or multinomial-choice scale).

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APPENDICES

ชุดที่ 1.1A

☐☐☐

วิศวกรรมขนส่ง ภาควิชาวิศวกรรมโยธา จุฬาลงกรณ์มหาวิทยาลัย

Development of Passenger Van Performance Measures in Developing Country: A Case Study on Bangkok

แบบสอบถามชุดที่ 1.1 เส้นทางรถตู้โดยสาร หอการค้าไทย - เซ็นทรัลลาดพร้าว

วันที่……../………../2548 เวลา…………….……..ผู้รับผิดชอบ……………………

แบบสอบถามนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ในระดับปริญญาดุษฎีบัณฑิต จึงใคร่ขอความอนุเคราะห์จากท่านในการให้ข้อมูลที่ถูกต้องตามความเป็นจริง ซึ่งจะเป็นประโยชน์แก่การศึกษาในเรื่องพฤติกรรมของผู้เดินทาง และการวางแผนทางด้านการจราจรขนส่งในกรุงเทพมหานคร เพื่อนำผลที่ได้ไปปรับปรุงประสิทธิภาพการให้บริการของระบบขนส่งสาธารณะต่อไป หากมีข้อสงสัยโปรดติดต่อ นายประพัทธ์พงษ์ อุปลา หรือ รองศาสตราจารย์ ดร.สรวิศ นฤปิติ ภาควิชาวิศวกรรมโยธา คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โทร. 0-2218-6565

ชื่อผู้ตอบแบบสอบถาม……………………………………..…………คณะ…………….…………ชั้นปี……………………..……..

<u>ตอนที่ 1</u> ข้อมูลของผู้เดินทาง

1.1 เพศ ☐ ชาย ☐ หญิง

1.2 อายุ ………………………………ปี

1.3 รายได้เฉลี่ยของตัวท่าน ………………………………บาท/เดือน

1.4 รายได้เฉลี่ยของครอบครัวของท่าน ………………………………บาท/เดือน

1.5 จำนวนรถยนต์ส่วนตัวในครอบครัวของท่าน ………………………………คัน

1.6 ความถี่ในการใช้บริการรถตู้โดยสาร ………………………………ครั้ง/สัปดาห์

1.7 พาหนะที่ท่าน ใช้ เดินทาง **<u>ก่อนมา</u>** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ……………..

1.8 พาหนะที่ท่าน ใช้ เดินทาง **<u>หลังจาก</u>** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ……………..

1.9 **<u>เหตุผลสำคัญ</u>** ที่ทำให้ท่านเลือกใช้ บริการรถตู้โดยสาร

☐ ความรวดเร็ว ☐ ความตรงต่อเวลา ☐ ความสบาย

☐ ความสะดวก ☐ ความปลอดภัย ☐ ราคาค่าโดยสาร

1.10 โปรดให้ค่าคะแนนโดยรวมของ ระดับการให้บริการของรถตู้โดยสาร ที่ท่านเดินทางใน **<u>วันนี้</u>**

(หมายเลข 1 แทน ระดับการให้บริการที่แย่ที่สุด หมายเลข 7 แทน ระดับการให้บริการที่ดีที่สุด)

แย่ที่สุด ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ดีที่สุด

ตอนที่ 2 The 1st Game – SP Choice

โปรดระบุค่าตัวแปรต่างๆ ของรถตู้โดยสารที่ท่านใช้บริการใน **วันนี้** (Revealed Preference)

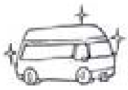
RP

2.1 ราคาค่าบริการ ....12.............................บาท

2.2 เวลาที่รอรถตู้ออก ....นาที

2.3 ระยะทางที่เดินมาขึ้นรถตู้ ....เมตร

2.4 ระดับความสบาย

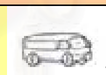
 ☐ น้อย  ☐ ปานกลาง  ☐ สูง

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2A	20	15	150	 น้อย	☐ ประเภท A
	10	20	100	 ปานกลาง	☐ ประเภท B

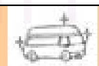
ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2B	20	10	100	 ปานกลาง	☐ ประเภท A
	10	17	100	 ปานกลาง	☐ ประเภท B

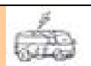
ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2C	20	5	50	 มาก	☐ ประเภท A
	10	14	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2D	15	15	100	 มาก	☐ ประเภท A
	10	20	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2E	15	10	50	 น้อย	☐ ประเภท A
	10	17	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

<u>ตอนที่ 3</u> The 2nd Game – SP Choice

โปรดระบุค่าปัจจัยต่างๆ ที่ท่านบริการรถตู้โดยสารใน **<u>วันนี้</u>** (Revealed Preference)

2.1 ราคาค่าบริการ ....12..........................บาท

2.2 ระยะเวลาในการเดินทาง ....นาที

2.3 จำนวนจุดในการจอดรับ-ส่ง ....ครั้ง หรือ ป้าย

2.4 ความปลอดภัยจากพฤติกรรมของคนขับ

 ☐ น้อย  ☐ ปานกลาง  ☐ มาก

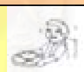
RP

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3A	20	35	15	 ต่ำ	☐ ประเภท A
	10	55	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3B	20	30	10	 ปานกลาง	☐ ประเภท A
	10	45	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3C	20	25	5	 สูง	☐ ประเภท A
	10	50	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3D	15	35	10	 สูง	☐ ประเภท A
	10	55	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3E	15	30	5	 ต่ำ	☐ ประเภท A
	10	45	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ตอนที่ 4 The 1st Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **รถตู้โดยสาร SP กับ รถเมล์** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 4A จนถึง 4E ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4A	15	15	150	น้อย	☐ รถตู้โดยสาร SP
	20	35	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4B	15	10	100	ปานกลาง	☐ รถตู้โดยสาร SP
	20	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4C	15	5	50	สูง	☐ รถตู้โดยสาร SP
	20	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4D	12	15	100	สูง	☐ รถตู้โดยสาร SP
	14	35	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4E	12	10	50	น้อย	☐ รถตู้โดยสาร SP
	14	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ตอนที่ 5 The 2nd Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **รถตู้โดยสาร SP กับ รถเมล์** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 5A จนถึง 5E ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5A	15	35	15	ต่ำ	☐ รถตู้โดยสาร SP
	20	55	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5B	15	30	10	ปานกลาง	☐ รถตู้โดยสาร SP
	20	45	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5C	15	25	5	สูง	☐ รถตู้โดยสาร SP
	20	50	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5D	12	35	10	สูง	☐ รถตู้โดยสาร SP
	14	55	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5E	12	30	5	ต่ำ	☐ รถตู้โดยสาร SP
	14	45	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ชุดที่ 1.1B

☐☐☐

วิศวกรรมขนส่ง ภาควิชาวิศวกรรมโยธา จุฬาลงกรณ์มหาวิทยาลัย

Development of Passenger Van Performance Measures in Developing Country: A Case Study on Bangkok

แบบสอบถามชุดที่ 1.1 เส้นทางรถตู้โดยสาร หอการค้าไทย - เซ็นทรัลลาดพร้าว

วันที่......../........./2548 เวลา........................ผู้รับผิดชอบ........................

แบบสอบถามนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ในระดับปริญญาดุษฏีบัณฑิต จึงใคร่ขอความอนุเคราะห์จากท่านในการให้ข้อมูลที่ถูกต้องตามความเป็นจริง ซึ่งจะเป็นประโยชน์แก่การศึกษาในเรื่องพฤติกรรมของผู้เดินทาง และการวางแผนทางด้านการจราจรขนส่งในกรุงเทพมหานคร เพื่อนำผลที่ได้ไปปรับปรุงประสิทธิภาพการให้บริการของระบบขนส่งสาธารณะต่อไป หากมีข้อสงสัยโปรดติดต่อ นายประพัทธ์พงษ์ อุปลา หรือ รองศาสตราจารย์ ดร.สรวิศ นฤปิติ ภาควิชาวิศวกรรมโยธา คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โทร. 0-2218-6565

ชื่อผู้ตอบแบบสอบถาม...คณะ.........................ชั้นปี.............................

<u>ตอนที่ 1</u> ข้อมูลของผู้เดินทาง

1.1 เพศ ☐ ชาย ☐ หญิง

1.2 อายุ ....ปี

1.3 รายได้เฉลี่ยของตัวท่าน ....บาท/เดือน

1.4 รายได้เฉลี่ยของครอบครัวของท่าน ....บาท/เดือน

1.5 จำนวนรถยนต์ส่วนตัวในครอบครัวของท่าน ....คัน

1.6 ความถี่ในการใช้บริการรถตู้โดยสาร ....ครั้ง/สัปดาห์

1.7 พาหนะที่ท่าน ใช้ เดินทาง **<u>ก่อนมา</u>** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ....

1.8 พาหนะที่ท่าน ใช้ เดินทาง **<u>หลังจาก</u>** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ....

1.9 **<u>เหตุผลสำคัญ</u>** ที่ทำให้ท่านเลือกใช้ บริการรถตู้โดยสาร

☐ ความรวดเร็ว ☐ ความตรงต่อเวลา ☐ ความสบาย

☐ ความสะดวก ☐ ความปลอดภัย ☐ ราคาค่าโดยสาร

1.11 โปรดให้ค่าคะแนนโดยรวมของ ระดับการให้บริการของรถตู้โดยสาร ที่ท่านเดินทางใน **<u>วันนี้</u>**

(หมายเลข 1 แทน ระดับการให้บริการที่แย่ที่สุด หมายเลข 7 แทน ระดับการให้บริการที่ดีที่สุด)

แย่ที่สุด	☐	☐	☐	☐	☐	☐	☐	ดีที่สุด
	1	2	3	4	5	6	7	

ตอนที่ 2 The 1st Game – SP Choice

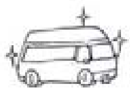
โปรดระบุค่าตัวแปรต่างๆ ของรถตู้โดยสารที่ท่านใช้บริการใน **วันนี้** (Revealed Preference)

2.1 ราคาค่าบริการ ....12..............................บาท

2.2 เวลาที่รอรถตู้ออก ....นาที

2.3 ระยะทางที่เดินมาขึ้นรถตู้ ....เมตร

2.4 ระดับความสบาย

 ☐ น้อย  ☐ ปานกลาง  ☐ สูง

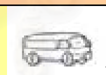
RP

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2E	15	10	50	 น้อย	☐ ประเภท A
	10	17	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2F	15	5	150	 ปานกลาง	☐ ประเภท A
	10	14	100	 ปานกลาง	☐ ประเภท B

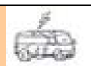
ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2G	10	15	50	 ปานกลาง	☐ ประเภท A
	10	20	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2H	10	10	150	 มาก	☐ ประเภท A
	10	17	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2I	10	5	100	 น้อย	☐ ประเภท A
	10	14	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

<u>ตอนที่ 3</u> The 2nd Game – SP Choice

โปรดระบุค่าปัจจัยต่างๆ ที่ท่านบริการรถตู้โดยสารใน **<u>วันนี้</u>** (Revealed Preference)

2.1 ราคาค่าบริการ ....12..............................บาท

2.2 ระยะเวลาในการเดินทาง ....นาที

2.3 จำนวนจุดในการจอดรับ-ส่ง ....ครั้ง หรือ ป้าย

2.4 ความปลอดภัยจากพฤติกรรมของคนขับ

 ☐ น้อย  ☐ ปานกลาง  ☐ มาก

RP

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3E	15	30	5	ต่ำ	☐ ประเภท A
	10	45	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3F	15	25	15	ปานกลาง	☐ ประเภท A
	10	50	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3G	10	35	5	ปานกลาง	☐ ประเภท A
	10	55	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3H	10	30	15	สูง	☐ ประเภท A
	10	45	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3I	10	25	10	ต่ำ	☐ ประเภท A
	10	50	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

ตอนที่ 4 The 1st Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **รถตู้โดยสาร SP กับ รถเมล์** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 4E จนถึง 4I ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4E	12	10	50	น้อย	☐ รถตู้โดยสาร SP
	14	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4F	12	5	150	ปานกลาง	☐ รถตู้โดยสาร SP
	14	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4G	10	15	50	ปานกลาง	☐ รถตู้โดยสาร SP
	5	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4H	10	10	150	สูง	☐ รถตู้โดยสาร SP
	5	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4I	10	5	100	น้อย	☐ รถตู้โดยสาร SP
	5	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

<u>ตอนที่ 5</u> The 2nd Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **<u>รถตู้โดยสาร SP กับ รถเมล์</u>** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 5E จนถึง 5I ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5E	12	30	5	ต่ำ	☐ รถตู้โดยสาร SP
	14	45	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5F	12	25	15	ปานกลาง	☐ รถตู้โดยสาร SP
	14	50	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5G	10	35	5	ปานกลาง	☐ รถตู้โดยสาร SP
	5	55	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5H	10	30	15	สูง	☐ รถตู้โดยสาร SP
	5	45	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5I	10	25	10	ต่ำ	☐ รถตู้โดยสาร SP
	5	50	10	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ชุดที่ 2.1A

วิศวกรรมขนส่ง ภาควิชาวิศวกรรมโยธา จุฬาลงกรณ์มหาวิทยาลัย

Development of Passenger Van Performance Measures in Developing Country: A Case Study on Bangkok

แบบสอบถามชุดที่ 2.1 เส้นทางรถตู้โดยสาร รามคำแหง – รามคำแหง 2

วันที่……../………/2548 เวลา………………..…….ผู้รับผิดชอบ……………………

แบบสอบถามนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ในระดับปริญญาดุษฎีบัณฑิต จึงใคร่ขอความอนุเคราะห์จากท่านในการให้ข้อมูลที่ถูกต้องตามความเป็นจริง ซึ่งจะเป็นประโยชน์แก่การศึกษาในเรื่องพฤติกรรมของผู้เดินทาง และการวางแผนทางด้านการจราจรขนส่งในกรุงเทพมหานคร เพื่อนำผลที่ได้ไปปรับปรุงประสิทธิภาพการให้บริการของระบบขนส่งสาธารณะต่อไป หากมีข้อสงสัยโปรดติดต่อ นายประพัทธ์พงษ์ อุปลา หรือ รองศาสตราจารย์ ดร.สรวิศ นฤปิติ ภาควิชาวิศวกรรมโยธา คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โทร. 0-2218-6565

ชื่อผู้ตอบแบบสอบถาม……………………………………..……………คณะ……………..…………ชั้นปี…………………...……..

ตอนที่ 1 ข้อมูลของผู้เดินทาง

1.1 เพศ ☐ ชาย ☐ หญิง

1.2 อายุ ……………………………….ปี

1.3 รายได้เฉลี่ยของตัวท่าน ……………………………….บาท/เดือน

1.4 รายได้เฉลี่ยของครอบครัวของท่าน ……………………………….บาท/เดือน

1.5 จำนวนรถยนต์ส่วนตัวในครอบครัวของท่าน ……………………………….คัน

1.6 ความถี่ในการใช้บริการรถตู้โดยสาร ……………………………….ครั้ง/สัปดาห์

1.7 พาหนะที่ท่าน ใช้ เดินทาง **ก่อนมา** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ……………..

1.8 พาหนะที่ท่าน ใช้ เดินทาง **หลังจาก** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ……………..

1.9 **เหตุผลสำคัญ** ที่ทำให้ท่านเลือกใช้ บริการรถตู้โดยสาร

☐ ความรวดเร็ว ☐ ความตรงต่อเวลา ☐ ความสบาย

☐ ความสะดวก ☐ ความปลอดภัย ☐ ราคาค่าโดยสาร

1.12 โปรดให้ค่าคะแนนโดยรวมของ ระดับการให้บริการของรถตู้โดยสาร ที่ท่านเดินทางใน **วันนี้**

(หมายเลข 1 แทน ระดับการให้บริการที่แย่ที่สุด หมายเลข 7 แทน ระดับการให้บริการที่ดีที่สุด)

แย่ที่สุด ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ดีที่สุด

<u>ตอนที่ 2</u> The 1st Game – SP Choice

โปรดระบุค่าตัวแปรต่างๆ ของรถตู้โดยสารที่ท่านใช้บริการใน **<u>วันนี้</u>** (Revealed Preference)

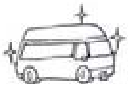
RP

2.1 ราคาค่าบริการ ………………………………,,,………………………บาท

2.2 เวลาที่รอรถตู้ออก ……………………………………………………………นาที

2.3 ระยะทางที่เดินมาขึ้นรถตู้ ……………………………………………………………เมตร

2.4 ระดับความสบาย

 ☐ น้อย  ☐ ปานกลาง  ☐ สูง

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2A	27	15	150	 น้อย	☐ ประเภท A
	17	20	100	 ปานกลาง	☐ ประเภท B

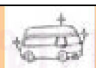
ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2B	27	10	100	 ปานกลาง	☐ ประเภท A
	17	17	100	 ปานกลาง	☐ ประเภท B

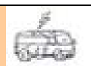
ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2C	27	5	50	 มาก	☐ ประเภท A
	17	14	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2D	22	15	100	 มาก	☐ ประเภท A
	17	20	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2E	22	10	50	 น้อย	☐ ประเภท A
	17	17	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

ตอนที่ 3 The 2nd Game – SP Choice

โปรดระบุค่าปัจจัยต่างๆ ที่ท่านบริการรถตู้โดยสารใน **วันนี้** (Revealed Preference)

RP

2.1 ราคาค่าบริการ ....,,,.........................บาท

2.2 ระยะเวลาในการเดินทาง ....นาที

2.3 จำนวนจุดในการจอดรับ-ส่ง ....ครั้ง หรือ ป้าย

2.4 ความปลอดภัยจากพฤติกรรมของคนขับ

 ☐ น้อย  ☐ ปานกลาง  ☐ มาก

3A	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
	27	45	15	 ต่ำ	☐ ประเภท A
	17	65	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

3B	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
	27	40	10	 ปานกลาง	☐ ประเภท A
	17	55	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

3C	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
	27	35	5	 สูง	☐ ประเภท A
	17	60	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

3D	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
	22	45	10	 สูง	☐ ประเภท A
	17	65	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

3E	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
	22	40	5	 ต่ำ	☐ ประเภท A
	17	55	10	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ตอนที่ 4 The 1st Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **รถตู้โดยสาร SP กับ รถเมล์** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 4A จนถึง 4E ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4A	24	15	150	น้อย	☐ รถตู้โดยสาร SP
	25	35	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4B	24	10	100	ปานกลาง	☐ รถตู้โดยสาร SP
	25	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4C	24	5	50	สูง	☐ รถตู้โดยสาร SP
	25	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4D	20	15	100	สูง	☐ รถตู้โดยสาร SP
	16	35	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4E	20	10	50	น้อย	☐ รถตู้โดยสาร SP
	16	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

<u>ตอนที่ 5</u> The 2nd Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **<u>รถตู้โดยสาร SP กับ รถเมล์</u>** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 5A จนถึง 5E ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5A	24	50	15	ต่ำ	☐ รถตู้โดยสาร SP
	25	65	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5B	24	45	10	ปานกลาง	☐ รถตู้โดยสาร SP
	25	55	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5C	24	40	5	สูง	☐ รถตู้โดยสาร SP
	25	60	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5D	20	50	10	สูง	☐ รถตู้โดยสาร SP
	16	65	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5E	20	45	5	ต่ำ	☐ รถตู้โดยสาร SP
	16	55	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ชุดที่ 2.1B

☐☐☐

วิศวกรรมขนส่ง ภาควิชาวิศวกรรมโยธา จุฬาลงกรณ์มหาวิทยาลัย

Development of Passenger Van Performance Measures in Developing Country: A Case Study on Bangkok

แบบสอบถามชุดที่ 2.1 เส้นทางรถตู้โดยสาร รามคำแหง – รามคำแหง 2

วันที่……../………/2548 เวลา……………….…….ผู้รับผิดชอบ……………………

แบบสอบถามนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ในระดับปริญญาดุษฎีบัณฑิต จึงใคร่ขอความอนุเคราะห์จากท่านในการให้ข้อมูลที่ถูกต้องตามความเป็นจริง ซึ่งจะเป็นประโยชน์แก่การศึกษาในเรื่องพฤติกรรมของผู้เดินทาง และการวางแผนทางด้านการจราจรขนส่งในกรุงเทพมหานคร เพื่อนำผลที่ได้ไปปรับปรุงประสิทธิภาพการให้บริการของระบบขนส่งสาธารณะต่อไป หากมีข้อสงสัยโปรดติดต่อ นายประพัทธ์พงษ์ อุปลา หรือ รองศาสตราจารย์ ดร.สรวิศ นฤปิติ ภาควิชาวิศวกรรมโยธา คณะวิศวกรรมศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โทร. 0-2218-6565

ชื่อผู้ตอบแบบสอบถาม……………………………………..…………คณะ…………….…………ชั้นปี………………….……..

<u>ตอนที่ 1</u> ข้อมูลของผู้เดินทาง

1.1 เพศ ☐ ชาย ☐ หญิง

1.2 อายุ ……………………………..ปี

1.3 รายได้เฉลี่ยของตัวท่าน ……………………………..บาท/เดือน

1.4 รายได้เฉลี่ยของครอบครัวของท่าน ……………………………..บาท/เดือน

1.5 จำนวนรถยนต์ส่วนตัวในครอบครัวของท่าน ……………………………..คัน

1.6 ความถี่ในการใช้บริการรถตู้โดยสาร ……………………………..ครั้ง/สัปดาห์

1.7 พาหนะที่ท่าน ใช้ เดินทาง **<u>ก่อนมา</u>** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ……………

1.8 พาหนะที่ท่าน ใช้ เดินทาง **<u>หลังจาก</u>** ใช้บริการรถตู้โดยสาร

☐ เดินเท้า ☐ รถเมล์ธรรมดา ☐ รถเมล์ปรับอากาศ ☐ มอเตอร์ไซด์รับจ้าง ☐ อื่นๆ ……………

1.9 **<u>เหตุผลสำคัญ</u>** ที่ทำให้ท่านเลือกใช้ บริการรถตู้โดยสาร

☐ ความรวดเร็ว ☐ ความตรงต่อเวลา ☐ ความสบาย

☐ ความสะดวก ☐ ความปลอดภัย ☐ ราคาค่าโดยสาร

1.13 โปรดให้ค่าคะแนนโดยรวมของ ระดับการให้บริการของรถตู้โดยสาร ที่ท่านเดินทางใน **<u>วันนี้</u>**

(หมายเลข 1 แทน ระดับการให้บริการที่แย่ที่สุด หมายเลข 7 แทน ระดับการให้บริการที่ดีที่สุด)

แย่ที่สุด ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ดีที่สุด

ตอนที่ 2 The 1st Game – SP Choice

โปรดระบุค่าตัวแปรต่างๆ ของรถตู้โดยสารที่ท่านใช้บริการใน **วันนี้** (Revealed Preference)

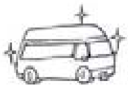
RP

2.1 ราคาค่าบริการ ....บาท

2.2 เวลาที่รอรถตู้ออก ....นาที

2.3 ระยะทางที่เดินมาขึ้นรถตู้ ....เมตร

2.4 ระดับความสบาย

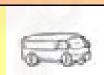
 ☐ น้อย  ☐ ปานกลาง  ☐ สูง

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2E	22	10	50	 น้อย	☐ ประเภท A
	17	17	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2F	22	5	150	 ปานกลาง	☐ ประเภท A
	17	14	100	 ปานกลาง	☐ ประเภท B

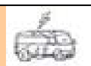
ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2G	17	15	50	 ปานกลาง	☐ ประเภท A
	17	20	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2H	17	10	150	 มาก	☐ ประเภท A
	17	17	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาที่รอรถตู้ออก	ระยะทางที่เดินมาขึ้นรถตู้	ระดับความสบาย	ประเภทการบริการที่เลือก
2I	17	5	100	 น้อย	☐ ประเภท A
	17	14	100	 ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

ตอนที่ 3 The 2nd Game – SP Choice

โปรดระบุค่าปัจจัยต่างๆ ที่ท่านบริการรถตู้โดยสารใน **วันนี้** (Revealed Preference)

2.1 ราคาค่าบริการ ……………………………………………………………บาท

2.2 ระยะเวลาในการเดินทาง ……………………………………………………………นาที

2.3 จำนวนจุดในการจอดรับ-ส่ง ……………………………………………………………ครั้ง หรือ ป้าย

2.4 ความปลอดภัยจากพฤติกรรมของคนขับ

RP


☐ น้อย


☐ ปานกลาง


☐ มาก

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3E	22	40	5	ต่ำ	☐ ประเภท A
	17	55	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3F	22	35	15	ปานกลาง	☐ ประเภท A
	17	60	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3G	17	45	5	ปานกลาง	☐ ประเภท A
	17	65	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3H	17	40	15	สูง	☐ ประเภท A
	17	55	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

	ราคาค่าบริการ	ระยะเวลาในการเดินทาง	จำนวนจุดในการจอดรับ-ส่ง	ระดับความปลอดภัย	ประเภทการบริการที่เลือก
3I	17	35	10	ต่ำ	☐ ประเภท A
	17	60	10	ปานกลาง	☐ ประเภท B

ถ้าสมมติว่า มีการให้บริการของรถตู้ (A หรือ B) ที่ท่านเลือก มาแทน รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช่ ☐ ไม่ใช่

<u>ตอนที่ 4</u> The 1st Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **<u>รถตู้โดยสาร SP กับ รถเมล์</u>** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 4E จนถึง 4I ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4E	20	10	50	น้อย	☐ รถตู้โดยสาร SP
	16	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4F	20	5	150	ปานกลาง	☐ รถตู้โดยสาร SP
	16	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4G	16	15	50	ปานกลาง	☐ รถตู้โดยสาร SP
	5	35	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4H	16	10	150	สูง	☐ รถตู้โดยสาร SP
	5	25	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	เวลาในการรอรถตู้ออก	ระยะทางที่เดินเพื่อมาขึ้นรถตู้	ระดับความสบาย	ประเภทพาหนะที่เลือก
4I	16	5	100	น้อย	☐ รถตู้โดยสาร SP
	5	30	100	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

<u>ตอนที่ 5</u> The 2nd Game - Mode Choice

ถ้าสมมติว่าท่านจำเป็นต้องเดินทางด้วย **<u>รถตู้โดยสาร SP กับ รถเมล์</u>** ซึ่งมีลักษณะการให้บริการ เป็นตามสถานการณ์ด้านล่าง จาก 5E จนถึง 5I ท่านจะเลือกใช้พาหนะประเภทใด ในแต่ละสถานการณ์

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5E	20	45	5	ต่ำ	☐ รถตู้โดยสาร SP
	16	55	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5F	20	40	15	ปานกลาง	☐ รถตู้โดยสาร SP
	16	60	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5G	16	50	5	ปานกลาง	☐ รถตู้โดยสาร SP
	5	65	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5H	16	45	15	สูง	☐ รถตู้โดยสาร SP
	5	55	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

	ราคาค่าบริการ	ระยะเวลาที่ใช้ในการเดินทาง	จำนวนจุดที่จอด	ระดับความปลอดภัย	ประเภทพาหนะที่เลือก
5I	16	40	10	ต่ำ	☐ รถตู้โดยสาร SP
	5	60	20	ปานกลาง	☐ รถเมล์

ถ้าสมมติ มีการให้บริการ(รถตู้โดยสาร SP หรือ รถเมล์) ที่ท่านเลือก <u>มาแทน</u> รถตู้ที่ท่านใช้บริการในวันนี้ (RP) ท่านจะใช้บริการดังกล่าวหรือไม่ ☐ ใช้ ☐ ไม่ใช้

BIOGRAPHY

Prapatpong Upala was born in Nong Khai, Thailand on September 26, 1976. He was graduated from Department of Civil Engineering, Faculty of Engineering, King Mongkut's Institute of Technology Ladkrabang in 1999 with Bachelor Degree in Construction Engineering. In addition, he was graduated from Department of Urban and Regional Planning, Faculty of Architecture, King Mongkut's Institute of Technology Ladkrabang in 2002 with Master Degree in Urban and Regional Planning (Urban and Environmental Planning). He has received the Master-Doctoral Scholarship for Development Lecturer from Ministry of Education, which enables him to start him Doctoral Degree in Civil Engineering (Transportation Engineering) at Chulalongkorn University, Thailand. At the present, Prapatpong Upala is a full time lecturer at Department of Urban and Regional Planning, Faculty of Architecture, King Mongkut's Institute of Technology Ladkrabang.