USAGE OF SMART CARD E-PAYMENT IN PUBLIC TRANSPORTATION AND OTHER ENTERPRISES. AN EMPIRICAL STUDY IN PENANG

By

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ABSTRAK

Kad pintar hari ini digunakan di seluruh dunia sebagai kad pengenalan peribadi untuk akses komputer peribadi peralatan kawalan dan sistem keselamatan bangunan korporat. Di samping itu, ia bertindak sebagai satu cara untuk menyediakan keselamatan dan perkhidmatan yang lebih baik kepada pelanggan dan pengguna. Pengangkutan, telekomunikasi, kerajaan, perkhidmatan kewangan, penjagaan kesihatan, pendidikan, perusahaan, runcit dan industri lain-lain lagi merancang atau telah menggunakan kad pintar.

Selain itu, kad pintar mencipta nilai kepada kedua-dua pengguna dan perniagaan yang serupa melalui peningkatan kelajuan dan daya pemprosesan pada pengangkutan awam, menawarkan kecekapan dan kemudahan bagi urus niaga pembelian. Ianya juga menyediakan kemudahan keseluruhan dan kecenderungan terhadap satu kad yang digunakan dalam pelbagai aplikasi. Oleh itu, teknologi kad pintar adalah salah satu daripada revolusi-revolusi komputer yang paling terkini dan ia perlu membuat cara yang di seluruh dunia ke dalam tangan dan dompet semua orang.

Walau bagaimanapun, terdapat sedikit kajian yang dilakukan ke atas faktor-faktor yang menerima pakai teknologi kad pintar dalam pengangkutan awam dan perusahaan lain. Ini adalah kajian penerokaan untuk model menentukan samada seseorang itu mempunyai kecenderungan atau niat untuk menggunakan kad pintar

dalam pengangkutan awam dan perusahaan lain. Dalam kajian ini, Model Penerimaan Teknologi (TAM) disesuaikan sebagai model asas dan dilanjutkan dengan memperkenalkan pembolehubah lain. Data ini dikumpul daripada soal selidik yang ditadbir sendiri daripada 150 responden. Hasil kajian menunjukkan keserasian itu mempunyai pengaruh yang paling penting ke arah niat untuk menggunakan kad pintar, diikuti dengan anggapan senang diguna, keselamatan dan pengalaman sediaada. Pembolehubah lain yang diperolehi serderhana untuk mempengaruhi niat untuk menggunakan kad pintar termasuk pengaruh sosial dan tanggapan nilai kegunaan. Kajian itu juga mendapati bahawa sokongan adalah tidak penting ke arah niat untuk mengunakan kad pintar. Dengan memahami semua faktor-faktor ini boleh membantu pengendali kad pintar, agensi-agensi pengangkutan awam, pengendali Koleksi Tol Elektronik (ETC), perusahaan dan peruncit untuk menyusun strategi perancangan dan pelaksanaan mereka dalam membina sistem e-pembayaran dan ianya juga dapat dipelbagai guna dalam sistem transaksi urusniaga lain seperti bayaran untuk pengangkutan awam, meter letak kereta, pasar raya, dan restoran.

USAGE OF SMART CARD E-PAYMENT IN PUBLIC TRANSPORTATION AND OTHER ENTERPRISES. AN EMPIRICAL STUDY IN PENANG

ABSTRACT

Today smart cards are used all over the world as personal identification cards for personal computer equipment access control and corporate building security systems. In addition, smart cards act as a means of providing better security and improved services to its customers and users. Transportation, telecommunications, governments, financial services, healthcare, education, enterprises, retails and many other industries are planning or already using the smart cards.

Moreover, smart cards create value to both consumers and businesses alike by increasing speed for throughput processes on public transport, offering efficiency and convenience for purchase transactions, and providing overall ease and versatility in multiple applications. Thus, smart card technology is one of the most recent computer revolutions and it should be making its way into the hands and wallets of everyone worldwide.

However, there is little study done on the technology adoption factors on smart card in public transportation and other enterprises. This is an exploratory study to model the determinants of intention to use smart card in public transportation and other enterprises. In this study, the Technology Acceptance Model (TAM) is adopted as the fundamental model with adaptations to include other variables. Data was collected with a self-administered questionnaire from 150 respondents. The findings showed that

compatibility has the most significant influence towards intention to use, followed by perceived ease of use, security, and prior experience. Other variables found moderate significant influence towards intention to use included social influence and perceived usefulness. The study also found that support is non significant towards intention to use. Knowing and understanding all these factors can help smart card operators, public transportation agencies, electronic toll collection (ETC) operators, enterprises and retailers to strategize their planning and implementation in building an e-payment system. It can boost the growth of its usage from its currently limited deployment for highways toll payment to fare payments for public transportation and other various forms of payment in car park meters, supermarkets and restaurants.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter shall explain an introduction to this study and comprises eight sections. The first three sections illustrate the background of the studies. The rest of the following sections discuss foundation of the concerns and consequence of the problems if unattended, research objectives, research questions and the definitions of the independent and dependent variables.

1.2 Background of the Study

The arena of modern day information technology, smart cards play a primary function with its microprocessors recognized as verification tokens in identification cards, passports, automated teller machine (ATM), debit, credit cards, mobile phones and so forth. Microprocessors were believed to be a flexible approach to protect data and information storage during their invention in the 60s and 70s (Jurgensen & Guthery, 2002; Markantonakis, 2008). The key features of smart cards technology and therefore the microprocessors such as their security, programmability, and upgradeability are considered to have contributed towards their extensive disposition (Markantonakis, 2008; Markantonakis & Mayes, 2003).

Since the technology was invented it has in the 1970s with many functions and characteristics were extended to primary theory (Shelfer & Procaccino, 2002). Smart

cards are very convenient and easy to carry (because of its credit card size), reliable, and long lasting (Lu, H. K., 2007). Therefore smart cards are formed to collect and run data and put them together suitable for payment, identification, authorization and other applications.

The smart cards provide simplicity, speed, security (prevent fraud), and flexibility. Therefore users recognize their benefits and this has spurred the extensive development and growth in the transport area. Within London transportation, Oyster card has permitted customers to use the public transport without the necessity to carry cash or coin, queuing for tickets and getting the lowest fare (Transport for London, 2011). Octopus card in Hong Kong (Octopus Cards Limited, 2009) and EZ Link in Singapore (EZ-Link Pte Ltd Co, 2011) are the comparable systems in the Asia countries. There is considerable awareness in the adoption of multi-functional smart cards and the development of these systems become more compatible and well-known, such as mobile phones with contact-less card interfaces with Near Field Communication (NFC) (Near Field Communications World, 2011) and credit card plus e-ticket (Federal Reserve Bank of Boston, 2011).

Many considered smart cards as one form of intelligent transportation system (ITS) technologies of the next generation for fare collection media in transport systems. In the United States, pilot projects or conversions to smart card systems as a fare payment medium are viewed as growing among the transportation agencies (Iseki, Yoh, & Taylor, 2007). This flexible fares implementation improves fare responsibility; smart card systems have the possibility to enhance transport service processes and strategies (Chira-Chavala & Coifman, 1996). Furthermore, smart cards can reduce boarding time

and offer wide-ranging ridership and journey data than presently available in the system by offering the convenience and a faster processing speed (Fleishman, Schweiger, Lott, & Pierlott, 1998; Maxey & Benjamin, 2001; McDonald, 2000). The adoption across multiple transit operators and the use of a same platform, riders can use one smart card across service region and allowing operators to offer ideal travelling (Balducci, 2003).

People are becoming dependent on smart cards and like devices for communication, purchases and services as seen by global growth of electronic transactions. A contactless smart card technology was launched on 1 September 1997 in Hong Kong. This Octopus card was a touch-and-go electronic payment system card and has become a link to the lives of 95% of Hong Kong residents on a daily basis since its launch. Now, it is the most comprehensive and world‟s leading smart card system through innovative technical and business development of its engineers and with the cooperation of transportation operators (Octopus Cards Limited, 2005a).

The Octopus card is defined as a stored value card or multipurpose card. In this case, a person pays a sum of money to the Octopus card company (card issuer) in order for the value of that money to be stored in the card as data. This data is stored in magnetic, electronic or optical form. The person may then obtain the supplied goods and services (including money) by just producing the card to the card issuer or the appointed third party (Hong Kong Monetary Authority, 2011).

The probability of using smart cards as another method for business activities is realized by the organizations from different sectors in various countries. The powerful capability of Octopus is leveraged by the transport and business sectors in Hong Kong. The employers has reduced cost and retained customers simultaneously. Furthermore

organizations has maintained profitable growth by Octopus help (Paynter & Law, 2001).

In the initial stages, Octopus Cards Limited (OCL) was deployed for transport payment, the strategic moves in developing an e-payment system and increasing its expansion to payments for a variety of different type of business dealings such as restaurants, supermarkets, petrol station, vending machines, parking meters, and so forth. In Hong Kong, Octopus smart card sustained primacy of e-payment business with their business and technology strategies and alignment in rapid diffusion (Banerjee, Ma, Lai, & Shroff, 2008).

There are several advantages of fare collection methods by using smart card e-payment if compared to other traditional methods such as cash, common tickets, prepaid monthly passes, and magnetic cards for public transportation are (Vuchic, 2005). The advantages are:

i. User friendly and convenience: The magnetic cards and common tickets are less convenient than smart cards. The smart card is durable and is a perpetual fare payment system which can be operated for many years and the user does not need to put the smart card in a reader, just the same as the case for magnetic cards (Phil Blythe & Holland, 1998).

ii. Vehicle not delaying: Boarding time is shorter if compare traditional methods by using cash payment method. It takes about 1.5 sec of networking within the smart card and the reader (White, Bagchi, Bataille, & East, 2010).

iii. Ease of monitoring the payment: The smart card transactions are simple to compose, if compared to using cash, magnetic cards, and other electronics

payment channels. The users can get the bills and the transit authority can summarize the financial reports quickly and accurately.

iv. Reduction in operating costs: The major disadvantage of the smart card system is it needs fund or money for the instrument at counters or boarded the transport with the information system fundamental and the assigned personnel. Thus, the transit authorities can add other functions to make the equipment more profitable, for example like money counting machines, electronics route display, and the drivers‟ working aspect. The transport operating costs can reduce with implementing smart card e-payment system. The operating costs come from the purchase of the fare machine boxes and the instrument maintenance costs, employee‟s salary, tickets‟ issuing cost which is about 5-15% of the profits and therefore high funding is needed (Smart Card Alliance, 2010).

v. The fare deposits or credit security: The smart card authenticates the right to travel, whenever a passenger embark on bus, train, ferry or others transportation at the terminal or counter. Thus, it reduces fraud like magnetic cards. By using the traditional fare collection methods like cash payment or tickets, which expend more time and require many employee for the report amendment.

vi. Interoperability: The complicated fare system with many zones are not easy to be implemented by using common ticket and prepaid monthly passes, because the smart card always need to verify at the entry and exist stations, and which is inappropriate with the driver‟s work aspect. But smart card has the capability to use multiple fare system and styles. It can verify embarking, plan out the fares,

support different mode of fare at the same time, and change fare system by recoding the reader device.

In a nutshell, the advantages of using the smart card e-payment system for fare collections have been proved and justified by the previous researchers. The advantages mentioned above will strongly encourage the acceptance and participation of the users, smart card service providers and operators, in the smart card e-payment system implementation.

1.3 Overview of Customer Acceptance Model for the Usage of Smart Card E-payment in Malaysia

Touch 'n Go Sdn. Bhd. (TNGSB) is the operator of Touch „n Go, SmartTAG and the Central Clearing House System (CCHS). In March 1997 Touch 'n Go Sdn. Bhd. officially launched its services at Metramac highway and PLUS expressways. TNGSB offers a prepaid e-payment card (Touch „n Go card) or contactless fare payment services to improve the expediency and effectiveness of paying for low-value but high frequency transactions. At the point-of-usage, it reduces the transaction time efficiently and diminishes the problem of getting ready small change for the fare (Touch 'n Go Sdn Bhd, 2011).

In Malaysia, for all highways Touch „n Go is the only Electronic Toll Collection (ETC) operator and as the Common Ticketing System (CTS) for major public transports in Federal Territory of Kuala Lumpur, Federal Territory of Putrajaya and Klang Valley in Selangor. Moreover, in Selangor, the Touch „n Go card might be accepted in enterprises or retail shops as e-payment like Sakae Sushi, Starbucks Coffee, Nasi

Kandar Pelita, A&W, Caltex, Cathay, and so forth and the number of retails will continue to increase (Touch 'n Go Sdn Bhd, 2011).

Beginning 27 Feb 2011, RapidKL introduced the new smart ticketing system like touch-and-go electronic payment system card. Which provide a) Easy - the new smart ticketing system guarantees faster ticket transactions and reduce queue time. An overall seamless travel, wherever your current location and desired destination; b) Environmental friendly - go green. The paperless system means more trees are saved; c) Accessibility- integration and connectivity. The new bus ticketing system makes inter-modal transport a breeze among RapidKL Bus, LRT, KL Monorial and Park-n-Ride; d) Accuracy – GPS Tracking. The built-in GPS system recognizes bus zones and allows for automated and accurate fare deduction. Furthermore, Rapid KL had collaborated with Touch n Go Sdn. Bhd. for the payment method and the card can be used on all highways and tolls throughout Malaysia, provided there is value in the card (Rangkaian Pengangkutan Integrasi Deras Sdn Bhd, 2011).

Starting 1 June 2011, Rapid Penang Sdn. Bhd. just began a test run of its e-ticketing system for three months to enhance the bus fare collection process. Under the "Tap-to-pay" electronic fare system, customers only have to tap their bus passes on decoders once they board the bus, and the fare will be deducted automatically (Rapid Penang Sdn. Bhd., 2011).

1.4 Statement of Research Problem

Smart card technology is among the quickest growing use of existing technologies (Masrom, Ismail, Ahmad, & Taherdoost, 2009b). Furthermore, the technology has

greatly improved the ease and security of payment transactions by using the smart card. In smart card e-payment systems development, the acceptance has been viewed as a role of customer assurance. Thus, it is essential to view customer acceptance and assurance as a very important aspect of the smart card e-payment system for continuous further development.

Researchers in a diversity of fields and purchasers of technology for giant organizations are interested to understand the factors that affect customer acceptance of information technology (Masrom et al., 2009b). Understanding the user view of and behavioural intention to adopt technology ought to become vital in the judgment making process (Masrom et al., 2009b).

Currently, users or customers are facing problems by using the traditional payment method such as cash transactions in public transportation and other business transactions. For public transportation, each time before boarding a bus and ferry, the passengers must ensure that they have the small change or coin for paying the fares. Most of the time, it takes extra time on queuing, counting, paying, changing, and boarding at the ticketing counters or fare collection machine box at the entry gates by using cash or coins. These has caused passengers spending and taking extra time, especially during peak hour, and for preparing small change it might cause the a long queue at the ticketing counter, congesting the road traffic, and delaying the arrival of the desired destinations at the prescheduled time. For other business transactions, such as car parking, supermarkets, restaurants, petrol stations, and so forth, the users or customers often queue at the tickets paying machine and cashier counters for payment

transaction. It takes longer transaction time when the money is stuck on the ticket paying machines, vending machines and changing money machines.

In fact, the smart card e-payment is not relatively new in Malaysia. The Touch 'n Go card was implemented since 1997 for use in all highways and Penang Bridge (Penang Bridge Sdn Bhd, 2011; Touch 'n Go Sdn Bhd, 2011). However the majority of the consumers still prefer to pay cash at the toll collection counters. The reason is there is a service charge or transaction cost imposed on reloading by each operator with the amount of RM0.50 per transaction at petrol stations, third party agents, and banks (users must have an ATM account, but it is still opened to customers with a service charge is RM1.00 per transaction). Moreover, first time users have to buy the smart card at RM10.00 each. Besides, the number of merchants, enterprises, and retailers accepting the smart card e-payment system is still not significant in other states such as in Penang. The consumers mainly use the smart card for Penang Bridge and highways use only.

Centre Bank of Malaysia Financial Report 2010 revealed that Touch 'n Go processed over 684.6 million transactions amounting to RM2 billion, which accounted for volume (7.9%) and value (74.5%) of total e-money (electronic money) transactions. According to this report, Table 1.1 has revealed that e-money value of transaction per capita was only even 5% out of the cash in circulation value of transaction per capita in Year 2010. It showed that our society has still yet to be consistent with the evolutionary cashless and paperless for environmental friendly, improving the society standard of living, and productivity (Centre Bank of Malaysia, 2010).

Table 1.1

The Value (RM) of Transaction per capita in Malaysia from 2006 to 2010

YEAR	2006		2007		2008		2009		2010	
VALUE OF TRANSACTION PER CAPITAL	**RM**	**%**	**RM**	**%**	**RM**	**%**	**RM**	**%**	**RM**	**%**
Cash In Circulation	***1,249.30***	***1.76***	***1,333.30***	***8.58***	***1,467.80***	***1.57***	***1,557.20***	***1.68***	***1,687.90***	***1.49***
Cheque	53,741.70	75.68	63,049.50	405.59	63,962.90	68.60	60,068.50	64.95	65,209.10	57.74
Credit Card	1,772.40	2.50	2,067.70	13.30	2,370.70	2.54	2,485.00	2.69	2,825.10	2.50
Charge Card	87.20	0.12	89.00	0.57	111.10	0.12	148.60	0.16	183.30	0.16
Debit Card	24.20	0.03	41.50	0.27	71.10	0.08	99.40	0.11	166.80	0.15
E-money	***47.50***	***0.07***	***60.30***	***0.39***	***75.10***	***0.08***	***78.90***	***0.09***	***95.90***	***0.08***
Interbank GIRO	1,705.20	2.40	2,462.90	15.84	3,254.10	3.49	3,902.00	4.22	4,490.90	3.98
MEPS Direct Debit	0.70	0.00	16.40	0.11	35.80	0.04	68.10	0.07	133.60	0.12
ATM	80.00	0.11	857.60	5.52	696.80	0.75	708.90	0.77	1,107.40	0.98
Internet banking	12,306.10	17.33	12,207.30	78.53	21,194.20	22.73	23,361.90	25.26	37,030.50	32.79
Mobile banking	0.40	0.00	0.80	0.01	2.50	0.00	4.70	0.01	4.30	0.00
Total	71,014.70	100.00	15,545	100.00	93,242	100.00	92,483	100.00	112,935	100.00

***Sourced from Centre Bank of Malaysia Financial Report 2010

Based on the latest Auditor-General's Report 2010, it has revealed that Rapid Penang‟s establishment since February 2007 through 2010 recorded a total of RM1.14mil in fare discrepancies. It also reported the bus company had suffered losses before tax for 2008 (RM7.67mil), 2009 (RM10.68mil) and no figure was quoted for 2010. The main reasons reported by Rapid Penang‟s from such losses included insufficient bus station and bus centers, not well-managed cleaning contracts for buses and Rapid Penang premises, deferred transportation projects and not fully utilized hostels (The Star Online, October 24, 2011).

According to the Malaysia population distribution report 2010, the total population in Penang was 1.56 million (Department of Statistics Malaysia, 2010). If compared to the number of registered users for monthly passes reported by Rapid Penang Sdn. Bhd as in Table 1.2, it was only around 3.3% of the population using

public transport in Penang. The rest of them might be using their own vehicles such as cars, motorcycles, bicycles, and so forth. Consequently, Penang is facing traffic congestion issues especially during peak hours.

Table 1.2

The Number of Users for the Monthly's Passes from 2008 to 2010

YEAR	YOUTH	PASSPORT	PREFERRED	EMAS	COMBO
2008	996				
2009	4,782	3,770	811		
2010	19,075	26,623	3,252	2,461	
2011 (May 2011)	5,625	1,051	7,575	3,218	191

***sourced from Rapid Penang Sdn Bhd

On the other hand, the Business Ferry Services Unit, Penang Port Sdn. Bhd. is facing problem of the vehicles and pedestrians stuck because of congestions at the ticketing counters (stop-pay-change-go traffic). The statistics below is the total number of ferry trips, vehicles, and pedestrians from 2009 to 2010 (see Table 1.3).

Table 1.3

Total Number of Ferry trips, Vehicles, and Pedestrians from 2009 to 2010

YEAR	TRAFFIC CLASSIFICATION (TOTAL NO OF)						TOTAL NO OF
	BICYCLES	CARS	LORRIES	MOTORCYCLES	PEDESTRIANS	TRISHAWS	FERRY TRIP
2009 (Jan-Dec)	14,566	1,210,658	85,566	1,821,237	2,128,223	701	39,782
2010 (Jan-Dec)	13,920	1,034,568	72,725	1,601,288	1,833,752	835	34,696
2011 (Jan-May)	7,065	394,625	26,577	630,979	771,493	369	13,718

***sourced from Penang Port Sdn Bhd

Since smart card e-payment technology involves huge amount of investment especially in public transport, we should learn more about the users" acceptance on this technology innovation. Thus, the problem areas in this study are the public

transportation agencies, smart card service providers and operators, Electronic Toll Collection (ETC) operators, enterprises and retailers who are still not drastically able to understand the users‟ acceptance of smart card e-payment in public transport and other enterprises although those applications are not relatively new in Malaysia. The result in terms of savings of cost, time and convenience with the smart card e-payment would be noteworthy, but it will be a waste of money if there is no users‟ acceptance. Therefore, there is a need to study the factors for determining Malaysian users‟ intention to adopt this technology in the public transportation and other enterprises.

1.5 Research Objectives

This research attempts to identify the factors that influence the intention to use smart card e-payment in public transportation and other enterprises by users in Penang as a location for research study. Moreover, it makes recommendations to public transportation agencies, smart card service providers and operators, Electronic Toll Collection (ETC) operators, enterprises and retailers for the implementation of the use of smart card e-payment system. The customer acceptance model for the usage of smart card e-payment is measured by intention to use smart cards e-payment in public transportation and other enterprises.

1.6 Research Questions

To achieve the objectives of this research, the following questions are addressed:

- What are the factors that would influence the intention to use smart card e-payment in public transportation and other enterprises?

Sub questions are:

a) Does perceived usefulness influence the intention to use smart card e-payment in public transportation and other enterprises?
b) Does perceived ease of use influence the intention to use smart card e-payment in public transportation and other enterprises?
c) Does compatibility influence the intention to use smart card e-payment in public transportation and other enterprises?
d) Does social influence the intention to use smart card e-payment in public transportation and other enterprises?
e) Does security influence the intention to use smart card e-payment in public transportation and other enterprises?
f) Does support influence the intention to use smart card e-payment in public transportation and other enterprises?
g) Does prior experience influence the intention to use smart card e-payment in public transportation and other enterprises?

- Would the public favour the implementation of the use of smart card e-payment in public transportation and other enterprises?

There is limited research studies conducted regarding the adoption of smart cards e-payment in public transportation and other enterprises by individuals in Malaysia. The current available research material is mainly centered on smart card adoption. Thus, it is timely and worthwhile to conduct an exploratory research to

understand individual‟s intention to use smart cards e-payment in public transportation and other enterprises in Malaysia.

1.7 Significance of Study

This study is to identify and analyze the factors affecting the intention to use smart cards e-payment system in public transportation and other enterprises. It will highlight the main issues, and reveal the strongest factors influencing the customers to adopt this payment channel. This research will be useful to enable the public transportation decision makers, smart card systems vendors and service providers to formulate the appropriate strategies to encourage rapid migration of customers from cash to cashless and paperless by using smart cards e-payment in their daily low-value but high frequency daily transactions. There is still strong potential for growth for smart card e-payment, thus, the customers‟ or users‟ understanding of the technology must be developed.

1.8 Definition of Terminology

Some important terms used in the study are definite conceptually in this section:-

Perceived usefulness (PU) – define as the degree to which an individual believes that using a particular system would enhance his or her productivity (Davis, 1989).

Perceived ease of use (PEOU) – define as the degree of an individual believes that using a particular system would be free of effort (Davis, 1989).

Compatibility (COMP) – define as the degree to which the innovation is perceived to be consistent with the potential users‟ existing values, previous experiences and needs (Karahanna, Straub, & Chervany, 1999; Rogers, 2003).

Social Influence (SI) – define as the degree to which an individual perceives that it is important others believe he or she use the new system (Ajzen, 1985; Venkatesh & Davis, 2000).

Security (SEC) – define as the degree to which a person feels that security is important to them and believes that using smart card is secure (Vijayasarathy, 2004).

Support (SUPP) – define as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system (Al-Gahtani, Hubona, & Wang, 2007; Bailey & Pearson, 1983).

Prior experience (PRIORE) – the extent to which previous experience is a determinant of behaviour (Ajzen & Fishbein, 1980). We predict that those who have used the system before have more favourable towards its used rather than those who gave not used.

Intention (INTENT) – define as a function of the individuals attitude and subjective norm. The individual‟s attitude and subjective norm are both considered a function of the weighted sum of the appropriate beliefs (Ajzen & Fishbein, 1980).

1.9 Organization of the Chapters

This dissertation has been organized into five chapters. The first chapter explains the background of previous studies, foundation of the concerns, consequence of the problems, research objectives and questions, and the definitions of the independent and

dependent variables. The second chapter contains some previous studies on smart card technologies, literature review, various models and theories on the adoption of new technologies. The conceptual framework and hypotheses of the study are developed according to the literature review in this chapter. Chapter three discusses the research design, sampling technique and methodology for data collection and analysis. Chapter four discusses and presents the result and statistics findings derived from data analysis. The final chapter concludes with the recapitulation of the study, major findings, implications, limitations, future research suggestions and lastly the conclusion for this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter consists of the literature review for this study. It starts with an explanation on smart cards e-payment, followed by the description of various models on adoption as a new system. The next two sections will explain the comparisons of the models and the past research done on the extensions of the technology adoption model. The conceptual framework and hypotheses of the study are developed according to the guidance of literature review.

2.2 Smart Card

In 1968, Dethloff and Grotrupp published the first patent and evolved the theory of a plastic card which comprising a microchip (Shelfer & Procaccino, 2002). The Japanese listed a patent for smart card with their own edition by following the principle of the Germans in 1970 (Attoh-Okine & Shen, 1995). The first protected single chip microcontroller was developed by Motorola at the end of 1970. In order to enhance security in transactions, smart card was used by the French banking system. Since 1990 the adoption of smart card has become significant along with the extensively growth of the Internet and the increased elegance of mobile communication technologies (Blythe, P., 2004).

It has been almost three decades since Roland Moreno invented and patented the smart card technology in 1974 (Quisquater, 1997). In European and Asian regions, smart cards gained widespread acceptance (McElroy & Turban, 1998). Smart cards was forecasted by Schlumberger one of the world leaders, that more than 3100 million smartcards would be consumed worldwide by the year 2003 (Paynter & Law, 2004).

2.2.1 Smart Card E-Payments and Payment Stakeholders

Due to Electronic payment systems (EPS) significantly for completing the customer adapted electronic commerce transactions. EPS has drawn much attention from practitioners and researchers and this has led to a fast growth in the expansion of a variety of electronic payment systems. Early researches on electronic payment systems mostly fixed on the technological aspects of the system, especially those that are connected to the functionality and execution issues (Camenisch, Maurer, & Stadler, 1996; Herzberg, 2003)

Since various electronic payment systems have unsuccessful to be spread within the society. Most recently, the significant of study in this aspect has transformed to the administrative or industry aspects of electronic payment systems and also taken into consideration for the user‟s point of view. These most recent studies investigate these problems as causes for use and nonuse of the system, the process of acceptance by the users, in addition to advantages and disadvantages of the system based on various scope, including transaction costs, risks, size of payments, and actual payment time (Chau & Poon, 2003; Z. Liao & Wong, 2004; Yu, Hsi, & Kuo, 2002).

Normally, an electronic payment system is not supported by one association only, but by a range of groups (stakeholders) that are thoroughly organised in an intended approach by some prearranged rules. The stakeholders are any groups that have empowered interest in the achievement of the system and are influenced by the system and, hence, play a vital role in assuring the achievement of the system. In addition, consumers and merchants are also deemed as stakeholders while they are influenced by the payment system. Since stakeholders have different tasks, interests, and unknown agendas which all influence the achievement of the electronic payment systems. Therefore, a better comprehension of the expansion process of the systems can be achieved by researching electronic payment systems from the stakeholder perspective (Au & Kauffman, 2003).

2.2.2 Smart Card E-payments and Payment Models

Smart cards are basically credit card sized plastic cards with a memory chip and in some cases, with microprocessors implanted in them so as to provide as storage devices for much greater information than credit cards with inbuilt transaction processing capability. Thus, smart cards based electronic payment system is accepting and recognising improved interest as a mode of online payment (Chakrabarti & Kardile, 2002).

Over two decades now Smart cards have been in widely used mostly in Europe and Asian Countries. Moreover, due to their significant flexibility, they have been used for a wide range of service as highway toll payment, as prepaid telephone cards and as stored value debit cards. Smart card also comprises a few kinds of an encrypted key that

is compared to a secret key controlled on the user‟s processor. Some smart cards have condition to allow users to enter a personal identification number (PIN) code.

Hence, the vital success factors for smart card based payment system are creating a standard smart card system, or construct a different system interoperable with one another. Kalakota and Whinston (1996) categorized smart cards based electronic payment system as relationship based smart cards and electronic purses. Electronic purses may supersede money and are also known as debit card. Further Diwan and Sharma (2001), Sharma and Parag (2000) and Sumanjeet (2009) categorized smart cards into four types as memory cards, shared key cards, signature carrying card, and signature carrying cards.

2.2.3 Smart Card Applications and Public Transit Implementation

There are various functions to smart cards and its practice is becoming further widespread in our culture (McElroy & Turban, 1998). Currently the application of smart card can be discovered in healthcare, investment, government, education, human resources, electronic payments, access control, telecommunications, and of course, transportation, or transit. The technology provided the competence, comprehension, improved capacity, and cut cost, which attracted acceptance from consumers, and organisations (Hibbert & Here, 2000; McElroy & Turban, 1998; Puri, 1997; Szmigin & Bourne, 1999).

Most of the transport agencies are interested in smart card technology and they are replacing the traditional methods of payment like cash, common tickets, prepaid monthly passes and magnetic cards with the smart card as an applicable payment choice

(Blythe, P., 2004). The users perceived smart cards as a safe system for verification and fare payment collection**.** By using smart card system for collect the fare, the driver‟s job becomes easier. Moreover, it enhances the accuracy of the data and serving the transport a more modern view by the flexibility of fare system (Dempsey, 2008)**.** The smart card is played an important role for government who has stated the intention to creating world-class transit systems all over the United States (United States Department of Transportation, 2010). Now, smart cards have been enforced in Canada, instead of regularly used in Asia and Europe. Table 2.1, lists out the first launched smart cards of the selected countries‟ in the world (Wikimedia Foundation Inc., 2011).

Table 2.1 :

The First Launched Smart Cards of the Selected Countries' in the World

COUNTRY	PLACE	CARD	PROVIDER	INTRODUCTION
Finland	Oulu	Bus card	Koskilinjat OY	Jan-92
South Korea	Seoul Metropolitan Area	Upass	Seoul Metropolitan Bus Operator Association	Jun-96
Egypt	Cairo ,Menatel	Gemplus	Gemplus	Jan-97
Malaysia	(Whole area)	Touch 'n Go	Touch n Go Sdn Bhd	Mar-97
China	Hong Kong	Octopus	Octopus Cards Limited	Sep-97
Japan	Hiroshima	Skyrail IC Card	Skyrail Service	Aug-98
Russia	Moscow	Transport Card	Moscow Metro	1-Sep-98
Germany	Region Donau-Iller	DingCard	Donau-Iller-Nahverkehrs-GmbH	1998
Japan	Asahikawa	Do Card	Dōhoku Bus	Nov-99
China	Shanghai	CPTC / Jiaotong Yikatong	Shanghai Public Transportation Card Company, Limited	Dec-99
United States	Washington, D.C.	SmarTrip	Washington Metropolitan Area Transit Authority	1999
Italy	Rome	Metrebus Card	Motorola/ST	1999
Luxembourg	(Whole area)	miniCash electronic purse	Cetrel	1999
United Kingdom	Nottingham	EasyRider	Nottingham City Transport	Sep-00
Singapore	(Whole area)	EZ-Link	EZ-Link Pte Ltd	2001
United Kingdom	London	Oyster card	Transport for London	Jan-04
Thailand	Bangkok	Bangkok Metro Smart card	Bangkok Metro	2004
India	New Delhi	Delhi Metro Smart Card	Delhi Metro Rail Corporation	2005
Philippine	Manila	G-Pass	Globe Telecom	Jul-06
Indonesia	(Almost whole area)	Flazz	Bank Central Asia	2007

***sourced from Wikimedia Foundation Inc.

2.2.4 Smart Card E-Payment Privacy Concerns

The dilemma that has been disputed in various research studies is the smart card‟s accessible data and it is lead to the major privacy apprehension on the consumers. On

the other hand, the increasing amount of data collected can be treated as an enhancement in security, because the police can exploit it as an evidence for investigation, since the operator has extensive information of the position of consumers (Dempsey, 2008).

The issues related to smart card adoption are almost similar as those for debit cards, credit cards, on-line banking, Internet shopping, Internet purchase, e-government, cell phone telecommunication, and other path of technologies (Clarke, 2001). The transactions can be separated from card holder information, and to reconcile card numbers for putting it impossible to trace information back to personal users (Keuleers & Dinant, 2005). The feature of the smart card system makes it approachable to recognize abuse of behavioural information or theft. With an unknown terminal placed at short range, the data can be interfaced and hackers can aim the aboard workstation itself. The centralized database storage and card holder information are the most defenseless part of the system (Reid, 2007). The users are not probable to accept the connecting the adoption of smart card to an individual‟s socioeconomic or demographic information (Cottrill, 2009).

2.2.5 The Advantages and Disadvantages of the Smart Card E-Payment Systems

In recent years, the justification of the advantages and disadvantages of the use of smart card e-payment system for fare collection have been debated and discussed in several countries. With the early installation stage of the institutional, technical, user and equity issues that arose, have created uncertainty among promoters (McDonald, 2000).

Nowadays, the technology has become better and the advantages have become visible. The flexibility in pricing choices, long-term cost deduction, better profit management, and potential information sharing are on the positive perspective. In the negative perspective, high processing costs, technological complication, and slow social recognition or acceptance are perceive as possible barriers (Pelletier, Trépanier, & Morency, 2011). In most cases to initiate large implementation projects, the extrinsic funding seems to be essential (Iseki et al., 2007). Transit Cooperative Research Program, 2006 was reported that there are numerous business designs that are adopt to obtain, perform, and sustain smart card e-payment systems, such as the public single operator ownership in London, United Kingdom, as the private corporation in Hong Kong, as a joint power authority in Singapore and as a public–private partnership in Scandinavia (Yoh, Iseki, Taylor, & King, 2006).

2.3 Models and Theories on Adoption of New Technologies

To examine the factors of the adoption and application of new technology, there are various theories and models used in researches on adoption of new technologies. These models are based on the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), the Theory of Planned behaviour (TPB) (Ajzen, 1985) and Technology Acceptance Model (TAM) (Adams, Nelson, & Todd, 1992; Davis, 1989). Based on these models, the factors for the adoption of technology comes from the individual beliefs, attitudes, subjective norm, perceptions of behavioural control, perceived usefulness and its perceived ease of use. Diffusion of innovation (DOI) theory (Rogers, 1983) is an additional model that regularly applied in information technology to interpret customer