FACTORS INFLUENCING INFORMATION TECHNOLOGY ADOPTION IN ELECTRONIC TOLL COLLECTION (EASY PASS) IN THAILAND

WARINYA MEESILAPAWIKKAI

A THESIS SUBMITTED IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR
THE DEGREE OF MASTER OF SCIENCE
(TECHNOLOGY OF INFORMATION SYSTEM MANAGEMENT)
FACULTY OF GRADUATE STUDIES
MAHIDOL UNIVERSITY
2012

Thesis
entitled

FACTORS INFLUENCING INFORMATION TECHNOLOGY ADOPTION IN ELECTRONIC TOLL COLLECTION (EASY PASS) IN THAILAND

……..……..…..……
Miss Warinya Meesilapawikkai
Candidate

……..……..…..……
Asst. Prof. Tanawut Tantimongcolwat,
Ph.D. (Medical Technology)
Major advisor

……..……..…..……
Asst. Prof. Thanakorn Naenna,
Ph.D. (Engineering Science)
Co-advisor

……..……..…..……
Assoc. Prof. Tuanjai Somboonwiwat,
Ph.D. (Industrial Engineering)
Co-advisor

……..……..…..……
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

……..……..…..……
Lect. Supaporn Kiattisin,
Ph.D. (Electrical and Computer Engineering)
Program Director
Master of Science Program in Technology of Information System Management
Faculty of Engineering
Mahidol University

Thesis
entitled

FACTORS INFLUENCING INFORMATION TECHNOLOGY ADOPTION IN ELECTRONIC TOLL COLLECTION (EASY PASS) IN THAILAND

was submitted to the Faculty of Graduate Studies, Mahidol University
for the degree of Mater of Science (Technology of Information System Management)
on
May 18, 2012

……
Miss Warinya Meesilapawikkai
Candidate

……
Asst. Prof. Chanin Nantasenamat,
Ph.D. (Medical Technology)
Chair

……
Asst. Prof. Tanawut Tantimongcolwat,
Ph.D. (Medical Technology)
Member

……
Asst. Prof. Thanakorn Naenna,
Ph.D. (Engineering Science)
Member

……
Assoc. Prof. Tuanjai Somboonwiwat,
Ph.D. (Industrial Engineering)
Member

……
Lect. Arm Pangarad,
Ph.D. (Information Technnology)
Member

……
Prof. Banchong Mahaisavariya,
M.D., Dip Thai Board of Orthopedics
Dean
Faculty of Graduate Studies
Mahidol University

……
Lect. Worawit Israngkul,
M.S. (Technical Management)
Dean
Faculty of Engineering
Mahidol University

ACKNOWLEDGEMENTS

I wish to express my deepest appreciation and gratitude to all the people that have contributed to the completion of this thesis.

The success of this thesis can be succeeded by the attentive support from my major advisor, Asst. Prof. Dr. Tanawut Tantimongcolwat. I am very grateful for their guidance and encouragement and deeply thank him for the valuable advices and several suggestions reinforced my perception and knowledge to practice this research.

I also would like to sincerely express my appreciation and thank to Lect. Arm Pangarad, the external examiner of the thesis defense and Asst. Prof. Chanin Nantasenamat for their kindness in valuable suggestion and time sacrifice through this study. Special thanks Asst. Prof. Dr. Thanakorn Neanna and Assoc. Prof. Dr. Tuanjai Somboonwiwat my co-advisor for attentiveness and time sacrifice to give advices and comments for this research.

I would like to thank the entire respondent who was the sampling in this study for their participation.

Thank to my friends and staffs in Technology of Information System Management department Mahidol University, especially Miss Nisakorn Phichitchaisopa, for their help, kindness, support and cooperation during this study.

Lest but no least, I am very grateful to my family, especially my parents for unconditional support, entirely care, ever-present love and encouragement through my life. I also would like to thank to my aunt Asst. Prof. Dr. Kanchana Meesilapawikkai for her advices in English parts of the thesis. Without them none of this would ever have happened.

Warinya Meesilapawikkai

FACTORS INFLUENCING INFORMATION TECHNOLOGY ADOPTION IN ELECTRONIC TOLL COLLECTION (EASY PASS) IN THAILAND

WARINYA MEESILAPAWIKKAI 4837903 EGTI/M

M.Sc. (TECHNOLOGY OF INFORMATION SYSTEM MANAGEMENT)

THESIS ADVISORY COMMITTEE: TANAWUT TANTIMONGCOLWAT, Ph.D. (MEDICAL TECHNOLOGY), THANAKORN NAENNA, Ph.D. (ENGINEERING SCIENCE), TUANJAI SOMBOONWIWAT, Ph.D. (INDUSTRIAL ENGINEERING)

ABSTRACT

The purpose of this study was to determine the factors influencing the adoption of Electronic Toll Collection (ETC) System by expressway users. Questionnaires were used to gather data from 400 motorists who are EASY PASS users and 400 motorists who are not EASY PASS users. The research used the technology acceptance model (TAM) theory as the framework for analyzing the intention of motorists. The results were analyzed using one-way ANOVA and LISREL structural equation modeling to test hypotheses. The results obtained showed that the system quality was the main determinant of perceived usefulness. The perception of the determinants, self-efficacy, facilitating condition, perceived price fairness, system quality, and personal innovativeness led to perceived ease of use of ETC services. Moreover, perceived usefulness and perceived ease of use positively enhanced motorists' attitudes towards ETC services. Furthermore, these results also indicate that perceived usefulness, perceived ease of use, and attitude positively influenced the intention to use ETC services.

KEY WORDS: ELECTRONIC TOLL COLLECTION / TECHNOLOGY ACCEPTANCE MODEL / DELONE AND MCLEAN'S IS SUCCESS MODEL / STRUCTURAL EQUATION MODELING

117 pages

การศึกษาปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (EASY PASS) ในประเทศไทย
FACTORS INFLUENCING INFORMATION TECHNOLOGY ADOPTION IN ELECTRONIC TOLL COLLECTION (EASY PASS) IN THAILAND

วรินยา มีศิลปวิกกัย 4837903 EGTI/M

วท.ม. (เทคโนโลยีการจัดการระบบสารสนเทศ

คณะกรรมการที่ปรึกษาวิทยานิพนธ์: ธนาวุฒิ ตันติมงคลวัฒน์, Ph.D. (MEDICAL TECHNOLOGY), ธนกรณ์ แน่นหนา, Ph.D. (ENGINEERING SCIENCE), เตือนใจ สมบูรณ์วิวัฒน์, Ph.D. (INDUSTRIAL ENGINEERING)

บทคัดย่อ

การศึกษาครั้งนี้เป็นการวิจัยเชิงสำรวจเพื่อให้ทราบถึงปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (EASY PASS) ของผู้ใช้ทางด่วน โดยกลุ่มตัวอย่างเป็นผู้ที่มีประสบการณ์ในการใช้ระบบเก็บค่าผ่านทางอัตโนมัติ (EASY PASS) จำนวน 400 คน และผู้ที่ใช้ทางด่วนแต่ไม่ได้ใช้ระบบเก็บค่าผ่านทางอัตโนมัติ (EASY PASS) จำนวน 400 คน เก็บข้อมูลโดยการแจกแบบสอบถามให้กับผู้ที่สมัครใจในการเข้าร่วมตอบแบบสอบถาม การศึกษาครั้งนี้ใช้ทฤษฎีแบบจำลองการยอมรับเทคโนโลยี (TAM) เป็นกรอบในการวิเคราะห์ความตั้งใจในการใช้ของผู้ใช้ทางด่วน นำผลที่ได้จากการรวบรวมข้อมูลมาวิเคราะห์โดยใช้สถิติการทดสอบความแปรปรวนแบบทางเดียว (One Way ANOVA) และใช้การวิเคราะห์โมเดลสมการเชิงโครงสร้าง (Structural Equation Modeling) ด้วยโปรแกรม LISREL เพื่อทดสอบสมมติฐานในการหาความสัมพันธ์ของตัวแปรที่จะส่งผลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติของผู้ใช้ทางด่วน

ผลการวิจัยพบว่า ผู้ใช้ระบบเก็บค่าผ่านทางอัตโนมัติ ให้ความสำคัญต่อคุณภาพของระบบในการยอมรับถึงประโยชน์ การรับรู้ความสามารถของตนเอง สิ่งอำนวยความสะดวก ราคายุติธรรม คุณภาพของระบบ และการยอมรับนวัตกรรมส่วนบุคคล นำไปสู่การยอมรับถึงความง่ายในการใช้งาน นอกจากนั้นการยอมรับถึงประโยชน์ของระบบและการยอมรับถึงความง่ายในการใช้งานมีอิทธิพลโดยตรงต่อทัศนคติที่มีต่อระบบเก็บค่าผ่านทางอัตโนมัติ และผลการวิจัยยังพบว่าทัศนคติที่ดียังส่งผลต่อความตั้งใจในการใช้ระบบเก็บค่าผ่านทางอัตโนมัติ

117 หน้า

CONTENTS

CONTENTS (cont.)

LIST OF TABLES

LIST OF TABLES (cont.)

LIST OF FIGURES

CHAPTER I
INTRODUCTION

1.1 Background and Problem Statement

E-government has been defined as "the application of information and communications technology (ICT) to transform the efficiency, effectiveness, transparency and accountability of informational and transactional exchanges within government, between government and government agencies at federal, municipal and local levels, citizens and businesses; and to empower citizens through access and use of information" (Tambouris, Gorilas, and Boukis, 2001) to improve the efficiency and accountability of government. Common applications of e-government include online delivery of government information and services, e-Procurement, web-based licensing and registration, online taxation, intragovernmental system, and geographical information system (GIS) (Voss, 2003).

Interest in Intelligent Transportation System (ITS) comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications networks. ITS is defined as "the application of advanced sensor, computer, electronic, and communication technologies and management strategies–in an integrated manner–to increase the safety and efficiency of the surface transportation system" (FHWA, 1998). One of the ITS applications is the Electronic Toll Collection (ETC) System which is introduced to help reduce transit times and traffic congestion for commuters, and also streamline toll transaction processing and enhance auditing capabilities.

As in, Thailand has suffered a great deal of economic loss due to the growing traffic congestion problem. The Royal Thai Government, therefore, decided to establish an organization to study, construct, and manage expressways. Expressway and Rapid Transit Authority of Thailand (ETA) was then established to resolve the problem (Expressway Authority of Thailand, 2010). The term "Expressway" refers to newly constructed roads–either on the ground level or above ground and water

surface–that facilitate the land traffic in particular. The term encompasses roadways for monorails, subways, bridges, boat tunnels for car ferry, piers, pavements, parking lots, shoulders of roads, road fences, embankments, sewerages, retaining walls, kilometer signage, traffic lights and signs, and buildings associated with expressway undertakings. The Expressway covers about 198.4 kilometers of roadway in a north/south direction, connecting Bangkok to the different provinces.

A state enterprise under the Ministry of Interior, Expressway and Rapid Transit Authority of Thailand (ETA) was established under the Announcement of the National Executive Council number 290, dated November 27, 1972. The organization is responsible for the construction, maintenance, and management of expressways and public transportation infrastructures, as well as other efforts related to expressways. The organization was established with an aim to lighten the land transportation situation, and minimize problems and obstacles related to traffic and transportation, especially in Bangkok and its vicinity.

The Expressway Authority of Thailand (EXAT) under the Ministry of Transport is performing the newly Electronic Toll Collection System installation with the objective to provide the interoperability between the existing expressways. The installation of Chaloem Maha Nakhon, Chalong Rat (Ramindra-At Narong expressway and Ramindra-Outer Bangkok Ring Road Expressway), BangPhli-Suksawat Expressway were completed and open for service since 31 January 2010 and Sri Rat Expressway was completed and open for service since 25 July 2010. Meanwhile, Burapha Withi Expressway and its connecting roads which is also under implementation the Electronic Toll Collection by Bangkok Expressway Public Company Limited is expected to be accomplished within 2011.

The Electronic Toll Collection was declared as the system with no use of cash/coupons but the Electronic card (namely EASY PASS) was introduced to use as the equipment to be attached at the windshield in order to pay the toll fee. When entering the Easy Pass Lanes, it is not necessary to open the window and there is no queue waiting and no need to prepare cash which make convenience, rapidity and enhancing the quality of life.

Electronic Toll Collection (ETC) system uses various technologies to allow the manual in-lane toll collection process to be automated in such a way that

customers do not have to stop and pay cash at a tollbooth. To avail of an EASY PASS, a motorist buys a credit card-sized tag that must be attached to the inside surface of the vehicle's windshield behind the rearview mirror. The tag contains a memory chip that is loaded with pre-paid value. Antennas read the value of the card and the result is indicated by signal light. A green light indicates that the motorist has adequate fund loaded in the tag. A yellow light is a warning to replenish the card. Red light means that the motorist has an insufficient loaded value. The device debits the toll fee once the motorist exits the tollgate. An overhead antenna reads the account information provided by the transponder and deducts the correct toll from the prepaid account.

The enhancing of service efficiency on existing Expressways by developing the Electronic Toll Collection System at all routes is the significant core of Expressway administrative management to be the most benefit to the users and the Nation as a whole. Apparently, the Electronic Toll System is the system provided for toll collecting without Toll Collector. The users who intend to use the Electronic Toll Collection System are required to open account, Smart Card, in order to reserve some money as the advance toll fee then apply a request form and make a deposit for EASY PASS Card with EXAT as well. When the registration has been made, the users will consequently receive 2 important electronic equipments which are

1. EASY PASS Card has to be adhered to the windshield. When the users are driving through the EASY PASS Lane, EASY PASS will communicate with the Antenna and automatically deduct the toll fee from the users' account.

2. Smart Card is required to contact with the staff as well as to top up the advance toll fee in the users' account.

Electronic Toll Collection (ETC) systems are expected to benefit users of toll ways by increasing toll lane capacity, by reducing services times, resulting in reduced delays providing convenience to toll way users, and reducing fuel usage (by reducing waiting and idle times).

- to solve the traffic congestion problem in front of the Toll Plazas.

- to be able to accommodate the traffic flow at maximum 1,200 vehicles/hour/lane, meanwhile the efficiency on service, lane at Manual lane could accommodate the traffic flow at 450 vehicles/hour/lane.
- to provide the users easily passing with convenience and rapidity by no pay slips receiving, no queue waiting, no cash preparing and no window opening, only drive straight through EASY PASS Lane.
- to gain travelling time and fuel savings, for this purpose, the users could conduct the travelling plan and reduce the expenses accordingly.
- to be designed for interoperability among those existing expressways both Open System (flat rate at Entry) and Closed System (distance rate at Exit)
- to enhance the quality of life to the society, the users as well as the officers who work at the Expressway, in addition, to decrease the environmental impact to those communities in adjacent area.

As mentioned earlier, there are many factors influencing information technology adoption and the way of Expressway Authority of Thailand with the newly Electronic Toll Collection: ETC (Easy Pass). So, this research focuses on Factors Influencing Information Technology Adoption in Electronic Toll Collection: ETC (Easy Pass) of Expressway Authority of Thailand.

1.2 Objectives

The main objectives of this study are:

1. To study the influential factors that the motorist consider when they have to decision to use Electronic Toll Collection System.

2. To explore the relationships among each factors that importance for the motorist encouraging acceptance of Electronic Toll Collection System.

3. To recommend an appropriate guideline for The Expressway Authority of Thailand in order to plan and development of services.

1.3 Scope of Work

The scope of this study consists of:

1. This research collects data from the motorists who use expressway and focus on Electronic Toll Collection System (ETC) under the model of Technology Acceptance Model: TAM (Davis, 1989).
2. Representative Sample:
   - Respondent of motorists using Electronic Toll Collection System (ETC) from survey 400 questionnaires.
   - Respondent of motorists using expressways but deny Electronic Toll Collection System (ETC) from survey 400 questionnaires.
3. This research use SPSS version 20.0 for windows and LISREL 8.8 in order to analyze the data.

1.4 Expect Results

The expect outcomes of this study include:

1. Significant factors
2. The relationships of each factor that importance
3. This study will use as a guideline

CHAPTER II
LITERATURE REVIEW

In the area of information system and information technology, researchers are interested in investigating the theories and models that will be powerful in prediction and explaining behavior across many domains. The main objectives of these studies are to investigate how to promote usage and also examining what hinders usage and intention to use technology. As in this research, it is important to overview literature and study theories and research models intentionally to provide a sound basis for the theoretical concepts that could properly demonstrate the acceptance of technology. Researchers will introduce National IT Policy Development, Intelligent Transportation System, Electronic Toll Collection: ETC (EASY PASS) of Expressway Authority of Thailand, Technology Acceptance Model (TAM), prior research on Electronic Toll Collection (ETC) and the related studies.

2.1 National IT Policy Development

It is inevitable that the technology has changed rapidly nowadays. The technological changes and the widespread of information technology (IT) applications use have affected the country development. Therefore, it is necessary for Thailand to adjust the national policies to accommodate with the changes occurring. As the secretariat office of the National Information Technology Committee (NITC), National Electronics and Computer Technology Center (NECTEC) are responsible for the formulation of national IT policies and plan as follows:

2.1.1 National IT Policy

1) IT 2000 – The first national information technology policy in Thailand, namely IT 2000, was approved by the Cabinet in February 1996. The IT 2000 Policy provided the framework and guidelines for IT development of the country during 1996

– 2000. It identified three key areas necessary for IT development in Thailand, which were:

- National Information Infrastructure: invest in an equitable information infrastructure;
- Human Resource: invest in people;
- Good Governance: invest in the enhancement of government service.

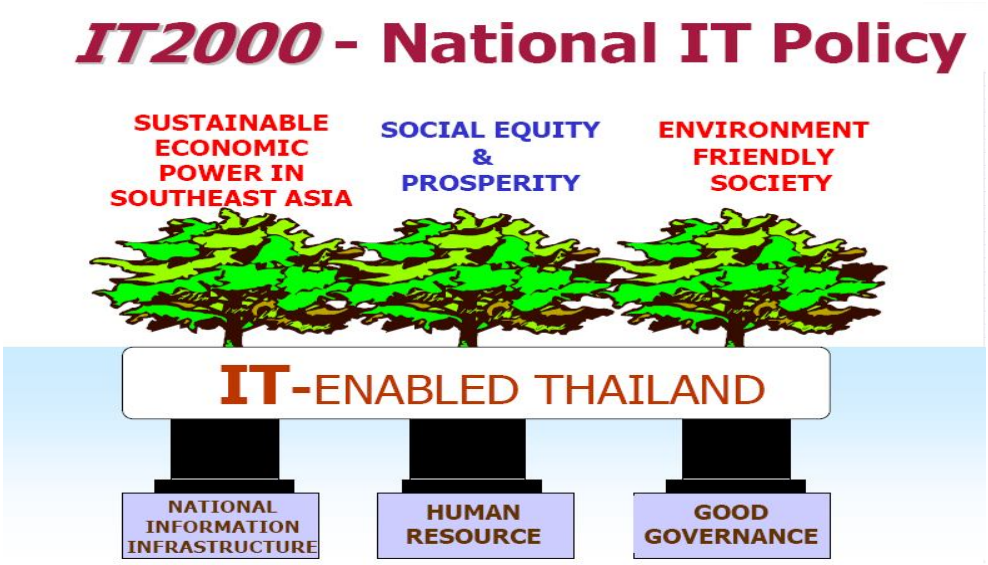


Figure 2.1 IT2000: The First National IT Policy
Source: Thuvasetthakul and Koanantakool (2002)

2) IT 2010 – The National IT Policy Framework for the year 2001 – 2010, namely IT 2010, was developed as a second phase of the national IT policy to move Thailand into the Knowledge-Based Economy (KBE) Knowledge-Based Society (KBS). IT 2010 was approved by the Cabinet in March 2002. It recommended five strategic flagships for Thailand, which were e-Commerce and e-Industry for the information economy; e-Society and e-Education for the information society; together with e-Government as the main drive for the five strategies. The issues related to these five flagships were (Tubtimhin, 2001; Thuvasethakul and Koanantakool, 2002):

- e-Society: bridging the digital divide, ***quality of life***, culture, health, and public participation.

- e-Education: developing human resources, life-long learning, computer literacy, and virtual education.
- e-Industry: focusing on e-manufacturing and IT-related industries, plus issues such as standardization.
- e-Commerce: specially focusing on e-services including not only finance, tourism and IT services, but also other industries.
- e-Government: including public service via electronic service delivery, employment, and legal infrastructure.

Figure 2.2 IT2010: The Knowledge-Based Economy and Society
Source: Thuvasetthakul and Koanantakool (2002)

2.1.2 National ICT Master Plan

The first National Information and Communications Technology (ICT) Master Plan for the year 2002 – 2006 was approved by the Cabinet on September 25, 2002. The Plan was jointly developed by NECTEC and the Office of the National Economic and Social Development Board (NESDB) in close consultation with representatives of all stakeholders. The National ICT Master Plan was developed in accordance with the IT 2010 Policy Framework as well as the 9th National Economic and Social Development Plan (2002 – 2006). It identifies seven strategies for development as follows:

Strategy 1: The development of ICT industry into a regional leader

Strategy 2: The utilization of ICT to enhance the ***quality of life and society***

Strategy 3: The reform and enhancement of the capability on ICT research and development

Strategy 4: The reinforcement of social capacity for future competition

Strategy 5: The development of entrepreneurs capacity for the expansion of international markets

Strategy 6: The utilization of ICT in Small and Medium Enterprises

Strategy 7: The utilization of ICT in government administration and services

The seven strategies of National ICT Master Plan provided ICT in the important areas for Thai people.

2.2 Intelligent Transportation System

As mention earlier, **Strategy 2:** The utilization of ICT to enhance the ***quality of life and society*** was the important one from the seven strategies. Interest in Intelligent Transportation System (ITS) comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communication networks. Traffic congestion has been increasing worldwide as a result of increased motorization, urbanization, population growth, and changes in population density. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution, and fuel consumption.

Figure 2.3 Concept of ITS Model
Source: Fukuda, Fukuda, Surasawadee, and Praditphet (2004)

From figure 2.3, Intelligent Transportation Systems empower actors in the transportation system-from commuters, to highway and transit network operators, to the actual devices, such as traffic lights, themselves-with actionable information (that is, intelligence) to make better-informed decisions, whether it's choosing which route to take; when to travel; whether to mode-shift (take mass transit instead of driving); how to optimize traffic signals; where to build new roadways; or how to hold providers of transportation services accountable for results. This information can be used both to maximize the operational performance of the transportation network and to move towards performance based funding for transportation systems.

Intelligent transportation systems include a wide and growing suite of technologies and applications. ITS applications can be grouped within five summary categories:

1) Advanced Traveler Information Systems provide drivers with real-time information, such as transit routes and schedules; navigation directions; and information about delays due to congestion, accidents, weather conditions, or road repair work.

2) Advanced Transportation Management Systems include traffic control devices, such as traffic signals, ramp meters, variable message signs, and traffic operations centers.

3) ITS-Enabled Transportation Pricing Systems include systems such as Electronic Toll Collection (ETC), congestion pricing, fee-based express (HOT) lanes, and Vehicle Miles Traveled (VMT) usage-based fee systems.

4) Advanced Public Transportation Systems, for example, allow trains and buses to report their position so passengers can be informed of their real-time status (arrival and departure information).

5) Fully integrated intelligent transportation systems, such as vehicle-to-infrastructure (VII) and vehicle-to-vehicle (V2V) integration, enable communication among assets in the transportation system, for example, from vehicles to roadside sensors, traffic lights, and other vehicles.

Applying information technology to a country's transportation network delivers five key classes of benefits by:

1) increasing driver and pedestrian safety,
2) improving operational performance of the transportation network, particularly by reducing congestion,
3) enhancing personal mobility and convenience,
4) delivering environmental benefits, and
5) boosting productivity and expanding economic and employment growth.

With the third major category, Transportation Pricing Systems include systems as Electronic Toll Collection (ETC) was provided in Thailand.

2.3 Electronic Toll Collection (ETC)

The application of the Electronic Toll Collection (ETC) System can be found in several countries. Montalbo Jr. (2005) explains that a pioneer is Singapore with its Electronic Road Pricing (ERP) system that it uses to implement congestion pricing. Japan initiated its ETC services in April 2000. Penang, Malaysia uses the "Smart TAG" for cars and the "Touch n Go Smartcard" for other vehicles. Norway

uses the “Q-FREE” where tolls are charged at entry points. In the United States, applications can be found in Florida where there are 150,000 “E-pass” subscribers. In New York, Delaware, and New Jersey, subscribers use the “E-Zpass”. In San Francisco, the Automatic Toll Collection (ATC) is used. The same is true for toll bridges in Louisiana, Oklahoma, and Texas. In the Philippines the ETC System is used in the South Luzon Tollway (SLT) and the Metro Manila Skyway (MMS) linking Metro Manila with the southern provinces.

Figure 2.4 presents ETC in the United States and Figure 2.6 shows as ETC in Japan, they are on the main concept but different transportation design.

Figure 2.4 ETC in the United States
Source: The E-ZPass Process (2011)

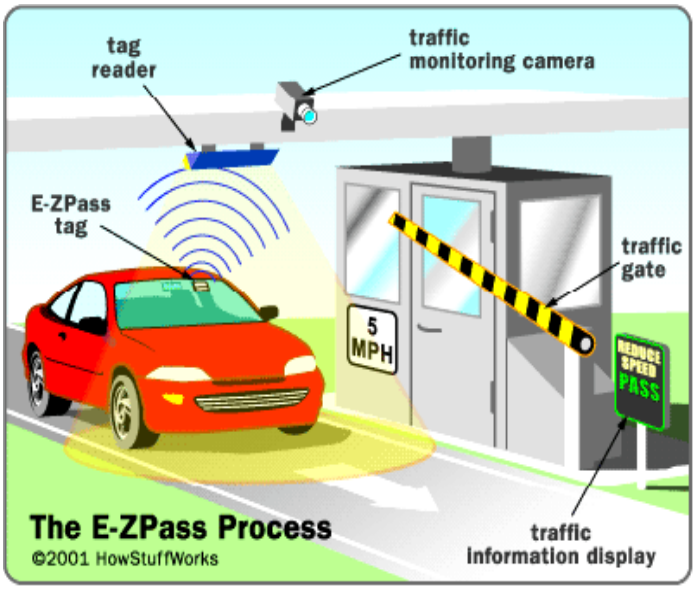


Figure 2.5 Layout image of ETC equipment in the United States

Source: The E-ZPass Process (2011)

Figure 2.6 ETC in Japan

Source: ETC in Japan (2011)

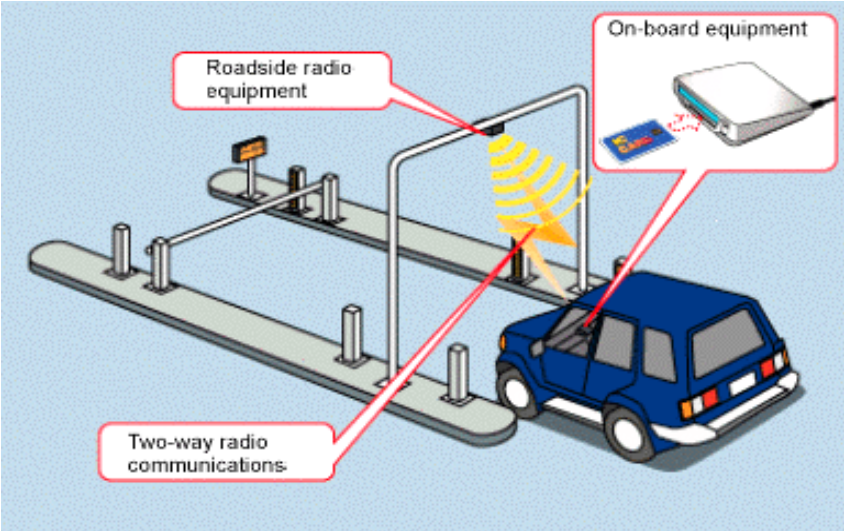


Figure 2.7 Layout image of ETC equipment in Japan
Source: ETC and Organization (2011)

In Thailand, the newly ETC System is used the “EASY PASS” in the Expressway covers about 198.4 kilometers of roadway in a north/south direction, connecting Bangkok to the different provinces.

Figure 2.8 ETC in Thailand
Source: Bangkok Expressway Public Company Limited (2011)

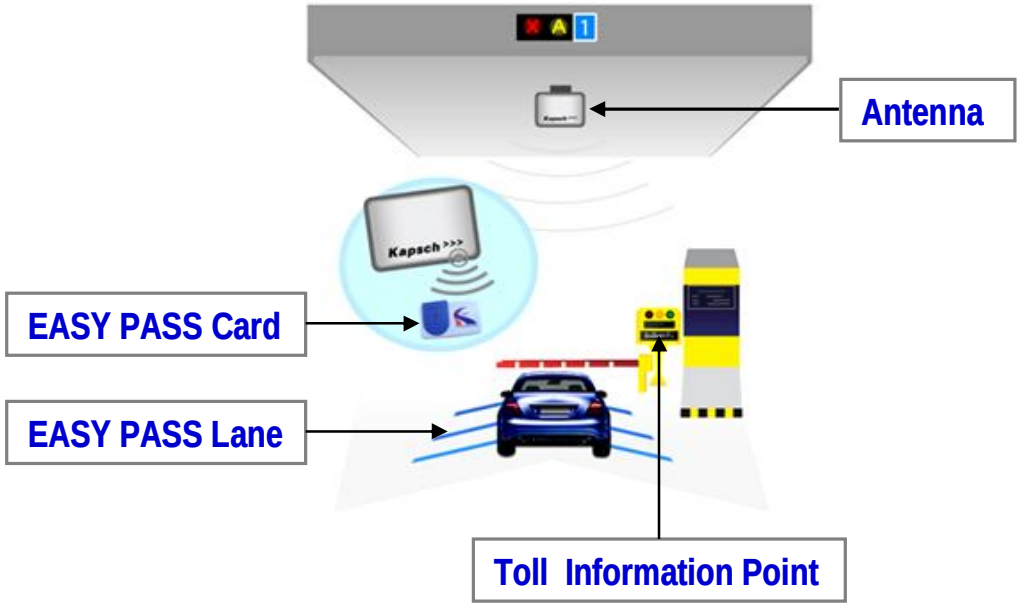


Figure 2.9 Layout image of ETC equipment in Thailand

Source: Thaieasypass (2010)

ETC is an ITS (Intelligent Transportation System) application that uses various technologies to allow the manual in-lane toll collection process to be automated in such a way that drivers do not have to stop and pay cash at a tollbooth. To avail of an EASY PASS, a motorist buys an EASY PASS Card (tag) that must be attached to the inside surface of the vehicle's windshield behind the rearview mirror. The tag contains a memory chip that is loaded with pre-paid value. Antennas read the value of the card and the result is indicated by signal light. A green light indicates that the motorist has adequate fund loaded in the tag. A yellow light is a warning to replenish the card. Red light means that the motorist has an insufficient loaded value. The device debits fee once the motorist exits the tollgate. An overhead antenna reads the account information provided by the transponder and deducts the correct toll from the prepaid account. The patron toll display tells how much prepaid account has been charged. Traffic signal flashes if there is sufficient account left in the prepaid card, and lane barrier rises allowing the vehicle to exit the toll plaza then an exit loop closes out the transaction. This new technology of electronic toll no longer requires the

motorist to halt, totally, at tollbooths to fumble for cash or wait for the change (Expressway Authority of Thailand, 2010).

Radio frequency identification (RFID) is a generic term used to identify technologies utilizing radio waves to automatically identify people or objects (Roberts, 2006). RFID technology was first introduced in 1948 when Harry Stockman wrote a paper exploring RFID technology entitled, "Communication by Means of Reflected Power." RFID technology has evolved since then, and has been implemented in various applications, such as in warehouse management, library system, attendance system, theft prevention, and so on. In general, RFID is used for tracking, tracing, and identifying objects.

A complete RFID system consists of a transponder (tag), reader/writer, antenna, and computer host. The transponder, better known as the tag, is a microchip combined with an antenna system in a compact package. The microchip contains memory and logic circuits to receive and send data back to the reader (Khan et., al, 2009). These tags are classified as either active or passive tags. Active tags have internal batteries that allow a longer reading range, while passive tags are powered by the signal from its reader and thus have shorter reading range (The Basics of RFID, *Veri-Logic*, LLC, 2003).

Tags could also be classified based on the content and format of information. The classifications range from Class 0 to Class 5. These classes have been determined by the Electronic Product Code (EPC) Global Standard. In the table below, classes refer to a tag's basic functionality (i.e., it either has a memory or an on-board power), while generation refers to the tag specification's major release or version number. The class structure for the tags is shown in the table below.

Table 2.1 Class Structure for Tags (Khan et al., 2009)

EPC Class	Definition	Programming
Class-0 Gen-1	Read only, Passive tags	Programmed by the factory
Class-1 Gen-1	Write once, read- many, passive tags	Programmed by the user and then locked
Class-1 Gen-2	Write-many, read-many, passive tags	Programmed by the user and then locked
Class-2	Rewritable passive tags with extra functionality, including encryption and emulation	Can be reprogrammed
Class-3	Semi-passive tags that support broadband communication	
Class-4	Active tags that can communicate with other peers	
Class-5	Readers, they can power other tags of Class 1, 2 and 3, can communicate with Class 4 wirelessly	Not applicable

A reader contains an antenna to transmit and receive data from the tag. The reader also contains a decoder and an RF module. It could be mounted or built as a portable handheld device. The computer host acts as an interface to an IT platform for exchanging information between the RFID system and the end-user. This host system then converts the information obtained from the RFID system into useful information for the end-user.

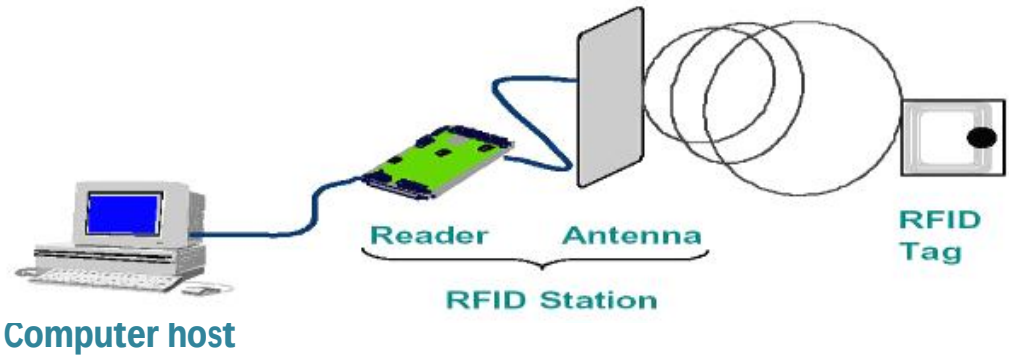


Figure 2.10 Elements of RFID System

Source: National Electronics and Computer Technology Center (NECTEC) (2011)

Radio frequency identification (RFID) is a term coined for short-range radio technology used to communicate mainly digital information between a stationary location and a movable objects. RFID is generally characterized by use of simple devices on one end of the link and more complex devices on the other end of the link. The simple devices (often called tags or transponders) are small and inexpensive, can be deployed economically in very large numbers, are attached to the objects to be managed, and operate automatically. The more complex devices (often called readers, interrogators, beacons) are more capable and are usually connected to a host computer or network. Radio frequencies from 100 kHz to 10 GHz have been used, figure 2.10.

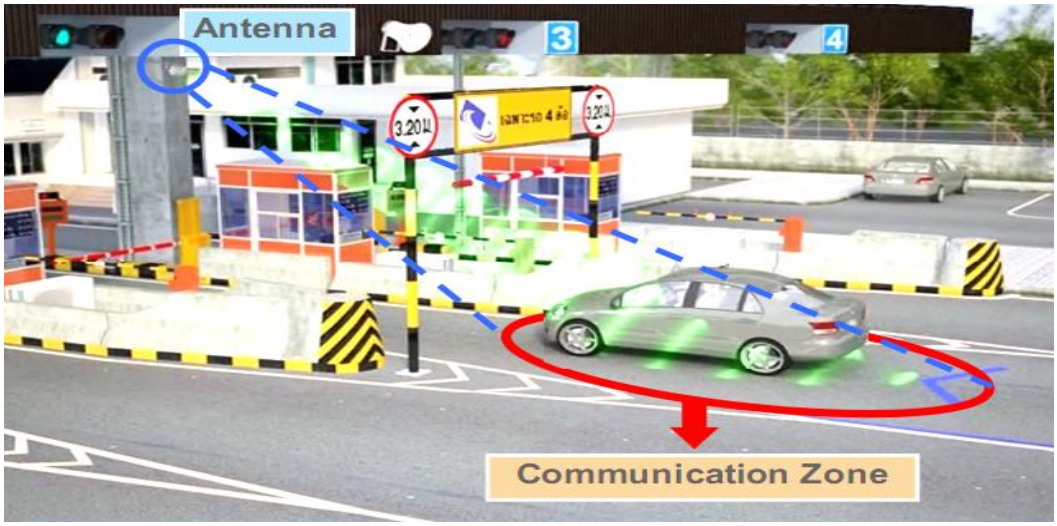


Figure 2.11 Communication Zone at Toll Plaza

Source: Bangkok Expressway Public Company Limited (2011)

Table 2.2 RFID System Characteristics (Smart Border Alliance)

Frequency Bands	Data & Speed	Read Range	Typical Usages	Strengths/Challenges
Low Frequency (LF): 125 – 134 KHz	Low read speed Small amounts of data	Very Short: inches	Access Control Animal Tagging Inventory Control Car immobilizer	▪ low tag costs ▪ small read range ▪ small data amounts ▪ low data transfer speed ▪ No singulation
High Frequency (HF): 13.553 – 13.567 MHz	Medium read speed Small to Med amounts of data	Short to Med: 1 to 3 Feet	Smart Cards Item or case level tagging	▪ sufficient data amounts ▪ most standards in place ▪ less susceptible to interference
Ultra High Frequency (UHF): 433 MHz	Good data speed Medium to large amounts of data	Long range: 50 -300 Feet	Active tags Container seals Container tracking for DLA	▪ read speed and range ▪ costs ▪ potential interference with certain devices
Ultra High Frequency (UHF): 900-950 MHz	High read speed Small to Med amounts of data	Medium: 2 to 10 Feet	Pallet or case level tagging SENTRI/NEXUS	▪ better vicinity read range ▪ more susceptible to interference ▪ high data transfer speed ▪ high tag costs
Microwave Frequency: 2.45 GHz	High read speed Med amounts of data	Med to Long: 3 to 20 Feet	Container or rail car Toll collection Pallet level tagging	▪ lone read range ▪ high data transfer speed ▪ high tag costs
Microwave Frequency: 5.8 GHz	Very high read speed High data rates	Long range: 50 -300 Feet	Toll tags	▪ long read range ▪ high data transfer speed ▪ high tag costs ▪ battery replacement

The tags are usually built using Complementary Metal Oxide Semiconductor (CMOS) circuitry while other technologies can be used such as Surface Acoustic Wave (SAW) devices or turned resonators. Tags can be powered by a battery or by rectification of the radio signal sent by the reader. Tags can send data to the reader by changing the loading of the tag antenna in a coded manner or by generating, modulating, and transmitting a radio signal. A variety of modulation and coding techniques have been used. RFID systems can be read only (data is transferred only in one direction, from the tag to the reader) or read-write (two-way communication).

Types of RFID Tags as active tag, RFID card, EASY PASS Card, and Smart Card on Figure 2.12 to 2.17.

Figure 2.12 A variety of RFID tags
Source: RFID Tags/Cards (2011)

Figure 2.13 Active RFID tag
Source: RFID Tag Considerations (2012)

Figure 2.14 EASY PASS Card install at windshield

Source: Expressway Authority of Thailand (2010)

Figure 2.15 A variety of Smart Card

Source: Smart Card (2012)

Figure 2.16 Smart Card to top up tolls

Source: Expressway Authority of Thailand (2010)

Figure 2.17 Sale Machines / Top Up
Source: Expressway Authority of Thailand (2010)

2.4 Technology Acceptance Model (TAM)

The model that is often used in adoption of information system, Technology Acceptance Model (TAM) was developed from TRA by Fred Davis and Richard Bagozzi (Davis et al., 1989; Bagozzi et al., 1992). The goal of TAM is to provide an explanation of the determinants of computer acceptance that is in general capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified (Davis, Bagozzi, and Warshaw, 1989). TAM claims that actual use is by behavioral intention and subsequently behavioral attention is determined by attitude or in the other words behavioral intentions are influenced directly by external variables through perceived ease of use (PEOU) and perceived usefulness (PU). Usage is determined by behavioral intention to use a system, which is jointly determined by a person's attitude towards using system and its perceived usefulness. This attitude is also jointly determined by both perceived ease of use and perceived usefulness. In addition, both perceived usefulness and perceived ease of use were influenced by external variables, see Figure 2.18.

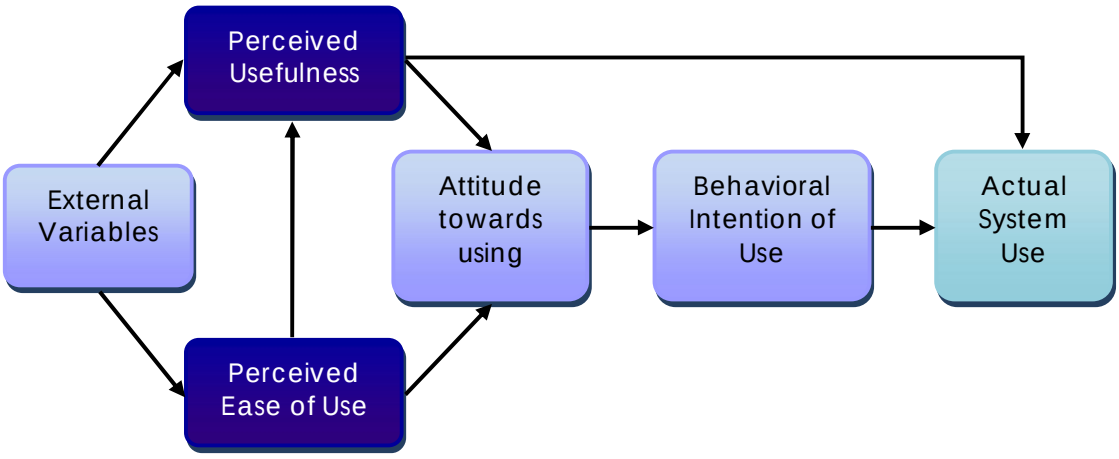


Figure 2.18 Technology Acceptance Model (TAM)
Source: Davis (1989)

TAM theorized that effects of external variables-system characteristics, development process, training-on intention to use are mediated by perceived usefulness and perceived ease of use. Perceived usefulness is also influenced by perceived ease of use because if other things are equal, the easier the system (technology) is, the more useful it can be (Venkatesh and Davis, 2000).

The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it. PU was defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" and PEOU as "the degree to which a person believes that using a particular system would be free from effort." TRA and TAM, both of which have strong behavioral elements, assume that when someone forms an intention to act, that they will be free to act without limitation. In the real world there will be many constraints, such as limit the freedom to act (Bagozzi et al., 1992).

Several researchers have replicated Davis's original study (Davis, 1989) to provide empirical evidence on the relationships that exist between usefulness, ease of use and system use (Adams, Nelson, and Todd, 1992; Szajna, 1994). Much attention has focused on testing the robustness and validity of the questionnaire instrument used by Davis. Adams et al. (1992) replicated the work of Davis (1989) to demonstrate the

validity and reliability of his instrument and his measurement scales. They also extended it to different settings and, using two different samples, they demonstrated the internal consistency and replication reliability of the two scales. Szajna (1994) found that the instrument had predictive validity for intent to use, self-reported usage and attitude toward use. The sum of this research has confirmed the validity of the Davis instrument, and to support its use with different populations of users and different software choices.

Davis (1989) pointed that one assumption made by TAM is the usage of a particular technology is voluntary. Another assumption is that, given sufficient time and knowledge about a particular behavioral activity, an individual's stated preference to perform the activity-behavioral intention- will in fact closely resemble the way they do behave. This assumption only applies when the behavioral is under a person's volitional control (Ajzen and Fishbein, 1980).

Attributes a new technology such as relative advantage and complexity are critical to the attitude and individual forms about a new technology (Rogers, 1995). These attributes conceptually embrace the main constructs of the TAM. For example, relative advantage is consistent with the perceived usefulness construct in the TAM, while complexity is consistent with perceived ease of use. According to the TAM, both perceived usefulness and perceived ease of use are beliefs about a new technology that influence an individual's attitude toward using that technology (Davis et al., 1989).

2.5 DeLone and McLean's IS Success Model

In 1992, DeLone and McLean synthesized various studies in their paper "Information System Success: The quest for the dependent variable" and provided a model to evaluate the success of information systems at an organizational level. Between 1993 to 2002, more than 200 papers has referenced the DeLone and McLean model, henceforth stated as D&M, for the factors contributing to IS success in acclaimed journals. The D&M model has been reviewed periodically and updated by its own authors.

DeLone and McLean combine a process and casual factors in their model. They comprehensive review of different IS success measures concludes with a model of interrelationships between six IS success variable categories: 1) System Quality 2) Information Quality 3) Use 4) User's satisfaction 5) Individual Impact and 6) Organizational Impact, see figure 2.19.

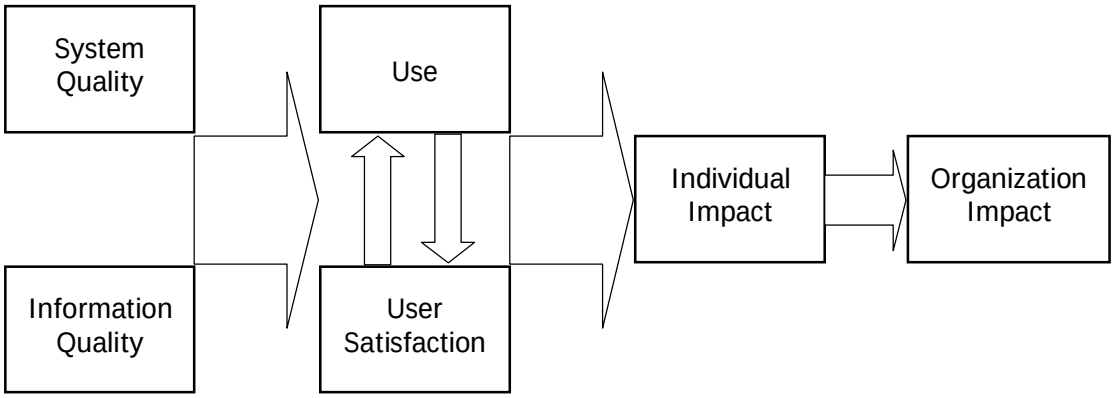


Figure 2.19 DeLone and McLean IS Success Model (1992)

They found that the success of an IS can be represented by the quality characteristics of the IS itself (system quality); the quality of the output of the IS (information quality); consumption of the output of the IS (use); the IS users' response to the IS (users' satisfaction); the effect of the IS on the behavioral of the user (individual impact); and the effect of the IS on organizational performance (organizational impact).

From figure 2.19; however, it can be inferred that DeLone and McLean have made several and considerable changes to their original model for over more than a decade to reflect the changes in technologies and user needs. They have merged the individual, organizational, industry, and social impacts in "net benefits." DeLone and McLean have included a third characteristic, "service quality" to the original model. The factors that contribute to service quality are, reliability, responsiveness, assure, and empathy. In the original model, "service quality" was part of system quality. However, it was separated based on the market changes and the emergence of IS organizations.

The updated model resembles the process model introduced by Newman and Robey while still retaining the temporal and causal effects. The updated D&M IS Success Model includes arrows to demonstrate proposed associations among success dimensions in a process sense, but does not show positive or negative signs for those associations in a causal sense.

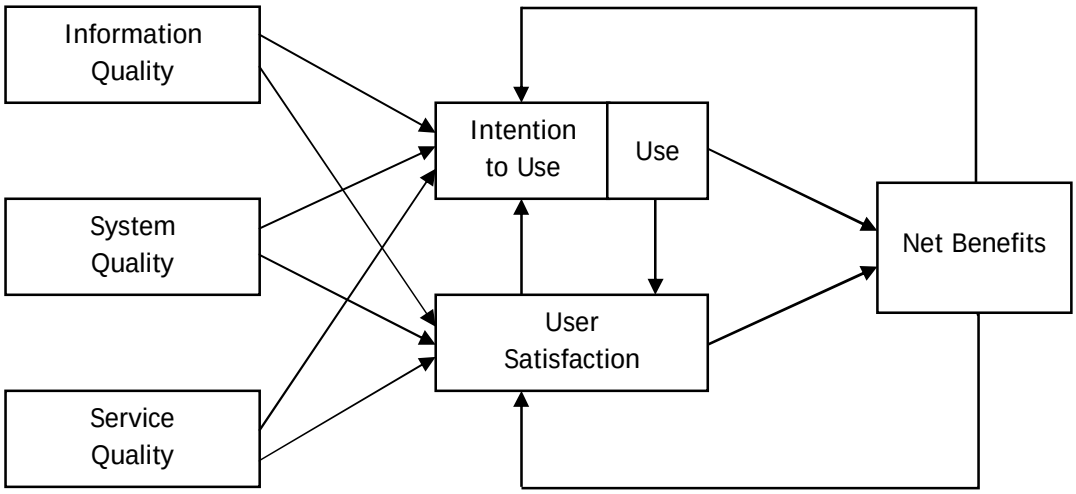


Figure 2.20 Updated DeLone and McLean IS Success Model (2003)

Adapting information systems to emergent technologies and customer needs will play an important role in the future. Information systems acquired from various organizations and implemented by different IS managers will cater to different needs of the users. DeLone and McLean's model will help organizations to be carefully evaluated the adaptability of the existing system to present and future technologies. Inability of the information systems to adapt may affect the competitive edge of an organization.

2.6 Related Research

Sajjad et al. (2009) study, Adoption of Information Technology: Measuring Social Influence for Senior Executive's, enhances the technology acceptance model (TAM) with an additional construct of social influence (SI). Data

are collected from senior executives of public and private sectors. A total of 1200 questionnaires are distributed using purposive sampling method. 431questionnaires are usable and included in the study with a response rate of 36%. Partial Least Square (PLS) has been used for data analysis. A structural model was proposed and tested, examining the important factors as well as social influence on the use of computers by senior executives. The proposed model serves as a base for comparison with other models. The model explained 63% and 65% of variance for attitude toward using computer and behavioral intention respectively. The results of this study also indicate that Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) are also the important factors which influence the use of computers by SE's in the environment of Pakistan. In addition, Social factors have strong and positive influence on acceptance and use of IT. So, it can be safely concluded that the acceptance and use of IT by SE's can be enhanced by giving them the insight that new computer technology is easy to use and useful.

Adegoke (2007) studies "Factors Influencing the Adoption of New Information Technology in the Staffing Industry." This study considered the impact of organizational decisions and practices on technological trends and the diffusion of technology in the staffing industry. Little empirical research has addressed the adoption of technology across organizations. Based on a nationally representative sample of U.S. organizations in the United States, this study explored the diffusion of Internet-based technology across staffing organizations and examined the organizational characteristics associated with the adoption of information technology in the staffing industry. The objectives of the study were as follows: (a) to determine the perceived importance and satisfaction level regarding selected information technology applications currently adopted by the staffing industry, (b) to assess individual perceptions of technology innovation and motivation to use technology, and (c) to analyze differences in individual perceptions of technology innovation, motivation, and technology inhibitors among staffing industry administrators with different demographic profiles and behavioral characteristics. Results showed that staffing administrators' adoption of new IT is affected by individual perceptions of technology, technology motivations, and technology inhibitors, but not by organizational computing supports.

Leonard and Sitting (2007) study up on their research, Improving Information Technology Adoption and Implementation Through the Identification of Appropriate Benefits: Creating IMPROVE-IT, and they describe the objectives of a collaborative initiative that attempts to provide the evidence that increased information technology (IT) capabilities, availability, and use lead directly to improved clinical quality, safety, and effectiveness within the inpatient hospital setting. This collaborative network has defined specific measurement indicators in an attempt to examine the existence, timing, and level of improvements in health outcomes that can be derived from IT investment. These indicators are in three areas: (1) IT costs (which includes both initial and ongoing investment), (2) IT infusion (i.e., system availability, adoption, and deployment), and (3) health performance (e.g., clinical efficacy, efficiency, quality, and effectiveness). Herein, we outline the theoretical framework, the methodology employed to create the metrics, and the benefits that can be obtained.

Podder (2005) explains in the thesis, Factors Influencing the Adoption and Usage of Internet Banking: a New Zealand Perspective. Although the offering of financial products and services over the Internet by banks and financial institutions continues to spread, reports on Internet banking show that the adoption and usage of such services by consumers are low. Further, relatively little empirical research has been carried out to examine factors influencing users' adoption or use of Internet banking services, particularly in New Zealand. Therefore, there is a need to identify relevant factors that influence New Zealand's bank customers' intentions to use Internet banking. This research used two commonly applied and empirically supported models of information technology adoption to achieve this objective. In this study, Davis's (1989) technology acceptance model (TAM) is extended by two external variables, namely risk and self-efficacy. The second model used is a reduced version of Moore and Benbasat's (1991) perceived characteristics of innovation (PCI) model, without the image and voluntariness constructs. A questionnaire was used to conducting a postal survey of 1,000 individuals in Auckland, New Zealand. Out of 163 responses received 157(15.70%) were usable and with this data both research models were tested. The results reveal that perceived usefulness, perceived ease of use, self-efficacy, relative advantage, compatibility, and result demonstrability have a significant association with intention to use Internet banking, while risk, visibility and

trial ability are not significant. Both the modified TAM and PCI models used in the study have a similar explanatory power of slightly over 20% of the variance in intention. In the TAM model, perceived usefulness and self-efficacy are significant variables, while compatibility is the only variable significant for the PCI model. Further, results indicate that users' perceptions of various aspects of Internet banking are more positive than non-users' perceptions, except for risk; and both TAM and PCI have low capabilities in explaining the variances in users' intention to adopt or use Internet banking services.

Salleh et al. (2006) explain in their study; Electronic Toll Collection (ETC) Systems Development in Malaysia; that the first ETC system was implemented along 22 km expressways in 1995 and as of today, the whole stretch of 1,459 km expressways are equipped with a single ETC system allowing for full interoperable. A Service Provider providing electronic payment service operates the system, not just for toll payment but also for payment of parking, public transportation fares.
The journey towards achieving 'single and interoperable ETC' is started in 1994 and by July 2004, the system was implemented nationwide. During the earlier stage of ETC Development in Malaysia, various system and technology were introduced. The toll highway operators were actively involved in ETC development in Malaysia as they realized the needs to reduce cost of toll collection, capital investment savings, fraud elimination, faster journey time, increased fuel, less congestion and reduce pollution. The first ETC Technology implemented is 2.45GHz microwave in 1994 and another highway operator introduced the same technology in 1997. The system was further enhanced in 2001 to meet the international standard of 5.8GHz.
A contactless smartcard ETC was introduced in 1997 and the system was enhanced further with the introduction of two-piece On-Board-Unit for ETC in 1998.
This system later adopted as the 'single ETC' system for Malaysia. Moving forward, the Ministry of Work, Malaysian Highway Authority together with the ETC community is now exploring the Multi-Lane Free Flow ETC implementation with the objective to reduce congestion at toll plazas, reduce environmental issues and increase road safety. The system targeted to be implemented by 2008.

The Audit Committee Institute of KPMG in India (ACI) is released Point of View (POV) titled “Revenue Assurance in Highway Toll Management.” Dumasia (2010), the Executive Director and Head, Governance, Risk and Compliance Services KPMG in India, the infrastructure story in India has only just begun and within this sector, road infrastructure is a key focus area. The Ministry of Road Transport has announced ambitious plans to build 20 kms of roads in India every day. Implementation of this vision is impossible without the active participation of the private sector.

A number of road development projects through Public Private Partnerships (PPP) are currently underway. However, it is also true that private investment in roads is falling short of the targets. Private road developers depend largely on highway toll collections as a medium to recover their investments and currently toll collections in India are fraught with challenges. Revenue leakages including uncollected toll charges on Indian roads are very high and this is a major deterrent to private investment in roads. This POV is an attempt to explore and zero in on the key issues in the area of highway toll management. Unreliable traffic estimation processes, pre-dominance of cash as a mechanism to collect toll, lack of smart cards/ tags and electronic toll collection systems, standardized approach to vehicle classification, inadequate regulatory oversight, lack of effective IT systems and inter-operability i.e. the inability of multiple developers and regulators to adopt common systems for tolling are some of the key issues around revenue leakages in toll collections.

From the research, in customer inevitability, shows that cost of smart tags/ transponders along with toll rates are an additional burden on the motorists in the absence of singular ETC systems; fuel wastage due to long waiting time at cash toll plazas; commercial truck operators resist paying toll as they are already paying motor vehicles tax and access on diesel and petrol; absence of a common ETC technology (e.g. smart cards, tags, etc) and wireless communication standards adopted by different toll operators.

CHAPTER III
RESEARCH METHODOLOGY

This chapter of the thesis, Factors Influencing Information Technology Adoption in Electronics Toll Collection: ETC (Easy Pass) of Expressway Authority of Thailand, discusses the research methodology. It also outlines research strategy and sampling methods. Finally, to present validity and reliability of measurements that will be used in the research. There are thirteen main steps to be done in order to achieve the objectives. The methodology is shown as the followings.

Figure 3.1 Overview of Research Methodology

3.1 Preliminary Study

Firstly, researcher studies related document that involve the characteristics of Electronic Toll Collection (ETC). Next, study related statistics theories and gather data from the study of related researches, theses, seminar papers, survey reports, and other statistics reports to cover these topic:

- National IT Policy Development
- Intelligent Transportation System
- Information technology adoption.
- Factors which influence information technology adoption.
- Electronics Toll Collection: ETC (Easy Pass).
- Expressway Authority of Thailand.

3.2 Scope of Survey

3.2.1 Population

Population is a group of people that ever used expressways and focus on Electronic Toll Collection: ETC (Easy Pass) of the Expressway Authority of Thailand, under the model of Technology Acceptance Model: TAM (Davis, 1989). From survey report of the Expressway Authority of Thailand on 31 December 2011 total 373,676 users

3.2.2 Sample

A stratified random sampling is employed to avoid biases during data collection process. A stratified and disproportional set is selected based on ETC users in Thailand. The questionnaires were distributed to people who were expressway users; 400 use ETC system, and 400 denied to use the system. A total of 800 samples are chosen. All participants are expressway users selected randomly from universities, companies, government offices, department store, and on internet.

Researcher selected Bangkok in Thailand for the sampling in this study because Thailand ETC users mostly are in Bangkok. Next step, the sampling method to select samples from all of population is conducted. Yamane theoretical statistics are

used to calculate the size of sampling group. The size of 400 samples conforms to Yamane's finite population sampling formula, along with a 95% confident level and a 5% precision level (Silpjaru, 2007).

$$N = \frac{n}{1 + N(e)^2}$$

Where n = Sample size

N = Population size

e = Level of precision

The sample random of this study has three methods as follows.

Stage 1: The first method use purposive sampling method for selecting a specific sample that live in Bangkok.

Stage 2: Quota sampling method was used in the second stage. There are 400 samples.

Stage 3: Accidental sampling method is applied in this stage. The questionnaires are distributed to ETC users selected randomly from universities, companies, government offices, department store, and on internet.

3.3 Research Framework and Hypotheses

The theoretical framework of this study, Figure 3.2, is developed based on the technology acceptance model (TAM) investigating the factors that affect citizen's attitudes towards ETC services by the TAM. Several important external variables are added to predict citizen's intention to use ETC including system quality, social influence, personal innovativeness, self-efficacy, facilitating condition, and perceived price fairness.

There are ten constructs in this model which include system quality, social influence, personal innovativeness, self-efficacy, facilitating condition, and perceived

price fairness, perceived usefulness, perceived, ease of use, attitude, and behavioral intention to use as the dependent variables.

As mentioned above, system quality, social influence, personal innovativeness, self-efficacy, facilitating condition, and perceived price fairness are directly affected perceived usefulness and perceived ease of use. Perceived usefulness is affected by perceived ease of use. Perceived usefulness and perceived ease of use influence user's attitude. Attitude influences behavioral intention to use ETC. User's behavioral intention will be used to predict actual use of information technology. All components and several hypotheses are constructed for testing.

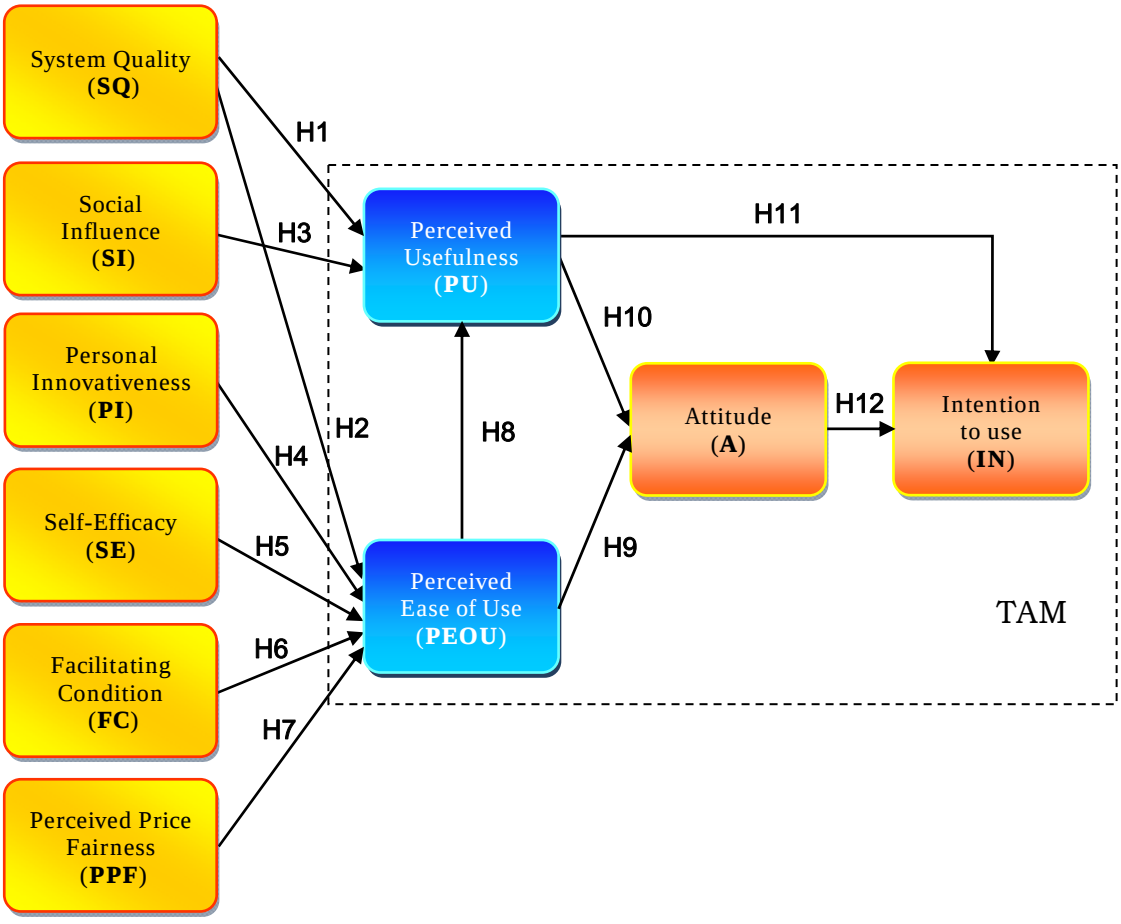


Figure 3.2 Theoretical framework

Table 3.1 Operational definition of questionnaire constructs

Construct	Operation definition	Source
System Quality	The quality which user's perception on performance of information system	Lee et al. (2007)
Social Influence	An individual's perception that people who are important think he or she should perform the behavior	Fishbein and Ajzen (1975)
Personal Innovativeness	The willingness of an individual to try out any new information technology	Agarwal and Prasad (1998)
Self-Efficacy	Users' belief his/her own capacity to affect a specific behavior	Bandura (1982)
Facilitating Conditions	Facilitating conditions or resources are the factors that help people easy to perform and accomplish their tasks	Thatcher et al. (2007)
Perceived Price Fairness	Perception of price fairness, may be a variable moderating perceived sacrifice and perceived product value, and therefore willingness to buy.	Martins and Monroe (1994)
Perceived Usefulness	Users' perception ETC easy to use when using it.	Davis (1989)
Perceived Ease of Use	User's perception when they using ETC services it improve efficiency of their life	Davis (1989)
Attitude	Relatively enduring feeling, belief, and behavioral tendency directed toward specific individuals	Ajzen and Fishbein, (1980)
Intention to Use ETC	An individual's behavioral intention to use ETC services	Moon and Kim (2001)

Hypothesis about System Quality

System quality refers to performance of the system. Many studies have develop measure of system quality such as ease of use, functionality, reliability, flexibility, data quality, portability, integration, and importance (DeLone and McLean, 2003). In this study, system quality is aspects to quality from ETC in the context of performance. Researcher has identified system quality in four dimensions; 1) usefulness, 2) reliability, 3) response time, and 4) correctness. High level system

quality will improve the convenience for users to access ETC system. Many studies have supported that system quality has positive effects on perceived ease of use, and perceived usefulness (Ahn et al., 2007).

Hypothesis about Social Influence

Social influence is defined as "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen, 1975). Social influence in this study is defined as an individual's perceive that important people for he or she believe that they should use ETC. Users will decide to use ETC when their family, friends or their peer recommend them to use it. In several previous researches, social influence has a positive effect on perceived usefulness (Taylor and Todd, 1995).

Hypothesis about Personal Innovativeness

Personal innovativeness in IT (PIIT) relates the perceptions in acceptance information technology of user (Agarwal and Prasad, 1998) and refers to user who is innovative person willingness to use new information technology (IT). High level of personal innovativeness leads to a more positive effect on intention to use information technology. Previous research found that personal innovativeness has significantly positive effects perceived ease of use in wireless Internet services via mobile technology (Lu et al., 2005) and 3G mobile value-added services (Kuo and Yen, 2009). More perceived of personal innovativeness in IT will enhance positive perceptions about ease of use in ETC.

Hypothesis about Self-Efficacy

Self-efficacy is defined as "the belief of the individual in his or her own capacity to affect a specific behavior" (Bandura, 1982). An individual with more self-efficacy have confidence to use a system that is difficult or complicated than an individual with lower self-efficacy. Individuals should feel that they have ability to handle processes in ETC process without any supports. Self-efficacy is an external variable included in TAM to predict individuals' behavior (Taylor and Todd, 1995; Hernandez et al., 2009). This study considers self-efficacy in context of ETC. In this

context, self-efficacy is defined as individuals have ability to access ETC and complete by themselves. From a previous research, self-efficacy has a direct effect on the perceived ease of use such as mobile banking (Gu et al., 2009), e-store (Venkatesh, 2000), and e-purchasing (Hernandez et al., 2009).

Hypothesis about Facilitating Conditions

Facilitating conditions or resources are the factors that help people to easily perform and accomplish their tasks (Thatcher et al, 2007). Facilitating conditions in this study are defined that individuals have existing resources to support them to use ETC, Taylor and Todd (1995) studied facilitating conditions in two contexts; resource facilitating conditions, and technological facilitating conditions. This study will examine both of them. Users cannot adopt ETC if they do not have available resources to access and use it. There are many barriers for adoption of ETC such as time, money, financial, security, trust, and information quality (Gilbert et al., 2004). Previous research exhibited facilitating conditions that directly affected the perceived ease of use (Gu et al., 2009; Taylor and Todd, 1995).

Hypothesis about Perceived Price Fairness

Martins and Monroe (1994) points in another side that the value of a product is postulated to be a tradeoff between the perceived benefits, or quality, offered by the product, and the sacrifice, both monetary and non-monetary, perceived as necessary to acquire it. Xia, Monroe, and Cox (2004) define price fairness as a "consumer's assessment and associated emotions regarding of whether the difference (or lack of a difference) between a seller's price and the price of a comparative other party in a transaction is reasonable, acceptable, or justifiable." The price-quality relationship research stream has identified brand, level of advertising and store image as variables affecting perceived product quality (Dodds et al. 1991), but so far no variable has been shown to moderate perceived sacrifice assessments. This paper suggests that perception of price fairness, a concept derived from equity research, may be a variable moderating perceived sacrifice and perceived product value, and therefore willingness to buy.

Hypothesis about Perceived Ease of Use

Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989). Several studies have supported that perceived ease of use has the effect on perceived usefulness (Lu et al., 2009; Lee and Kim, 2009) and behavioral intention (Moon and Kim, 2001; Jung et al., 2009; Lu et al., 2009). This study focuses on perceived ease of use on ETC context. The perceived ease of use will increase when users feel that ETC is easy to use, after that they will become accustomed and use it.

Hypothesis about Perceived Usefulness

Perceived usefulness is defined as "the degree to which a person believed that using a particular system would enhance his or her job performance" (Davis, 1989). A useful system to improve efficiency of the ETC in order to support users when their use the service. When users perceive a very useful technology, they believe that it offers performance for them (Hernandez et al., 2009). Perceived usefulness has more positive effects on behavioral intention (Taylor and Todd, 1995; Moon and Kim, 2001). The perceived usefulness will increase when users notice that it improves their lives efficiency such as more using conveniently and conducting transaction.

Hypothesis about Attitude

Griffin (1999) presents connotes the body of extant knowledge concerned with the structure of attitudes and the determination and consequences of attitudes. Attitude theory has generally tended to focus on the components of attitudes, the formation of attitudes, and the formation of quasi-consistent construct systems comprised of different attitudes, values, and beliefs. Central to this body of knowledge is work concerned with attitudes that manifest themselves in and/or that are relevant to the workplace. An attitude is a relatively enduring feeling, belief, and behavioral tendency directed toward specific individuals, groups of individuals, ideas, philosophies, issues, or objects (Ajzen and Fishbein, 1980). Thus, in an organization, a person may have attitudes about various co-workers and colleagues, supervisors, subordinates, various organizational policies and practices, physical working

conditions, rewards and other compensation, opportunities for advancement, the organization's culture and climate, and a wide variety of other organizational characteristics.

Tam is used as the baseline model and results in the following hypothesized relationship.

Hypothesis 1: System quality will have a positive effect on the perceived usefulness of ETC.

Hypothesis 2: System quality will have a positive effect on the perceived ease of use of ETC.

Hypothesis 3: Social influence will have a positive effect on the perceived usefulness of ETC.

Hypothesis 4: Personal innovativeness will have a positive effect on perceived ease of use of ETC.

Hypothesis 5: Self-efficacy will have a positive effect on the perceived ease of use of ETC.

Hypothesis 6: Facilitating conditions will have a positive effect on the perceived ease of use of ETC.

Hypothesis 7: Perceived price fairness will have a negative effect on the perceived ease of use of ETC.

Hypothesis 8: Perceived ease of use will have a positive effect to perceived usefulness ETC.

Hypothesis 9: Perceived ease of use will have a positive effect on attitude to use ETC.

Hypothesis 10: Perceived usefulness will have a positive effect on attitude to use ETC.

Hypothesis 11: Perceived usefulness will have a positive effect behavioral intention to use ETC.

Hypothesis 12: Attitude will have a positive influences behavioral intention to ETC user.

The demographic differences of respondents (e.g. age, gender, age, education level) have to examine the difference perceptions of user in various studied (Lu et al., 2009; Chou, 2003). Users may have different characteristics, education, and income are demographic variable use to study to investigate the different perceived attributes of users in ETC context.

Hypothesis about Education

The respondents rated their demographic of education in three identified groups: 1) high school or below, 2) associate's or bachelor's degree and 3) upper bachelor's degree. Accordingly, this research proposes the following hypothesis:

Hypothesis 13: The high school or below, associates or bachelor's degree and upper bachelor's degree will show differences in their perception of ETC using.

Hypothesis about Income

The respondents rated their demographic of income in five identified groups: 1) 10,001 – 20,000 baht; 2) 20,001 – 30,000 baht; 3) 30,001 – 40,000 baht; 4) 40,001 – 50,000 baht, and 5) upper 50,000 baht. Accordingly, this research proposes the following hypothesis:

Hypothesis 14: Income as 10,001 – 20,000 baht; 20,001 – 30,000 baht; 30,001 – 40,000 baht; 40,001 – 50,000 baht, and upper 50,000 baht will show differences in their perception of ETC using.

3.4 Instrument Development

The questionnaires are translated into Thai and modified to suit the context of ETC based on the hypotheses. The instrument is designed to include three parts. The questionnaire explained the purpose of the study and an introduction of the ETC.

The first part consists of a request for demographic information about respondents' characteristics including gender, age, marital status, education, occupation, income, current living place. There are 7 items in this part.

The second part there is 10 items, focuses on the usage of ETC include car identification; media that user getting ETC information; objective, rationale of using ETC; average weekly used; time period of using ETC; Express Way always used for ETC; amount of money for pre-paid account; convenience place for pre-paid account.

The third part including 35 items has questions measuring the constructs in the research model. All constructs are measured using multiple items consisting of the ten constructs: (1) System quality, (2) Social influence, (3) Personal innovativeness, (4) Self–efficacy, (5) Facilitating conditions (6) Perceived cost, (7) Perceived usefulness (8) Perceived ease of use (9) Attitude, and (10) Intention to use. All of the constructs included in the questionnaire were adapted from previous studies to ensure their reliability and validity. The measures for two determinants (perceived usefulness and perceived ease of use) and attitude of TAM were adapted from the measurement defined by Davis (1989), while intention to use was adapted from Moon and Kim (2001). As to the six external variables, these are:

- System quality (SQ); measured by Doll & Torkzadeh (1988), Delone and Mclean (1992), Aladwania and Palvia (2002), Wangpipatwong et al. (2005). System quality was measured in terms of five composite items: ease of registration, response time, efficiency, security, trust.
- Social influence (SI); adapted from Taylor and Todd (1995), Hung et al. (2006), Gu et al. (2009).
- Personal innovativeness adapted from Agarwal and Prasad 1998, Thatcher et al. (2007).
- Self-efficacy (SE); adapted from Taylor and Todd (1995).
- Facilitating conditions (FC); adapted from Taylor and Todd (1995), Mathieson et al., (2001), Hung et al. (2006), Gu et al., (2009)
- Perceived Price Fairness (PPF); adapted from Martins and Monroe (1994)

Table 3.2 Measure Items of constructs

Constructs		Source
System Quality		***Lee et al. (2007)***
SQ1	Using ETC system provides the useful functions as need.	
SQ2	The operation of ETC system is reliable.	
SQ3	The respond of ETC system is quick.	
SQ4	Automatically identifying the account and debiting the toll free correctly.	
Social Influence		***Fishbein and Ajzen (1975)***
SI1	People they knew influence to use ETC services.	
SI2	They use ETC service because many people use it.	
Personal Innovativeness		***Agarwal and Prasad (1998)***
PI1	They always search about a new information technology.	
PI2	They discuss and introduce technologies among their colleagues/relatives.	
PI3	They like to be innovators in technologies.	
Self-Efficacy		***Bandura (1982)***
SE1	I could complete using ETC if I had never used a system like it before.	
SE2	I could complete using ETC more easily when someone is giving introductions.	
Facilitating Conditions		***Thatcher et al. (2007)***
FC1	The Expressway Authority of Thailand provides public relations for the clear ETC services.	
FC2	The Expressway Authority of Thailand has a department or staff to solve service problems immediately.	
FC3	Has noticed obvious signs EASY PASS lane.	
FC4	EASY PASS lanes are sufficient to meet demands.	
FC5	EASY PASS system services to windshield. Makes it easy to pay the toll.	
FC6	Provide additional funds on the card, through electronic channels.	

Constructs		Source
Perceived Price Fairness		***Martins and Monroe (1994)***
PPF1	The additional fee of 25 baht for every additional 500 baht.	
PPF2	Card deposit has been involved in the decision to use the service.	
PPF3	They think there is value in using the system for accepting EASY PASS card deposits.	
PPF4	They think that The Expressway Authority of Thailand should have reduced the deposit card.	
Perceived Usefulness		***Davis (1989)***
PU1	Using ETC responses rush-hour need.	
PU2	ETC helps more driving convenience.	
PU3	Using ETC saves time for their routes.	
PU4	Using ETC had more efficiency in driving.	
Perceived Ease of use		***Davis (1989)***
PEOU1	EASY PASS system is easy to use.	
PEOU2	EAEY PASS system is used and learned for experience.	
Attitude		***Ajzen and Fishbein, (1980)***
A1	They are satisfied with the use of EASY PASS and pay tolls.	
A2	They agree to use the EASY PASS and pay tolls.	
A3	Using EASY PASS to pay tolls is a good method.	
A4	EASY PASS system provides quality service.	
Intension to Use		***Moon and Kim (2001)***
IN1	Are they willing to take the EASY PASS to pay toll?	
IN2	They intend to use the EASY PASS to pay tolls every time.	
IN3	They think that when they use the EASY PASS, they will recommend it to others to use as well.	
IN4	They still use EASY PASS card even though it will continue to ride despite the charges.	

3.5 Pilot Testing

The pilot test was conducted before the main survey to determine the problem of the instrument. The pilot test of the questionnaire involved 30 graduate students who had experienced with ETC. The purpose was to focus on the problems of the instrument. Respondents are asked the understanding about the meaning, comment on the length of the questionnaire, list items of the constructs, time to complete and format of questionnaire. After their comments and suggestions had been given, the questionnaire is revised which the wording of the items will be clear and easy for respondents to understand. The final questionnaires included 35 items for conducting the actual survey.

3.6 Data Collection Procedures

To test the hypotheses, data was gathered using a self-administered questionnaire. The first, respondents are asked to participate in the study whether they have any personal experience using ETC. Consequently, their answers are based on their experiences with ETC. ETC in the questionnaires refer to overall services, not a specific service. A cover letter explained the objectives and importance of the study, and ETC definition to promote participation in the survey. Participation in the study was voluntarily done by respondents who are willing to fill out the questionnaire and they are guaranteed that their responses would be treated as confidentiality.

In this study, self administered questionnaire is selected to gather the sampling data. The questionnaire is designed by using related researchers as a guideline for construction of questions and context as follow:

The first part: Demographics pattern: gender, age, education, marriage status, occupation, income, and current living place, close-end questions.

The second part: Using behavior in Electronics Toll Collection: ETC (Easy Pass), close-end questions.

The final part: Factors Influencing Information Technology Adoption in Electronics Toll Collection: ETC (Easy Pass); adoption base on the factors of system quality, social influence, personal innovativeness, self efficacy, facilitating

condition, perceived cost, perceived usefulness, perceived ease of use, attitude, and behavioral intention to use.

3.7 Data Coding

After the questionnaires has been returned, data are screened and uncompleted answers are eliminated. Respondents who has never experienced with ETC are also excluded from this study. The data is put in Microsoft Excel and converted to SPSS (Statistical Package for the Social Science for Windows) for analysis.

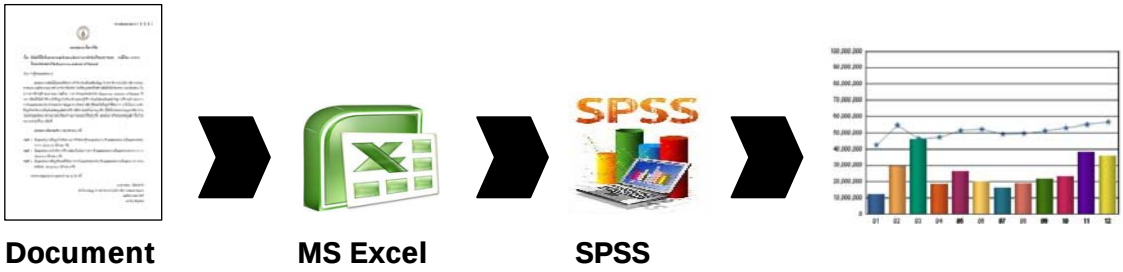


Figure 3.3 Methodology of data transfer from Microsoft Excel to SPSS

3.8 Data Analysis

Data is analyzed by using SPSS (Statistical Package for the Social Science for Windows) version 20.0 for window and LISREL 8.8 (student version). There are two steps for data analysis: 1) descriptive statistics to describe a quantitative data. 2) Inference statistical tests to test hypothesis.

3.8.1 Descriptive statistics

Descriptive statistics are used to describe the overview of data. Each variable is studied separately as follows;

Part 1 : The first part includes nominal scale. This part was used to collect demographics information about respondents including gender, age, education, marriage status, occupation, income, and current living place. This part consists of 7

items. All items of this part are checklist. Frequency method and percentage were used, the results were shown in table and graph formats.

Part 2 : The second part focuses on the usage of ETC consisting of 10 items which are checklist. Researcher use frequency and percentage approaches which are demonstrated results in table and graph styles.

Part 3 : This part consists of the constructs of system quality, social influence, personal innovativeness, self-efficacy, facilitating conditions, perceived cost, perceived usefulness, perceived ease of use, attitude, and behavioral intention to use. The characteristics of this part is rating scale, have 35 items. The researcher use mean value ($\overline{X}$) and standard deviation (SD) analyzed the data, the result that show in table and graph styles.

Each item is measured using a five-point Likert-type scale, with answer choices ranging from strongly disagree (1) to strongly agree (5). The perceptions were also interpreted for the five levels in Likert's scale (Silpjaru, 2007), the mean score as follows;

4.50 – 5.00 was interpreted as highest level
3.50 – 4.49 was interpreted as high level
2.50 – 3.49 was interpreted as medium level
1.50 – 2.49 was interpreted as low level
1.00 – 1.49 was interpreted as lowest level

3.8.2 Inference Statistics

The first part, the One-Way Analysis of Variance (ANOVA) was used to compare the means of all 35 items among the constructs for test hypotheses. The date are analyzed by dimensions level of education, marriage status, income, and Tukey statistic are performed which means different. The level of significance will be set at 5% among the demographic controls. The results of hypotheses testing are shown in table.

Secondly, structural equation modeling (SEM) is use to analyzed the relationships between independent variables to test the hypotheses. The proposed research model includes; perceived usefulness and perceived ease of use against attitude, and attitude against behavioral intention to use; system quality, and social

influence against perceived usefulness; and the last one, system quality, personal innovativeness, self-efficacy, facilitating condition and perceived cost against perceived ease of use.

3.9 Summarize Results

The findings of this study are discussion and concluding. The final result, research limitations and recommendations for the future research are presented to help ETC and system developers to improve ETC user's behavioral personal innovativeness intention.

3.10 Documentation

Finally, the result of this study will be analyzed, concluded and presented with recommendation for the future research. All research documents related had been carefully found out, considered, inspected, and referred for confident reliability.

3.11 Research Tools

Hardware		
CPU	:	Intel(R) Core(TM)2 Duo T5550
Hard Disk	:	160 GB
RAM	:	2 GB
Monitor	:	14.1" Widescreen
Peripheral Devices	:	Mouse, Printer
Software		
Operating System	:	Microsoft Windows 7
Statistical Program	:	SPSS Version 20.0 (Statistical Package for the Social Science for Windows) LISREL 8.8 (student version)
PDF View Tool	:	Adobe Reader 9.0
Document Generator	:	Microsoft Word 2007

3.12 Research Schedule

Table 3.3 Research schedule

Activities	Time (Months)											
	1	2	3	4	5	6	7	8	9	10	11	12
Preliminary Study	→	→										
Define Scope of Study			→									
Define Research Framework and Hypotheses				→								
Design Research Instruments				→								
Pilot Testing					→							
Data Gathering						→	→	→	→			
Data Coding									→	→		
Data Analysis & Interpretation										→	→	
Summarize Results												→
Documentation	→	→	→	→	→	→	→	→	→	→	→	→

CHAPTER IV
RESULTS AND DISCUSSION

The objective of this chapter will describe the results from the survey. The data from the survey was analyzed and presented in table style. This chapter is divided into two main parts.

The first part presents the results data from the questionnaire. There are three parts of questionnaire which include (i) profile of the respondents; (ii) the usage of Electronic Toll Collection, ETC, services; and the last one is (iii) the factors are influence that affect citizens for acceptance of ETC services.

The second part presents the results of hypotheses testing that investigate the influences of factors on Electronic Toll Collection services adoption. The hypotheses testing can be divided into two parts. Firstly, researcher used One-Way Analysis of Variance (ANOVA) to study possible interaction effects a) marital status: single and married, b) education in three identified groups: high school or below, associate's or bachelor's degree and upper bachelor's degree, and c) income in five identified groups: 10,001 – 20,000 baht; 20,001 – 30,000 baht; 30,001 – 40,000 baht; 40,001 – 50,000 baht, and upper 50,000 baht of respondents**.** Secondly, researcher used structural model analysis to investigate relationships among all factors on research model.

4.1 The Survey Results

The questionnaires were distributed to people who were highway users; 400 used ETC system, and 400 denied to use the system. A total of the samples were chosen. Among them, researcher deleted questionnaires that are incomplete and obviously unconcerned. (E.g. giving the same rating for all items, missing fill out in some items). Finally, the overall questionnaires were used for analysis, response rate of 100%. Table 4.1 to 4.2 show the summary of respondents who denied ETC system.

Descriptive statistics of respondents who denied ETC system was shown in Table 4.1 that the respondents were male and female in the same level at 50.0%. In terms of age of respondents, it was found that the majority of respondents were between 21 – 30 years old (39.25%). The majority status was single (67.75%). The education level of respondents was 69.50% associates or bachelor's degree and they were students (34.50%). The majority of respondents had income between 10,001 – 20,000 baht (45%), and lived in Bangkok Metropolitan (85%).

Table 4.1 Summaries of respondents who denied ETC system by demographics.

Measure	Item	Frequency	Percentage (%)
Total		400	100
Gender	Male	200	50.00
	Female	200	50.00
Age	18 – 20 years old	96	24.00
	21 – 30 years old	157	39.25
	31 – 40 years old	91	22.75
	41 – 50 years old	36	9.00
	51 – 60 years old	20	5.00
Marital Status	Single	271	67.75
	Married	129	32.25
Education	High school or below	75	18.75
	Associate's or bachelor's degree	278	69.50
	Master's degree or higher	47	11.75
Occupation	Students	138	34.50
	Government officials or government enterprises officials	71	17.75
	Private sector employees	88	22.00
	Self employments or proprietors	49	12.25
	Hirelings	39	9.75
	Others	15	3.75

Measure	Item	Frequency	Percentage (%)
Income	10,001 – 20,000 baht	180	45.00
	20,001 – 30,000 baht	112	28.00
	30,001 – 40,000 bah	61	15.25
	40,001 – 50,000 baht	32	8.00
	Over 50,000 baht	15	3.75
Living Area	Bangkok	340	85.00
	Up country	60	15.00

In Table 4.2; the summaries of respondents who denied ETC system, the majority of respondents used saloon 65.75%. It was found that the majority of respondents used friends as information channel 30.50% and the denied reason was no need to use 43%

Table 4.2 Summaries of respondents who denied ETC system by details of type of car, information channel, and denied reason

Measure	Item	Frequency	Percentage (%)
Type of car	Saloon	263	65.75
	Pickup	53	13.25
	Van	33	8.25
	Others	51	12.75
Information Channel	Television/ Radio	113	28.25
	Website	41	10.25
	Newspaper /Printing	61	15.25
	Brothers /Sisters/Cousins	51	12.75
	Friends	134	33.50
	Others	113	28.25
Denied Reason	Difficult process	92	23.00
	Service rate/High deposit	47	11.75
	Not sure in money cutting process	24	6.00
	Less of channels of putting money	32	8.00
	No need to use	172	43.00
	Others	33	8.25

Descriptive statistics of respondents show in Table 4.3, these show that, 50.25% of the respondents were male and 49.75% were female. In terms of age of respondents, it was found that the majority of respondents were between 21 – 30 years old (40.50%). The majority status was single (57.50%). The education level of respondents was 64.50% associates or bachelor's degree and worked in private sector (34.75%). The majority of respondents had income between 10,001 – 20,000 baht (44.50%), and lived in Bangkok Metropolitan (97.50%).

The majority of respondents used saloon (78.75%) and used friends as information channel (25.75%). In terms of ETC using objectives, self-satisfaction was the reason of the majority of respondents (54.75%). The average using in one week was between 1 – 5 times (39.50%). The majority of respondents used ETC System between 1 – 6 months (43%). In terms of used Toll Plaza, the majority of respondents used Chalong Rat Expressway, Ramindra-At Narong Expressway, (34.50%). The majority of respondents, 49%, using time period was between 6.00 – 10.00 am. The amount of money to add credit to Expressway Smart Card, the majority of respondents added credit between 501 – 1,500 baht (43.25%). Putting money channel, the majority of respondents used Krung Thai Bank and Siam Commercial Bank (23.25%) and Respondents expected to use counter service 27.50%.

Table 4.3 Summaries of respondents

Measure	Item	Frequency	Percentage (%)
Total		400	100
Gender	Male	201	50.25
	Female	199	49.75
Age	18 – 20 years old	67	16.75
	21 – 30 years old	162	40.50
	31 – 40 years old	91	22.75
	41 – 50 years old	49	12.25
	51 – 60 years old	28	7.00
	Over 60	3	0.75
Marital Status	Single	230	57.50
	Married	166	41.50
	Others	4	1.00

Measure	Item	Frequency	Percentage (%)
Education	High school or below	60	15.00
	Associate's or bachelor's degree	258	64.50
	Master's degree or higher	82	20.50
Occupation	Students	100	25.00
	Government officials or government enterprises officials	70	17.50
	Private sector employees	139	34.75
	Self employments or proprietors	67	16.75
	Hirelings	24	6.00
Income	10,001 – 20,000 baht	178	44.50
	20,001 – 30,000 baht	102	25.50
	30,001 – 40,000 bah	64	16.00
	40,001 – 50,000 baht	34	8.50
	Over 50,000 baht	22	5.50
Living Area	Bangkok	390	97.50
	Up country	10	2.50
Type of car	Saloon	315	78.75
	Pickup	39	9.75
	Van	37	9.25
	Others	9	2.25
Information Channel	Television / Radio	95	23.75
	Website	88	22.00
	Newspaper / Printing	58	14.50
	Brother / Sister / Cousin	56	14.00
	Friends	103	25.75
Objective of ETC Using	Self-satisfaction	219	54.75
	Company / Organization	38	9.50
	ETC system trial	128	32.00
	Others	15	3.75
Average using/ a week	1-5 / week	158	39.50
	6-10 / week	144	36.00
	11-15 / week	75	18.75
	16-20 / week	15	3.75
	Over 20 / week	8	2.00

Measure	Item	Frequency	Percentage (%)
Using Period	Below 1 month	77	19.25
	1-6 month	172	43.00
	7-12 month	78	19.50
	Over 1 year	73	18.25
Used Toll Plaza	Chaloem Maha Nakhon Expressway	117	29.25
	Sri Rat Expressway	74	18.50
	Chalong Rat Expressway	138	34.50
	BangPhli-Suksawat Expressway	71	17.75
Using Time Period	06.01-10.00	196	49.00
	10.01-13.00	62	15.50
	13.01-16.00	44	11.00
	16.01-19.00	65	16.25
	19.01-22.00	23	5.75
	22.01-06.00	10	2.50
Amount of Money to Add Credit to Expressway Smart Card	500 baht	113	28.25
	501-1,500 baht	173	43.25
	1,501-2,500 baht	68	17.00
	2,501-3,500 baht	34	8.50
	3,501-4,500 baht	3	0.75
	4,501-5,000 baht	9	2.25
Putting Money Channel	Toll Plaza Building	57	14.25
	Customer service center (BECL)	31	7.75
	Toll Plaza	66	16.50
	One-stop service	43	10.75
	Krung Thai Bank and Siam Commercial Bank	93	23.25
	Counter service	110	27.50

***Respondents' profile (*n* = 400)**

The sample size of respondents which usable can be confirmed by use the Yamane table to calculate the target sampling as 400 sample with significance level = 0.05.

4.2 Descriptive Analysis

4.2.1 System Quality

The Table 4.4 presents respondents' perception toward system quality of ETC services. The result of system quality showed that all of the item means are over 3, the respondents had perception on SQ2 (reliability) in high, mean scores were 3.67 (SD = 0.783), follow by SQ1 (usefulness) in high, mean scores were 3.63 (SD = 0.889). The highest perception were on the dual perceptions which in the same level, SQ3 (response time) in high, mean scores were 3.73 (SD = 0.810) and SQ4 (correctness) in high, mean scores were 3.73 (SD = 0.865). The results indicate that the respondents have perception of system quality of ETC services in high level and highest score on SQ3 (response time) and SQ4 (correctness).

This suggested that respondents felt ETC always offer good services to them, the respondents recognized, in high level, the quick system respond and the correctness of automatically identifying the account and debiting the toll fee. Moreover, motorists highly perceived in the operation reliability of ETC services. In addition, using ETC system provides the useful functions as need were in the high level for the respondents. These results show the respondents the importance of the system quality perception of ETC services in response time, correctness, reliability and usefulness

Table 4.4 System quality perception of ETC services

Measurement Items	Mean (n = 400)	Standard Deviation (n = 400)	Min	Max	Interpretation
1. SQ1: Using ETC system provides the useful functions as need. (usefulness)	3.63	0.889	1	5	High
2. SQ2: The operation of ETC system is reliable. (reliability)	3.67	0.783	1	5	High
3. SQ3: The respond of ETC system is quick. (response time)	3.73	0.810	1	5	High
4. SQ4: Automatically identifying the account and debiting the toll fee correctly. (correctness)	3.73	0.865	1	5	High
System Quality	**3.69**	**0.707**	**1**	**5**	**High**

4.2.2 Social Influence

The perceptions about social influence toward ETC services are illustrated in Table 4.5. The result of social influence showed that all of the item means were over 3, the respondents had perception on SI2 (social pressure) in medium, mean scores were 3.22 (SD = 0.925), follow by SI1 (individual pressure) in medium, mean scores were 3.18 (SD = 0.983).

This showed that motorists used ETC services as recommended by other people as social pressure; and by people they knew influence to use ETC services as individual pressure, in medium level. The results show that social pressure is lead respondents to use ETC services in medium level.

Table 4.5 Social influence perception of ETC services

Measurement items	Mean (n = 400)	Standard Deviation (n = 400)	Min	Max	Interpretation
1. S11: People they knew influence to use ETC services. (Individual pressure)	3.18	0.983	1	5	Medium
2. S12: They use ETC services because many people use it. (Social Pressure)	3.22	0.925	1	5	Medium
Social influence	**3.20**	**0.867**	**1**	**5**	**Medium**

4.2.3 Personal Innovativeness in IT

The results, as show in Table 4.6 most of personal innovativeness in IT include PIIT1 (always search about a new information technology) and PIIT2 (discuss and introduce technologies among their colleagues/relatives), the perception are high level. The mean scores were 3.53 (SD = 0.850).

This suggested that respondents perceived in discussion and introduction technologies among their colleagues/relatives; and searched about a new information technology in high level. The results show that respondents willing to using ETC services when they are a personal innovativeness in IT perception.

Table 4.6 Personal innovativeness in IT perception of ETC services

Measurement items	Mean (n = 400)	Standard deviation (n = 400)	Min	Max	Interpretation
1. PIIT1: They always search about a new information technology.	3.52	0.947	1	5	High
2. PIIT2: They discuss and introduce technologies among their colleagues/relatives.	3.53	0.892	1	5	High
Personal innovativeness	**3.53**	**0.850**	**1**	**5**	**High**

4.2.4 Self-Efficacy

Self-efficacy perception was illustrated in table 4.7. The results show that perceptions about self-efficacy from respondents had a high level on overall of items. The mean scores indicate that the respondents had confident to complete their task on ETC services.

Table 4.7 Self-efficacy perception of ETC services

Measurement Items	Mean (n = 400)	Standard deviation (n = 400)	Min	Max	Interpretation
1. SE1: I could complete using ETC if I had never used a system like it before.	3.52	0.822	1	5	High
2. SE2: I could complete using ETC more easily when someone is giving introductions.	3.69	0.870	1	5	High
Self-efficacy	**3.60**	**0.764**	**1**	**5**	**High**

4.2.5 Facilitating Conditions

Table 4.8 illustrates facilitating conditions that influences the perceptions of citizens. This perceptions occurred in high level include FC3 (has noticed obvious signs EASY PASS lane.) FC5 (EASY PASS system services to the windshield and makes it easy to pay the toll) and FC6 (provide additional funds on the card, through electronic channels). There were 3 items in medium level; FC1, FC2, and FC4.

This indicated that motorists realized well in EASY PASS system services to the windshield to make it easy to pay the toll, additional funds on the card through electronic channels, and the obvious signs EASY PASS lane in the high level. In addition, respondents medium perceived that The Expressway Authority of Thailand have a department or staff to solve service problems immediately and provide public relations for the clear ETC services; and EASY PASS lanes are sufficient to meet demands. It would appear that some facilitating conditions were still barriers for citizen's to use ETC services.

Table 4.8 Facilitating conditions perception of ETC services

Measurement items	Mean (n = 400)	Standard Deviation (n = 400)	Min	Max	Interpretation
1. FC1: The Expressway Authority of Thailand provides public relations for the clear ETC services.	3.34	0.894	1	5	Medium
2. FC2: The Expressway Authority of Thailand has a department or staff to solve service problems immediately.	3.40	0.931	1	5	Medium
3. FC3: Has noticed obvious signs EASY PASS lane.	3.53	0.834	1	5	High
4. FC4: EASY PASS lanes are sufficient to meet demands.	3.30	1.012	1	5	Medium
5. FC5: EASY PASS system services to the windshield. Makes it easy to pay the toll.	3.78	0.930	1	5	High
6. FC6: Provide additional funds on the card, through electronic channels.	3.71	0.910	1	5	High
Facilitating conditions	**3.51**	**0.690**	**1**	**5**	**High**

4.2.6 Perceived Price Fairness

Perceived Price Fairness perception was illustrated in table 4.9. The results show that perceptions about perceived price fairness from respondents had a high level on PPF4 but in negative way. The mean scores indicated that the respondents were sensitive in perceived price fairness on ETC services.

Table 4.9 Perceived Price Fairness perception of ETC services

Measurement items	Mean (n = 400)	Standard Deviation (n = 400)	Min	Max	Interpretation
1. PPF1: The additional fee of 25 baht for every additional 500 baht.	3.26	0.825	1	5	Medium
2. PPF2: Card deposit has been involved in the decision to use the service.	3.48	0.887	1	5	Medium
3. PPF3: They think there is value in using the system for accepting EASY PASS card deposits.	3.40	0.881	1	5	Medium
4. PPF4: They think that The Expressway Authority of Thailand should have reduced the deposit card.	3.84	0.872	1	5	High
Perceived Price Fairness	**3.50**	**0.621**	**1**	**5**	**High**

4.2.7 Perceived Usefulness

From the results in Table 4.10, the most perceptions about perceived usefulness reveal from using ETC services. The results show that perceptions about perceived usefulness from respondents had high level in all items; help more driving convenience, response rush-hour need, save time for their routes, and had more efficiency in driving. The mean scores indicated that the respondents consensus in high perceived usefulness of ETC.

Table 4.10 Perceived Usefulness perception of ETC services

Measurement Items	Mean (n = 400)	Standard Deviation (n = 400)	Min	Max	Interpretation
1. PU1: Using ETC responses rush-hour need.	3.84	0.867	1	5	High
2. PU2: ETC help more driving convenience**.**	3.87	0.871	1	5	High
3. PU3: Using ETC saves time for their routes.	3.79	0.878	1	5	High
4. PU4: Using ETC had more efficiency in driving.	3.78	0.881	1	5	High
Perceived Usefulness	**3.82**	**0.769**	**1**	**5**	**High**

4.2.8 Perceived Ease of Use

The perceptions of perceived ease of use were illustrated in table 4.11. The scores for all items were high; used and learned for experience and easy to use; the result relatively high level of perception. From the results indicated that respondents perceived the importance to get easy to use and clear, and they can understand when using ETC services.

Table 4.11 Perceived ease of use perception of ETC services

Measurement Items	Mean (n = 400)	Standard Deviation (n = 400)	Min	Max	Interpretation
1. PEOU1: EASY PASS system is easy to use.	3.64	0.893	1	5	High
2. PEOU2: EASY PASS system is used and learned for experience.	3.69	0.906	1	5	High
Perceived ease of use	**3.67**	**0.840**	**1**	**5**	**High**

4.2.9 Attitude

The perceptions of Attitude were illustrated in table 4.12. The scores for all items were high level; using EASY PASS to pay tolls is a good method, make satisfaction, agrees to use, and provide quality service. The data were shown that respondents had high perceptions of attitude. The result relatively high level of perception, to indicate that respondents had consensus attitude to perceived the importance of using ETC services.

Table 4.12 Attitude perception of ETC services

Measurement items	Mean (n = 400)	Standard deviation (n = 400)	Min	Max	Interpretation
1. A1: They are satisfied with the use of EASY PASS and pay tolls.	3.64	0.868	1	5	High
2. A2: They agree to use the EASY PASS and pay tolls.	3.64	0.921	1	5	High
3. A3: Using EASY PASS to pay tolls is a good method.	3.68	0.870	1	5	High
4. A4: EASY PASS system provides quality service.	3.55	0.818	1	5	High
Attitude	**3.63**	**0.744**	**1**	**5**	**High**

4.2.10 Intention to Use

The perceptions about intention to use toward ETC services are illustrated in table 4.13. The mean value of 3 items include; (IN1) respondents willing to take the EASY PASS to pay tolls, (IN2) respondents intend to use the EASY PASS to pay tolls every time, (IN3) respondents will recommend ETC to others to use as well, were high level. Anyhow, (IN4) respondents will still use EASY PASS card even though it will continue to rise despite the charges was medium level.

The most respondents intended to use EASY PASS services every time, be willing to use it and will recommend others people to use as well in high level. In addition, it still be sensitively in rising despite the charges in medium. Thus, the results also suggest that most motorists tend to agree with the questions that posed about intention to use.

Table 4.13 Intention to use perception of ETC services

Measurement items	Mean (n = 400)	Standard deviation (n = 400)	Min	Max	Interpretation
1. IN1: Are they willing to take the EASY PASS to pay tolls?	3.57	0.856	1	5	High
2. IN2: They intend to use the EASY PASS to pay tolls every time.	3.58	0.863	1	5	High
3. IN3: They think that when they use the EASY PASS, they will recommend it to others to use as well.	3.57	0.873	1	5	High
4. IN4: They still use EASY PASS card even though it will continue to rise despite the charges.	3.46	1.042	1	5	Medium
Intention to use	**3.55**	**0.769**	**1**	**5**	**High**

4.2.11 Overall Perception of All Constructs

The table 4.14 shows the mean, standard deviation for all of perceptions. Following tables 4.14, most perception about behavior or personality traits the score were high level of agreement. The highest value of perception was perceived usefulness follow by perceived ease of use, attitude, self-efficacy, intention to use, facilitating conditions, perceived price fairness, personal innovativeness in IT, and social influence, respectively. Anyhow, the mean value of system traits has a high level of agreement in system quality. This suggested that motorist feel confident,

interest in innovative technology and they have resources support to using ETC system and they feel ETC system offered useful convenience services to them.

Table 4.14 Perception of all constructs

Item	Mean (n = 400)	Standard Deviation (n = 400)	Interpretation
System quality	3.69	0.707	**High**
Social influence	3.20	0.867	**Medium**
Personal innovativeness in IT	3.53	0.850	**High**
Self-efficacy	3.60	0.764	**High**
Facilitating conditions	3.51	0.690	**High**
Perceived Price Fairness	3.50	0.621	**High**
Perceived Usefulness	3.82	0.769	**High**
Perceived ease of use	3.67	0.840	**High**
Attitude	3.63	0.744	**High**
Intention to use	3.55	0.769	**High**

4.3 Hypotheses Testing

In this study, researcher had conducted the following statistical analysis to test the hypotheses. Firstly, researcher used one-way analysis of variance (ANOVA) technique to test the possible effects of a) dimension of education: high school or below, associate's or bachelor's degree and upper bachelor's degree, and b) levels of income: 10,001-20,000 baht; 20,001-30,000 baht; 30,001-40,000 baht; 40,001-50,000 baht, and upper 50,000 baht of respondents on overall constructs. Secondly, researcher uses multiple regression analysis for investigated factor that influence ETC system from citizens' acceptance.

4.3.1 One-Way Analysis of Variance (ANOVA)

In order to use on-way analysis of variance (ANOVA) that was divided in two parts. Firstly, researcher conducted one-way analysis of variance (ANOVA) to compare the means of all constructs in the dimension of education. Finally, researcher compares the means of all constructs in the dimension of income.

- **Education**

From the table 4.15 data were also analyzed to examine the influence of level of education on all factors. When being compare the mean of education level toward the overall perceptions. The level of education include high school or below, associate's or bachelor's degree and master's degree or higher. The tables 4.15 that suggest citizens who have difference level of education are significant difference perception on personal innovativeness and self efficacy. Additionally, the significant difference were found self-efficacy p-value = 0.046 and personal innovativeness p-value = 0.048.

For social influence, system quality, intention to use, perceived usefulness, perceived ease of use, attitude, facilitating conditions, and perceived price fairness no significant differences were found among the three groups.

From the results levels of education have influence citizens perception on self-efficacy and personal innovativeness than other factors. Post-hoc range tests by the Tukey statistic were performed pair-wise comparison tests. Significant difference for the dimension of education levels show that different of personal innovativeness were at high school or below and master's degree or higher levels.

The results revealed that the citizens had different level of education, and those who had master's degree or higher perceived a higher perception of personal innovativeness than other groups.

These differences might be explained by aspirations for higher levels of education driving citizen have innovativeness for using ETC.

Table 4.15 One way ANOVA analysis for difference in overall constructs: Dimension of Education

Scale Items	Mean value of Education			*p*-value
	High school or Below (n = 60)	Associate's or Bachelor's Degree (n = 258)	Master's Degree or Higher (n = 82)	
System Quality	3.64	3.67	3.77	**0.441**
Social Influence	3.23	3.16	3.31	**0.346**
Personal Innovativeness	3.31	3.47	3.65	**0.048***
Self-Efficacy	3.56	3.49	3.54	**0.046***
Facilitating Conditions	3.53	3.49	3.48	**0.678**
Perceived Price Fairness	3.91	3.81	3.76	**0.876**
Perceived Usefulness	3.71	3.68	3.57	**0.486**
Perceived Ease of Use	3.72	3.61	3.60	**0.530**
Attitude	3.60	3.51	3.62	**0.555**
Intention to use	3.64	3.67	3.77	**0.480**
Remark: * = *p*-value significance at the 0.05				

- **Level of Income**

The table 4.16, data were also analyzed to examine the influence of level income level on all factors. When being compare the mean of income level toward the overall perceptions. The levels of income include 10,001 – 20,000 baht; 20,001 – 30,000 baht; 30,001 – 40,000 baht; 40,001 – 50,000 baht, and upper 50,000 baht. The table 4.16 suggests citizens who have difference levels of income are significant difference perception on system quality, personal innovativeness, intention to use, facilitating conditions, attitude, social influence, and self efficacy. Additionally, the significant difference were found system quality *p*-value = 0.000, personal innovativeness *p*-value = 0.000, intention to use *p*-value = 0.001, facilitating

conditions *p*-value = 0.001, attitude *p*-value = 0.003, social influence *p*-value = 0.003, and self efficacy *p*-value = 0.029.

For perceived usefulness, perceived ease of use, and perceived price fairness no significant differences were found among the five groups.

From the results levels of income have influence citizens perception on system quality, personal innovativeness, intention to use, facilitating conditions, attitude, social influence, and self efficacy than other factors. Post-hoc range tests by the Tukey statistic were performed pair-wise comparison tests. Significant difference for the level of income show that: (i) different of system quality were significant at income levels 20,001 – 30,000 baht and upper 50,000 baht; (ii) different of social influence were significant at income levels 20,001 – 30,000 baht and 30,001 – 40,000 baht; (iii) different of personal innovativeness were significant at income levels 20,001 – 30,000 bah and 30,001 – 40,000 baht; (iv) different of facilitating conditions were significant at income levels 20,001 – 30,000 baht; 30,001 – 40,000 baht, and upper 50,000 baht; (v) different of attitude were significant at income levels 20,001 – 30,000 baht and upper 50,000 baht; (vi) different of intention to use were significant at income levels 20,001 – 30,000 baht and upper 50,000 baht.

The results revealed that the citizens have different levels of income, and those who have income between 20,001 – upper 50,000 perceived a higher perception of system quality, social influence, personal innovativeness, facilitating conditions, attitude, and intention to use ETC than other groups.

These differences might be explained by higher levels of income have driving citizens to using ETC.

Table 4.16 One way ANOVA analysis for difference in overall constructs: Dimension of Income

Scale items	Mean value of Income					*p*-value
	10,001–20,000 (n=178)	20,001–30,000 (n=102)	30,001–40,000 (n=64)	40,001–50,000 (n=34)	Over 50,000 (n=22)	
System Quality	3.53	3.85	3.79	3.66	4.00	**0.000***
Social Influence	3.01	3.38	3.35	3.32	3.27	**0.003***
Personal Innovativeness	3.27	3.67	3.66	3.62	3.68	**0.000***
Self-efficacy	3.51	3.75	3.70	3.40	3.70	**0.029***
Facilitating Conditions	3.37	3.60	3.67	3.47	3.83	**0.001***
Perceived Price Fairness	3.45	3.52	3.58	3.45	3.56	**0.601**
Perceived Usefulness	3.78	3.84	3.86	3.63	4.11	**0.203**
Perceived ease of use	3.60	3.74	3.73	3.59	3.80	**0.544**
Attitude	3.48	3.75	3.75	3.54	3.95	**0.003***
Intention to use	3.39	3.66	3.66	3.49	4.02	**0.001***
Remark: * = *p*-value significance at the 0.05						

4.3.2 Structural Model Test

Structural equation modeling (SEM) was used to predict the relationship between factors in the research model (Path Analysis). The propose hypotheses were analyzed, LISREL 8.8 (student) software was tool that used to analysis the data in this study.

A preliminary test to check multi-collinearity problem of data was analyzed by employs the correlations. This analyzed found, all factors the correlation value below 0.8 and supported at the 0.01 level, no multi-collinearity problem in the variables as shown in Table 4.17.

Table 4.17 The result of Correlation Analysis of variables

Variables	PEOU	PU	A	IN	SQ	SI	PI	SE	FC	PPF
PEOU	1.000									
PU	0.660**	1.000								
A	0.491**	0.753**	1.000							
IN	0.524**	0.581**	0.744**	1.000						
SQ	0.612**	0.618**	0.669**	0.627**	1.000					
SI	0.523**	0.260**	0.430**	0.438**	0.424**	1.000				
PI	0.650**	0.416**	0.468**	0.507**	0.491**	0.414**	1.000			
SE	0.618**	0.590**	0.502**	0.488**	0.524**	0.250**	0.447**	1.000		
FC	0.669**	0.638**	0.684**	0.656**	0.612**	0.373**	0.458**	0.596**	1.000	
PPF	0.627**	0.545**	0.628**	0.512**	0.523**	0.356**	0.360**	0.492**	0.611**	1.000

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

The overall index values were assessed to measurement model for a good model fit (see Table 4.18), the chi-square value at 13.72 and degrees of freedom at 6. The results indicate that the ratio of chi-square to degrees of freedom (χ^2 / df) at 2.286, GFI at 0.99, AGFI at 0.94, NFI at 1.00, CFI at 1.00, RMR at 0.013, and RMSEA at 0.057 all values were acceptance and indicate a good model fit.

Table 4.18 Fit indices for measurement

Goodness-of-fit measure	Recommended value*	Model value
Fit measures		
χ^2 / degree of freedom	≤ 3.00	2.286
Goodness-of-fit (GFI)	≥ 0.90	0.99
Adjusted goodness-of-fit (AGFI)	≥ 0.80	0.94
Normalized fit index (NFI)	≥ 0.90	1.00
Non-normalized fit index (NNFI)	≥ 0.90	0.99
Comparative fit index (CFI)	≥ 0.90	1.00
Root mean square residual (RMR)	≤ 0.05	0.013
Root mean square error of approximation (RMSEA)	≤ 0.10	0.057
***Recommended values have been adapted since Hair, Black, Babin, and Anderson (2010)**		

- **Explaining Perceived Usefulness**

The effect of user's perception about system quality and social influence positively affects perceived usefulness toward the intention of citizen to accept ETC respectively. Perceived usefulness was entered as dependent variable, and perceived ease of use, system quality and social influence were entered as independent variables. The three factors can explain 99% of the variance in perceived usefulness of ETC. System quality ($ß = 0.54$, $p < 0.01$), social influence ($ß = 0.29$, $p < 0.05$) and perceived ease of use ($ß = 0.24$, $p < 0.01$) were found significantly positively to affect perceived usefulness of ETC. System quality, social influence, and perceived ease of use were positive effect to perceived usefulness. Therefore, hypothesis H1, H3, and H8 were supported, respectively.

♦ **Explaining Perceived Ease of Use**

Hypotheses H2, H4, H5, H6, and H7 examine the effect of user's perception about system quality, social influence, personal innovativeness, self-efficacy, facilitating conditions, and perceived price fairness were the factors that significantly positively to affect perceived ease of use of ETC. To perform the hypotheses testing, perceived ease of use was entered as dependent variable, and system quality, personal innovativeness, self-efficacy, facilitating conditions, and perceived price fairness were entered as independent variables. The R^2 value for this analysis explains 51% of the variance in perceived ease of use of ETC. System quality ($ß = 0.16$, $p < 0.05$), personal innovativeness ($ß = 0.08$, $p < 0.05$), self-efficacy ($ß = 0.23$, $p < 0.01$), facilitating conditions ($ß = 0.22$, $p < 0.05$), and perceived price fairness ($ß = 0.17$, $p < 0.01$) had the significance impact to perceived ease of use. System quality, personal innovativeness, self-efficacy, facilitating conditions, and perceived price fairness were found significantly positively to affect perceived ease of use. As a result, hypotheses H2, H4, H5, H6, and H7 were supported. Another determinant did not have any significant effect on ETC perceived ease of use.

♦ **Explaining Attitude**

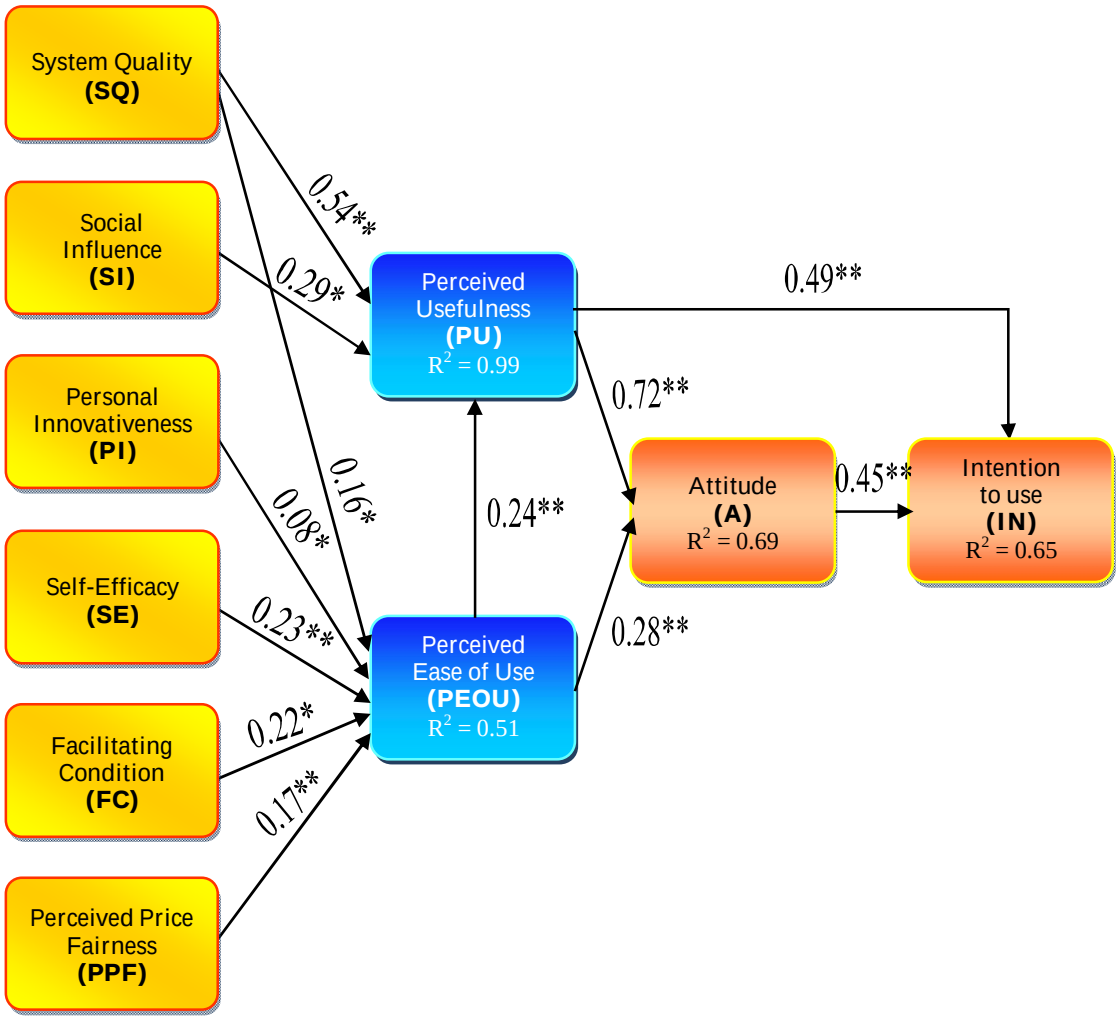
To perform the hypotheses testing, attitude was entered as dependent variable, and perceived usefulness and perceived ease of use were entered as independent variables. The R^2 value for this analysis explains 69% of the variance in attitude to use ETC. Perceived usefulness ($ß = 0.72$, $p < 0.01$), perceived ease of use ($ß = 0.28$, $p < 0.01$) had the significance impact to attitude. Perceived ease of use and perceived usefulness were found significantly positively to affect attitude. As a result, hypotheses H9, and H10, were supported.

♦ **Explaining Intention to Use EASY PASS Services**

Perceived usefulness H11 and attitude H12 were positively affects the intention to use of citizen to accept ETC respectively. Therefore, hypotheses H11 and H12 were supported. Intention to use was entered as dependent variable, and perceived usefulness and attitude were entered as independent variables. The R^2 value for this analysis was 0.65, which can explain 65% of the variance in citizen intention

to use ETC. From the result it was also found that impact of perceived usefulness (ß = 0.49, $p < 0.01$) and attitude (ß = 0.45, $p < 0.01$). This result was supported perceived usefulness and attitude had significant effects on intention to use ETC. As a result, hypotheses H11 and H12 were supported respectively.

From the results of hypotheses tests, researcher can show the statistical significant on research model as follow. Twelve hypotheses were supported.



* 0.05 significance level

** 0.01 significance level

Figure 4.1 Result of Structural modeling analysis

Total result 12 hypotheses were supported. The results of hypotheses testing were presented in Table 4.19.

Table 4.19 Results of test of ETC services acceptance model

Model	Beta	R^2
(1) Perceived Ease of Use (PEOU)		**0.51**
PEOU = SQ + PI + SE + FC + PPF		
SQ	0.16*	
PI	0.08*	
SE	0.23**	
FC	0.22*	
PPF	0.17**	
(2) Perceived Usefulness (PU)		**0.99**
PU = SQ + SI + PEOU		
SQ	0.54**	
SI	0.29*	
PEOU	0.24**	
(3) Attitude (A)		**0.69**
A = PU + PEOU		
PU	0.72**	
PEOU	0.28**	
(4) Intention to use (IN)		**0.65**
IN = PU + A		
PU	0.49**	
A	0.45**	

* 0.05 significance level.

** 0.01 significance level.

Table 4.20 A decomposition of the effects analysis (direct, indirect, and total effects)

Criterion variable predictors	Perceived ease of use			Perceived usefulness			Attitude			Intention to use		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
System Quality	0.16*	-	0.16*	0.54**	0.04*	0.58**	-	0.46**	0.46**	-	0.49**	0.49**
Social Influence	-	-	-	0.29*	-	0.29*	-	0.21*	0.21*	-	0.24*	0.24*
Personal Innovativeness	0.08*	-	0.08*	-	0.02	0.02	-	0.04*	0.04*	-	0.03	0.03
Self-Efficacy	0.23**	-	0.23**	-	0.06**	0.06**	-	0.11**	0.11**	-	0.08**	0.08**
Facilitating Conditions	0.22*	-	0.22*	-	0.05*	0.05*	-	0.10*	0.10*	-	0.07*	0.07*
Perceived Price Fairness	0.17**	-	0.17**	-	0.04**	0.04**	-	0.08**	0.08**	-	0.06**	0.06**
Perceived Usefulness	-	-	-	-	-	-	0.72**	-	0.72**	0.49**	0.32**	0.81**
Perceived Ease of Use	-	-	-	0.24**	-	0.24**	0.28**	0.18**	0.46**	-	0.33**	0.33**
Attitude	-	-	-	-	-	-	-	-	-	0.45**	-	0.45**
Note : * 0.05 significance level, ** 0.01 significance level												
DE (Direct Effect), IE (Indirect Effect), and TE (Total Effect)												

According to the results from the above table shows value of direct effect, value of indirect effect, and values of total effect of factors affected dependent variables comprising perceived usefulness, perceived ease of use, attitude, and intention to use. The variable of perceived ease of use received direct effect from the factors of self-efficacy, facilitating conditions, perceived price fairness, system quality, and personal innovativeness, respectively. Self-efficacy is an important factor affecting use ETC system. This means that motorists' good skills and ability enable motorists to use ETC system by themselves. The variable of perceived usefulness received direct effects from system quality, social influence, and perceived ease of use. These factors have to create more reliability to motorists. Reliability may mean organization image or system stability. The variable of attitude received direct effect from the variable of perceived usefulness and perceived ease of use. The motorists adopt more positive attitudes toward adoption of services when they perceive higher usefulness and ease of use of ETC system. The variable of intention to use received direct effects from the factor of attitude than the factor of perceived usefulness. Attitudes could strongly determine their willingness to use ETC system services. The motorists' perceptions of the ease and effectiveness of ETC services may directly lead to motorist's intention of ETC services adoption via their attitude.

Table 4.21 Summary of hypotheses testing

Hypotheses	Description	Result
Hypothesis 1	System quality will have a positive effect on the perceived usefulness of ETC.	**Supported**
Hypothesis 2	System quality will have a positive effect on the perceived ease of use of ETC.	**Supported**
Hypothesis 3	Social influence will have a positive effect on the perceived usefulness of ETC.	**Supported**
Hypothesis 4	Personal innovativeness will have a positive effect on the perceived ease of use of ETC.	**Supported**
Hypothesis 5	Self- efficacy will have a positive effect on the perceived ease of use of ETC system.	**Supported**
Hypothesis 6	Facilitating conditions will have a positive effect on the perceived ease of use of ETC.	**Supported**
Hypothesis 7	Perceived price fairness have a negative effect on the perceived ease of use of ETC.	**Supported**
Hypothesis 8	Perceived ease of use will have a positive effect to perceived usefulness of ETC.	**Supported**
Hypothesis 9	Perceived ease of use will have a positive effect on attitude to use ETC.	**Supported**
Hypothesis 10	Perceived usefulness will have a positive effect on attitude of use ETC.	**Supported**
Hypothesis 11	Perceived usefulness will have a positive effect behavioral intention to use ETC.	**Supported**
Hypothesis 12	Attitude will have a positive influences behavioral intention to ETC user.	**Supported**

4.4 Discussion of Findings

The research discussions are shown as follows:

This study explained factors influence citizen's toward acceptance of ETC system. The result showed that personality trait (social influence, personal innovativeness, self-efficacy, facilitating conditions, and perceived price fairness) and system trait (system quality) lead citizens' acceptance and use ETC. The extended the Technology Acceptance Model (TAM) was tested the impact of this concept for analyzing citizens' perception toward ETC intention from G2C context.

Hypothesis 1: System quality will have a positive effect on perceived usefulness of ETC.

Hypothesis 2: System quality will have a positive effect on perceived ease of use of ETC.

The research reveals that system quality significantly affected perceived usefulness and perceived ease of use (H1 and H2). System quality refers to performance of the system. Many studies have develop measure of system quality such as ease of use, functionality, reliability, flexibility, data quality, portability, integration, and importance (DeLone and McLean, 2003) and have supported that system quality has positive effects on perceived ease of use, and perceived usefulness (Ahn et al., 2007). This is again consistent with the results of previous studies. In this study, system quality is aspects to quality from ETC in the context of performance. High level system quality will improve the convenience for users to access ETC system. When citizens perceive a high system quality in using ETC, they should sense that it is useful and simple which will lead to use the system. Thus, system quality should be improved to enhance the perception of useful and easy to use. Using ETC system provides the useful functions as needed, the reliability of ETC operation, quick respond of ETC system, and automatically identifying the account and debiting the toll fee correct. If citizens find an ETC difficult use, they will not use again.

Hypothesis 3: Social influence will have a positive effect on perceived usefulness of ETC.

Social influence significantly affected perceived usefulness (H3), as social influence can enhance citizens' perception of perceived usefulness in ETC system. Social influence is defined as "a person's perception that most people who are important to him think he should or should not perform the behavior in question" (Fishbein and Ajzen, 1975). Social influence in this study is defined as an individual's perceive that important people for he or she believe that they should use ETC. Users will decide to use ETC when their family, friends or their peer recommend them to use it. In several previous researches, social influence has a positive effect on perceived usefulness (Taylor and Todd, 1995). This result is consistent with the finding of Taylor and Todd (1995). If ETC is not capable of providing quality system, which is important for citizens, it is likely that they will not consider using the ETC to achieve their satisfaction.

Hypothesis 4: Personal innovativeness will have a positive effect on perceived ease of use of ETC.

The personal innovativeness affected perceived ease of use to acceptance ETC is significant (H4). Personal innovativeness in IT (PIIT) relates the perceptions in acceptance information technology of user (Agarwal and Prasad, 1998) and refers to user who is innovative person willingness to use new information technology (IT). Previous research found that personal innovativeness has significantly positive effects perceived ease of use (Lu et al., 2005). The result is supported with the findings of other studies (Agarwal and Prasad, 1998). High level of personal innovativeness leads citizens' more positive effect on intention to use information technology. More perceived of personal innovativeness in IT will enhance citizens' positive perceptions about ease of use in ETC. The citizens who have greater personal innovativeness, the more likely that it lead them think ETC useful and less difficult to use.

Hypothesis 5: Self-efficacy will have a positive effect on perceived ease of use of ETC.

This study reveals that self-efficacy has a positive influence on perceived ease of use (H5). The result is supported with the results of previous studies (Venkatesh, 2000; Gu el al., 2009; Hernandez et al., 2009). Citizens with more self-

efficacy have confidence to use a system that is difficult or complicated than the lower self-efficacy. Thus, self-efficacy was a key factor for predicted citizens' ease of use toward ETC acceptance. This implies that self-efficacy made citizens feel no effort throughout the use of ETC. Therefore, self-efficacy considerably improved the perception on simplicity of ETC.

Hypothesis 6: Facilitating conditions will have a positive effect on perceived ease of use of ETC.

Facilitating conditions significantly affected perceive ease of use (H6). This is again supported with the results of previous studies (Gu et al., 2009; Taylor and Todd, 1995). It can be seen that facilitating conditions in this study are defined that individuals have existing resources to support them to use ETC in two contexts, resource facilitating conditions and technological facilitating conditions, both of them are directly impact to citizens feel using ETC. Citizens cannot adopt ETC if they do not have available resources; ETC information billboard at toll plaza; number of toll enough lanes, ETC card using in any toll plaza. Facilitating conditions or resources are the factors that help citizens to easily perform and accomplish their tasks.

Hypothesis 7: Perceived price fairness will have a negative effect on perceived ease of use of ETC.

This study reveals that perceived price fairness has a negative influence on perceived ease of use (H7). The result is supported with the results of previous studies (Martins and Monroe 1994) Thus, perceived price fairness was a key factor for predicted citizens' ease of use toward ETC acceptance. This implies that perceived price fairness make citizens feel no effort throughout the use of ETC. Therefore, perceived price fairness considerably improved the citizens' perception of ETC using.

Hypothesis 8: Perceived ease of use will have a positive effect to perceived usefulness ETC.

Hypothesis 9: Perceived ease of use will have a positive effect on attitude to use ETC.

Hypothesis 10: Perceived usefulness will have a positive effect on attitude to use ETC.

Hypothesis 11: Perceived usefulness will have a positive effect on intention to use ETC.

The finding showed that system quality, personal innovativeness, self-efficacy, facilitating conditions and perceived price fairness have influence on perceived ease of use, which were predicting the attitude to use ETC. The results indicate that perceived ease of use is the most important factor in predicting perceived usefulness. This is again supported with the results of previous studies (Davis et al., 1989; Taylor and Todd, 1995; Moon and Kim, 2001). The perceived ease of use will increase when citizens feel that ETC is easy to use, after that they will become accustomed and use it. ETC should provide easy way for citizens to use.

Perceived usefulness was significant affected by system quality, social influence and perceived ease of use. The higher level of perceived usefulness, the high level of attitude to use ETC it will be. This result found that perceived usefulness was the important factor that influences the acceptant of ETC, which was supported with previous studies in TAM (Davis et al., 1989; Taylor and Todd, 1995; Moon and Kim, 2001). Citizens' intentions to use ETC when they find it useful for them to increase efficiency. A useful system improves efficiency of the ETC in order to support citizens when they use. When citizens perceive a very useful system, they believe that it offers performance for them. Perceived usefulness has more positive effects on behavioral intention (Taylor and Todd, 1995; Moon and Kim, 2001). The perceived usefulness will increase when citizens notice that it improves their lives efficiency such as more using conveniently and conducting transaction.

Hypothesis 12: Attitude will have a positive influences on intention to ETC user.

As for attitude, both usefulness and ease of use have a direct effect on attitude to intention to use ETC (H12). This is again supported with the results of many TAM studies (Taylor and Todd, 1995; Moon and Kim, 2001; Jung et al., 2009; Lu et al., 2009). The finding reveals that perceived ease of use is the most important,

perceived usefulness has a positive effect by perceived ease of use of ETC. This is again consistent with the results of other studies (Davis et al., 1989; Taylor and Todd, 1995; Moon and Kim, 2001; Lee et al., 2009; Lu et al., 2009; Gu et al., 2009). From the result, it can be implied that perceived usefulness was encouraging citizen's intention because of the belief that ETC is useful. Confidence of citizens in using ETC is an important factor of citizens' intention. Citizens perceive ETC useful because it is easy to use. For ETC, not only usefulness and ease of use are important, but other factors also have influences on willingness of citizens to use it such as personality trail and system trait of information system.

This study applied TAM to explore motorists' to use technology by explaining factors influence them toward acceptance of ETC system. The results of this study provide support for the research model presented in Fig.3.2 and for the hypotheses regarding the directional linkage among the model's variables and they showed that personality trait (social influence, personal innovativeness, self-efficacy, facilitating conditions, and perceived price fairness) and system trait (system quality) lead citizens' acceptance and use ETC.

This study aimed to gain insights of the expressway users who denied adoption of ETC. *Firstly*, the majority of users give the reason was no need to use because they do not use the Expressway every day 43%. *Secondly*: facilitating conditions; it was difficulties in the application, 23%, for motorists who desire to register for Easy Pass must prepare document and paid deposit card 1,000 baht and refill minimum 500 baht and this process he/she could not register instead of each other. *Thirdly*: perceived price fairness; point was the high card deposit, which made motorists denied adoption to use Easy Pass, 11.8%. *Fourthly:* facilitating conditions; it was less of channels for top up the smart card 8%. *Fifthly:* system quality; motorists were not sure in money cutting process 6%. *The Last*, 8.3%, there was miscellaneous. The Expressway Authority of Thailand should realize these results because most of the barriers are not concerned in system quality, it means motorists did not deny the system quality of ETC too much so that EXAT can make them as the new targets not too difficult.

System quality significantly affected perceived usefulness, which is the most important of intention to use. For motorists who desire a convenient and rapid

transportation or who desire to shorten the traveling distance to their destinations as well as to avoid the traffic congestion along the normal roads, which is a major problem in Bangkok; Easy Pass also enhances the efficiency of toll collection during rush hours. When using Easy Pass, it is presently found that Easy Pass is able to collect tolls at a The Expressway Authority of Thailand ("EXAT") installed the new technology of Electronic Toll Collection system, which is available from several manufacturers. Furthermore, EXAT also employed specialists to give advice on technology to ensure modern and quality equipment and system, which would build up all the motorists' confidence. The results of research, with respect to the toll collection system (correctness), and the communication (response time) which are important to EXAT's operation. EXAT has provided the preventive maintenance as well as the data backup system. Consequently, Easy Pass is a system to facilitate the services, which would alleviate traffic congestion at the front of the toll plazas, and encourage more motorists to use the Expressways.

Social influence significantly affected perceived usefulness, which is the factor of intention to use. Motorists used ETC services as recommended by other people as social pressure; and by people they knew influence to use ETC services as individual pressure, in medium level. The results reflect that dual social and individual pressures lead motorists to use ETC services just in medium level. EXAT should provide the process of public relations or may be advertising to gain more motorists as "new targets."

Personal innovativeness significantly affected perceived ease of use, which is the factor of intention to use. Motorists perceived in discussion and introduction technologies among their colleagues/relatives; and searched about a new information technology in high level. The results show that they willing to using ETC services when they are a personal innovativeness in IT perception. EXAT could provide the new innovation for ETC services and motorists can gain to update themselves for ETC services.

Self-efficacy significantly affected perceived ease of use, which is the factor of intention to use. The motorists' perception of self-efficacy was a high level. The mean scores indicate that motorists had confident to complete their task on ETC services. Self-efficacy perception of ETC services reflects that motorists could

complete using ETC more easily when someone is giving introductions, and eventually they could complete using ETC even though they had never used a system like it before. This is a good touch point that EXAT should realize that motorists concern about self-efficacy not much but they concern about the benefit of using ETC.

Facilitating conditions significantly affected perceived ease of use, which is the second important of intention to use. Service on the Expressways are the core of EXAT's management, therefore, over the past period, EXAT has been determined to develop and enhance the efficiency of its services so as to ensure that motorists will be impressed by the convenience, rapidity and cost-efficiency of the services. The results of this research reflect that EASY PASS system services, windshield easily makes motorists to pay the toll and additional funds on the card through electronic channels in high level. EXAT should manage for the best and fast services. In present, EXAT has arranged specific staff, message sign, top-up via electronic channels, installation, with technical team for troubleshooting for the Expressway users facing problems relating to the Easy Pass for instance, installation and checking services, window film cutting services for Easy Pass installation. Expressway users may bring their vehicles to receive such services free of charge. EXAT takes into account the safety of motorists by providing message sign "Easy Pass" which are installed at Toll Plaza. In addition, Expressway users can top up the smart card every Toll Plaza or Toll booths, via ATM, and the Online Banking systems of Krung Thai Bank, The Siam Commercial Bank, and KASIKORNBANK now. And top up via Bangkok Bank and Counter Service within 2012. All of the services of expressways to facilitate motorists under the theme that EXAT provides the best services to customers throughout the routes. Even though, EXAT provides the best services but EXAT has potential to do more to serve new more target as counter service to make this point easier. The last of the results reflects that EASY PASS lanes are sufficient to meet demands and this is should be the first priority of EXAT for strategic planning.

Perceived price fairness has a negative significant affected perceived ease of use, which is the third important of intention to use. This research, the result shows that motorists thought that The Expressway Authority of Thailand should reduce the deposit card. In present, when motorists' decision to utilize the Easy Pass system they must paid deposit card (Refundable after cancellation for services) plus toll refill 500

baht for pay the tolls. In case that the deposit card, EXAT provides discount 200 baht from 1,000 baht remain 800 baht. In the sales promotion activities, EXAT provides discount on tolls on electronic channels when motorists top up every 500 baht get additional 25 baht, which aimed at attracting target customers to continue to use the Expressway services and eventually become regular customers. Even though, EXAT always use marketing as sales promotion activities in pricing, EXAT should realize about sales promotion in frequency/day/week/month for another way for selection.

Perceived usefulness was significantly affected by system quality, which is the most important of intention to use. This study suggests that motorists are the most likely to use ETC system in their travels, if ETC system had made sure they received benefit as their desired (e.g., response time, correctness). Thus, system stability should be the first priority for motorists to make decision to use ETC system. System quality should be develop and up-to-date seriously to increase reliable to the system.

Perceived ease of use was significantly influenced by self-efficacy, which is the most important to adoption of ETC services. This implies that self-efficacy made motorists feel no effort throughout to use ETC system. Therefore, self-efficacy considerably improved the perceptions on simplicity of ETC system. Thus, self-efficacy was a key factor for predicted motorists' ease of use toward ETC system acceptance.

Intention to use ETC system is primarily affected by attitude. Attitude is the most important positive predictor of the intention to use ETC system. This highlights that motorists attitude could strongly determine their willingness to use ETC system. The results reveal that motorist perceptions of the ease and effectiveness of ETC service many directly lead to motorists' intention of ETC services adoption via their attitude.

The findings of this study strongly suggest that the model with six independent constructs has a higher ability to predict and explain the behavioral intention of citizens to use ETC system. The results suggest that perceived usefulness has a significant effect on the intention to use ETC System. Moreover, it has an indirect influence, via attitude, on behavioral intention to use ETC System. This result is similar to the finding reported in Taylor and Todd (1995), which indicated that perceived usefulness has both direct and indirect influences on behavioral intentions

toward system use. Perceived usefulness was significant affected by system quality, social influence and perceived ease of use. The higher level of perceived usefulness, the high level of attitude to use ETC it will be. This result found that perceived usefulness was the important factor that influences the acceptant of ETC, which was supported with previous studies in TAM (Davis et al., 1989; Taylor and Todd, 1995; Moon and Kim, 2001). Citizens' intention to use ETC when they find it is useful for them to increase efficiency. A useful system improves efficiency of the ETC in order to support citizens when they use. The perceived usefulness will increase when citizens notice that it improves their lives efficiency such as more using conveniently and conducting transaction. Similar findings were obtained by Taylor and Todd (1995), Moon and Kim (2001) who investigated that perceived usefulness has more positive effects on behavioral intention.

As we knew from previous research, perceived usefulness was always an important determinant of attitude in TAM, and it may mediate the influence of perceived ease of use on attitude. The finding showed that system quality, personal innovativeness, self-efficacy, facilitating conditions and perceived price fairness have influence on perceived ease of use, which were predicting the attitude to use ETC. The results indicate that perceived ease of use is the most important factor in predicting perceived usefulness. This is again supported with the results of previous studies (Davis et al., 1989; Taylor and Todd, 1995; Moon and Kim, 2001). The perceived ease of use will increase when citizens feel that ETC is easy to use, after that they will become accustomed and use it. ETC should provide easy way for citizens to use.

From all results, it can be implied that perceived usefulness was encouraging citizen's intention because of the belief that ETC is useful. Confidence of citizens in using ETC is an important factor of citizens' intention. Citizens perceive ETC useful because it is easy to use. For ETC, not only usefulness and ease of use are important, but other factors also have influences on willingness of citizens to use it such as personality trait and system trait of information system. On the marketing side, even though there is no competition, ETC should strongly accentuate the full functionality of their systems to cater efficiently for "new targets."

CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

According to the results in the previous chapter, the study conclusions and limitation and recommendations for future research are presented as follows;

5.1 Conclusions

Interest in Intelligent Transportation System (ITS) comes from the problems caused by traffic congestion and a synergy of new information technology for simulation, real-time control, and communications networks. ITS is defined as the application of advanced sensor, computer, electronic, and communication technologies and management strategies–in an integrated manner–to increase the safety and efficiency of the surface transportation system. One of the ITS applications is the Electronic Toll Collection (ETC) System which is introduced to help reduce transit times and traffic congestion for commuters, and also streamline toll transaction processing and enhance auditing capabilities.

ETC aims to provide citizens with great benefits. However, various services are not accepted by citizens. The main purpose of this research was to study citizens' behavior when they made decision to use ETC. The results showed that the research model is able to predict citizens' acceptance on ETC. This research extended TAM model (system quality) and personality traits (social influence, personal innovativeness, self-efficacy, facilitating conditions and perceived price fairness) which effect perceived usefulness and perceived ease of use for research model of ETC context. The survey was conducted by collecting data from 400 respondents who ETC users and 400 respondents who denied ETC system. According to this research, the researcher found two factors of TAM (perceived usefulness and perceived ease of use) and external factors (system quality, social influence, personal innovativeness, self-efficacy, facilitating conditions and perceived price fairness) which extend TAM

were also important factors for ETC users to accept this system. The key factors of intention to use in ETC system were perceived usefulness and attitude which revealed from perceived ease of use.

Respondents of this study who denied ETC system were male and female in the same level at 50%. In terms of age of respondents, it was found that the majority of respondents were between 21 – 30 years old (39.25%). The majority status was single (67.75%). The education level of respondents was 69.50% associates or bachelor's degree and they were students (34.50%). The majority of respondents had income between 10,001 – 20,000 baht (45%), and lived in Bangkok Metropolitan (85%), the majority of respondents used saloon 65.75%. It was found that the majority of respondents used friends as information channel 33.50% and the denied reason was no need to use 43%

The study results revealed that citizens who denied ETC were single and used saloons. They accepted in perception of system quality and perceived price fairness. Facilitating condition was the second important denied reason to use ETC system.

Respondents of this research who use ETC system, 50.25% of the respondents were male and 49.75% were female. In terms of age of respondents, it was found that the majority of respondents were between 21 – 30 years old (40.50%). The majority status was single (57.50%). The education level of respondents was 64.50% associates or bachelor's degree and worked in private sector (34.75%). The majority of respondents had income between 10,001 – 20,000 baht (44.50%), and lived in Bangkok Metropolitan (97.50%).

The perception of citizens in each factor on ETC system acceptance, according to descriptive statistics could be described as follows; firstly the perception of system quality was high with the mean of 3.69. The perception of social influence was medium with the mean of 3.20. Mean of the perception of personal innovativeness was 3.53. Mean of the perception of self-efficacy was 3.60. Mean of the perception of facilitating condition was 3.51 and mean of the perception of perceived price fairness was 3.50.

The perception of social influence was medium with the mean of 3.20 while perception of system quality was high with the mean of 3.69. The perception of

perceived ease of use was high with the mean of 3.67. The perception of intention to use was high with the mean of 3.55. The perception of attitude was high with the mean of 3.63. Finally, respondents have perceptions of perceived usefulness on ETC in the highest level with the mean of 3.82. The findings revealed that system quality, self-efficacy, facilitating condition, perceived price fairness, perceived ease of use, perceived usefulness, attitude, and intention to use influence citizens' perception in the high level. The results indicated that citizens perceive system traits rather than personal traits.

The results of One-Way Analysis of Variance (ANOVA) test related with dimension of education levels showed that different of personal innovativeness were at high school or below and master's degree or higher levels. The results revealed that dimension of education levels correlates with citizen's perceptions of personal innovativeness than other groups.

In addition, the results of One-Way Analysis of Variance (ANOVA) test related with level of income showed that: (i) different of system quality were significant at income levels 20,001 – 30,000 baht and upper 50,000 baht; (ii) different of social influence were significant at income levels 20,001 – 30,000 bah and 30,001 – 40,000 baht; (iii) different of personal innovativeness were significant at income levels 20,001 – 30,000 bah and 30,001 – 40,000 baht; (iv) different of facilitating conditions were significant at income levels 20,001 – 30,000 baht; 30,001 – 40,000 baht, and upper 50,000 baht; (v) different of attitude were significant at income levels 20,001 – 30,000 baht and upper 50,000 baht; (vi) different of intention to use were significant at income levels 20,001 – 30,000 baht and upper 50,000 bah. According to the results, different level of income influence citizens' perceptions of system quality, social influence, personal innovativeness, facilitating conditions, attitude, and intention to use than other groups.

The study results revealed that perceive ease of use of citizen is affected by self-efficacy, facilitating condition, perceived price fairness, system quality and personal innovativeness. The higher level of system quality, social influence, and perceived ease of use influence the higher level of perceived usefulness of ETC. Finally, perceived usefulness and perceived ease of use influence attitude, that reveal to

intention to use ETC. Perceive usefulness most affects attitude. In addition, social influence is not important to citizens when they make decision to use ETC.

The results showed that twelve hypotheses are supported. This study found that system quality, personal innovativeness, self-efficacy, facilitating condition, and perceived price fairness most affects intention to use through perceived ease of use and attitude. Therefore, it is important for the Expressway Authority of Thailand (EXAT) to improve system quality, personal innovativeness, self-efficacy, facilitating condition, and perceived price fairness of citizens. According to the results, the researcher can present important factors path to lead to citizens' intention to use ETC: system quality → self-efficacy → facilitating condition → perceived price fairness → perceive ease of use → perceive usefulness → intention to use of citizens. ETC with high system quality, self-efficacy, facilitating condition, and perceived price fairness will make citizens feel that ETC is quality system, easily used, good facilitating, and fairness price making them want to use ETC. Perceived ease of use should be supported from self-efficacy of citizens. Influence of system quality, self-efficacy, facilitating condition, and perceived price fairness makes citizens convenience and comfortable when using ETC.

In the research model, perceived ease of use has more impact on usefulness toward through attitude and intention to use ETC. The results implied that citizens make decision to use ETC because they can easily use ETC system. Usefulness makes citizens decide to use ETC if the system is easily used.

The model variables have explained 65% of the variance in citizens' intention to use ETC. Therefore, further study is required to find other significant factors for the remaining 35% of the variance to find more intention to use.

5.2 Limitations and Recommendations for Future Research

This study has some limitations as follow.

Firstly, the data gathered were focused on a specific group; expressway users; of citizens in Bangkok, being limitation of this study. The sample size in future studies should include expressway staff to compare difference.

Secondly, future research may define system traits (system quality, service quality) as other dimensions. (i) System quality has: comprises system reliability, design, functionality, flexibility; (ii) Service quality have: comprises reliability, follow-up service, and competence.

Thirdly, only limited factors were focused in this study. For further research, a number of new factors must be considered as determinants of ETC to effectively investigate users' intention such as perceived value of information system, and sales promotion.

Finally, future research may focus on denied ETC group to study effective barriers of not to use expressway to compare difference

5.3 Recommendations

The research provides the Expressway Authority of Thailand (EXAT) with some guidelines to improve its system provided to citizens. The researcher gave recommendations to the Expressway Authority of Thailand (EXAT) to persuade people to use ETC, the EXAT should pay attention to nine factors which influence citizens' perception, found from this study. According to the above finding, the researcher provides strategies important to EXAT to create citizens' acceptance.

There are nine factors that support citizens' acceptance of ETC in this study. Important factors of perceive usefulness towards attitude to use ETC are system quality, social influence and perceived ease of use. Perceived ease of use is the most important factor on perceived usefulness. The system quality has high effect, but social influence has little effect on perceive usefulness. Benefits increase when citizens use ETC more easily. ETC will achieve success if EXAT promotes benefits of ETC system quality. To improve perceived usefulness, EXAT should try to make public relations to help make citizens understand the easy use of ETC such as brochures, advertising and social network to improve usefulness of system.

Different level of income influence citizens' perceptions of system quality, which is the most important factor to stimulate citizen's perceived ease of use of ETC. The Expressway Authority of Thailand should increase system quality to ETC usage. ETC should provide citizens with quality and easily used system by strongly

management in correctness: automatically identifying the account and debiting the toll fee correctly, and in response time: the quick respond of ETC system that make citizens satisfaction.

Different levels of education have influence citizens perception on self-efficacy and personal innovativeness, and those who had master's degree or higher perceived a higher perception of self-efficacy and personal innovativeness than other groups. Self-efficacy is the important factor which ETC needs to consider offering appropriate feature to help users efficiently. To increase level of citizen's intention, citizens have to feel more confident when using ETC system. The Expressway Authority of Thailand should focus to the new segment as the new market in university by using marketing tools as advertising, public relations, or may be promotion.

REFERENCES

Adams, D. A., Nelson, R. R. & Todd, P. A. (1992). Perceived usefulness, ease of use and usage of information technology: A replication. *MIS Quarterly*, *16*(2), 227 – 247.

Adegoke, B. B. (2007). Factors influencing the adoption of new information technology in the staffing industry. Dissertation Abstracts International, *68*(11), 126 p.

Agarwal, R., & Prasad, P. (1998). A conceptual and operational definition of personal innovativeness in the domain of information technology. *Information Systems Research, 9*(2), 204 – 215.

Ahn, T., Ryu, S., & Han, I. (2007). The impact of web quality and playfulness on user acceptance of online retailing. *Information & Management*, *44*(3), 263 – 275

Ajzen, I., & Fishbien, M. (1980). Understanding attitudes and predicting social behavior, Englewood Cliffs, NJ: Prentice-Hall.

Aladwania, A. M., & Palvia, P. C. (2002). Developing and validating an instrument for measuring user-perceived web quality. *Information & Management, 39*(6), 467 – 476.

Ashok, A., Thangavelu, V., & Harikrishnan, N. (2010). Electronic toll collection using active RFID System. Georgian Electronic Scientific Journal: Computer Science and Telecommunications, *1*(24).

Bagozzi, R. P., David, F. D., & Warshaw P. R. (1992). Development and test of a theory learning and usage. *Human Relations*, 45, 659 – 686.

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist, 37*(2), 122 – 147.

Bangkok Expressway Public Company Limited. (2011). Retrieved August 24, 2011, http://www.becl.co.th/2006/EN/Shared/EasyPass/Easy%20Pass_brief.pdf

Chen, C.-D., Fan, Y.-W., & Farn, C.-K. (2007). Investigating Factors Affecting the Adoption of Electronic Toll Collection: A Transaction Cost Economics Perspective, Proceeding of the 40th Hawaii International Conference on System Sciences, 2007.

Chou, C. (2003). Incidences and correlates of Internet anxiety among high school teachers in Taiwan. *Computer in Human Behavior, 19*(6), 731 – 749.

David, F. D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly, 13*(3), 319 – 339.

David, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science, 35*(8), 982 – 1003.

DeLone, W. H., & McLean, E. R. (1992). Information systems success: The quest for the dependent variable. *Information Systems Research, 3*(1), 60 – 95.

DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9 – 30.

Diaz, C. E. D., Madrigal, J. J., Mappala, A. U., Palmiano, H. S., & Sigua, R. G. (2005) Allocation of electronic toll collection lanes at toll plazas considering social optimization of service times and delay. Proceedings of the Eastern Asia Society for Transportation Studies, 5, 1496 – 1509.

Dodds, W. B., Monroe, K. B., & Grewal, D. (1991). Effects of price, brand, and store information on buyers' product evaluations. *Journal of Marketing Research, 28*(3), 307 – 319.

Doll, W. J., & Torkzadeh, G. (1988). The measurement of End-User Computing Satisfaction. *MIS Quarterly, 12*(2), 259 – 274.

Dumasia, N. (2010). *Revenue Assurance in Highway Toll Management.* Retrieved October 17, 2011, from https://www.in.kpmg.com/SecureData/aci/Files/Revenue%20Assurance%20in%20Highway%20Toll%20Management_3008102.pdf

ETC and Organization. (2011). Retrieved January 26, 2011, from http://www.orse.or.jp/english/organization/etc.html

ETC in Japan. (2011). Retrieved January 26, 2011, from http://www.hido.or.jp/itsos/4.%20ETC%20in%20Japan.pdf

Expressway Authority of Thailand. (2010). History. Retrieved August 3, 2010, from http://www.exat.co.th/about/2/0/44/#EN

Federal Highway Administration (1998). Intelligent Transportation Systems, Real World Benefits, January 1998.

Fishbien, M., & Ajzen, I. (1975). Belief, intention and behavior: an introduction to theory and research. Addison Wesley.

Flint, D. (2004). Electronic Toll Collection: An Introduction and Brief Look at Potential Vulnerabilities, *SANS Institute infoSec Reading Room*, 1.4b ed. 2004.

Fukuda, T., Fukuda, A., Surasawadee, K., & Praditphet, P. (2004, July 31). Preliminary Development of Intelligent Transportation system (ITS) in Thailand, the Sixth International Summer Symposium, Saitama University, Japan

Gilbert, D., Balestrini, P., & Littleboy, D. (2004). Barrier and benefits in the adoption of e-government. *The International Journal of Public Sector Management, 17*(4), 286 – 301.

Griffin, R. W. (1999), "Management", Houghton Mifflin Company, 6th Edition.

Gu, J.-C., Lee, S.-C., & Suh Y.-H. (2009). Determinants of behavioral intention to mobile banking. *Expert Systems with Applications, 36*(9), 11605 – 11616.

Hair, Jr., J. F., Black, W. C., Babin, B, J., & Anderson, R. E. (2010). Multivariate data analysis (7th ed.). Uppersaddle River, New Jersey: Pearson Education International.

Hernandez, B., Jimenez, J., & Martin, M.J. (2009). The impact of self-efficacy, ease of use and usefulness on e-purchasing: An analysis of experienced e-shoppers. *Interacting with Computers, 21*(1-2), 146 – 156.

Hung, S.-Y., Chang, C.-M., & Yu, T. J. (2006). Determinants of user acceptance of the e-Government service: The case of online tax filling and payment system. Government Information Quarterly, *23*(1), 97 – 122.

Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8 user's reference guide*. Scientific Software International.

Jung, Y., Perez-Mira, B., & Wiley-Patton, S. (2009). Consumer adoption of mobile TV: among psychological flow and media content. *Computer in Human Behavior*, *25*(1), 123 – 129.

Kamarulazizi, K., & Ismail W. (2005-2010). Electronic Toll Collection System Using Passive RFID Technology, *Journal of Theoretical and Applied Information Technology*, 70 – 76, 2005 – 2010.

Khan, M. A., Sharma M., & Prabhu R, B., (2009) A Survey of RFID Tags, *International Journal of Recent Trends in Engineering*, *1*(4), 68 -71

Kuo, Y.-F., & Yen, S.-N. (2009). Towards an understanding of the behavioral intention to use 3G mobile value-added services. *Computers in Human Behavior*, *25*(1), 103 – 110.

Lee, H., Kim, J., & Kim, J. (2007). Determinants of success for application service provider: An empirical test in small businesses. *International Journal of Human-Computer Studies*, *65*(9), 769 – 815.

Lee, S. & Kim, B. G. (2009). Factors affecting the usage of intranet: A confirmatory study. *Computers in Human Behavior*, *25*(1), 191 – 201.

Leonard, K. J., & Sitting, D. F. (2007) Improving Information Technology Adoption and Implementation Through the Identification of Appropriate Benefits: Creating IMPROVE-IT, *Journal of Medical Internet Research*, Apr-Jun; *9*(2): e9.

Lu, J., Yao, J. E., & Yu, C.-S. (2005). Personal innovativeness, social influence and adoption of wireless internet service via mobile technology. *Journal of Strategic Information Systems*, *14*(3), 245 – 268.

Lu, J., Lui, C., Yu, C.-S., & Wang, K. (2008). Determinants of accepting wireless mobile data services in China. *Information & Management*, *45*(1), 52 – 64.

Lu. Y., Zhou, T., & Wang, B. (2009). Exploring Chinese users' acceptance of instant messaging using the theory of planned behavior, the technology acceptance model, and the flow theory. *Computers in Human Behavior*. *25*(1), 29 – 39.

Makino, H., & Tsuji H. (2006). Electronic Toll Collection System of Japan, PIARC International Seminar on Intelligent Transportation System (ITS) in Road Network Operations August 14-16, 2006, Kuala Lumpur, Malaysia

Martins, M., & Monroe, K. B. (1994). Perceived price fairness: A new look at an old construct, In C.T. Allen and D.R. John (Eds.) Advances in Consumer Research , 21, 75 – 78.

Mathieson, K., Peacock, E., & Chin W. W. (2001). Extending the Technology Acceptance Model: The Influence of Perceived User Resources. *The DATA BASE for Advances in Information Systems. 32*(3), 86 – 112.

Montalbo, Jr., C. M., Ishida, H., Okamoto, N., & Tsutsumi, M. (2005). A study on the acceptability of the ETC in Metro Manila and a framework for estimating ITS environmental benefits. *Journal of the Eastern Asia Society for Transportation Studies*, 6, 2530 – 2545.

Moon, J.-W., & Kim, Y.-G. (2001). Extending the TAM for a World-Wide-Web context. *Information & Management, 38*(4), 217 – 230.

National Electronics and Computer Technology Center (NECTEC). (2011). Retrieved January 15, 2011, from http://www.nectec.or.th

National Electronics and Computer Technology Center (NECTEC), National Science and Technology Development Agency (NSTDA) and Ministry of Science and Technology. (2003). Thailand Information and Communication Technology (ICT) Master Plan (2002-2006): National Electronic and Computer Technology Center.

National Information Technology Committee Secretariat (NITC). (2002). IT 2000 Evaluation, report submitted to the National Technology Committee Secretariat.

Nowacki, G., Mitraszewska, I., & Kamiński, T. (2008). The national automatic toll collection system for the Republic of Poland, *Transport and Telecommunication, 9*(2), 2008

RFID Tag Considerations. (2012). Retrieved February 9, 2012, from http://www.cisco.com/en/US/docs/solutions/Enterprise/Mobility/wifich6.html

RFID Tags/Cards. (2011). Retrieved January 26, 2011, from http://www.fastpigeon.net/fp/product-tag.html

Roberts, C.M. (2006). Radio Frequency Identification (RFID). *Computers & Security, 25*(1), 18 – 26

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

Podder, B (2005). Factors Influencing the Adoption and Usage of Internet Banking: A New Zealand Perspective. Master of Information Technology Dissertation. Auckland University of Technology.

Porter, C. E., & Donthu, N. (2006) Using the technology acceptance model to explain how attitudes determine Internet usage: The role of perceived access barriers and demographics. *Journal of Business Research*, 59, 999 – 1007.

Sajjad, M., Saif, M. I. & Humayoun, A, A. (2009). Adoption of Information Technology: Measuring Social Influence for Senior Executive's. *American Journal of Scientific Research*, (3), 81 – 89.

Salleh, I., Yusoff, K. U. M., & Aziz, Z. A. (2006). Electronic Toll Collection (ETC) Systems Development in Malaysia, PIARC International Seminar on Intelligent Transportation System (ITS) in Road Network Operations August 14-16, 2006, Kuala Lumpur, Malaysia

Silpjaru, T. (2007). *Research and Analysis data from SPSS*. Bangkok: SE-EDUCATION PUBLIC COMPANY LIMITED.

Smart Border Alliance. *US-VISIT Increment 2C RFID Feasibility Study, Final Report, Attachment D: RFID Technology Overview.* Retrieved February 9, 2011, from http://www.dhs.gov/xlibrary/assets/foia/US-VISIT_RFIDattachD.pdf

Smart Card. (2012). Retrieved February 9, 2012, from http://www.made-in-china.com/products-search/hot-china-products/Smart_Card.html

Stephen Ezell. (2010). The Information Technology & Innovation Foundation. Explaining International IT Application Leadership: Intelligent Transportation Systems. January 2010

Szajna, B. (1994). Software evaluation and choice: Predictive Validation of the Technology Acceptance instrument. *MIS Quart. 18*(3), 319 – 324.

Tambouris, E., Gorilas, S. & Boukis, G.. (2001). Investigation of electronic government, Proceedings of the 8th Panhellenic Conference on Informatics, 2, 367 – 376.

Taylor, S., & Todd, P. (1995). Understanding information technology usage: A test of competing models. *Information System Research*, *6*(4), 144 – 176.

Thaieasypass. (2010). Retrieved August 3, 2010, from http://www.thaieasypass.com/etcsite/index.php?option=com_content&view=article&id=15&Itemid=12&lang=th

Thatcher, J. B., Loughry, M. L., Lim, J. & McKnight, D. H. (2007). Internet anxiety: An empirical study of the effects of personality, beliefs, and social support. *Information & Management*, *44*(4), 353 – 363.

The Basics of RFID. (2003). *Veri-Logic, LLC*. Retrieved December 8, 2010, http://www.veri-logic.com/documents/RFID.pdf

The E-ZPass Process. (2011). Retrieved January 26, 2011, from http://auto.howstuffworks.com/e-zpass1.htm

Thuvasethakul, C., & Koanantakool, T. (2002, March 25 – 29). National ICT Policy in Thailand. NECTEC (Nation Electronic and Computer Technology Center). Paper presented at Africa-Asia Workshop Promoting Co-operating in Information and Communications Technologies Development, Kuala Lumpur and Penang, Malaysia.

Tubtimhin, J. (2001). *Thailand's e-Government 2001*. Retrieved January 13, 2011, from http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan012807.pdf

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information System Research, 11*(4), 342 – 365.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies, Management Science, *46*(2), February 2000, 186 – 204

Voss, C. V. (2003). Rethinking paradigms of service-service in a virtual enviorment. *International Journal of Operations & Production Management*, *23*(1), 88-104.

Wangpipatwong, S., Wichian, S., Chutimaskul, W., & Papasratorn B. (2005, November 19-20). Factors Influencing the Adoption of Thai eGovernment Websites: Information Quality and System Quality Approach. Paper presented at the Proceedings of the Fourth International Conference on eBusiness, Bangkok, Thailand.

Xia, L., Monroe, K., & Cox, J. (2004). The Price Is Unfair! A Conceptual Framework of Price Fairness Perceptions, *Journal of Marketing, 68*(4), 1 – 15.

Xu, G.-X., Liu, J.-H., Tao, Z.-Y., & Li, X.-C. (2007). The research and development of the highway's electronic toll collection system, World Academy of Science, Engineering and Technology 31, 231 – 235, 2007

ทวีศักดิ์ กออนันตกูล. (2548). *เทคโนโลยี RFID กับผลกระทบต่อประเทศไทย.* วันที่ค้นข้อมูล 26 มกราคา 2554, จาก เว็บไซต์: http://www.ttc.most.go.th/stvolunteer/Upload Clinic/.../A_ReflexRFID.pdf

พัฒนาธุรกิจและออกแบบวงจรรวม, ศูนย์. (2548). รู้จักกับเทคโนโลยีอาร์เอฟไอดี. ปทุมธานี: สำนักงานพัฒนาวิทยาศาสตร์และเทคโนโลยีแห่งชาติ, ศูนย์เทคโนโลยีอิเล็กทรอนิกส์และคอมพิวเตอร์แห่งชาติ กระทรวงวิทยาศาสตร์และเทคโนโลยี.

วัชรากร หนูทอง, อนุกูล น้อยไม้ และ ปรินันท์ วรรณสว่าง. (2547). RFID เทคโนโลยีสารพัดประโยชน์. *วารสาร NECTEC*, *11*(60), 15 – 22.

วัชรากร หนูทอง และ อนุกูล น้อยไม้. (2554). *RFID หนึ่งในเทคโนโลยีที่น่าจับตามอง.* วันที่ค้นข้อมูล 26 มกราคม 2554. จาก เว็บไซต์: http://www.nectec.or.th/pressnews/bid/RFID/RFID_technology_final2.pdf

สรวิศ นฤปิติ. (2543). ความรู้เรื่องระบบขนส่งอัจฉริยะ. วันที่ค้นข้อมูล 14 ธันวาคม 2553, จาก เว็บไซต์: http://wiki.nectec.or.th/itswiki/bin/viewfile/Main/ITS_for_Beginner?rev=1;filename=%A4%C7%D2%C1%C3%D9%E9%E0%BA%D7%E9%CD%A7%B5%E9%B9-ITS-A-Sorawit.pdf

APPENDICES

APPENDIX A
EXPRESSWAY AUTHORITY OF THAILAND (EXAT)

History of Expressway and Rapid Transit Authority of Thailand (ETA)

Thailand has suffered a great deal of economic loss due to the growing traffic congestion problem. The Royal Thai Government, therefore, decided to establish an organization to study, construct, and manage expressways. Expressway and Rapid Transit Authority of Thailand (ETA) was then established to resolve the problem.

A state enterprise under the Ministry of Interior, Expressway and Rapid Transit Authority of Thailand (ETA) was established under the Announcement of the National Executive Council number 290, dated November 27, 1972. The organization is responsible for the construction, maintenance, and management of expressways and public transportation infrastructures, as well as other efforts related to expressways. The organization was established with an aim to lighten the land transportation situation, and minimize problems and obstacles related to traffic and transportation, especially in Bangkok and its vicinity.

The term "Expressway" refers to newly constructed roads – either on the ground level or above ground and water surfaces – that facilitate the land traffic in particular. The term encompasses roadways for monorails, subways, bridges, boat tunnels for car ferry, piers, pavements, parking lots, shoulders of roads, road fences, embankments, sewerages, retaining walls, kilometer signage, traffic lights and signs, and buildings associated with expressway undertakings.

Chronology

1966 The government appointed a committee on Land Traffic Obstacles Study and Planning.

1969 The committee conferred its observation to the government and suggested that the Office of the National Economic and Social Development Board request assistance from the German government in surveying and preparing a master plan to solve the traffic situation in Bangkok.

1970 The Ministry of National Development at that time proposed through the cabinet to appoint a committee for Preparation of the Establishment of a Toll Collection Organization. The committee was under the supervision of the Ministry of Interior.

September 21, 1971 The cabinet agreed to appoint the committee for Preparation of the Establishment of a Toll Collection Organization. This committee was chaired by Mr. Tawin Soonthornsarathoon.

October 20, 1971 The committee formed a sub-committee to draft a legislation supporting the toll collection organization, and a sub-committee to study the formation of the toll collection organization.

January 17 - February 5, 1972 The Ministry of interior delegated 4 officers to acquire information on the legislation and establishment of the organization in Japan and Korea.

November 27, 1972 The sub-committee responsible for legislation proposed to the committee and the Juridical Council a draft of the Expressway and Rapid Transit Authority of Thailand Act. The country was then governed by the National Executive Council, the Act was therefore legislated as the Announcement of the National Executive Council number 290, dated November 27, 1972.

1972 According to the Announcement of the National Executive Council no 290, dated November 27, 1972 (ETA's founding date), Expressway and Rapid Transit Authority of Thailand was instituted as a state enterprise under the Ministry of Interior. The organization has just celebrated its 30th anniversary in 2002.

In 2002, The Royal Thai government issued 2 royal decrees on the Government Reformation Policy:

1. A Royal decree to transfer administration and responsibilities of government agencies according to the Act Organizing Ministries, Sub-Ministries and Departments, B.E. 2545.

2. A Royal decree to amend other provisions according to the transfer of administration and responsibilities of government agencies under the Ministry of Interior. This decree transfers the administration and responsibilities of Expressway and Rapid Transit Authority of Thailand to the Ministry of Transport as of the announcement of the decree in the Royal Gazette on October 6, 2002

The EXAT one-stop service center

The primary objective of policies on the administrative reform is to help the bureaucracy undergo the metamorphosis into the electronic government (e-Government) to improve the government services to satisfy the citizens as much as possible. Under the e-Government policies, the members of public are treated as a VIP customer who is offered with quality and quick service when getting in contact with government agencies. Besides, the transparency, the freedom of information legislation and accountability are part of the digital government policies. For this reason, the government calls for the government agencies and state enterprises to set up a one-stop service center with the aim of achieving the e-Government goal. To that end, the EXAT under the Transport Ministry draws a master plan which the advanced technology is incorporated to maximize the operational effectiveness. The information and communication technology plays a vital role in the improved services, greater availability, two-way interaction and the complete transparency. The EXAT establishes its one-stop service center at the headquarters with fixed address of 2380, Phahonyothin road, Ladyao, Chatujak district, Bangkok, 10900.

The objective

1. To provide people with quick and excellent service while in contact with the EXAT
2. To minimize the time-consuming procedures in order for the improved management and organizational effectiveness
3. To enhance the functionality of the e-Government
4. To render assistance within scopes of service;

- The financial affairs
  - Sales of toll tickets of all stripes
  - Top-up of TAG-operated toll card/ setting, changing and sequestering of toll card
  - Tax invoice issuance after the top-up of TAG-operated toll card and purchase of toll ticket
  - Tax invoice issuance for those who pay toll by cash
  - Payment service for rental fee of the EXAT property and postal purchase cost
- The scrutiny on the land expropriation
- The news and information
- To ensure the smooth running of service procedures

Step 1 – Get an advice, fill up a form, and check documents at the information desk

Step 2 – Receive a queue number from the desk (The queuing has two parts of information, the service type and the number)

Step 3 – Contact a counter corresponding to the number you hold

- The automatic voice is used for queuing. The number and service type will be consistent with the counter number which is shown on a board
- The queue number is in order of the counter responsible for each service

Step 4 – Receive a certification, a receipt after payment or an arrangement paper for the next appointment (in case the procedures take more time to be finished).

Note: The EXAT one-stop service center opens daily from 8.30an – 3.30pm

Service for motorists

Telecommunication and hi-tech devices

The EXAT sets up a control center to manage and monitor the traffic on the expressways which the expressway traffic management employees work in cooperation with the emergency service units, tollway policemen and other agencies around the clock. The closed-circuit televisions (CCTV) installed at regular intervals is part of advanced technology incorporated into the expressway traffic management. The motorist is assured of rapid assistance in the event of emergency on toll roads. Besides, the Emergency Telephone System (ETS) installed for every kilometer on the expressways helps the distressed motorists get connected with employees at the control center. At the push of a button on the ETS, the employees are alerted and then they turn the surveillance camera situated nearest the location of the ETS the motorist make contact. The camera footage will show what the trouble the motorist encounters. The communication between the motorists and employees are visually and audibly recorded. As well, the variable-message sign (VMS) installed at interchanges gives the motorists useful information on traffic situation and important events.

Toll traffic management

The uninterrupted flow of traffic on the expressway is the EXAT's routine task which requires a close cooperation with its traffic division and toll police in the expressway traffic management, especially traffic jam at the exits during the rush hour. The road safety is the most top priority of the toll traffic management.

- The key traffic signs from speed limit to the traffic direction are put in to make sure the motorists keep road safety in mind while driving on toll road.
- The weight control on the trucks is to ensure that the overloaded trucks cannot gain access to expressway in line with laws. If the load exceeds the legal limit, the weight station does not allow the troubled vehicle to pass through the toll plaza.

Emergency service and vehicle recovery

The EXAT emergency service unit is at the ready in case the motorist encounters a road accident or an engine trouble on the expressway. If the car problem

is too difficult to be handled, the unit will tow the vehicle to a nearest garage free of charge. The payment is involved in case of the petrol fill-up and the clean-up operation on oil sludge after a car accident.

- The toll officers helps fill up a tank to certain extent if the petrol runs out while you are driving on the expressway, so that you can make a visit to a nearest gas service station once leaving the toll gate. The petrol charge is based on market prices. On average, it costs around 100 baht.
- The toll officers carry out the clean-up operation on oil sludge leaked by the troubled vehicle or a car accident to ensure safety for other motorists.

APPENDIX B
QUESTIONNAIRE

แบบสอบถามเพื่อการวิจัย

เรื่อง ปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS กรณีศึกษา: การทางพิเศษแห่งประเทศไทย (Expressway Authority of Thailand)

เรียน ท่านผู้ตอบแบบสอบถาม

แบบสอบถามฉบับนี้เป็นส่วนหนึ่งของการทำวิทยานิพนธ์ในระดับปริญญาโท สาขาวิชาเทคโนโลยีการจัดการระบบสารสนเทศ คณะวิศวกรรมศาสตร์ มหาวิทยาลัยมหิดล โดยมีวัตถุประสงค์ที่จะสำรวจปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS กรณีศึกษา: การทางพิเศษแห่งประเทศไทย (Expressway Authority of Thailand) ซึ่งผลการวิจัยครั้งนี้จะทำให้ทราบถึงข้อมูลเกี่ยวกับพฤติกรรมของผู้ใช้ทางพิเศษที่จะยอมรับและนำไปสู่การใช้งานบริการของการทางพิเศษแห่งประเทศไทย คำตอบของท่านมีคุณค่าอย่างยิ่งต่องานวิจัย ผู้วิจัยจะเก็บข้อมูลที่ได้รับจากท่านไว้เป็นความลับ ข้อมูลที่ตรงกับความเป็นจริงและสมบูรณ์จะช่วยให้การวิจัยดำเนินไปด้วยความถูกต้อง ผู้วิจัยจึงใคร่ขอความอนุเคราะห์จากท่าน โปรดตอบแบบสอบถามตามความคิดเห็นของท่านอย่างรอบคอบให้ครบทุกข้อ แบบสอบถามที่ตอบครบสมบูรณ์เท่านั้นที่จะสามารถนำไปใช้ในการวิจัยได้

แบบสอบถามนี้แบ่งออกเป็น 4 ตอน มีจำนวน 8 หน้า

ตอนที่ 1 เป็นแบบสอบถามข้อมูลเกี่ยวกับสถานภาพทั่วไปของผู้ตอบแบบสอบถาม ลักษณะแบบสอบถามเป็นแบบตรวจสอบรายการ (Check List) มีจำนวน 7 ข้อ

ตอนที่ 2 เป็นแบบสอบถามเกี่ยวกับการใช้งานระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS ลักษณะแบบสอบถามเป็นแบบตรวจสอบรายการ (Check List) มีจำนวน 12 ข้อ

ตอนที่ 3 เป็นแบบสอบถามข้อมูลทัศนคติที่มีต่อการทางพิเศษแห่งประเทศไทย ลักษณะแบบสอบถามเป็นแบบมาตราส่วนประเมินค่า (Rating Scale) มีจำนวน 35 ข้อ

ตอนที่ 4 เป็นแบบสอบถามข้อคิดเห็นและข้อเสนอแนะอื่น ๆ ลักษณะแบบสอบถามเป็นแบบปลายเปิด มีจำนวน 1 ข้อ

ขอขอบพระคุณในความกรุณาของท่านมา ณ โอกาสนี้

นางสาววรินยา มีศิลปวิกกัย
นักศึกษาปริญญาโท สาขาวิชาเทคโนโลยีการจัดการระบบสารสนเทศ
คณะวิศวกรรมศาสตร์
มหาวิทยาลัยมหิดล

<u>คำนิยาม</u> การให้บริการของระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ **EASY PASS** คือ ผ่านง่าย ๆ ไม่ต้องรอคิวยาว ไม่ต้องเตรียมเงินให้ยุ่งยาก ไม่ต้องเปิดกระจก ไม่ต้องรอใบรับค่าทาง ใช้เวลาผ่านไม่นาน ไม่กี่วินาที

<u>ตอนที่ 1</u> ข้อมูลสภาพทั่วไปของผู้ตอบแบบสอบถาม

<u>คำชี้แจง</u> โปรดทำเครื่องหมาย ✓ ลงในช่อง ❒ หน้าคำตอบที่ตรงตามความเป็นจริงเพียง 1 ข้อ และหากท่านเลือกคำตอบที่ระบุว่า **อื่น ๆ** กรุณาระบุรายละเอียดเพิ่มเติมในช่องว่าง

---

1. เพศ ❒ (1) ชาย ❒ (2) หญิง
2. อายุ ❒ (1) 18 – 20 ปี ❒ (2) 21 – 30 ปี ❒ (3) 31 – 40 ปี
   ❒ (4) 41 – 50 ปี ❒ (5) 51 – 60 ปี ❒ (6) 60 ปี ขึ้นไป
3. สถานภาพ
   ❒ (1) โสด ❒ (2) สมรส
   ❒ (3) อื่น ๆ (โปรดระบุ)_____
4. ระดับการศึกษา
   ❒ (1) ต่ำกว่าปริญญาตรี ❒ (2) ปริญญาตรี
   ❒ (3) สูงกว่าปริญญาตรี
5. อาชีพ
   ❒ (1) นักเรียน / นักศึกษา
   ❒ (2) ข้าราชการ / พนักงานรัฐ / พนักงานรัฐวิสาหกิจ
   ❒ (3) พนักงานบริษัทเอกชน
   ❒ (4) เจ้าของธุรกิจส่วนตัว
   ❒ (5) รับจ้างทั่วไป
   ❒ (6) อื่น ๆ (โปรดระบุ)_____

6. รายได้ประจำต่อเดือน

❒ (1) 10,001 – 20,000 บาท ❒ (2) 20,001 – 30,000 บาท

❒ (3) 30,001 – 40,000 บาท ❒ (4) 40,001 – 50,000 บาท

❒ (5) มากกว่า 50,000 บาท ขึ้นไป

7. ที่พักอาศัยปัจจุบัน

❒ (1) กรุงเทพมหานครและปริมณฑล ❒ (2) ต่างจังหวัด

<u>ตอนที่ 2</u> แบบสอบถามเกี่ยวกับการใช้ระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS

<u>คำชี้แจง</u> โปรดทำเครื่องหมาย ✓ ลงในช่อง ❒ หน้าคำตอบที่ตรงตามความเป็นจริงเพียง 1 ข้อ ถ้าไม่มีการระบุไว้เป็นอย่างอื่น และหากท่านเลือกคำตอบที่ระบุว่า **อื่น ๆ** กรุณาระบุรายละเอียดเพิ่มเติมในช่องว่าง

ในกรณีที่ไม่ใช้ระบบเก็บเงินค่าผ่านทางทำเฉพาะข้อ 1 ถึง 4

---

1. ท่านใช้ระบบเก็บเงินค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS หรือไม่

❒ (1) ใช้ ❒ (2) ไม่ใช้

2. ประเภทรถยนต์ที่ท่านใช้

❒ (1) รถเก๋ง ❒ (2) รถกระบะ

❒ (3) รถตู้ ❒ (4) อื่น ๆ _____

3. ท่านทราบว่ามีการนำระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS มาใช้จากแหล่งใด

❒ (1) โทรทัศน์ / วิทยุ ❒ (2) เว็บไซต์จากอินเทอร์เน็ต

❒ (3) หนังสือพิมพ์ / สื่อสิ่งพิมพ์ ❒ (4) พี่น้อง, ญาติ

❒ (5) เพื่อน. คนรู้จัก ❒ (6) อื่น ๆ _____

4. เพราะเหตุใดท่านจึงยังไม่เลือกใช้ระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS

❒ (1) ขั้นตอนในการสมัครมีความยุ่งยาก

❒ (2) อัตราค่าบริการ / ค่ามัดจำบัตรแพงเกินไป

❒ (3) ไม่มั่นใจในระบบตัดเงินค่าผ่านทาง

❒ (4) ช่องทางการจัดจำหน่ายและเติมเงินสำรองน้อย

❒ (5) ยังไม่มีความจำเป็นในการใช้งาน

❒ (6) อื่น ๆ _____

5. จุดประสงค์ที่ท่านเข้ามาใช้บริการระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS

❒ (1) ความพึงพอใจส่วนตัว

❒ (2) บริษัท / หน่วยงานที่ท่านทำงานออกค่าใช้จ่ายให้

❒ (3) ต้องการทดลองใช้ระบบใหม่

❒ (4) อื่น ๆ _____

6. จากข้อ 5 เพราะเหตุใดท่านจึงเลือกใช้บริการทางพิเศษ

❒ (1) ประหยัดเวลา ❒ (2) สะดวกรวดเร็ว

❒ (3) ใกล้ที่พักอาศัย ❒ (4) อื่น ๆ _____

7. ท่านใช้ระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS เฉลี่ยสัปดาห์ละกี่ครั้ง

❒ (1) 1 – 5 ครั้ง / สัปดาห์ ❒ (2) 6 – 10 ครั้ง / สัปดาห์

❒ (3) 11 – 15 ครั้ง / สัปดาห์ ❒ (4) 16 – 20 ครั้ง / สัปดาห์

❒ (5) มากกว่า 20 ครั้ง / สัปดาห์

8. ท่านใช้บริการระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS นี้มานานเท่าใด

❒ (1) ต่ำกว่า 1 เดือน ❒ (2) 1 – 6 เดือน

❒ (3) 7 เดือน – 1 ปี ❒ (4) มากกว่า 1 ปี

9. ด่านเก็บค่าผ่านทางที่ท่านใช้บริการระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS นี้เป็นประจำ (ตอบได้มากกว่า 1 ข้อ)

❒ (1) ทางพิเศษเฉลิมมหานคร (ทางด่วนขั้นที่ 1)

❒ (2) ทางพิเศษศรีรัช (ทางด่วนขั้นที่ 2)

❒ (3) ทางพิเศษฉลองรัช (ทางด่วนสายรามอินทรา – อาจณรงค์)

❒ (4) ทางพิเศษบางพลี – สุขสวัสดิ์

10. ช่วงเวลาที่ใช้บริการบ่อยที่สุด

❒ (1) 06.01 – 10.00 น. ❒ (2) 10.01 – 13.00 น.

❒ (3) 13.01 – 16.00 น. ❒ (4) 16.01 – 19.00 น.

❒ (5) 19.01 – 22.00 น. ❒ (6) 22.01 – 06.00 น.

11. จำนวนการเติมเงินในแต่ละครั้ง

❒ (1) 500 บาท ❒ (2) 501 – 1,500 บาท

❒ (3) 1,501 – 2,500 บาท ❒ (4) 2,501 – 3,500 บาท

❒ (5) 3,501 – 4,500 บาท ❒ (6) 4,501 – 5,000 บาท

12. สถานที่ที่ท่านคิดว่าสะดวกในการเติมเงินบัตร EASY PASS มากที่สุด

❒ (1) อาคารด่านเก็บค่าผ่านทางพิเศษของการทางพิเศษที่เปิดให้บริการระบบ

❒ (2) ศูนย์บริการลูกค้า บริษัท ทางด่วนกรุงเทพ จำกัด มหาชน (BECL)

❒ (3) ด่านเก็บค่าผ่านทางพิเศษด้วยเงินสด

❒ (4) ศูนย์บริการที่เดียวเบ็ดเสร็จ

❒ (5) ธนาคารกรุงไทย และธนาคารไทยพาณิชย์

❒ (6) Counter Service (แนวความคิด)

ตอนที่ 3 ข้อมูลเกี่ยวกับปัจจัยที่มีอิทธิพลต่อการตัดสินใจใช้บริการระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS

คำชี้แจง โปรดเลือกตัวเลขที่ตรงกับความคิดเห็นของท่านมากที่สุด ซึ่งมีความหมายดังนี้

1 = เห็นด้วยน้อยที่สุด 2 = เห็นด้วยน้อย
3 = เห็นด้วยปานกลาง 4 = เห็นด้วยมาก
5 = เห็นด้วยมากที่สุด

โดยทำเครื่องหมาย ✓ ลงในช่องคำตอบที่ตรงตามความเป็นจริงเพียงข้อเดียวเท่านั้น

ปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS	ระดับความคิดเห็น				
	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
	1	2	3	4	5
ด้านคุณภาพของระบบ (System Quality)					
1. ท่านคิดว่าการใช้ระบบ EASY PASS ทำให้ท่านได้รับประโยชน์ตามความต้องการ					
2. ท่านคิดว่าการทำงานของระบบ EASY PASS มีความน่าเชื่อถือ					
3. ท่านคิดว่าการตอบสนองของระบบ EASY PASS เป็นไปอย่างรวดเร็ว ปลอดภัย					
4. ท่านคิดว่าการแสดงผลการตัดเงินที่ป้ายบอกราคา และยอดเงินคงเหลือถูกต้อง แม่นยำ ตรวจสอบได้					
ด้านอิทธิพลทางสังคมที่มีผลต่อการตัดสินใจใช้ (Social Influence)					
5. ท่านคิดว่าเพื่อนหรือคนรอบข้างที่รู้จักมีอิทธิพลต่อท่านในการตัดสินใจใช้ระบบ EASY PASS					
6. ท่านคิดว่าการใช้ระบบ EASY PASS เพราะกำลังเป็นที่นิยม					

ปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS	ระดับความคิดเห็น				
	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
	1	2	3	4	5
ด้านการยอมรับนวัตกรรมใหม่ (Personal Innovativeness)					
7. ท่านมักจะอ่านข่าวสาร และข้อมูลด้านเทคโนโลยีใหม่ ๆ เสมอ					
8. ท่านมักจะพูดคุย หรือแนะนำเทคโนโลยีใหม่ ๆ กับคนรู้จัก					
9. ท่านชอบที่จะเป็นคนกลุ่มแรก ๆ ในการใช้งานเทคโนโลยีใหม่ ๆ					
ด้านความมั่นใจในการใช้ระบบฯ (Self-Efficacy)					
10. ท่านสามารถใช้ระบบ EASY PASS ได้อย่างง่ายแม้ไม่เคยใช้มาก่อน					
11. ท่านสามารถใช้ระบบ EASY PASS ได้ง่ายขึ้นเมื่อมีคนให้คำแนะนำการใช้					
ด้านสิ่งอำนวยความสะดวก (Facilitating Conditions)					
12. การทางพิเศษฯ มีการประชาสัมพันธ์ให้ทราบถึงรูปแบบการให้บริการที่มีความชัดเจน					
13. การทางพิเศษฯ มีหน่วยงานหรือเจ้าหน้าที่รับปัญหาจากการใช้บริการได้ทันที					
14. มีจุดสังเกตหรือป้ายบอกช่องทาง EASY PASS ที่ชัดเจน					
15. จำนวนเลน EASY PASS เพียงพอต่อความต้องการ					
16. การใช้บริการระบบ EASY PASS ไม่ต้องเปิดกระจกรถ ทำให้ไม่ยุ่งยากในการชำระค่าผ่านทาง					

ปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS	ระดับความคิดเห็น				
	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
	1	2	3	4	5
ด้านสิ่งอำนวยความสะดวก (Facilitating Conditions)					
17. เปิดให้บริการเติมเงินสำรองในบัตรผ่านช่องทางอิเล็กทรอนิกส์					
ด้านราคายุติธรรม (Perceived Fairness Price)					
18. ได้ส่วนเพิ่มค่าผ่านทาง 25 บาท ทุก ๆ การเติมเงิน 500 บาท					
19. ค่ามัดจำบัตรมีส่วนในการตัดสินใจ ในการใช้บริการ					
20. ท่านคิดว่ามีความคุ้มค่าในการใช้ระบบ EASY PASS ทำให้ยอมรับค่ามัดจำบัตรได้					
21. ท่านคิดว่าการทางพิเศษฯ ควรมีการลดค่ามัดจำบัตรลง					
ด้านการรับรู้ว่ามีประโยชน์ (Perceived Usefulness)					
22. ระบบ EASY PASS ตอบสนองความต้องการในช่วงเวลา เร่งด่วน					
23. ระบบ EASY PASS ช่วยเพิ่มความสะดวกในการเดินทางของท่าน					
24. ระบบ EASY PASS ช่วยประหยัดเวลาโดยรวมในการเดินทาง					
25. ระบบ EASY PASS ช่วยเพิ่มประสิทธิภาพในการเดินทางและในการชำระค่าผ่านทาง					
ด้านการรับรู้ว่าง่ายในการใช้ (Perceived Ease of Use)					
26. ระบบ EASY PASS ง่ายต่อการใช้บริการ					
27. ระบบ EASY PASS ใช้งานเพียงไม่กี่ครั้งก็สามารถเกิดความชำนาญ					

ปัจจัยที่มีอิทธิพลต่อการยอมรับระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS	ระดับความคิดเห็น				
	น้อยที่สุด	น้อย	ปานกลาง	มาก	มากที่สุด
	1	2	3	4	5
ด้านทัศนคติในการใช้ (Attitude)					
28. ท่านมีความพึงพอใจในการใช้ระบบ EASY PASS เพื่อชำระค่าผ่านทาง					
29. ท่านเห็นด้วยกับการใช้ระบบ EASY PASS เพื่อชำระค่าผ่านทาง					
30. การใช้ระบบ EASY PASS เพื่อชำระค่าผ่านทางเป็นวิธีการที่ดีสำหรับท่าน					
31. ระบบ EASY PASS เป็นระบบการให้บริการที่มีคุณภาพ					
ด้านความตั้งใจในการใช้ (Intension to use)					
32. ท่านมีความสมัครใจที่จะใช้ระบบ EASY PASS ในการชำระค่าผ่านทาง					
33. ท่านมีความตั้งใจที่จะใช้ระบบ EASY PASS ในการชำระค่าผ่านทางทุกครั้ง					
34. ท่านคิดว่าเมื่อได้ใช้งานระบบ EASY PASS แล้ว ท่านจะแนะนำให้ผู้อื่นได้ใช้งานเหมือนท่านด้วย					
35. ท่านยังคงใช้บัตร EASY PASS ต่อไป แม้จะมีการขึ้นค่าบริการ					

<u>ตอนที่ 4</u> ข้อคิดเห็นและข้อเสนอแนะอื่น ๆ เพื่อใช้เป็นแนวทางในการพัฒนาระบบเก็บค่าผ่านทางอัตโนมัติ (ETC) หรือ EASY PASS

ข้อคิดเห็นและข้อเสนอแนะที่ท่านมีต่อระบบเก็บค่าผ่านทางอัตโนมัติ **(ETC)** หรือ **EASY PASS**

_____

_____

_____

_____

_____

_____

_____

_____

ꕥ ขอขอบพระคุณท่านเป็นอย่างสูงที่กรุณาให้ความร่วมมือในการตอบแบบสอบถามนี้ ꕥ

BIOGRAPHY

NAME	Miss Warinya Meesilapawikkai
DATE OF BIRTH	19 June 1976
PLACE OF BIRTH	Bangkok, Thailand
INSTITUTIONS ATTENDED	Siam University, 1995-1999 Bachelor of Accounting
	Mahidol University, 2005-2012 Master of Science (Technology of Information System Management)
HOME ADDRESS	367 Issaraphap Rd, Klongsan, Bangkok, Thailand 10600
E-MAIL ADDRESS	pookpik799@hotmail.com