Extended UTAUT Model of Mobile Commerce:
An Empirical Study of
Negative User Acceptance Behaviours of
Mobile Commerce in Hong Kong

Student Name: LAI Chi Fai

Student ID: 40881776

Supervisor: Prof. Ernest Jordan

Macquarie Graduate School of Management (MGSM)

Macquarie University, Sydney, Australia

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Abstract

With the introduction of the iPhone in 2007, the modern smart phone significantly differs from the traditional definition and understanding of smart phones. With redefined networking, hardware and software capacities, modern smart phones are internet-enabled, location-aware, with a finger-friendly multi-touch interface, large screen size supporting a huge range of colours, multi-gigabytes storage, and much more. Previous mobile commerce studies based on primitive WAP (Wireless Application Protocol) technology are no longer relevant to the new configuration of smart phones.

With the introduction of the iPhone App Store in mid 2008, iPhone users are able to browse, download and install applications for games, personal applications and mobile commerce. However, the utilization rate of mobile commerce has been below the smart phone adoption rate, despite significant progress. The current literature is not sufficient to explain the new paradigm of mobile commerce using modern smart phones. New research and analysis are required.

This research seeks to validate an extended model of technology acceptance for new information systems in the context of mobile commerce with respect to the influence of advanced smart phones. It extends the comprehensive Unified Theory of Acceptance and Use of Technology (UTAUT) model with an added construct of *disturbance concerns*. It is the only construct demonstrating a negative influence on the technology acceptance models that can explain the reasons for the poor user acceptance of mobile commerce. The proposed

model brings together extant research on mobile commerce with the constructs of both positive and negative influence on behavioural intention.

The study of mobile commerce is characteristically different from general information systems research because the target users are individuals rather than corporate users. Their acceptance of mobile commerce is voluntary and for their own benefit. This research complements current technology acceptance models and should be applicable to research relating to other forms of new technology acceptance. It also provides an important cluster of antecedents to eventual technology acceptance models via the proven and comprehensive set of constructs influencing behavioural intention to adopt new technology. The proposed model is practical and valuable to the markets, especially the service providers of mobile commerce systems. The model is useful for them in developing strategy to motivate the rapid acceptance of their mobile commerce services by mobile users.

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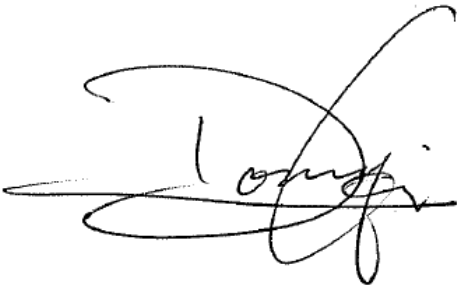
My beloved wife, Sara Law, has always supported and encouraged me so that I was able to overcome many challenges. Without her support, I cannot say where I would be now. To my beloved child, Jeun-Sing Lai, now I will be able to play with you and spend more time with you, as a father should. Finally, my mother and my parents-in-law have provided great support to my family so that I could achieve this goal. I am deeply indebted to them.

Certification

This thesis is submitted in fulfilment of the requirements of the degree of Doctor of Business Administration (DBA), in the Macquarie Graduate School of Management (MGSM), Macquarie University. This represents the original work and contribution of the author, except as acknowledged by general and specific references.

I hereby certify that this has not been submitted for a higher degree to any other university or institution. The research presented in this thesis was approved by Faculty of Business and Economics (FBE), Human Research Ethics Sub-Committee (reference number: R00004) on 14th December 2010.

LAI Chi Fai (Donny)

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Table of Contents

List of Figures

List of Tables

List of Acronyms

ARPU	Average Revenue Per User
CES	Consumer Electronics Show (http://www.cesweb.org)
DOI	Diffusion Of Innovations
DTPB	Decomposed Theory of Planned Behaviour
ERP	Enterprise Resource Planning
HCI	Human-Computer Interaction
IDT	Innovation Diffusion Theory
IOS	Formerly means iPhone OS. It is a mobile operating system developed and distributed by Apple Inc.
IT/IS	Information Technology/Information Systems
MM	Motivation Model
MMS	Multimedia Message Service
MPCU	Model of Personal Computer Utilization
PLS	Partial Least Square
RIM	Research In Motion – The company of BlackBerry phones
SCT	Social Cognitive Theory
SEM	Structural Equation Modelling
SMS	Short Message Service
TAM	Technology Acceptance Model
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology
WAP	Wireless Application Protocol
WML	Wireless Markup Language

Chapter 1
Introduction

The rapid development of modern wireless communication technology, coupled with integration with the internet, is promoting mobile commerce (m-commerce) as a significant application for both enterprises and consumers (Wu and Wang 2005). Following the advancement of 3G and 4G wireless communication technologies, modern internet-enabled mobile phones have gained significant user acceptance. In March 2009, Apple Inc. reported sales of over 13.7 million iPhones in 80 countries by the end of 2008. Given the iPhone was introduced in 2007 this demonstrates a significant adoption of this new technology. Market analysts predicted that iPhone sales would surpass 100 million units by 2011. In fact, by the first quarter of 2011, about 90 million iPhones have already been sold as announced by Apple Inc. (www.apple.com/about/#section=company). In September 2010, Apple reported that 120 million IOS devices (i.e. Apple's internet-enabled mobile devices) were sold, of which 56% were iPhones. The remaining 44% were the mobile gadgets of iPod Touch and the iPad. Both have similar features to the iPhone but without telephony. The iPhone's widespread acceptance suggests that mobile phones are used for fast web surfing and m-commerce.

Before the release of the internet-enabled iPhone, m-commerce was below expected levels of adoption, despite more than 80 million smart phones or WAP-based phones, such as the phones of Nokia and RIM, being sold in 2006 prior to the release of the iPhone. Jarvenpaa et al (2003) explained that, although the continuous connectedness of mobile communications and information services has increased users' freedom psychologically, socially, and physically, there is a side effect to this increased freedom. They argued that users experienced 'disorders of freedom' that were significant barriers to their adoption of m-commerce.

User acceptance is crucial to the success of new information systems but it is difficult to predict, although there are many well established technology acceptance models. User acceptance of new information systems does not reflect incremental improvements on existing systems. Rather new information systems can represent radical change, with a major impact on people's lives. While many studies have explored user acceptance behaviour relating to m-commerce and mobile services, the dramatic hardware and software advancements in mobile

devices mean those studies are no longer adequate or relevant. It is unclear whether rapid advancements in mobile technologies have, in fact, stimulated user adoption of m-commerce. The growth rate of m-commerce is actually slow, particularly when compared to the boom of e-commerce. Previous studies have analysed and explained the adoption of m-commerce and mobile services, but they are limited to consideration of the positive factors of user adoption based on the user acceptance models of new Information Systems. There are some undiscovered or neglected factors that may explain the relatively slow adoption of m-commerce. This research concentrates on the neglected negative factors influencing the user acceptance of m-commerce.

With the introduction of the iPhone, m-commerce applications are easily developed and installed onto personal mobile phones. The impact has been difficult to predict because the adoption rate for mobile internet use significantly outpaces desktop internet adoption as shown in Figure 1.1. The chart outlines the first 20 quarters of user growth for the mobile internet services offered by AT&T. Only eight quarters after its launch, the iPhone and iPod Touch have more than twice as many users (57 million) as i-mode (25 million), five times as many as Netscape (11 million), and eight times as many as AOL (7 million) at comparable points in their histories.

Figure 1.1 The adoption rate of mobile internet (Morgan Stanley, 2009)

Furthermore, the iPhone's native applications have dynamically changed m-commerce acceptance. While smart phones were already available prior to the release of the iPhone, there was no significant uptake of m-commerce. The introduction of the iPhone changed the mobile market and caused the dramatic shift of user behaviour towards the acceptance of m-commerce. An iPhone application for a business is widely considered necessary in today's competitive marketplace. At the 2010 annual CES (Consumer Electronics Show) conference a panel of industry experts gathered together to discuss the impact of iPhone apps on culture, technology, advertising and entertainment, concluding that:

> *It's like 10 years ago when the debate was: if you're not on the Web, it's like you don't exist. Now, it's almost a requirement. You've got to be on the iPhone; same as you've got to be on the Web.*

Acceptance and usage of m-commerce services has varied significantly between countries (Harris et al 2005). Hong Kong has among the highest mobile telephony penetration rates in the world at 91% in 2003 and 96% in 2010 (www.OFTA.gov.hk). However, the m-commerce market is not as mature as expected because of the low adoption rate. For example, Harris et al (2005) indicated that SMS (Short Message Service) penetration in Hong Kong in 2003 was much lower at 43% compared with other high mobile telephony penetration countries. They commented that Hong Kong is a mature and appropriate market for the development and trial of m-commerce services, although currently m-commerce adoption falls below expectation. Therefore, this study examines the acceptance behaviour in relation to potential m-commerce users in Hong Kong.

Understanding user acceptance behaviour in relation to m-commerce is important to service providers and developers of m-commerce applications. Sarker and Wells (2003) agreed that it is necessary to have a clear understanding of the motivations and circumstances surrounding mobile device use and adoption from the perspective of the consumers themselves. They explained that the areas of m-communication and m-commerce are promising, yet confusing. Much of the existing literature dwells on the description of technological leaps and economic implications, largely ignoring the fact that without widespread acceptance of the current installable m-commerce applications on smart phones, the promise of m-commerce cannot be realised.

1.1 Research questions and objectives

This thesis studies user acceptance of m-commerce based on a series of surveys of user perceptions, experience and attitudes of m-commerce services. The surveys were taken via a website dedicated to collecting user responses. In order to chronologically support the validity and reliability of the findings, three surveys were conducted in Hong Kong across three years from 2009 to 2011. The target respondents were the mobile users of Hong Kong. Although some information about the user profile was collected, no private data, such as name, identity number, or contact information, was required and for that reason the responses were anonymous, meaning that a website was a suitable means of surveying respondents. Due to the limited resources of the data collection, the respondents were well-educated young university students in the most part. However, this group of respondents was suitable for this research because it is this group that is most likely to adopt electronic gadgets and accept new m-commerce services.

With the distinct benefits that m-commerce service brings to mobile users, service providers are eager to stimulate the user acceptance rate. Although there are well-defined technology acceptance models adopted for the domain of information systems research, previous findings have not explained user reluctance to use m-commerce. This gap informs the following research question:

"What factors have significant negative influence on the user acceptance of m-commerce services by general mobile users?"

The question can be elaborated into two sub-questions:

(1) *What are the undiscovered factors with negative influence on user acceptance behaviour that should be considered, other than those identified by existing technology acceptance models?*

(2) *What are the suggested business strategies to stimulate the acceptance of m-commerce services by general mobile users if there are negative factors that have significant influence on user acceptance?*

The first sub-question tries to explore the missing elements of the theoretical technology acceptance models and enhance the robustness of those models. The second sub-question explains the business value of the findings and describes the applications of the proposed model. These two sub-questions have value both for academic studies and for business strategy.

In order to investigate these questions, a conceptual Technology Acceptance Model for m-commerce was proposed. It extends the well-accepted Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh et al. 2003), which incorporates eight prominent technology acceptance models. According to the UTAUT model, user acceptance behaviour is influenced by five integrated constructs. They are *performance expectancy, effort expectancy, social influence, facilitation conditions, and behavioural intention*. For user acceptance of a new information system, performance expectancy, effort expectancy, and social influence are proven to have a significant positive influence on behaviour intention; while facilitation conditions and behaviour intention have direct influence on the actual usage behaviour. In the conceptual model developed for this study, a new construct of disturbance concerns was introduced to conclude the negative influence on behavioural intention. By applying the conceptual model, the research analysis involves two main objectives as follows:

(1) It verifies the validity of applying the UTAUT model in the context of this research. It is necessary to ensure that the UTAUT model is relevant and valid for predicting user acceptance of m-commerce.

(2) It verifies the validity of the newly proposed construct that can significantly explain the negative factors of the unexplained user adoption behaviour. It is necessary to prove that the proposed enhancement is a valid extension to support user acceptance of m-commerce.

Based on the conceptual model extended from the UTAUT Model, this research proposes a new construct to explore and resolve those factors that will lead to disturbance concerns and subsequently affect the acceptance of a new m-commerce service. It is believed that disturbance concerns may significantly lead to user reluctance to accept m-commerce. The

research questions were designed with reference to the published questions used for the survey research for the UTAUT model (Venkatesh et al. 2003). A website was established to facilitate the collection of user responses. Respondents can freely forward the site address of the survey to other people after they have filled in the questionnaire so that the survey can collect responses from people through a simple social network approach. The survey includes the collection of the general and relevant user profile only but not the identity of the respondent in order to ensure the unbiased analysis of the data and avoid any privacy issues.

A pilot test of the questionnaire was conducted in late 2008 by a group of 20 opportunity samples for validating the relevance of questions. Subsequently, three sets of empirical data were collected in early 2009, 2010, and 2011 respectively. The technique of Structural Equation Modelling (SEM) was used to evaluate the causal model and confirmatory factor analysis was performed to examine the reliability and validity of the measurement model. Furthermore, the traditional t-test analysis was also applied to ensure the validity of the hypotheses of the measurement model in order to triangulate the analysis.

In summary, this is a quantitative research study. A conceptual model is proposed to prove the existence of negative factors that have significant influence on user acceptance of m-commerce. The conceptual model is extended from the unified UTAUT model (Venkatesh et al. 2003) because of the robustness of the model for information systems research. This research aims at proving that, besides catering for the user perceptions of performance gains, ease of use, social influence, and effective facilitation provisions of the UTAUT model, it is necessary to include the negative factors of user worries and uncertainties. The worries and uncertainties are derived from the proposed construct of disturbance concerns. The construct of disturbance concerns primarily consists of security, privacy, spam, and any unexpected disturbance due to the usage of the service. For business purposes, in order to successfully gain user acceptance of a m-commerce service, the original positive factors must be provided and the extended negative factors of disturbance concerns must be resolved. Otherwise, those disturbance concerns will be an obstacle to accepting m-commerce.

1.2   Research value and significance

Okazaki (2005) addressed a major problem in m-commerce research. That is the lack of standards in terms, concepts, and theories. Although the infrastructure of wireless technology varies across markets, researchers tend to use the term "m-commerce" without considering the specific conditions and prerequisites of what they are examining. Besides the unique mobility of m-commerce, Okazaki stated that the mobile phone is a very personal device, and therefore marketing information can be more easily transmitted by voice, messaging or email functions. Hence, word-of-mouth (WOM) can be achieved by wireless instead of person-to-person or PC-based WOM. Thus, social norms or peer pressures may be important factors that influence such WOM information networks or chains. They are important factors in influencing the acceptance of m-commerce applications.

Mobile applications can automatically capture privacy data through personal mobile devices and the mobile network, and transmit the information to m-commerce service providers. The privacy data includes user name, identity name, contact information, current location information, phonebook data, installed applications, or even accessed web pages. Users assume the service providers primarily use the privacy information for customising the service provided to them only, but they cannot ensure whether service providers protect the privacy information collected. Users gain user convenience and satisfaction, but risk losing security and privacy.

Although many studies examine the user acceptance of m-commerce and related areas, some issues are not considered. First, only a few studies consider the significance of the advanced internet-enabled mobile devices. The previously studied mobile devices were mainly WAP phones. Modern iPhones and Android phones are powerful and different from WAP phones, with their application operation models more advanced and user-friendly. New m-commerce studies should consider these significant differences.

Due to the successful introduction of the iPhone, there are significant improvements to the newly introduced mobile phones. The iPhone defined the benchmark for the basic design of a modern smart phone. To be considered a competitive smart phone, any new phone model should be equipped with excellent computing capacity and multimedia capability, enough

storage for information and media, colourful and large screen size and multi-touch finger-based interface, with intuitive user interface design. Besides that, there are two important pre-installed mobile applications. The first mobile application is a mobile internet browser for accessing the internet. Mobile users have adapted to accessing the internet anytime and anywhere. User experience with the mobile web browser should be equivalent to using the web browsers of desktop computers. The second mobile application is a mobile store that can access the mobile marketplace of millions of entertainment items (such as ring-tones, songs, and games) and installable mobile applications. Through the mobile store, mobile applications searched from the mobile marketplace can be purchased, downloaded, upgraded, and installed into smart phones. It is clear that research based on older phones is not adequate for explaining the new phenomenon of smart phones. New studies aimed at smart phones are needed.

Concerning the cultural differences amongst different mobile users, only a few studies focus on the unique market of Hong Kong. Harris et al (2005) commented that Hong Kong is eminently suitable for the development and trial of m-commerce services because of its population density, market freedom, and leading telecommunication networks. Studies undertaken in Hong Kong are generalisable to reflect the special cultural behaviours of Asian people.

Furthermore, previous studies, through the widely adopted technology acceptance models, such as TAM, TRA and TPB, focused only on understanding the positive factors that could influence the acceptance of m-commerce. Because of the actual slow growth rate of m-commerce acceptance, it is essential to explore and identify additional factors that may affect negative adoption behaviour (user rejection), apart from those defined by contemporary technology acceptance models. The proposed extension to technology acceptance models includes a new construct to conclude the negative influence on behavioural intention. The findings will make a significant academic contribution and will influence the fundamental understanding of user acceptance of new information systems.

1.3 Research Contribution

This study aims to contribute to the existing pool of knowledge by identifying negative factors influencing the acceptance of m-commerce by users of smart phones. Further research can be conducted to obtain additional insight to service providers so that they can formulate appropriate business strategies, stimulate the usage of m-commerce services, and increase business transactions through better customer convenience, satisfaction, and trust by taking advantages of internet-enabled mobiles. Furthermore, the right strategy will bring competitive advantage to the service providers of m-commerce.

In summary, the proposed research represents a substantial and original contribution to understanding the user acceptance behaviour of new information systems, especially in relation to m-commerce. There are two main key contributions. First, the theoretical contribution is to reveal negative factor(s) that may influence technology acceptance apart from those employed by the selected technology acceptance model. Second, the practical contribution is to understand factors affecting user acceptance of m-commerce services for service providers to formulate strategies to stimulate usage.

1.4 Outline of This Thesis

This thesis is structured as follows. The relevant literature is discussed in chapter 2, giving an overview of the evolution of electronic commerce and m-commerce. It identifies challenges for user acceptance studies of m-commerce services. It also discusses some important mobile technologies relevant to m-commerce services, including the success and failure of WAP technology, WAP-based m-commerce, the impact on m-commerce of smart phones (such as iPhones and Android phones), and recent research about the user acceptance of m-commerce .

Chapter 3 describes the theoretical background of this research. It discusses and analyses the prominent technology acceptance models currently used for information systems research. There are several technology acceptance models developed specifically for information systems research. The models characterise via different perspectives the user acceptance of new information systems. Their history, development, and recent applications on e-commerce or m-commerce are explored and explained. Other relevant theories are explained, including the two-factor theories (Herzberg 1959) and the newly proposed constructs of trust and perceived risk. The chapter also analyses the applicability of these theories and models to the study of m-commerce services. Their distinctions and applications are discussed and compared.

Chapter 4 explains the research methodology and framework. The conceptual model, research hypotheses, and research methods are explained. It includes a thorough explanation of the development of the research framework and the conceptual model. It also explains the proposal of an extended construct for technology acceptance models applicable for m-commerce services. The proposed construct is important for the explanation of the m-commerce services by mobile users, who are individuals rather than organisations, the more usual subject of these models.

Chapter 5 explains the analysis process and the findings. In order to understand acceptance behaviour in relation to m-commerce, the demographic profile, the application of Structure Equation Model (SEM), the model confirmatory analysis with the Partial Least Analysis (PLS), multiple validity and reliability tests, and the traditional hypothesis tests

through t-tests, have been applied. The final structural model is shown to be a viable extension of technology acceptance models for the study of m-commerce.

Finally, chapter 6 provides conclusions and discussion. The implications of the findings and the structural model are discussed. As a case study to explain the implication to practice, the phenomenon of the iPhone App Store is explained and discussed because the structural model incorporates the success of the iPhone App Store. Finally, avenues for potential further research are proposed.

There are three conference papers (Lai et al 2008, 2009, 2010) and one published journal paper (Lai et al 2010) written with this thesis. The papers are attached at the end of this thesis.

1.5 Conclusion

Understanding user acceptance behaviour of m-commerce is important to service providers and developers of m-commerce applications. Although there are well-defined technology acceptance models adopted for the domain of information systems research, previous findings have not explained user reluctance to use m-commerce. This research aims to explore the undiscovered factors with significant negative influence on the user acceptance of m-commerce services by general mobile users.

The proposed conceptual model of this research was extended from the well-accepted UTAUT model (Venkatesh et al. 2003); in which a new construct was proposed to explore and resolve those factors that will lead to disturbance concerns and subsequently affect the acceptance of a new m-commerce service. The findings will make a significant academic contribution and will influence the fundamental understanding of user acceptance of new information systems. The study was justified with both theoretical contribution to the existing technology acceptance model and practical contribution to the service providers of m-commerce services.

Chapter 2
Electronic and Mobile Commerce

This chapter describes the historical background of electronic commerce (e-commerce) and its recent development. This research has adopted the definition of e-commerce used by Turban et al (2000). Mobile commerce (m-commerce) has been developed from e-commerce but with several distinct characteristics. Although m-commerce is considered as an extension of e-commerce, several studies (Okazaki 2005, Stafford and Gillenson 2003, Jarvenpaa et al 2003) indicated that the unique mobility and personal nature of m-commerce are actually beyond the capacity of general e-commerce. It is necessary to understand the distinct characteristics of m-commerce and how these cause it to differ from general e-commerce concepts.

Wireless Application Protocol (WAP) was an early technology integrating software and hardware for mobile-based applications designed for earlier incarnations of the smart phone. WAP initiated the development of m-commerce. This chapter discusses the development of WAP and explains its failure and success. Understanding the evolution of m-commerce through WAP is important to understanding the revolution in m-commerce as a consequence of smart phones, such as the iPhone.

The user adoption of e-commerce and m-commerce has been widely researched in different contexts. Some studies have explored cultural differences in user adoption behaviour. This following section describes the early development of e-commerce, the evolvement of e-commerce due to the availability of the internet, the technologies related to m-commerce, the development of the WAP-based m-commerce, and several important research of m-commerce acceptance.

2.1 Development of e-commerce

E-commerce originated from the electronic transmission of messages, with the first recorded use being that of the 1948 Berlin Airlift, where the problem of coordinating air-freighted consignments, such as food and consumables, was addressed by the invention of a standard manifest. The standardisation of trade documents led to the successful application of electronic transmission of messages through telecommunication networks. This electronic data interchange (EDI) was an early form of e-commerce.

In the 1960s, EDI was used in the rail and road transport industries in the USA, and later spread to the UK and Europe for international trade purposes in the 1970s. With the use of EDI, the amount of data capture and transcription is reduced. This results in a decreased incidence of errors and an increased efficiency of data processing in the business operation of e-commerce, such as transport and distribution, inventory management, procurement management and trade administration. E-commerce, based on EDI using private telecommunication networks, developed into the early 1990s, but it was mainly applicable to business-to-business (B2B) transactions.

In 1990, the world-wide-web web browser was invented and an academic telecommunication network was transformed into a worldwide integrated communication system - the internet. The internet enabled many new e-commerce models beyond the EDI-based B2B models. Business-to-consumer (B2C), such as internet-based online shopping, and consumer-to-consumer (C2C), such as internet-based online auction, were growing rapidly.

By 2000, many European and American organisations offered their B2C e-commerce services through the World Wide Web. Since then e-commerce has been associated with internet-based online shopping and electronic payment services. Nowadays, the setup of a website for e-commerce is simple and easy. There are over a hundred e-commerce hosting websites for companies to instantly set up their e-commerce websites without any technical knowledge. There are also plenty of open-source projects for e-commerce systems. Companies are free to download any open-source e-commerce systems and install their own e-commerce systems. There are also plenty of payment gateways able to integrate with any websites, such as paypal or alipay. Using e-commerce for business is common. There are

almost no technical barriers for companies to participate in e-commerce.

Because of the internet, the definition of e-commerce is extended to cover the commerce activities of products, services, and/or information. Turban et al (2000, p.4) stated that there is no one commonly agreed definition of e-commerce because e-commerce business models are continually evolving and new e-commerce models are emerging. For instance, B2C e-commerce through mobile devices and smart phones, rather than desktop computers, is radically growing. E-commerce is also expanding in the new and evolving mobile platforms. However, they adopted the following definition "the process of buying, selling, transforming, or exchanging products, services, and/or information via computer networks, including the internet". Furthermore, they stated that e-commerce can be defined in different perspectives, including business process, service, learning, collaborative, and community.

Vladimir Zwass (Zwass 1996, p.3), the editor-in-chief of the *International Journal of Electronic Commerce* (IJEC), stated that e-commerce is "sharing business information, maintaining business relationships and conducting business transactions by means of telecommunication networks". He considered that the business activities of maintaining business relationships, such as customer relationship management, should be in the scope of e-commerce for aligning contemporary business practices. For this research, the definition of e-commerce stated by Turban is appropriate and adopted. The survey questions in this study relating to e-commerce transactions are confined to the described definition of e-commerce.

2.2 M-commerce Technologies

The rapid development of telecommunication and mobile network technology is the key driver of m-commerce. The evolution of mobile network technology can be divided into four generations: 1G, 2G, 3G, and the forthcoming 4G. The development of m-commerce began with 2G digital telephony. The 2G digital telephony was able to transmit voice, data, and signalling data between mobile phones and cell sites of cellular networks. In early 2000, the two main mobile data transmission technologies of 2G were GRPS (General Packet Radio System, also called 2.5G) and EDGE (Enhanced Data Rate for GSM Evolution, also called 2.75G). They could transmit mobile data only up to 115 and 236.8 kilo-bits per second respectively.

Despite limited bandwidth for data communication with 2G, the corresponding m-commerce software technology of WAP was developed and introduced. WAP is an open standard for application-layer network communications in a wireless-communication environment. The WAP technology can be considered as a down-sided web solution for early mobile phones. Major WAP usage involves accessing the mobile web from a mobile phone. A WAP browser is required to browse the web sites written in or convertible to Wireless Markup Language (WML). The WAP browser provides the basic navigation of WML-based web pages, and the operation is simplified within the restrictions of a mobile phone, with a smaller view screen and a simple numeric key pad. As shown in figure 2.1, the early generation of WAP phones were equipped with tiny green screens and only limited characters could be shown on the screens. Thus, the capability of the early WAP browsers was primitive and character-oriented. Information presentation was restricted by the limited size of screen and reliance on a limited number of characters. The later generation WAP phones were equipped with larger colour screens and they could show some simple graphs and pictures. The WAP technology with WML offered a new opportunity for m-commerce enabling a simple mobile phone to browse the internet, access m-commerce websites, and conduct m-commerce transactions within the low data bandwidth. Popular m-commerce activities included emails by mobile phones, tracking of stock-market prices, sports results, news headlines, music downloads, and etc.

Figure 2.1 Sample displays of the first WAP phones by Ericsson, Nokia, Siemens.

However, the only successful WAP development and implementation was in Japan. NTT DoCoMo's i-mode is a mobile internet service popular in Japan. It was launched on 22 February 1999. An extension of WAP technology, i-mode encompasses a wider variety of internet standards, including web access, email service and the packet-switched network that delivers the data. Users of i-mode can access various data services such as email, sports results, weather forecasts, games, financial services and ticket booking. Content is provided from the mobile carrier or by specialised service providers. DoCoMo has tight control over the billing method and model of the service providers. Shown in figure 2.2 are i-mode phones with larger colour screens that can show characters with different fonts and some small pictures.

Figure 2.2 Sample i-mode content shown on a colourful NEC phone

2.3   The Success and Failure of WAP Technology

Barnes and Huff (2003) adopted the research model of the Theory of Reasoned Action (TRA) to investigate the success of i-mode. They explained that the success of i-mode only in Japan includes the importance of a trusted, branded, useful, easy-to-use, holistic packaging by DoCoMo of i-mode services, the value of investment, and leveraging of technological infrastructure, such as the vertical integration from i-mode phone handsets to data networks and finally to the servers of the service providers, and the unique market situation where NTT DoCoMo was the market leader with 60% market share in the mobile phone market of Japan.

China has its own WAP implementation, but the commercially successful mobile service is the Short Message Service (SMS). The Chinese mobile communications market has enjoyed impressive growth in terms of the huge potential numbers of subscribers in the early 2000s. But, unfortunately for Chinese operators, a subscriber is not necessarily a user. The average revenue per user declined during the period. In order to fully exploit the potential of the mobile network's resources and boost revenue from current subscribers, the two main operators, China Mobile and China Unicom, have introduced a variety of value-added services, including caller number display, voice mail, short message service (SMS), call forwarding, call waiting, conference calls, and long-distance internet protocol telephony. However, the most popular service was the simple SMS service. The Chinese subscribers used their mobile handsets as a substitute for PCs for sending and receiving text messages, substituting the email functions because of the cheaper price of each SMS. There were only 2% of Chinese subscribers accessing mobile internet via WAP phones, the lowest percentage of the eight Asia-Pacific economies studied. Xu Yan (2003) pointed out that the Chinese experienced that an advanced but less-than user-friendly technology like WAP is not necessarily more commercially viable than basic but easy-to-use ones likes SMS.

The success of mobile business relies on the integration of mobile infrastructure, mobile phones, and mobile software. The advancement of mobile network technology and telecommunication enabled fast wireless data service and mobile-connected internet access. The innovative design of mobile phones and mobile software technology were revolutionised by the introduction of the iPhone. This new mobile technology ushers in a new horizon for m-commerce and fosters many new m-commerce applications and mobile services.

2.4 Development of M-commerce

General B2C e-commerce is conducted through the internet with the use of a desktop computer. M-commerce extends e-commerce by using mobile networks and mobile phones, such that the m-commerce transaction, involving the transfer of ownership or rights to use goods and services, is initiated and/or completed by using mobile access to computer-mediated networks with the help of a mobile phone. M-commerce is not always, strictly speaking, classical e-commerce. Both are computer-assisted and network-enabled, but each also possesses unique characteristics that tend to define its state and functionality (Stafford and Gillenson 2003).

M-commerce began in 1997 in the Helsinki area of Finland when people could send payment to Coca Cola vending machines using SMS from their mobile phones. In the same year, Merita bank of Finland launched a mobile banking service by using SMS. In 1998, the first commercial downloadable ringing tones were launched in Finland by Radionlinja. Both SMS based transactions and digital content sales, such as ring tones, songs, wallpaper, and photos, were the major types of m-commerce transactions in the early stage of m-commerce service offered in other countries. M-commerce services extended rapidly in early 2000 from Norway with the launch of mobile parking, Austria with mobile purchases of train tickets, and Japan with mobile purchases of airline tickets (wikipeida.org/wiki/mobile_commerce). The rapid development of mobile technologies facilitated the extension and expansion of m-commerce service. Nowa, m-commerce services includes mobile ticketing, mobile banking, mobile brokerage, mobile purchase, mobile marketing and advertising, mobile browsing, information services, location-based services, and etc.

In early 2000, WAP technology (Hung et al 2003) was used for m-commerce. It was designed to work on a mobile device with limited computing power, low bandwidth and small screen size. The user experience of conducting m-commerce with restricted hardware and WAP are significantly different from e-commerce with desktop computers. Liang and Wei (2004) discussed attempts in m-commerce and their failure to meet expectations, particularly in relation to WAP. This failure significantly slowed the link between m-commerce and internet-based e-commerce, except in the case of i-mode in Japan.

Nowadays, modern mobile devices are equipped with excellent computing power, with hundreds of megahertz (e.g. 500mhz.) or even gigahertz CPU speed, several gigabytes RAM storage (e.g. 8G RAM), screen resolution in full-colour HVGA (320x480 pixels) or up to WVGA (480x800 pixels), and with a big 2.6 to 4.3 inch screen size. The computing power of mobiles is now sufficient for surfing the internet and mobile users can easily conduct m-commerce by using the mobile versions of the desktop-based internet browsers, such as pocket internet explorer (by Microsoft) or Safari (by Apple). The mobile software applications are now as mature and efficient as the desktop applications.

Figure 2.3 Contemporary Smart Phones

In addition, new mobile applications are finger friendly. The innovative touch-based and multi-touch interfaces have provided new user friendly technology and radically improved the perceived ease of use (Davis 1989) of mobile applications, which is a construct of the technology acceptance models. It is believed that future desktop computers and notebooks will be equipped with multi-touch capability.

Moreover, the wireless communication capability of mobile devices is actually more sophisticated than that of desktop computers. Modern mobile devices are generally equipped with 3G mobile connection, 3.5G plus Wi-Fi data communication, and the GPS or A-GPS feature for location detection. These sophisticated communication capabilities facilitate users to conduct m-commerce transactions anywhere and anytime.

Tarasewich et al (2002) defined m-commerce as all activities related to a (potential)

commercial transaction conducted through communication networks that interface with mobile (or wireless) devices. A consumer transaction is the conduct or carrying on of trade, business or a financial matter to a conclusion or settlement, including the activities of marketing, promotion, sales and customer services related to the transaction. Mobile devices include mobile phones, smart phones (with user installable applications and plug-ins), mobile internet personal computers, ultra-mobile personal computers, and those handheld devices that can connect to mobile services.

Though new mobile devices are powerful enough to comfortably surf the internet and conduct m-commerce (making it difficult to distinguish between m-commerce and e-commerce), some researchers have identified and explained the unique identity of m-commerce. Okazaki (2005) described the rapidly achieved worldwide penetration of the internet-enabled mobile device as due to its very personal nature and its sophisticated communication technologies. Personal mobile devices carry a lot of the owners' private information, such as phone number, personal data, contact addresses, and business appointments.

M-commerce with personal mobile devices can capture, process and record personal data and user location with transactions. This has meant that new type of services can be offered to consumers that may both enhance customer convenience and satisfaction and increase the potential of commercial transactions. However, new challenges are also encountered, especially in relation to security and privacy risks (Ghosh and Swaminaha 2001; Siau and Shen 2003). Tarasewick (2003) identified several challenges of m-commerce, such as dynamic environment, security, safety, and social concerns. These concerns of m-commerce could affect decisions to adopt. Mobile users are concerned about SMS or email spam, privacy, data leaks, security, and any potential or unexpected interrupts or disturbances.

2.5 M-commerce Acceptance Research

Given the efficiency and effectiveness of m-commerce services and the technology available, the adoption rate should be higher. Research about the user adoption of mobile services and m-commerce in different contexts has been popular for several years. Hung et al (2003) adopted Davis's Technology Acceptance Model (TAM) (Davis 1989) and Innovation Diffusion Theory (IDT) to conduct one of the most comprehensive studies of user adoption of WAP services in Taiwan. Their aim was to identify the critical factors of WAP service adoption, explore the relative importance of each factor between WAP adopters and non-adopters, and examine the causal relationships among variables on WAP services adoption behaviour. They concluded that connection speed and service charges must be acceptable to users in order to successfully promote WAP services. Further needs are user satisfaction, ease of use and facilitating conditions.

Wu et al (2005) conducted an empirical study in Taiwan and presented an extended TAM that integrates innovation diffusion theory (IDT), perceived risk and cost into the TAM to investigate what determines user m-commerce acceptance. The result indicated that *perceived risk*, *cost*, *compatibility*, and *perceived usefulness* significantly affected users' behavioural intention. Among them, *compatibility* had the most significant influence. *Cost* is one of the important predictors of m-commerce adoption intention, and this has a significantly negative direct effect on behavioural intention to use. *Perceived ease of use* does not directly influence behavioural intention to use but indirectly affects behavioural intention to use through *perceived usefulness*.

Nysveen et al (2005) carried out similar research in Norway to study mobile service acceptance. They proposed an integrated model that explains intention to use mobile services. The model is composed of four overall influences on usage intention: motivational influences; attitudinal influences; normative pressure; and perceived control. The model was formulated through triangulating theories from the diverse fields of information systems research, use and gratification research from sociology and social psychology, and domestication research from social science. It combines the TAM model (Davis 1989), TRA (Fishbein and Ajzen 1975) and Theory of Planned Behaviour (TPB) (Ajzen 1991), to examine cross-service comparisons via multi-group structural equation modelling (SEM). The results indicated that the proposed

model explained 72.3% of intention to use whereas TAM generally explains 40%. All the proposed variables as antecedents of intention to use mobile services are significant. The two most promising and notable effects revealed in this study were perceived expressiveness and perceived enjoyment, which are the factors used in use and gratification research and domestication research.

Some studies explored the cultural difference of the user adoption behaviour conducted by country. For example, Lee et al (2002) studied a cross-cultural comparison between Korea and Japan. They proposed a value structure in order to investigate the cross-cultural differences in mobile internet usage. They found that the value structures of the mobile internet were significantly different between Korea and Japan, and the effects of the values on the degree of satisfaction derived from the mobile internet varied across the two countries. They showed that Korean users more often use entertainment services, such as downloads or games, while Japanese users more frequently use information services. They concluded that mobile internet users are influenced by various factors, and identified critical factors that highly affect usage behaviours, such as cultural factors, demographic or socio-economic factors.

Harris et al (2005) compared m-commerce usage in the United Kingdom and in Hong Kong, areas with apparently similar mobile telecommunications infrastructures but with markedly different cultural profiles. They found significant differences between the UK and Hong Kong in usage of, and attitudes to, m-commerce services. In Hong Kong 23% of users only have experience of two core services (voice and SMS). In contrast, half the UK users have experience of six m-commerce services (two core plus four additional m-commerce services, including communication, transaction, information, and entertainment services). They also found that ringtone download is viewed as the most useful entertainment service in Hong Kong, while the mobile internet is viewed as the least useful service. UK respondents, however, rate mobile internet as the most useful service, but view downloads of wallpaper and screensavers as the least useful service. Hong Kong respondents are consistently more negative than those from the UK in their attitudes to usefulness and in their satisfaction ratings. Thus it is useful to study m-commerce acceptance behaviour in Hong Kong.

2.6 Conclusion

In conclusion, this chapter stated that although m-commerce is extended from e-commerce, the two are significantly different, with mobility and the very personal nature of mobile devices being important characteristics of m-commerce services. Many studies have examined information systems acceptance, including e-commerce and m-commerce, but they focus on the positive influence only. There are other unidentified factors that contribute to the slow acceptance of m-commerce. This research aims to identify the negative factors that influence behavioural intention and to study the significance of those negative factors in relation to user acceptance behaviour.

This thesis is a study of the user acceptance of m-commerce in Hong Kong because the mobile device market in Hong Kong means it is ideally positioned for the development and trial of m-commerce services (Harris et al 2005). The research is significant for exploring a more comprehensive model for m-commerce systems acceptance and it is generalisable for other information systems. The results contribute to the needs of business in setting strategies to stimulate the usage of m-commerce service by mobile users.

In the next chapter, we will review the literature of the development of technology acceptance models. They are the foundation theories of this research. Technology acceptance models were developed specifically for information systems research. The models are discussed and compared in relation to their applicability to m-commerce.

Chapter 3
Technology Acceptance Theories

In contemporary organisations, information technology has had a pervasive impact. The 2010 International Conference on Advances and Emerging Trends in Computing Technologies in India (http://www.srmuniv.ac.in/icaet10) revealed that the number of mobile phone users worldwide could surpass the adult population by 2014. According to market research, it has taken 20 years to reach one billion cell phone users worldwide, 40 months to increase to 2 billion, and just two years to reach 3.5 billion. With the high penetration of mobile phones, m-commerce should have boomed in line with the popularity of mobile phones. However, several studies suggest that the acceptance of m-commerce is less than expected (Harris et al 2005), with a few exceptions, for example, the Japanese i-mode mobile service. For information technologies to improve productivity and enrich information usage, they must be widely accepted and used by employees in organisations and customers in markets. Research in relation to user behaviour and new information technology has been widespread since the late 1980s. As a result, several theoretical models were developed with roots in psychology, sociology, and information systems.

In this chapter, technology acceptance models and their supporting theories are reviewed and discussed. First, fundamental and prominent technology acceptance theories are identified and explained. The origin, history, development, perspective, and contemporary applications of those theories are explained and analysed, including their prior use in, and relevance to, the study of m-commerce acceptance. Venkatesh et al (2003) proposed the UTAUT model that combined the eight most prominent models used in information systems research; this theory has been used in many studies. The UTAUT model is adopted as the model for this research because of its robustness and relevance. The proposed m-commerce acceptance model is principally developed and extended from UTAUT. This chapter discusses UTAUT, summarising the interrelationship between the unified models of UTAUT. It also explains and elaborates the significance and impact of UTAUT in recent information systems research.

Beside technology acceptance theories, this chapter includes discussion of Herzberg's

Two-Factor theory (Herzberg 1968). This is also known as the dual factor theory or motivation-hygiene theory. The theory is significant to the development of the conceptual m-commerce acceptance model of this thesis. It supports and justifies the introduction of the factor of "*disturbance concerns*" as a viable construct to extend the UTAUT model. This theory incorporates both positive and negative factors of m-commerce acceptance by general mobile users. There are some similar and relevant studies applying the two-factor theory into technology acceptance models. The implications and contributions of those studies are also discussed.

Two further extended factors of technology acceptance models are included in this study. These are the factors of perceived risk and trust. There are several studies that apply these in the domain of e-commerce research (Pavlou 2003, Featherman and Pavlou 2003, Gefen et al 2003). However, there are some limitations to their adoption in relation to m-commerce. The proposed factor of disturbance concerns is more appropriate as an extended construct of the UTAUT model for m-commerce studies.

3.1 Development of Technology Acceptance Theories

Research into user behaviour in relation to acceptance of new information technology has been undertaken since the 1980s. Many competing theoretical models have been proposed and adopted to study user acceptance of information technology innovation or new information systems, each with a different focus and tested in different contexts and countries. Many of the previous empirically researched models were drawn from the theories of psychology and sociology. Technically, they are classified as studies in social psychology. For example, the Theory of Reasoned Action (TRA), the Theory of Planned Behaviour (TPB), and motivation theories are drawn from social psychology. They explain the relationships between individual beliefs, behavioural intention, and actual behaviour. Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT) are drawn from sociology. IDT explains the relationships between perceived characteristics of an innovation and its consequent adoption. SCT explains the relationship between self-efficacy, outcome expectations, emotions, and consequent usage. With hundreds of empirical studies, researchers adopted these models to explain the innovation acceptance and adoption behaviour of end-users.

In the domain of information systems research, significant progress has been made in the latter part of last century and early this century in explaining and predicting user acceptance of new information technology (Venkatesh and Davis 2000). In particular, substantial theoretical and empirical support has accumulated in favour of the TAM (Davis 1989, Davis et al 1989) followed by TRA and TPB. TRA is a general behavioural model developed by Fishbein and Ajzen (1975). TPB is an extension of TRA proposed by Ajzen (1985). TAM is proposed and derived from TRA by Davis (1989). In TAM, two main factors namely, perceived ease of use and perceived usefulness, were identified as the main behavioural factors that influence user intentions towards the use of a new information system. Numerous empirical studies have found that TAM consistently explains typically a 40% variance in usage intentions and behaviour (Venkatesh and Davis 2000). Although TAM was considered to be well established and robust, Venkatesh and Davis (2000) further enhanced TAM to include the subjective norm construct as a new component and named the enhanced model as TAM2. Besides the contribution in information systems research, the development of technology acceptance theories is important to technology investors and service providers

of information systems, because these theories can help in improving user acceptance of their new products.

With no consensus as to which model is most applicable to the study of technology adoption, researchers faced a dilemma in choosing a suitable model for technology acceptance research. In 2003, Venkatesh et al (2003) compared the similarities and differences among various models. Consequently, they combined eight prominent models, identified the critical constructs of user acceptance and constructed UTAUT. Because the robustness of UTAUT has been tested by numerous empirical studies, this research adopted UTAUT as the foundation theory of the proposed conceptual model.

Figure 3.1 UTAUT and the comprised models

UTAUT is comprised of eight prominent theories, including:

1. Innovation Diffusion Theory (Rogers 1962) (IDT), from sociology;

2. Theory of Reasoned Action (Fishbein and Ajzen 1975, 1980) (TRA) from the behavioural change theories of social psychology;

3. Theory of Planned Behaviour (Ajzen 1985) (TPB), and the Decomposed TPB, which are extended from TRA;

4. Technology Acceptance Model (Davis 1986) (TAM), as well as TAM2, which are developed particularly for modelling user acceptance of information systems;

5. the Combined TAM and TPB (Taylor and Todd 1995);

6. Model of Personal Computer Utilization (Thompson et al 1991) (MPCU);

7. Motivation Model (MM) of social psychology which focuses on the study of intrinsic and extrinsic motivation factors;

8. Social Cognitive Theory (Bandura 1986) (SCT) from social and educational psychology.

Among the eight models, MPCU, TAM, TAM2, and the Combined TAM and TPB models are designed for the domain of information systems research. Other models are borrowed from sociology and psychology theories for use in information systems research. In around 1990, sociology and psychology theories were widely adopted for explaining the user acceptance behaviour of information systems. As shown in figure 3.1, Moore and Benbasat (1991) adopted IDT theory to measure the characteristics perceptions of information technology innovation. Davis et al (1986) studied TRA and developed TAM for modelling information systems acceptance in 1986. He later compared the effectiveness of the TRA model against the TAM model for technology acceptance in 1989. He also used the MM, which is composed of extrinsic and intrinsic motivation factors, to study user behaviour in accepting computers in the workplace in 1992. TPB was extended from TRA by Ajzen (1985). Taylor and Todd (1995) published a paper about using a decomposed TPB model for studying information technology acceptance. They also published a paper about using a combined model of TAM and TPB for studying information technology acceptance. The implications and application of their studies are discussed in the coming sections.

Furthermore, Thomson et al (1991) developed a model of Person Computer Utilization. Davis et al (1992) adopted the MM to analyse the intrinsic and extrinsic factors that can motivate people to accept new information systems. Compeau and Higgins (1995a) applied the SCT into the training of computer skills in 1995. Figure 3.1 shows the adoption relationship of the models. Years are specified for each model in order to indicate chronological sequence.

All eight theoretical models are discussed in this chapter. The origin, history, development, perspective, and contemporary applications of these theories are explained, analysed, and compared. The literatures of these theories are discussed and examined to underpin the research framework outlined in chapter four.

3.1.1 Innovation Diffusion Theory (IDT)

Among the adopted sociological and psychological theories for behavioural research into user acceptance of information systems, the Innovation Diffusion Theory (IDT) is the most fundamental theory that has been used since the 1960s. The theory was developed from the concept of Diffusion of Innovations (DOI). It is a theory of how, why, and at what rate an innovation spreads through a social system. It was first studied by the French sociologist Gabriel Tarde and also by German and Austrian anthropologists around the 1900s. Everett Rogers published his book of *Diffusion of Innovations* in 1962, in which he defined diffusion as the process by which an innovation is communicated through certain channels over time between the members of a social system. An innovation is an idea, practice, or object perceived as new by an individual or other unit of adoption (Rogers, 2003). During the communication process, the members of the social system pass from the knowledge of the innovation to their attitudes toward it, and then to the decision of either adopting or rejecting the innovation (Rogers, 2003). IDT was widely used to study various forms of innovation in different areas, such as agricultural tools and organisational innovations. The book synthesised research from over 508 diffusion studies and produced a theory for the adoption of innovations among individuals and organisations.

The purpose of IDT is to provide a conceptual framework for understanding the process of diffusion and social change. It is useful in fields of anthropology, early sociology, rural sociology, education, industry, and medical sociology. Rogers (1962, 2003) studies DOI to incorporate different aspects. The widely referenced concepts include the stages of innovation diffusion, adopter categories, and the characteristics of innovations. Rogers identified five stages of innovation diffusion. He named the stages as awareness, interest, evaluation, trial, and adoption in his earlier edition. Later, he named the stages as knowledge, persuasion, decision, implementation, and confirmation. However the descriptions of the categories have remained similar throughout the various editions of his book. He specified that an individual might reject an innovation at any time during or after the adoption/decision stage. Rogers suggests five categories of adopters in order to standardise the usage of adopter categories in diffusion research. The adoption of an innovation plotted over a length of time is a bell-shaped curve. The categories of adopters are: innovators, early adopters, early majority, late majority, and laggards. Both early majority and late majority are usually around one third

of total adopters. Innovators, early adopters and laggards account for the remaining one third of total adopters, with innovators sometimes less than 5% of total adopters.

Figure 3.2 Rogers' IDT model

Rogers defines several characteristics of innovation that influence an individual's decision to adopt or reject. The characteristics are subject to the individual's perception of the innovation characteristics, the individual's attitudes and beliefs, and the communication received by the individual from his/her social environment. Rogers indicated that relative advantage, complexity, compatibility, trialability, and observability are the five key constructs of perceived characteristics that closely relate to the decision to adopt an innovation (Rogers 1962, 2003). The five characteristics are depicted in figure 3.2 and defined as follows:

- Relative Advantage refers to the extent to which an innovation is perceived as being better than previous generations or current alternatives.
- Complexity refers to the extent to which an innovation is perceived as difficult to understand, learn, or use.
- Compatibility refers to the extent to which an innovation is perceived as being in line with the values, needs, and experiences of prospective adopters.
- Trialability refers to the extent to which an innovation can be experienced before its actual adoption. The ease and simplicity of trials affects the adoption decision.

- Observability refers to the extent to which the benefits or attributes of an innovation can be observed, described, or depicted to prospective adopters. An innovation that is more observable or visible will mean better communication among the individual's peers and personal networks and will in turn create more positive or negative reactions.

Tornatzky and Klein (1982) reviewed seventy-five articles concerned with innovation characteristics and identified only three innovation characteristics that have a consistent significant relationship to innovation adoption. They are relative advantage, compatibility, and complexity. In the domain of information systems, Moore and Benbasat (1991) built on the IDT model of Rogers (1962) and expanded the innovation characteristics to eight in their study of personal workstation acceptance in an organisation. Their studies consisted of employees of a university, utility companies, and some enterprises in 1991. The concluded characteristics are relative advantage, compatibility, trialability, ease of use, result demonstrability, visibility, image, and voluntariness of use.

Among these characteristics, relative advantage, compatibility, and trialability are directly borrowed from Rogers. Ease of use is close related to Rogers' complexity. Result demonstrability and visibility are derived from Rogers' observability. Visibility is the degree to which one can see others using the innovation or system in an organisation. Result demonstration is the tangibility of the results of using the innovation including their observability and communicability. It is an important dimension of Rogers' observability. Moore and Benbasat (1991) defined image as the degree to which use of an innovation is perceived to enhance one's image or status in one's social system. Rogers considered image as an aspect of relative advantage. Moore and Benbasat (1991) found image to be an independent predictor of adoption instead of an internal component of relative advantage. Finally, voluntariness of use (Moore and Benbasat 1991) is included to clarify assumptions about the freedom of choice in innovation adoption. Voluntariness of use is defined as the degree to which use of the innovation is perceived as being voluntary, or of free will. It is therefore a binary variable. It also indicates whether the end users are organisational or personal users.

The three-phase instrument-development process of Moore and Benbasat's (1991)

study was also widely used for exploring perceived characteristics in many information systems research. The three phases are defined as item creation, scale development, and instrument testing. In item creation, in-depth interviews with subject experts and potential users are carried out in order to create a pool of items that apparently fit the construct definitions. In scale development, items are vigorously sorted and examined by panels of judges. The various scales are then combined into an overall instrument for the instrument testing stage. Instrument testing will go through three sub-stage tests in an evolutionarily growing scale.

Moore and Benbasat's (1991) study has been widely read. Much information systems research has adopted the IDT model as a reference model. Some studies are based on, or extend, the IDT model for the study of e-commerce, enterprise resource planning systems, etc. Kendall et al (2001) studied e-commerce adoption in Singapore by referring to the IDT model. Their paper indicated that only relative advantage, compatibility and trialability appear significant, with the overall regression explaining around 36% of willingness to adopt. Al-Qirim (2005) conducted an empirical investigation of an e-commerce Adoption-Capability Model in small businesses in New Zealand by extending the IDT model. The research concluded that the manager's innovativeness, firm size, and compatibility are significant to the acceptance of e-commerce for small business in New Zealand. Hsu et al (2007) conducted an empirical study of multimedia message service (MMS) acceptance in Taiwan using the IDT model and found that relative advantage and compatibility are significant factors to MMS acceptance. They found that the IDT model is robust for the purposes of identifying attributes of user acceptance in different contexts.

In summary, IDT is the one of the most widely accepted models for studying the diffusion of innovation, including information systems. It is widely adopted for identifying the perceived characteristics of new innovations that can influence user behaviour, such as the acceptance of a new information system. In the development of the unified model of UTAUT (Venkatesh et al 2003), the perceived characteristics of innovations proposed by Rogers (1962, 2003), as well as the perceived characteristics extended by Moore and Benbasat (1991) have been included.

3.1.2   Theory of Reasoned Action (TRA)

The Theory of Reasoned Action (TRA) was one of the most fundamental and influential social psychology theories of human behaviour (Venkatesh et al, 2003). It is concerned with the determinants of consciously intended behaviours. The theory, developed by Fishbein and Ajzen (1975, 1980), is derived from previous research about the theory of human attitude in the field of social psychology; it later led to the study of attitude and behaviour. By the 1980s, TRA was used for human behaviour research and appropriate intervention development (Brown, 1999). Sheppard et al (1988) reviewed TRA and indicated that it has been used to predict a wide range of human behaviours. Later studies extended TRA to develop the TPB (Ajzen 1985) and the TAM (Davis 1986). These were developed for research in information technology acceptance in the late 1980s. Davis et al (1989) applied TRA to user acceptance of information technology and found that the variance explained was largely consistent with studies of other behaviours.

Figure 3.3 Theory of Reasoned Action (TRA)

According to the TRA (Figure 3.3), a person's performance of a specific behaviour is determined by the person's behavioural intention (BI) to perform the behaviour. The behavioural intention is determined by both the person's attitude (A) toward the behaviour and subjective norm (SN) (Davis et al 1989). Attitude is defined as a person's positive and negative feelings about performing the target behaviour (Fishbein and Ajzen 1975). Subjective norm is defined as the person's perception that most people who are important to the individual think that he or she should or should not perform the behaviour in question (Fishbein and Ajzen 1975). Both attitude and subjective norm lead to behavioural intention and then to the performance of the behaviour. In other words, an individual's behaviours are decided by the person's intentions, and the intentions are affected by the individual's attitude

and subjective norm, with relative weights typically estimated by regression (Davis et al 1989). The relationship can be concluded and expressed in form of a mathematical equation as below, in which W_1 and W_2 are the weights applied on attitude and subjective norm respectively:

$$BI = W_1(A) + W_2(SN).$$

TRA theorised that a person's attitude towards behaviour is determined by the person's salient attitudinal beliefs (ab) about consequences of performing the behaviour multiplied by the evaluation of those consequences (ec). A person's subjective norm is determined by the person's normative beliefs (nb), that is the perceived expectations of specific referent individuals or groups, multiplied by the person's motivation to comply (mc) with those expectations. To integrate all these factors into the theory, the concept can be mathematically expressed by the following three equations:

$$A = \sum(ab)(ec)$$
$$SN = \sum(nb)(mc)$$
$$BI = W_1(\sum(ab)(ec)) + W_2(\sum(nb)(mc))$$

The purpose of TRA is to view an individual's intention to perform or not to perform a behaviour as the determinant of the action (Ajzen and Fishbein 1980). The theory can be used to predict and understand motivational influences on behaviour. TRA provides a research model to study attitudes toward behaviours. TRA is based on the assumption that people are rational, that is, that most people would consider the implications of their actions before they perform certain behaviours. However, this assumption of TRA leads to certain limitations for management research. For example, the factor of unconscious motives is not considered. TRA provides a very useful theoretical groundwork for understanding attitudes toward behaviours in the user adoption process. Many studies implement TRA along with other theories to establish the factors affecting technology acceptance. For example, Karahanna et al (1999) combined TRA and IDT to study the determinants of IT adoption and usage and to offer an in-depth investigation of factors influencing the adoption intention of potential users and adopters.

Sheppard et al (1988) argued that the model performed extremely well in the prediction of goals and in the prediction of activities involving an explicit choice among

alternatives. However, appropriate enhancement of the original TRA model to account for goal intentions, choice situations, and differences between intention and estimation measures should be investigated further. Based on the ground work of TRA, Ajzen (1991) revised and extended TRA into the TPB. The extension involves the addition of one major predictor, perceived behavioural control, to the model. This addition was made to account for times when there is intention to carry out a behaviour, but the actual behaviour is thwarted due to a lack of confidence or control over the behaviour (Miller 2004). Davis et al (1989) applied TRA to individual acceptance of new technology and eventually developed the TAM. TPB and TAM have become the two main streams of technology acceptance models in management and information systems research.

In summary, TRA is a widely adopted fundamental model for predicting human behaviour. The model depends on two main factors: attitude and subjective norm. Within a research context it is necessary to first conduct comprehensive studies in order to discover the antecedents of these two factors. TRA classified them as attitudinal beliefs and normative beliefs. Their effects are measured and weighted by the person's evaluation of those consequences and the person's motivation to comply. The success of the application of TRA is determined by whether the appropriate antecedents of attitude and subjective norm can be rigorously discovered for the specific research context. If so, the model can provide rich and specific information for decision making. Extensions to TRA, such as TPB and TAM, are, in fact, more popular than TRA for the domain of information systems research.

3.1.3   Theory of Planned Behaviour (TPB)

As a social psychology theory, the TPB was proposed by Ajzen (1985, 1991) as an extension of the TRA (Ajzen and Fishbein, 1975, 1980). TPB was adapted from the existing model of TRA to address the issues that Ajzen and Fishbein (1985, 1990) had found through their research using TRA. It accounts for conditions in which individuals do not have complete control over their behaviour. Ajzen introduced the TPB by adding a new component, perceived behavioural control (PBC). PBC is the individual's perception of his or her control over performance of behaviour. It explains that behaviour is determined by both behavioural intention (BI) and perceived behavioural control (PBC). The behavioural intention is determined by attribute toward behaviour, which reflects feelings of like or dislike towards performing a behaviour; subjective norms, which reflects perceptions that significant referents desire the individual to perform or not perform a behaviour; and perceived behavioural control (PBC). Formally, behaviour (B) was a weighted function of behavioural intention (BI) and perceived behavioural control (PBC). The behavioural intention (BI) is the weighted sum function of the attitude toward behaviour (A), subjective norm (SN), and perceived behavioural control (PBC). The mathematical expression of the theory can be expressed in the following equations. W_1 to W_5 are the weights to the factors:

$$B = W_1(BI) + W_2(PBC)$$
$$BI = W_3(A) + W_4(SN) + W_5(PBC)$$

Figure 3.4 Theory of Planned Behaviour (TPB)

As shown in Figure 3.4, attitude toward behaviour, subjective norm, and perceived behavioural control are, in turn, determined by underlying belief structures. TPB theorised that an individual's attitude is determined by his or her salient attitudinal beliefs (ab) about the

consequences of performing the behaviour multiplied by the evaluation of those outcomes (eo). An individual's subjective norm is determined by his or her normative beliefs (nb), that is the perceived expectations of specific referent individuals or groups, multiplied by his or her motivation to comply (mc) with those expectations. The added component of perceived behaviour control (PBC) is determined by the individual's salient control beliefs (cb) multiplied by the perceived facilitation (pf). A control belief is a perception of the availability of skills, resources, and opportunities. Perceived facilitation is the individual's assessment of the importance of those skills, resources, and opportunities to the achievement of outcomes. These concepts can be mathematically expressed by the following three equations:

$$A = \sum(ab)(eo)$$
$$SN = \sum(nb)(mc)$$
$$PBC = \sum(cb)(pf)$$

Perceived behavioural control (PBC) reveals that a person's intention is influenced by how difficult the behaviours are perceived to be, as well as the perception of how successfully the individual can perform the activity (Brown 1999). Among the theoretical models in IT adoption, TPB has been found to have considerable influence on new technology usage behaviour and is a useful guide for research development because of the more specific information included from the PBC (Mathieson 1991).

The evaluation of outcomes (eo), motivation to comply (mc), and perceived facilitation (pf) are weighted for beliefs. They can be measured in two ways. First, they can be weighted using direct assessment, for example using a Likert scale. Second, indirect assessment can be used, for example as coefficients in regression equations. Direct assessment is useful when subjects disagree about weighting (Fishbein and Ajzen 1975).

Among the theoretical models in IT adoption, TPB has been found to have considerable influence on new technology usage behaviour and is a better guide for research development because of more specific information (Mathieson 1991). Many studies of e-commerce have adopted pure TPB or TPB with other theories to find out the factors affecting technology acceptance. For example, Bhattacherjee (2000) used TPB to hypothesise a model of e-commerce service acceptance by a field survey of 172 e-brokerage users. He found TPB useful in explaining e-commerce service acceptance, but that acceptance motivations were

P. 48

significantly different from those of typical information systems. Based on a broader conceptualisation of TPB's subjective norm to include both external (mass media) and interpersonal influences, he found that subjective norm is as important as attitudinal judgments in influencing service acceptance decisions, behavioural control has minimal impact on e-commerce acceptance, and external influence is as important as interpersonal influence in individuals' formation of subjective norms toward e-commerce acceptance. The study underscores the importance of building public awareness of e-commerce services using both mass media exposure and positive testimonials (i.e. high quality service) from satisfied customers.

Pavlou and Chai (2002) adopted the TPB to study the determinants of e-commerce across cultures (China and the United States), proposing a model that draws upon the TPB to relate online transaction intentions with attitude, subjective norm, and perceived behavioural control. The proposed model also incorporates Hofstede's (2001) cultural dimensions (individualism/collectivism, power distance, and long term orientation) as key moderators of the effect of TPB variables to explain e-commerce adoption of online consumers across cultures. Further, they integrated trust in e-commerce into TPB and empirically validated that trust influences transaction intentions through attribute and perceived behavioural control. Pavlou and Fygenson (2006) proposed an extension of the TPB by drawing upon theories from information systems, social psychology, marketing, and economics. They proposed, operationalised, and empirically examined a more comprehensive technology adoption model that explains and predicts two key online consumer behaviours: getting information and purchasing products. The extended model focused on two distinct dimensions of perceived behavioural control (PBC): self-efficacy and controllability. Self-efficacy (Bandura 1986) is individual judgments of a person's capability to perform a behaviour. Controllability (Ajzen 2002) is individual judgments about the availability of resources and opportunities to perform the behaviour. Their findings stress the importance of trust and technology adoption variables (perceived usefulness and perceived ease of use) as salient beliefs for predicting e-commerce adoption, justifying the integration of trust and technology adoption variables within the TPB framework.

Those studies support the TPB as a useful model to find out important factors of technology acceptance, including e-commerce acceptance. The IT literature demonstrates that

the PBC of TPB may be an important determinant (e.g. Bhattacherjee 2000). In a direct test, Mathieson (1991) found that PBC had a significant relationship with behavioural intention, though it did not provide substantial explanatory power. Other indirect evidence (Moore and Benbasat 1993) found that perceived voluntariness, which they liken to PBC, was significant for usage. Furthermore, Compeau and Higgins (1995a) have shown that self-efficacy has a significant impact on usage. Overall, the literature suggests that PBC should influence IT usage.

Taylor and Todd (2001) proposed a decomposed model of TPB (DTPB) for the study of IT acceptance. They pointed out that monolithic belief sets (i.e. $\sum(ab)(eo)$, $\sum(nb)(mc)$, $\sum(cb)(pf)$) may not be consistently related to attributes, subjective norm, or perceived behavioural control. They further explained that belief sets, especially those relating to attitude, are idiosyncratic to the empirical setting, making it difficult to operationalise the TPB. Therefore, they proposed a DTPB in order to address these two limitations of the TPB by recommending a set of stable, decomposed belief structures for the TPB model.

Figure 3.5 Decomposed TPB (DTPB)

In DTPB, as shown in Figure 3.5, attitudinal, normative and control beliefs specified in TPB are decomposed into specific belief constructs that derive from the literature of IDT. From the aspect of IT usage, they suggest that a set of attitudinal belief dimensions can be derived from the literature describing the perceived characteristics of an innovation (Rogers 1983). They proposed that relative advantage (analogue to the perceived usefulness construct of the TAM model), complexity (analogue to the perceived ease of use construct of the TAM model), and compatibility of the IDT model make up attitudinal belief. The normative belief structure is decomposed into three main influence groups. They are peers, supervisors, and subordinates. However, in Taylor and Todd's study (2001), the respondents were students. Only peers (i.e. students) and supervisors (i.e. teachers) were studied, because students do not have subordinates. Finally, the behavioural control belief is decomposed into individual's self-efficacy (Bandura 1977), resource facilitating conditions, and technology facilitating conditions.

In Taylor and Todd's study (2001), they examined the pure TPB, the proposed DTPB and the TAM (TAM is discussed in the next section). The results show that all three models are comparable. They exhibited a reasonable fit to the results and explained similar amounts of the target behaviour. When behavioural intention is considered, the results show improvement in explanatory power for both the pure and the DTPB over the TAM. By comparing the two TPB models, the DTPB is a more complex model by virtue of the additional constructs. However, because of its unidimensional belief constructs, the DTPB model provides better diagnostic value than the pure TPB model. It provides greater insight into the factors that influence IT usage.

In summary, DTPB offers several advantages over the other research models. Firstly, the belief structure represents a diversity of dimensions in DTPB. Secondly, by providing a stable set of beliefs that can be applied in different settings, DTPB faces fewer problems than other traditional acceptance models in operationalisation. Finally, DTPB is more managerially relevant because it focuses on specific beliefs, pointing to specific factors that may affect adoption.

3.1.4　　　*Technology Acceptance Model (TAM)*

In the domain of information systems research, there are two prominent user acceptance models of computer technology. Apart from TPB, the Technology Acceptance Model (TAM) (Davis 1986) is widely used in IS research. In 1989, Davis et al introduced the TAM, which is an adaptation of TRA. TAM is specifically developed to explain computer usage behaviour. TAM (Figure 3.6) was developed with the reference of TRA as a theoretical basis for specifying the causal links between two key beliefs: Perceived usefulness (Larcker and Lessig, 1980) and Perceived ease of use. These two constructs are considered as the primary determinants of attitudes toward IT usage intentions, and thus actual usage behaviours (Davis et al 1989). TAM is considerably less general that TRA because of these two specific constructs and because it is designed to apply only to computer usage behaviour. The two specific constructs are based on the findings accumulated from over a decade of information systems research, meaning TAM is well-suited for modelling computer acceptance. In recent years, researchers have continuously proposed a number of variants of TAM for new information technologies (Lederer 2000, Moon and Kim 2001, Koufaris 2002, Pavlou 2003, Gefen et al 2003, Wu and Wang 2005), such as world-wide-web and e-commerce, to predict the usage of information technology.

Figure 3.6 Technology Acceptance Model (TAM)

According to TAM, as shown in Figure 3.6, these two beliefs of perceived usefulness and perceived ease of use will significantly impact an individual's attitudes toward using a particular information system. Perceived usefulness is defined as the degree to which a person believes that using a system would enhance his or her job performance. Perceived ease of use is defined as the extent to which a person believes that using a system would be free of effort (Davis 1989). As explained by Davis et al (1989), actual usage may not be a direct or

immediate consequence of attitudes, because new technologies, such as personal computers and information systems, are complex and there are elements of uncertainty existing in the minds of decision makers with respect to successful adoption. People form attitudes from two key elements: perceived usefulness and perceived ease of use. These attitudes may support the intention of learning to use new technology before using it.

TAM departs from TRA in one significant way. The perceived usefulness of TAM can have a direct impact on usage intentions. Besides that, there is no subjective norm in the original TAM. However, because it is specially designed for technology acceptance, TAM is easier to use than TRA and TPB. For example, Davis (1989) found that TAM predicted new software usage intention better than TRA. Mathieson (1991) found that TAM predicated intention to use a spreadsheet package better than TPB. While TAM has received extensive empirical support in management research throughout the years, TAM has been criticised for failing to explain how the acceptance of information technology is no better than expectations (Hung et al 2003).

There has been substantial empirical support in favor of TAM over the last two decades (Venkatesh and Bala 2008). TAM consistently explains about 40% of the variance in individuals' intention to use an information technology and actual usage. By 2007, the Social Science Citation Index listed over 1,700 citations and Google Scholar listed over 5,000 citations to the two journal articles that introduced TAM (Davis 1989, Davis et al 1989).

TAM2 (otherwise known as extended TAM) is an important extension of TAM proposed by Venkatesh and Davis (2000). TAM2 included social influence processes (subjective norm, voluntarism, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use). Their research indicated that both social influence processes and cognitive instrumental processes significantly influenced user acceptance and that perceived usefulness and perceived ease of use indirectly influenced actual usage through behavioural intention.

Wu and Wang (2005) conducted a study that integrated TAM2 and IDT and two additional variables (cost and perceived risk) to model user acceptance in the B2C mobile commerce context in Taiwan. They indicated that e-commerce has fatal consumer privacy

weaknesses and issues involving monetary transactions, product purchases, and merchandise services. Thus, business concerns, privacy protection, security, and perceived risk are the breakpoints for mobile commerce popularity. The proposed factors of cost and perceived risk were examined in order to validate if they determine consumer mobile commerce acceptance. The results showed that perceived usefulness and perceived ease of use indirectly influence the actual usage through behavioural intention to use, which is consistent with the work of Venkatesh and Davis. The most important determinant for behavioural intention to use is compatibility.

TAM3 proposed an integrated model drawn from the vast body of research on the TAM, particularly the work of the determinants of perceived usefulness and perceived ease of use, by Venkatesh and Bala in 2008. The theoretical framework proposed four different types of determinants of perceived usefulness and perceived ease of use. They are individual differences, system characteristics, social influence, and facilitating conditions. Individual difference includes personality and/or demographics (e.g. traits or states of individuals, gender, and age) that can influence his/her perceptions of perceived usefulness and perceived ease of use. System characteristics are those salient features of a system that can help individuals develop favourable or unfavourable perceptions regarding the usefulness or ease of use of a system. Social influence captures various social processes and mechanisms that guide individuals to formulate perceptions of various aspects of an information technology. Finally, facilitating conditions represent organisational support that facilitates the use of an information technology (Venkatesh and Bala 2008). The proposed model was designed for organisational users. They defined the adoption stages of a new information technology in an organisation into five stages. They are the stages of initiation, adoption, adaptation, routinisation, and infusion. The model is still under further empirical test and validation.

In summary, TAM and TAM2 are widely adopted for technology acceptance research because of their simplicity in research setting and operationalisation. Compared with TPB or DTPB, they may provide a better understanding of IT adoption than TAM because TPB or DTPB offers more factors that may influence usage. The factors are specific and provide useful information for managerial decisions.

P. 54

3.1.5   Combined TAM and TPB (TAM+TPB)

Comparing TAM against TPB, there are three main differences (Mathieson 1991). The first is various degrees of generality. TAM can be considered as a special case of TPB or TRA. TAM assumes that beliefs about usefulness and ease of use are always the primary determinants of use decisions. Second, the original TAM does not explicitly include any social variables, whereas social influence is one of the constructs of TPB. Venkatesh and Davis (2000) realised that social influence is an important construct and therefore extended TAM by adding the new construct of social influence creating TAM2. Third, TAM and TPB treat behavioural control differently. TAM only considers the factor of ease of use. In TPB, the perceived ease of use (EOU) is a factor of perceived behavioural control (PBC). The perceived behavioural control in TPB actually refers to the skills, opportunities, and resources needed to use the system. EOU in TAM corresponds to the internal factor of skill, but external control issues are not considered in any obvious way (Mathieson 1991).

Furthermore, the research model of TPB is more situation-specific. TPB elicits important control variables for each situation independently. It is more likely to capture important situation-specific factors in the initial or early stage of each research. Davis et al (1989) developed TAM for making the model applicable across many situations. However, it has the potential to miss important factors in particular contexts (Mathieson 1991).

Taylor and Todd (1995) found that the models of TAM and TPB were developed to predict information systems acceptance and facilitate design changes before users have experience with a system (Davis 1989). They indicated that empirical tests of these models have generally focused on either systems that were already in use by the study participants, or systems that the participants were familiar with, such as word processing packages and spreadsheets. Thus, they proposed a combined model of TAM and TPB in order to study if the models are predictive of behaviour for inexperienced users and if the determinants of IT usage are the same for experienced and inexperienced users of a system. The study was conducted by surveying 430 experienced and 356 inexperienced potential users of an IT system in a student computing information resource centre.

The Combined TAM and TPB (Figure 3.7) incorporates subjective norm and

perceived behavioural control of TPB with the original TAM model. As in the TPB model, subjective norm is a direct determinant of behavioural intention. Perceived behavioural control is a direct determinant of both behavioural intention and actual behaviour. The research result suggested that the augmented TAM provided an adequate model of IT usage for both experienced and inexperienced users. They found that there was a stronger link between behavioural intention and behaviour for experienced users, because experienced users employ the knowledge gained from their prior experiences to form their intentions (Fishbein and Ajzen 1975). For inexperienced users, their intentions will not translate completely to behaviour. They tend to place less emphasis on control information or control factors in the formation of intentions. They instead rely primarily on perceived usefulness.

Figure 3.7 Combined TAM and TPB

In summary, the combined model integrated the strengths of both TAM and TPB. It provided insight into the effectiveness of integrated models for studying information technology acceptance. The constructs in different models are designed for different perspectives. The integrated view can provide a new understanding of the interrelationship among the constructs. The subsequent UTAUT model was integrated from eight prominent theories including TAM, TRA, TPB, and the combined TAM and TPB.

3.1.6 Model of Personal Computer Utilization (MPCU)

In 1991, Thompson et al examined the factors that influence the use of personal computers (PC) by a knowledge worker in an optional use environment based on a competing theory of behaviour. They adopted the theory proposed by Triandis in 1980 as the theoretical grounding of the research. Triandis (1980) explained that behaviour is influenced by what people have usually done (habits), by their behavioural intentions, and by facilitating conditions. Habits are defined as a function of frequency, intensity, and immediacy of reinforcements that follow particular acts. Unlike TRA and TPB, MPCU attempted not to predict intention but usage behaviour. Thompson et al (1991) examined the theory proposed by Triandis (1980) and found significant influences between social factors, affect toward use, perceived consequences, facilitating conditions, and PC utilisation. The key definitions are listed as follows:

- Social Factors are social norms which depend on messages received from others and reflect what individuals think they should do.
- Affect Toward Use refers to the emotions and feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act.
- Perceived Consequence is defined as the potential consequences that have value, together with a probability that the consequence will occur.
- Facilitating Conditions are defined as the objective factors that several judges or observers agree make an act easy to do.

In the study of Thompson et al (1991), perceived consequence was further defined in three dimensions. These are complexity, job fix, and long-term consequence. They are defined as follows:

- Complexity is defined as the degree to which an innovation is perceived as relatively difficult to understand and use.
- Job Fix is defined as the extent to which an individual believes that using a PC can

enhance the performance of his or her job.

- Long-term Consequence is defined as the outcomes that have a pay-off in the future, such as increasing the flexibility to change jobs or increasing the opportunities for more meaningful work.

Figure 3.8 Model of PC Utilisation

Thompson et al (1991) excluded habits in the context of PC utilisation, because of the difficulty in distinguishing between habits of PC use and required PC use. The utilisation of PC as shown in Figure 3.8 might be used for certain tasks simply because it has been used in the past, not necessarily because it is the most efficient or effective approach. Furthermore, Triandis (1980) notes that habits can be measured by the frequency of occurrence of behaviour. This is identical to our measure of utilisation, which leads to a tautology. Ajzen (2002) commented that habits, being a construct, were not well operationalised but was a major predictor of behaviour.

Thompson et al's (1991) research was a quantitative study. They collected responses from 212 knowledge workers in nine divisions of a multi-national firm, and the measures and research hypotheses were analysed using partial least squares. The results show that social norms and three components of perceived consequences (complexity of use, job fit, PC capabilities, and long-term consequences) have a strong influence on utilisation. The research confirms the importance of the perceived consequences of using PC technology. They also

suggested that training programs and organisational policies could be instituted to enhance or modify these expectations. They analysed MPCU in comparison with TAM (Davis et al 1989), finding that job fit is operationalised similar to the perceived usefulness (Davis et al 1989). There is no significant relationship between facilitating conditions and utilisation because they only measured one aspect of facilitating conditions.

Cheung et al (2000) employed a research model similar to the MPCU to study internet usage. They modified the model with constructs of complexity, near-term consequences, long-term consequences, affect towards use, social factors, and facilitation conditions. Job-fit was replaced with the construct of near-term consequences. They surveyed and collected data from 255 MBA and part-time students. The results concluded that affect and the social factors are the most important determinants for forming the intention to use the internet followed by near-term consequences and facilitating conditions. Complexity does not affect intention directly, but it does affect intention indirectly through its effect on perceived near-term consequences and affect.

Jiang et al (2000) proposed an integrated model based on the MPCU model to study the usage of e-commerce and named the model Utilization of Internet Technology. The model studies the relationship between the constructs of experience of the internet, near-term consequences, long-term consequences, facilitating conditions, and the utilization of the internet. They studied the utilisation of two internet-based software packages and collected data from 285 administrative or clerical staff of a case study organisation. The result indicated that all constructs have direct influences on the utilisation of internet technology. Both user experience and facilitating conditions showed significant influence on the utilisation of the internet technology.

The MPCU model was designed to identify crucial factors that can influence user behaviour in PC utilisation. The specific information is useful for enabling users to utilise computers or computer applications. Unlike previous models, the MPCU attempted not to predict intention but rather usage behaviour.

3.1.7   Motivational Model (MM)

Motivation is the activation of goal-oriented behaviour. The study of motivation is an inquiry into the why of behaviour (Deci and Ryan 1985). In psychology, motivational theories are often used for human behaviour studies, which include incentive theories, need theories, cognitive theories, unconscious motivation, etc. Social Cognitive Theory (SCT) and Herzberg's two-factor theory (Herzberg et al. 1959) are also classified as motivation theories. These two theories are discussed in section 3.1.8 and 3.3 respectively. The basic concept of motivation is classified into intrinsic and extrinsic motivations.

Intrinsic motivation is based on the human need to be competent and self-determining (Deci and Ryan 1985). It refers to motivation that is driven by an interest or enjoyment in the task itself, and exists within the individual rather than relying on any external pressure. It means the performance of an activity for no apparent reinforcement other than the activity per se. Perceived enjoyment (Davis et al 1992) and perceived ease of use are forms of intrinsic motivation (Deci and Ryan 1985). Bandura's (1986) self-efficacy is also considered a form of intrinsic motivation.

Extrinsic motivation is defined as the performance of an activity because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself (Deci and Ryan 1985). Common extrinsic motivations are rewards like money, grades, job positions, coercion, threat of punishment, winning goals, etc. Perceived usefulness is described as a form of extrinsic motivation (Deci and Ryan 1985).

Davis and his colleagues (Davis et al 1992) applied the motivational model to predict technology acceptance and usage behaviour. They found that both intrinsic and extrinsic motivations are key drivers of behavioural intention to use. They refer to intrinsic motivation as the pleasure and inherent satisfaction derived from a specific activity. Extrinsic motivation refers to the rewards gained from performing a behaviour to achieve a specific goal (Deci and Ryan 1987). Based on their definitions, Davis et al (1992) associated intrinsic motivation with perceived enjoyment, and extrinsic motivation with perceived usefulness. Davis et al (1992) defined perceived enjoyment as the extent to which the activity of using a computer is perceived to be enjoyable in its own right, apart from any performance consequences that may

be anticipated. They linked the relationship between using the computer and the enjoyment it gives, and between the computer usage and perceived usefulness. The results showed that the intrinsic motivation of enjoyment had a significant influence on intention. The results also indicated that enjoyment and perceived usefulness were found to influence the effect of output quality and perceived ease of use on both behavioural intention and usage.

Venkatesh (1999) integrated the motivational model into TAM with playfulness and enjoyment as an intrinsic motivation factor and perceived usefulness as an extrinsic motivation factor in order to compare a traditional training method with a game-based training method that included a component aimed at enhancing intrinsic motivation. The results illustrated strong influence of intrinsic motivation on perceived ease of use and subsequent influence on behavioural intention. Thus, Venkatesh concluded the importance of the use of intrinsic motivation during training and in the technology acceptance context.

Recent research of e-commerce acceptance utilises the motivational model of intrinsic and extrinsic factors as key constructs. Sheng et al (2005) examined whether intrinsic motivation could be used to explain consumers' acceptance of on-line shopping. They developed a theoretical model based on the TAM to describe the intrinsic and extrinsic motivations of consumers to shop on-line. The results of their empirical study showed that perceived usefulness (which is an extrinsic factor) is not an antecedent of on-line shopping, while fashion (i.e. social influence) and cognitive absorption experiences (which means a state of deep involvement with software, an intrinsic factor) on the web were more important than extrinsic factors in explaining on-line consumer behaviour. Kim et al (2007) examines the adoption of mobile-internet as a new information and communication technology from the value perspective. Mobile-internet is an enabling technology of m-commerce. They identified the phenomenon that although mobile-internet essentially provides the same services as stationary internet, its adoption rate in many countries is very low compared to that of stationary internet. They developed the Value-based Adoption Model to explain customers' mobile-internet adoption from the value maximisation perspective. The results found that consumers' perception of the value of mobile-internet is a principal determinant of adoption intention, and other beliefs, including perceived usefulness (extrinsic factor) and perceived enjoyment (intrinsic factor), are mediated through perceived value.

3.1.8   Social Cognitive Theory (SCT)

The social cognitive theory (SCT) explains how people acquire and maintain certain behavioural patterns, while providing the basis for intervention strategies (Bandura 1997). The theory deals with cognitive aspects, emotional aspects and aspects of behaviour for understanding behavioural change. It provides a framework for designing, implementing and evaluating behavioural change. Bandura (1986) proposed and broadened the social learning theory, which stemmed from work in the area of social learning theory, based on the principles of observational learning and vicarious reinforcement. Observational learning is a type of learning in which a person learns new information and behaviours by observing the behaviours of others. Vicarious reinforcement is a reinforcement achieved indirectly by observing another person who is being reinforced. Bandura developed the concept of reciprocal determinism to account for human behaviour. He explained that evaluating behavioural change depends on the factors of environment, people and behaviour. The three factors of environment, people and behaviour are constantly influencing each other. He provided his concept of self-efficacy in 1977, while he refuted traditional learning theories for understanding learning. He defined self-efficacy as the belief in one's capabilities to organise and execute the sources of action required to manage prospective situations. In short, self-efficacy means a person's confidence in performing a particular behaviour.

Compeau and Higgins (1995a) applied and extended SCT for the context of computer utilisation. Their research focused on identifying the training processes for learning computer skills, and the relative effectiveness of different methods for such training. They proposed a behaviour modelling training program, based on Social Cognitive Theory, and compared it to a more traditional, lecture-based program. The behaviour modelling training program arranged the trained users to observe others interacting with a computer system. It studied if others' performance can influence the observers' perceptions of their own ability to perform the behaviour, or self-efficacy, and the expected outcomes that they perceive, as well as providing strategies for effective performance. Compeau and Higgins (1995a, 1995b) studied computer use but the nature of the model and the underlying theory allowed it to be extended to acceptance and use of information in general (Venkatesh et al, 2003). The model shown in Figure 3.9 consisted of five distinct constructs: outcome expectations – performance, outcome expectations – personal, self-efficacy, affect, and anxiety. Compeau and Higgins (1995a,

P. 62

1995b) defined the constructs as follows:

- Outcome Expectations – Performance: The performance-related consequences of the behaviour. Consequences may include, but are not limited to, increased efficiency, enhanced productivity, and improved accuracy (Compeau and Higgins 1995a). In particular, performance expectations deal with job-related outcomes.
- Outcome Expectations – Personal: The personal consequences of the behaviour. Specifically, personal expectations deal with individual esteem and sense of accomplishment.
- Self-efficacy: Judgment of one's ability to use a technology to accomplish a particular task.
- Affect: An individual's liking for a particular behaviour.
- Anxiety: Evoking anxious or emotional reactions when it comes to performing a behaviour.

Figure 3.9 Social Cognitive Theory (SCT)

Compeau and Higgins' research (1995a, 1995b) concluded that computer self-efficacy was found to exert a significant influence on individual's expectations of the outcomes of using computers, their emotional reactions (affect and anxiety) to computers, as well as their actual computer use. An individual's self-efficacy and outcome expectations were found to be positively influenced by organisational influence (including the encouragement of others in their work group and support), as well as others' use of computers. The model is shown in Figure 3.9. Compared with other models for new information technology adoption, there is a significant difference. The SCT model measures the actual usage of a system instead of

behavioural intention, which is usually measured as the dependent variable in other models.

The Social Cognitive Theory based model, used for identifying influences on computing behaviour, established that computer self-efficacy played an important role in shaping individuals' feelings and behaviours towards the use of computers. Individuals with high self-efficacy used computers more, derived more enjoyment from their use, and experienced less computer anxiety (Compeau and Higgins 1995b). In addition, outcome expectations, in particular those relating to job performance, were found to have a significant impact on affect and computer use. Affect and anxiety also had a significant impact on computer use. Compeau and Higgins' (1995b) paper received more than 1,600 citations by 2010 in Google scholar. The concept of Computer Self-Efficacy has been widely accepted as important to the study of individual behaviour toward information technology.

Compeau et al (1999) conducted another study to test the SCT model for the use of computers using longitudinal data gathered from 394 end users over a one-year interval. Significant relationships were found between computer self-efficacy and outcome expectations, and between self-efficacy, affect and anxiety, and use. Performance outcomes were found to influence affect and use, while affect was significantly related to use. Compared with other technology acceptance models, the model of Compeau et al (1999) explained two main differences. While the TAM and DOI perspectives focus almost exclusively on beliefs about the technology and the outcomes of using it, SCT and TPB include other beliefs that might influence behaviour, independent of perceived outcomes. The TPB model incorporates perceived behavioural control as an independent influence on behaviour, recognising that there are circumstances in which a behaviour might not be undertaken due to a perceived lack of ability to control the execution of the behaviour. The concept of self-efficacy in SCT recognises that the belief of one's capability might dominate the expectations of positive outcomes of a behaviour. The second difference is in causal structures. TAM, TPB, and DOI view causal relationships as essentially unidirectional, with environment influencing cognitive beliefs, which influence attitudes and behaviours. SCT, in contrast, explicitly acknowledges the existence of a continuous reciprocal interaction between the environment in which an individual operates, his or her cognitive perceptions (self-efficacy and outcome expectations), and behaviour (Bandura 1986). Thus, self-efficacy can be viewed as both a cause and an effect.

P. 64

3.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Many competing theoretical models have been proposed and adopted in the research of user acceptance and adoption of new information technology innovation, each with different focuses and tested in different contexts and countries. Each researcher must consider which model is the most appropriate for studying the technology acceptance of new information systems. In addition, it is imperative to understand whether there are any special requirements or situations that make one model more suitable than others. Many of the previous empirically researched models were drawn from the theories of psychology and sociology, such as TRA, Motivational Model (MM), and TPB from social psychology, and SCT and IDT from sociology. In hundreds of studies, researchers have adopted these models to explain innovation acceptance and adoption behaviour of end-users. As mentioned previously, in the domain of information systems research, TAM is the most widely adopted model followed by TRA and TPB. Two main factors namely, perceived ease of use and perceived usefulness, were identified as the main behavioural factors that influence user intentions towards the use of a new system. Although, TAM was considered to be well established and robust (Venkatesh and Morris, 2000), Venkatesh and Davis (2000) further enhanced TAM to include a subjective norm construct as a new component and named the enhanced model as TAM2. These acceptance theories are important to technology investors and service providers, because the theories can help them to improve user adoption of their new products.

Faced with a range of models for the study of technology adoption, Venkatesh et al (2003) compared the similarities and differences among the various models. They then combined the following eight prominent models, identified the critical constructs of user acceptance and constructed UTAUT (Venkatesh et al, 2003).

The eight prominent models are:

- Innovation Diffusion Theory (IDT) adopted by Moore and Benbasat (1991)
- Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1975)

- Theory of Planned Behaviour (TPB) by Ajzen (1991)

- Decomposed Theory of Planned Behaviour (DTPB) by Taylor and Todd (1995)

- Technology Acceptance Model (TAM) by Davis (1989)

- Model of PC Utilization (MPCU) by Thompson et al (1991)

- Motivational Model (MM) of computer in workplace adopted by Davis et al (1992)

- Social Cognitive Theory (SCT) of computer utilisation adopted by Compeau and Higgins (1995a)

UTAUT integrated constructs across eight models and provided a refined view of how the determinants of intention and behaviour evolved over time and identified that there are three direct determinants of behavioural intention (performance expectancy, effort expectancy and social influence) and two direct determinants of usage behaviour (facilitating conditions and behavioural intention) as shown in Figure 3.10. Venkatesh et al (2003) empirically validated UTAUT with six longitudinal field studies of six different departments of six large firms in six different industries. UTAUT accounted for 70% of the variance (adjusted R^2) in usage intention, better than any of the eight models alone Subsequent research tested UTAUT and accepted it as a definitive model that synthesises known factors and provides a foundation to guide future research in the area of technology adoption.

The five main constructs are defined as follows:

- Performance Expectancy: defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance.

- Effort Expectancy: defined as the degree of ease associated with the use of the system.

- Social Influence: defined as the degree to which an individual perceives that important others believe he or she should use the new system.

- Facilitating conditions: defined as the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system.

- Behavioural intention: consistent with the underlying theory for all of the discussed intention models. It has a significant positive influence on technology usage.

Figure 3.10 UTAUT model

Besides the five main constructs, the UTAUT model, as shown in Figure 3.10, hypothesised four main constructs influencing the set of relationships as moderating factors. These moderating factors are identified as age, gender, experience, and voluntariness. The behavioural intention also significantly influenced use behaviour with no moderation effect assumed. However, the factors of computer self-efficacy, computer anxiety and affect toward behaviour were not showing significant effect in the study of Venkatesh et al (2003) because the effects are being captured by effort expectancy. In order to have a thorough understanding of the interrelationship between the UTAUT model and the eight technology acceptance models, a summary table is constructed to illustrate the contribution of the main constructs of the employed models and the inter-relationships among the constructs.

* UTAUT (Venkatesh et al. 2003)	Performance Expectancy => Behavioral Intention	Effort Expectancy => Behavioral Intention	Social Influence => Behavioral Intention	Facilitating Conditions => Usage Behavior	Behavioral Intention => Usage Behavior
IDT (Rogers 1962, 2003) * (Moore & Benbasat 1991)	Relative Advantage => Behavioral Intention	Ease of use (Complexity) => Behavioral Intention	Image <Observability> => Behavioral Intention	Compatibility <Trialability> => Behavioral Intention	
TRA (Fishbein & Ajzen 1975) (Ajzen & Fishbein 1980) * (Davis et al. 1989)	Attitude Toward Behavior => Behavior Intention		Subjective Norm => Behavioral Intention		Behavioral Intention => Usage Behavior
* TAM / TAM2 (Davis 1986) (Venkatesh & Davis 2000)	Perceived Usefulness => Behavioral Intention	Perceived Ease of Use => Behavioral Intention	(TAM2) Social Influence => Behavioral Intention		Behavioral Intention => Usage Behavior
TPB / DTPB (Ajzen 1991) *(Mathieson 1991) * (Taylor & Todd 1995)	Attitude Toward Behavior (Behavioral Beliefs) => Behavior Intention		Subjective Norm (Nomative Beliefs) => Behavioral Intention	Perceived Behavioral Control (Control Beliefs) => Behavioral Intention => Usage Behavior	Behavioral Intention => Usage Behavior
* Combined TAM+TPB (Taylor & Todd 1995)	Perceived Usefulness (Attitude) => Behavioral Intention	Perceived Ease of Use (Attitude) => Behavioral Intention	Subjective Norm => Behavioral Intention	Perceived Behavioral Control => Behavioral Intention => Usage Behavior	Behavioral Intention => Usage Behavior
* MPCU (Thompson et al. 1991)	Job-fit <Long Term Consequence> => Utilization	Complexity (Ease of use) => Utilization	Social Factors => Utilization	Facilitating Conditions => Utilization	<Emotions (Affect)> => Utilization
* Motivation Model (Davis et al. 1992) (Venkatesh & Speier 1999)	Extrinsic Motivation (Perceived Usefulness) => Behavioral Intention	Intrinsic Motivation (Perceived Enjoyment) => Behavioral Intention			
SCT (Bandura 1986) * (Compeau & Higgins 1995)	Outcome expectancies (Performance & personal) => Affect & Anxiety => Usage Behavior	Self-Efficacy (Bandura 1977) => Affect & Anxiety => Usage Behavior			<Affect & Anxiety> => Usage

* indicates the theory/model is dedicated to the study of user adoption of IT/IS
=> indicates a significant influence on the specified factor
<> indicates the factor is not a significant influence on the specified factor

Table 3.1 Table of UTAUT's constructs against the eight prominent models

As shown in Table 3.1, the summary table contains six columns and nine rows. Each row represents one model and contains the main constructs. The first row is the UTAUT model and the subsequent rows are the eight discussed technology acceptance models. The model name is shown in the first column with the theory proposer, the publishing year of the paper, and/or the key researchers who adopted the model for studying in the domain of information system research. An asterisk indicates the model or the research is dedicated for the study of user adoption behaviour of new information technology or information systems. The subsequent columns are the constructs of the model mapping to the constructs of the UTAUT model. There are five main constructs of the UTAUT model. They are shown in columns 2 to 6 accordingly. Inside the content of the constructs, the "=>" mark indicates a significant influence on the specified factor. For example, performance expectancy of UTAUT has a significant influence on behavioural intention. Outcome expectancies has a significant

influence on both affect and anxiety and usage behaviour. Furthermore, the construct enclosed by a pair of "< >" brackets indicates that the factor does not have any significant influence on the specified factor examined in the development of the UTAUT model. For example, long term consequence does not have any significant influence on utilisation in the UTAUT study.

By analysing the constructs, the performance expectancy of UTAUT encompasses the relative advantage of IDT, perceived usefulness of TAM, job-fit of MPCU, outcome expectancies of SCT, and extrinsic motivation. The effort expectancy of UTAUT encompasses complexity (ease of use) of IDT and MPCU, perceived ease of use of TAM, self-efficacy of SCT, and intrinsic motivation. The social influence of UTAUT encompasses image (or observability) of IDT, subjective norm of TRA and TPB, social influence of TAM, and social factors of MPCU. The facilitating conditions of UTAUT encompass compatibility and trialability of IDT, perceived behavioural control of TPB, and facilitating conditions of MPCU. Finally, the behavioural intention of UTATU has similar definitions of the behavioural intention of all other models.

According to the analysis, there are some common characteristics among the models. Both IDT and the MM are focused on the influence of behavioural intention, while MPCU and SCT are focused on usage behaviour only. IDT, TRA, TPB, MPCU, and SCT explore more specific factors, while TAM and the MM provide two specific factors respectively. TAM considers perceived usefulness and perceived ease of use to be the main influencing factors of behavioural intention, while the motivation mode adopted by Davis et al considers perceived usefulness and perceived enjoyment to be the main influencing factors of the computer learning and adoption model.

Numerous studies have been carried out to validate and verify the robustness of the UTAUT model. Oshlyansky et al (2007) proposed using the UTAUT model as a tool to verify human-computer interface (HCI) methods and tools cross-culturally. They conducted a survey across nine countries, which included Czech Republic, Greece, India, Malaysia, New Zealand, Saudi Arabia, South Africa, United Kingdom, and United States. The results showed that the UTAUT tool is robust enough to withstand translation and to be used cross-culturally. The finding enables HCI researchers and practitioners to use the tool in an international context without concern for its cross-cultural validity.

Pu Li et al (2006) tested the robustness of UTAUT. They chose to analyse the acceptance of online community weblog systems among 265 business school undergraduate students. Multiple group invariance analysis was used to assess the equivalence of the UTAUT scales across different subgroups based on gender, general computing knowledge, weblog-specific knowledge, experience with weblogs, and frequency of using weblogs. The results indicated that the scales for the constructs in UTAUT have invariant true scores across most, but not all, subgroups. Pu Li et al (2006) advised that caution is needed when interpreting results from studies conducted using UTAUT scales.

In China, Min et al (2007) adopted and extended the UTAUT model to study m-commerce acceptance and usage. They proposed a conceptual model extended from UTAUT, incorporating the information system user satisfaction theory, and moderated with Chinese culture. The main constructs are trust and privacy, utility expectancy, effort expectancy, social factors, and convenience and cost (as the main facilitating conditions). The new factor of information satisfaction has direct influence on utility expectancy, while another new factor of system satisfaction has direct influence on both information satisfaction and effort expectancy. This research is still being undertaken so no further results are available. However, it is remarkable that the added factors of trust and privacy are closely related to the proposed factor of disturbance concern, central to this thesis. It will be discussed in the next chapter. The authors explained that trust is closely related to the previous study of perceived risk (Wu and Wang 2005). They further classified trust into two categories: trust of technology and trust of m-commerce service providers. Privacy protection is different from trust because perception of privacy protection is also affected by the third party, such as government and its privacy protection policy.

3.3 Two-Factor Theory of Herzberg

The two-factor theory (also known as Herzberg's motivation-hygiene theory) is a psychological motivation theory developed to describe job satisfaction in the workplace. It states that there are certain factors in the workplace that cause job satisfaction, while a separate set of factors, if absent or weak, cause dissatisfaction (Herzberg et al. 1959). Frederick Herzberg, a psychologist, developed the theory in the 1960s and hypothesised that job satisfaction and job dissatisfaction act independently of each other. Those job satisfaction factors relate to the job itself, for example its complexity, or importance, which Herzberg named the Motivators or Growth Factors. Job dissatisfaction factors relate to the job environment and the context in which the job was performed and thus extrinsic to the job itself, for example the quality of supervision, or level of pay. Herzberg (1959) labelled these the Hygiene or Maintenance Factors. Herzberg explained that hygiene can preserve and promote the physical, mental, and emotional health of an individual; the lack of it creates a dissatisfying situation. The existence of hygiene creates an equilibrium in which satisfaction is maintained. He also states that both factors are equally important, but that good hygiene will only lead to average performance, preventing dissatisfaction, but not creating a positive attitude or motivation to work by itself.

According to the motivation theories, motivations can be basically classified as intrinsic and extrinsic factors. Intrinsic motivation is driven by an interest or enjoyment in the task itself, and exists within the individual rather than relying on any external pressure. Extrinsic motivation comes from outside of the individual, such as rewards, money, promotion, etc. Both cause satisfaction. The two-factor theory states an alternative perspective that motivations can be classified as motivators and hygiene factors. Motivators cause satisfaction if present and strong. Hygiene factors cause dissatisfaction if absent or weak. They can maintain satisfaction, but not create a positive attitude or motivation.

It is found that the prevailing technology acceptance models mainly focus on the study of motivations of user intentions and usage behaviour, but neglect the hygiene factors that should be included in the models in order to maintain an equilibrium that enables the motivators to create a positive attitude or motivation for driving user adoption of new technology. The two-factor theory (Herzberg 1959, 1968) is actually the foundation theory

that fully supports the described hypothesis developed for this research. The conceptual model of this research is constructed from the robust UTAUT model and extended from the concept of the two-factor theory in which the new factor of disturbance concerns is developed as the hygiene factor and added into the proposed conceptual model as one of the critical constructs of the model. The definition of disturbance concern and the corresponding hypotheses are discussed in the next chapter.

Many previous studies adopted the two-factor theory as the foundation theory in researching technology acceptance behaviour. Centefelli (2004) agreed that information systems research has focused extensively on the factors that foster adoption and usage, but much less attention has been given to what perceptions uniquely inhibit usage. With reference to the two-factor theory, he proposed a theory for the existence, nature, and effects of system attribute perceptions that lead solely to discourage use. He posited that usage inhibitors deserve an independent investigation on the basis of the following arguments.

- There exist perceptions that serve solely to discourage usage.
- These inhibiting and enabling perceptions are independent of one another and can coexist.
- These inhibiting and enabling perceptions have differing antecedent and consequent effects.
- Such inhibitors may not only be important to the IS usage decision, they may be more important than enabling beliefs.

Centefelli (2004) introduced the concept of enablers and inhibitors. Enablers are the perceptions that users have about a system that encourage them to adopt technology that, if absent, do not discourage adoption. Enablers are analogue to motivators that have possible effects on an individual's behavioural intention. Inhibitors are the perceptions that users have about a system that discourage them to adopt technology that, if absent, do not encourage adoption. He explained that these inhibitors are fundamentally different in nature and effects from previously established positively oriented perceptions within the technology acceptance and user satisfaction literature.

Centefelli (2004) provided evidence to support the proposed concept of inhibitors. For

example, Microsoft Word™ was derided for the use of animated cartoon characters to encourage less willing users to adopt the new software version. Venkatesh and Brown (2001) identified specific facets of technology that served solely to discourage but not encourage PC adoption, such as high cost and rapid change. They noted high cost coupled with rapid change in technology results in a cost-to-useful-life ratio that is possibly unacceptable to many consumers. They also pointed out that if a system is perceived to possess volatile design characteristics, rejection is likely. However, the absence of volatility (design stability) is not psychologically meaningful. Gatignon and Robertson (1989) found that secrecy was a predictor of technology rejection, but lack of secrecy did not predict adoption. Centefelli (2004) also outlined that a successful e-business transaction is taken for granted, and not conducive to satisfaction, but a failed transaction will certainly dissatisfy. His study supports the view that inhibitors could formulate into a viable construct of technology acceptance models.

Several recent studies focus on the application of Herzberg's two-factor theory into the domain of information systems research. Wong and Arjpru (2007) investigated the factors that influence user satisfaction and the factors that influence user dissatisfaction. They conducted a qualitative study by interviewing staff from a tertiary institution who continually use an Enterprise Education System to support teaching. The results suggest that it is important not only to make users satisfied but also to avoid user dissatisfaction. Liu and Goodhue (2008) criticised existing studies of website characteristics and their impact on intentions, assuming a linear relationship between them. They drew on motivational theory and studied different methods of testing for hygiene and motivator factors for predicting website reuse. Their research is based the WebQual model, which was developed by Loiacono et al in 2007. WebQual is based on the TAM and the TRA, and is focused on measuring those characteristics of a website that might contribute to a user's intention to revisit or purchase from a given website. The results show the hygiene effect of trust. They suggested that piecewise linear regression may be superior to quadratic regression in exploring the non-linear mechanisms of website qualities. They presented highly suggestive evidence that, at least for Trust, traditional linear mechanism studies are ignoring an important aspect of the complexity of human motivations.

3.4 Perceived Risk and Trust of User Acceptance

Among the extensions of technology acceptance models, two significant factors are found to be widely considered as viable constructs. They are perceived risk and trust. Trust has long been regarded as a catalyst for business transactions that can provide consumers with high expectations of satisfying exchange relationships and is essential for understanding interpersonal behaviour and economic exchanges, including the transactions of e-commerce (Pavlou 2003). While trust has a positive influence on behavioural intention and other constructs (Pavlou 2003), perceived risk has a negative influence on the constructs of technology acceptance models (Featherman and Pavlou 2003). Perceived risk is considered as the perception of uncertainty regarding possible negative consequences of using a product or service. It is a barrier of e-commerce that is important and likely to affect consumer behaviour. Since trust and perceived risk are essential constructs when uncertainty is present, these beliefs are commonly integrated in e-commerce acceptance models.

Trust is a social concept that has been conceptualised in a variety of ways, both theoretically and operationally. Gefen et al (2003) conducted research on experienced repeat online shoppers and proposed an integrated model of trust and TAM. They reviewed over 50 studies related to the conceptualisation of trust. They concluded that trust can be summarised as:

- a set of specific beliefs dealing primarily with the integrity, benevolence, and ability of another party;
- a general belief that another party can be trusted;
- an affect reflected in feelings of confidence and security in the caring response of the other party; or
- a combination of these elements.

For e-commerce, trust is a central aspect in many business transactions because of an inherent human need to understand the social surroundings that identify what, when, why, and how other behave (Gefen et al 2003).

Gefen et al (2003) defined four antecedents of trust for e-commerce. They are:

- Calculative-based trust is a rational assessment of the costs and benefits of another party cheating and cooperating in the relationship.

- Knowledge-based familiarity is an experience-based assessment of social complexity relating to future activities of the other party, which is experience of what, who, how, and when of what is happening. Familiarity (i.e. ease-to-use and intuitive interface) reduces social uncertainty through increased understanding of what is happening in the present.

- Institution-based situational normality is an assessment that the transaction will be a success, based on how normal or customary the situation appears to be.

- Institution-based structural assurances refer to assessments of success due to the present of safety nets such as legal recourse, guarantees, and regulations that exist in a specific context.

Gefen et al (2003) concluded that trust is a social antecedent of behavioural intention. Perceived ease of use and perceived usefulness of TAM are technological antecedents. The results supported that perceived ease of use is associated with increased trust, and increased trust, in turn, is associated with increased perceived usefulness.

Perceived risk has formally been defined as "a combination of uncertainty plus seriousness of outcome involved" (Bauer 1967). Featherman and Pavlou (2003) defined perceived risk as the potential for loss in the pursuit of a desired outcome of using an e-service. Cunningham (1967) typified perceived risk as having six dimensions. Featherman and Pavlou (2003) applied Cunningham's classification of perceived risk into TAM for predicting e-service adoption. They defined perceived risk as comprising:

- Performance risk: The possibility of the product failing to deliver the desired benefits.
- Financial risk: The potential monetary outlay and the recurring potential for financial loss due to fraud.
- Time Risk: The potential loss or waste of time.
- Privacy Risk: The potential loss of control over personal information.
- Social Risk: The potential loss of status in one's social group.
- Psychological Risk: The negative effect on the person's peace of mind or self-perception.

- Overall Risk: A general measure of perceived risk when all criteria are evaluated together.

The results supported the view that performance-related risk facets (time risk, privacy risk, and financial risk) proved to be the most salient concerns for the sample and context, while social risk concerns were not salient.

A recent study undertaken by Cocosila et al (2009) combined a multi-faceted perceived risk with a motivational model to describe the possible use of wireless text messaging on cell phones to improve user adherence to healthy behaviour. The theoretical model focused on testing the effects of the financial risk, social risk, privacy risk, and perceived psychological risk on intrinsic motivation, extrinsic motivation, and behavioural intention.

Trust and perceived risk are usually studied together. Pavlou (2003) extended the TAM model by integrating trust and perceived risk into the model for predicting consumer acceptance of e-commerce. The research included an exploratory study comprising three experiential scenarios with 103 students, and a confirmatory study using a sample of 155 on-line consumers. The results showed that trust and perceived risk are direct antecedents of intention to transact, suggesting that uncertainty reduction is a key component in consumer acceptance of e-commerce that deserves particular attention. Second, trust also acts as an indirect antecedent through perceived risk, perceived usefulness, and perceived ease of use. Finally, although the theoretical model indicated that trust is a significant antecedent of perceived risk, they could be interrelated constructs. The causal relationship between trust, perceived risk, and behavioural intention deserves further research.

Kim et al (2008) developed a theoretical framework to describe the trust-based decision making process of e-commerce consumers, in which trust and perceived risk are the key and added constructs. The results suggested that a consumer's trust has a strong positive effect on the purchasing intention as well as a strong negative effect on a consumer's perceived risk. They also found that a consumer's perceived risk reduces the consumer's intention to purchase, whereas a consumer's perceived benefit increases the consumer's purchasing intention. It is consistent with the study undertaken by Pavlou (2003).

P. 76

Luo et al (2009) integrated trust and perceived risk into a conceptual TAM for predicting the acceptance behaviour of mobile banking services. They examined multi-dimensional trust and multi-faceted risk in the initial acceptance of mobile banking. The results indicated that risk perception, derived from eight different facets, is a salient antecedent to the acceptance of mobile banking services. They found that personal trait factors such as trust disposition (Gefen 2000) and self-efficacy (Bandura 1977) become the major levers to overriding the effect of perceived risks and directly influence the intention to adopt mobile banking.

Trust and perceived risk are two viable factors for technology acceptance models. Trust, as shown in the research results, has a positive influence on behavioural intention and other constructs. Increased user trust can promote behavioural intention. Perceived risk is an opposing factor that has a negative influence on behavioural intention and other constructs. Increase perceived risk can detract from behavioural intention. Their impact on behavioural intention is similar to the effects of the motivators and hygiene factors of the two-factor theory (Herzberg 1959) on job satisfaction. They support the conceptual proposition of the study of the negative influence factors of this paper. However, the causal relationship between trust and perceived risk is concluded not to be directional. They may influence each other. Further research is suggested to explore the causal relationship among trust, perceived risk, behavioural intention, and other constructs.

Furthermore, trust and perceived risk are complex factors. They have multiple dimensions and multiple facets. Trust in terms of e-commerce can be defined into four dimensions (Gefen et al 2003), while perceived risk is divided into seven facets (Featherman and Pavlou 2003). The individual dimension or facet can impact on other constructs. For example, Lee (2008) found that only social risk has a direct influence on subjective norms but not attitude toward use. Both financial risk and security risk have a direct influence on behavioural intention. It means that trust and perceived risk cannot be concluded as a single composed construct, and it is appropriate to simply conclude and apply the relationship of trust and perceived risk into other direct constructs. Instead of using these terms this thesis proposes the new construct of disturbance concerns. It includes the factors with negative influence on behavioural intention. It includes all concerns in relation to usage of a system, such as spam, security, privacy, and any potential loss due to usage.

3.5 Conclusion

The prediction of user acceptance of a new technology or information systems is a behavioural study. Technology acceptance models are mainly developed from the foundation theories and models of psychology and sociology. TAM and TPB are two main streams of technology acceptance models in information systems research. TAM is widely adopted because of its simple research setup and constructs. Its basic constructs of perceived usefulness and perceived ease of use are designed specifically for the domain of information systems research. TPB is a general model that possesses the constructs of attributes, subjective norm, or perceived behavioural control. Prior to undertaking research, exploration of the attributes of those constructs specific for the research is necessary. Different perspectives may produce different attributes, but there are some commonly used attributes, such as usefulness, ease of use, compatibility, self-efficacy, facilitation, etc.

The UTAUT, adopted for this research, is the unified model of eight prominent technology acceptance models (Venkatesh et al 2003). It is comprised of the major components of eight integrated models and includes five main constructs of performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioural intention. UTAUT is able to account for 70% of the variance (adjusted R2) in usage intention, better than any of the eight models alone.

In addition to the technology acceptance models, the two-factor theory (Herzberg 1967) provides an insight into the two-sided view of influence factors on behavioural intention. Major studies concentrate on positive influence factors, although negative influence factors may be the main reason for the acceptance of m-commerce. Finally, trust and perceived risk are commonly proposed constructs for e-commerce acceptance. Their characteristics have been examined. Their relationship with the proposed construct of disturbance concerns has been explained and will be expanded upon in the next chapter.

Chapter 4
Research Methodology and Framework

This research extends the UTAUT model, the conceptual model developed is employed to study user acceptance of m-commerce. The study has two main purposes. The first purpose is verification of the extended UTAUT model to test its capability to apply for the analysis of user acceptance behaviour of m-commerce services, particularly focusing on the influence of behavioural intention. The second purpose is that the proposed enhancement can complement and enhance the current UTAUT model for m-commerce acceptance.

The study aims to establish that the proposed new construct of disturbance concerns can statistically support the significant influence of behavioural intention. The result can enhance our understanding of the user acceptance behaviour of m-commerce by exploring more new factors from the extended UTAUT model. The UTAUT model is robust but it mainly focuses on the positive influence factors of user acceptance behaviour. Several research studies have identified possible negative influences in user acceptance behaviour in relation to new information systems. This research aims to establish the importance and viability of negative factors in technology acceptance models.

In this chapter, the research framework, approach, and process are explained. It includes the explanation of the research methodology and the development of the research hypotheses. The conceptual model and its development are outlined. Finally, the research process and the timeline of the research operation are discussed. It is remarkable that the conceptual model was presented in two international conferences (SCMIS 2008 and ICEB 2009) in order to collect feedbacks from the field experts. Very helpful comments were received to support the viability of the research. Furthermore, data has been collected for three years from 2009 to 2011, in order to support the chronological validity of this study.

4.1   Research Development

Based on different social and psychological theories, various studies have used models that incorporate various factors identified with user acceptance of new information systems (Davis 1986, Davis et al 1989, Moore and Benbasat 1991, Mathieson 1991, Thompson et al 1991, Taylor and Todd 1995, Compeau and Higgins 1995, Venkatesh and Speier 1999, Venkatesh and Davis 2000, Venkatesh et al 2003). However, these studies do not consider the acceptance rate of m-commerce services, which is the particular focus of this thesis. Despite high acceptance of smart phones, the acceptance of m-commerce has been slow when compared with that of e-commerce applications with the introduction of the internet. This study proposes the following:

1.   Previous studies have analysed and explained the adoption of m-commerce and mobile services, but only explain positive factors associated with user acceptance behaviour, based on the technology acceptance models of information systems research. There are some unidentified factors to be explored and defined in order to explain the slow acceptance of m-commerce, specifically negative factors that may influence user acceptance behaviour of new information systems. This concept is similar to that of Herzberg's two-factor theory (Herzberg et al. 1959), in which he suggests that human behaviours can be influenced by both positive and negative factors. Positive factors motivate behavioural intention, but negative factors may result in behavioural hesitation. Negative factors must be mitigated in order to make the positive factors effective (see section 3.3 for further discussion). Centefelli (2004) described those factors as inhibitors.

2.   The majority of technology acceptance studies were initially designed for and conducted on organisational users, such as company employees, instead of individual users, such as general mobile users. For this reason those technology acceptance models do not fully explain the adoption or otherwise of m-commerce. Other factors may influence adoption by individuals and technology acceptance models should be modified for this purpose. For voluntary uptake by individuals, there may be additional factors that influence their acceptance of new information systems. Several extensions to established models have been proposed, including

perceived risk and trust (Featherman and Pavlou 2003, Pavlou 2003) as described in section 3.4.

The objective of this study is to propose and verify an extended technology acceptance model for identifying factors of m-commerce acceptance by individual mobile users. The factors include the present positive factors adopted in the contemporary technology acceptance models and a set of newly explored negative factors. Thus, a quantitative research study is designed to establish whether there are any negative factors significantly influence in the acceptance of m-commerce in alignment with the prevailing positive factors of technology acceptance models.

This research extends the UTAUT model (Venkatesh 2003) because of its proven robustness. It has been tested in many different settings and contexts. The UTAUT model incorporates eight prominent technology acceptance models, encompassing the significant factors of these models. The factors are also re-examined in the hypotheses of this research in order to verify the applicability of the model in the context of this research. The composition and framework of the UTAUT model have been discussed in section 3.2. The proposed new model is discussed in the next section.

4.2 Research Methodology

Since the proposed conceptual model is an extension of the UTAUT model, the research methodology is also extended from the quantitative research methods that were applied in the development of the UTAUT model. However, new measures and instruments are introduced in this research in order to incorporate the specific requirements of the m-commerce service. The proposed conceptual model includes a new construct of disturbance concerns. It includes the negative factors that can influence behavioural intention. In order to study the effectiveness of the new construct of disturbance concerns in the context of m-commerce, two categories of m-commerce are included. The first category is web-based m-commerce applications, which run in an internet browser environment. Security and privacy issues for this category are consistent with the security and privacy issues of internet-based e-commerce. The second category is native mobile applications. These are installed onto mobile phones as an application and thus they have the ability to access all information stored and provided by the mobile phone. The security and privacy issues for this category are more significant than for the web-based applications. Two instruments are designed to cater for both situations. The results are then evaluated and compared.

Quantitative research is appropriate for this study. Survey questions were designed by following the process of the UTAUT development. A questionnaire was developed and a pilot test undertaken to verify the validity, relevance, and effectiveness of the questions, in January 2009. Around 20 individuals at the City University of Hong Kong were invited by opportunity to answer the questions; the individuals were either teachers or students. The collected responses were analysed and the questions were proved to be valid, relevant, and effective. Only minor changes were made to the wordings of the questions for clarification.

In order to facilitate the collection of the responses, a web-based system was set up. The system was developed with flash and hosted in a HTML page. The web address was http://www.cs.cityu.edu.hk/~donny/survey/. The collected data were stored in a MySQL database, which was able to export to Excel files for facilitating statistical analysis. For privacy protection, the identities of the respondents were not collected. Only their relevant information from their profiles was recorded, such as their gender, age range, education level, mobile capability, and m-commerce experience. In addition the WiFi availability and internet

accessibility of their phones were collected in order to understand if their phones were already well-equipped for conducting mobile commerce.

In order to identify the chronological validity of the research results, the survey was designed to be taken three times in three years. It is an omnibus research across three years. The samples of each survey were different and their identities were not collected. The first survey was taken in February and March of 2009. There were 148 valid responses collected. The second survey was taken from January to March 2010, with 150 valid responses collected. The final survey was taken from January to February of 2011. Only 94 valid responses were collected, which is sufficient to support this research. During data collection, some invalid data was found, which might distort the analysis result. Those invalid records included all answers of extremely agree or extremely disagree. There were five invalid records in the 2009 data, five invalid records in the 2010 data, and three invalid records in the 2011 data. These answers were considered as irrational and irrelevant, and thus were deleted.

The data collected from the quantitative research were analysed by the partial least squares (PLS) regression technique of the structural equation modelling (SEM) because PLS is relevant to the confirmatory factor analysis (CFA) in this context. The reliability and validity of the measurement model was examined by the corresponding techniques of CFA. The results are discussed in chapter five. SmartPLS, a PLS software, was selected for statistical analysis. SmartPLS supports graphical path modelling with latent variables and produces many useful statistics. It was developed by Ringle et al (2005) at the University of Hamburg. It is widely used and appropriate for this research. In addition, traditional t-tests were taken to test the hypotheses and the results can be used to triangulate the PLS analysis.

Qualitative research is not appropriate for this study, being more suitable for studying a new problem in its early stage or for exploring new factors of an existing problem (Creswell 2002). In view of the nature of this study, factors affecting technology acceptance have been identified by existing research. The construction of a new construct is based on the analysis of existing literature. The new construct simply includes the potential negative factors identified by other relevant literature.

4.3 Research Hypotheses

As discussed in chapter 1, the research question of this thesis is "*What factors have significant negative influence on the user acceptance of m-commerce by general mobile users?*" In order to address the research question, hypotheses are developed based on the research framework of the UTAUT model adopted for this research. The research model is composed of the UTAUT constructs of performance expectancy, effort expectancy, social influence, facilitating conditions, and behavioural intention, but actual usage is ignored in this research because there were no measures of the subsequent actual usage of m-commerce by the anonymous respondents. A new construct of disturbance concerns is added to support the research question. The new construct concludes the negative influence on the user acceptance of m-commerce.

To investigate the user's perception of each construct, three to five highly correlated questions are designed for each construct in order to have a consolidated and consistent measurement. For measuring user behaviour, a modified Likert scale system is adopted and assigned as the options of the questions relate to user perception. Each question is designed to elicit one of the seven answers. They are (1) strongly disagree, (2) moderately disagree, (3) somewhat disagree, (4) neutral, (5) somewhat agree, (6) moderately agree, and (7) strongly agree. This seven-level scale system is commonly used in statistical analysis and was also adopted for the development of the UTAUT model. The key constructs and the corresponding hypotheses of the conceptual model are outlined in the following subsections.

4.3.1 Performance Expectancy

Performance expectancy is the degree to which an individual believes that using the system will provide benefit or enhance job performance (Venkatesh 2003). It is similar to the concept of perceived usefulness in TAM, extrinsic motivation in MM, job-fit in MPCU, relative advantage in IDT, and outcome expectations in SCT. The performance expectancy construct should influence the behavioural intention of an individual using a new technology. In this research, it is about the benefits gained from using m-commerce. Thus, in this proposed framework, the first hypothesis states that:

(H1) *Performance expectancy has a positive influence on behavioural intention towards adopting m-commerce.*

In order to investigate user perception, there are four questions for performance expectancy:

1. PE1: Mobile devices are useful tools for conducting online transactions

2. PE2: Using mobile devices enables me to conduct online transactions easily

3. PE3: Using mobile devices for online transactions increases my efficiency

4. PE4: I can do transactions faster on mobile devices than using desktop computers

4.3.2 Effort Expectancy

Effort expectancy is the degree of ease an individual associates with the use of a system (Venkatesh 2003). Effort expectancy is a similar concept to that used in existing technology adoption models, such as perceived ease of use in TAM, complexity in MPCU, and ease of use in IDT. It is based on the expectation that individuals use a new technology if they find it easy to use. In this research, it is about the ease of using m-commerce through a mobile phone. For the proposed model, the second hypothesis states that:

(H2) *Effort expectancy has a positive influence on behavioural intention towards adopting m-commerce.*

In order to investigate user perception, there are four questions for effort expectancy:

1. EE1: It would be easy for me to understand the operation of online transactions in the mobile device

2. EE2: It would be easy for me to adapt to using the mobile device for online transactions

3. EE3: I would find the mobile transactions easy to conduct

4. EE4: Learning to conduct mobile transactions is easy for me

4.3.3 Social Influence

Social influence is a subjective norm for TRA, TAM2, and TPB/DTPB and describes the situation in which an individual perceives that important others believe the person should use the new technology (Venkatesh 2003). It is also equivalent to social factors in MPCU, and image in IDT. For the proposed model, the third hypothesis states that:

(H3) *Social influence has a positive influence on behavioural intention towards adopting m-commerce*.

In order to investigate user perception, there are four questions for social influence:

1. SI1: People who influence my behaviour (such as teachers, friends, actors, singers, etc) think that I should use the mobile device for online transactions

2. SI2: People who are important to me (such as family members, supervisors, friends, etc) think that I should use the mobile device for online transactions

3. SI3: I do mobile transactions because many people are doing so

4. SI4: In general, Hong Kong people support mobile devices for online transactions

4.3.4 Facilitating Conditions

Facilitating conditions is defined as the degree of belief in the existence of the technical and organisational infrastructure to support the usage of a new technology (Venkatesh 2003). It is embodied by three constructs of user acceptance models: the perceived behavioural control of TPB/DTPB, the facilitating conditions of MPCU, and the compatibility of IDT. Unlike other constructs, facilitating conditions do not have a direct influence on behavioural intention. The UTAUT model stated that facilitating conditions have a positive influence on actual usage rather than behavioural intention. For this research, it is difficult to examine the actual usage of m-commerce. The respondents to the surveys conducted in this study are anonymous in order to avoid any privacy issues

Thus, facilitating conditions is included in the conceptual model for maintaining consistency with the original UTAUT model, but it is excluded from the data analysis. The collected data of facilitating conditions is reserved for future analysis. There are four questions designed for facilitating conditions:

1. FC1: Mobile devices are generally well equipped (including hardware, software, network, etc) for doing online transactions

2. FC2: It is easy to gain the knowledge (such as from leaflets, manuals, user guides, internet, etc) necessary for mobile transactions

3. FC3: Mobile transactions are generally compatible with online transactions undertaken on a desktop computer.

4. FC4: I think service providers will arrange customer service to help people do mobile transactions

4.3.5 Disturbance Concerns

Disturbance concerns is the degree to which an individual believes and worries about the potential disturbance and subsequent loss caused by the use of the system. This construct extends the original UTAUT model to explore, analyse and critically assess the negative influence factors on the adoption of m-commerce. Disturbance is an activity that is a malfunction, intrusion, or interruption as defined in the dictionary of WordNet 3.0 of Princeton University.

Disturbance can be security or privacy risks (Ghosh and Swaminaha 2001), customer trust (Siau and Shen 2003), pressures, stress, anxiety, inter-dependency (Jarvenpaa et al 2003), mobile spam (Leppaniemi and Karjaluoto 2005), hidden transaction costs (Wu and Wang 2005), and any unanticipated (potential) loss caused by the use of the system. To explore and analyse the impact of disturbance concerns is the main purpose of the proposed model of this study, hence, the fourth hypothesis is defined as:

(H4) *Disturbance concerns have a negative influence on behavioural intention towards adopting m-commerce.*

Since the construct of disturbance concerns is critical for supporting the proposed extension of the UTAUT model, there are ten questions related to disturbance concerns. In mobile computing, there are two ways to provide an m-commerce service. First, the m-commerce application can be developed using web-based technology and accessed via the internet browser of mobile phones. The security and privacy issues of this method are equivalent to those of other web-based applications.

Second, the m-commerce application can be developed using the native technology of the mobile device. For example, iPhone applications could be developed in a Mac OS system using the Xcode development tool and coded in the programming language of Objective-C. Native mobile applications can access all the data and resources of mobile phones instead of being restricted by the security and privacy constraints of internet browsers. This means using a native application for conducting m-commerce transactions is more risky. This research caters for both mobile scenarios.

In order to understand if users have different levels of disturbance concerns with the two types of m-commerce applications, there are two sets of identical questions set for these two scenarios. Each set of five questions is prefaced by the scenario. The two situations described in the questionnaire are as follows:

1) DC1: If your mobile device (such as your phone) can use an internet browser to surf the internet,

2) DC2: If your mobile device (such as your phone) can install some applications for undertaking online transactions and those applications can access your privacy information (such as phone number and contacts) and your current location (such as by means of GPS or A-GPS).

The five questions are identical for each scenario:

1. DC11/DC21: I worry about being spammed when using the mobile device to conduct online transactions

2. DC12/DC22: I worry about losing privacy data (such as my location, my phone number) when using the mobile device to conduct online transactions

3. DC13/DC23: I worry about my personal information (such as address, bank account, etc) being stolen or leaked if I use the mobile device for online transactions

4. DC14/DC24: The mobile transaction is not as secure as the traditional electronic commerce.

5. DC15/DC25: I worry that using the mobile device for online transactions may result in unexpected interruptions or disturbances.

In situation 1, users understand that their mobile devices are equivalent to desktop computers equipped with an internet browser for surfing the internet. Their personal data are protected similar to the protection offered by desktop computers. In situation 2, users are reminded that their personal data can be captured by someone during the use of installed m-commerce applications. The same set of five questions is asked, covering disturbance concerns of spam, privacy, information leaks, security, unexpected interruptions, or any potential disturbances. In total there are 10 questions related to disturbance concerns.

In data analysis, both situations were tested individually and in a combined model. The purpose of this approach is to test the disturbance concerns of the different levels of data protection on those two typical situations of m-commerce and study the validity of the extension of disturbance concerns applicable to both situations. The design of these two instruments is unique in the research of mobile computing.

4.3.6 Behavioural Intention

Behavioural intention is the degree to which an individual intends to use the system. Behavioural intention is consistent with the underlying theory for all of the intention models discussed in this thesis. The UTAUT model was tested to have a significant positive influence on technology usage. In this research, there are only three questions for investigating the behavioural intention of the respondent:

1. BI1: Given that I have a smart mobile phone capable of accessing the internet, I would use the mobile for online transactions.

2. BI2: If I can use my mobile phone for online transactions, I want to use it as much as possible.

3. BI3: Given that I do NOT have a smart mobile phone for online transactions, I plan to get a smart mobile phone and conduct online transactions in the next 6 months.

4.3.7 Summary of Hypotheses

To summarise, there are four main hypotheses. The first three hypotheses are designed to verify and validate the proposed model. If the research result matches with the original UTAUT model, the structure of the proposed model can be considered a valid extension of the UTAUT model.

The fourth hypothesis is to verify the effectiveness of the proposed concept of negative influence for technology acceptance models when they are applied to individual users in the context of m- commerce. As explained, a limitation of this research is that it excludes the study of facilitating conditions and use behaviour. However, it will not affect the validity of the proposed model.

4.4 The Conceptual Model

The primary objective of this research is to identify whether undiscovered factors negatively influence the user acceptance of m-commerce. The negative factors have been identified from other relevant research. Therefore, CFA is appropriate for this research. Further research is necessary to explore the key factors that form the negative influence through qualitative research and exploratory analysis. Having explained the hypotheses, the proposed conceptual model of this research is depicted in figure 4.1

Figure 4.1 Conceptual Model

The conceptual framework depicts the interrelationships of the constructs. Constructs on the left are the independent variables that influence either behavioural intention of m-commerce or use behaviour of m-commerce. The first three independent variables (performance expectancy, effort expectancy, and social influence) are the determinants of behavioural intention in the UTAUT model. The independent variables of facilitating conditions and behavioural intention are the determinants of use behaviour. Dotted lines are used to represent the dependency relationships. The final independent variable of disturbance concerns is added to explore and analyse the potential influence on behavioural intention in relation to m-commerce. Solid lines are used to present the mainly examined relationship between disturbance concerns and behavioural intention. Four main hypotheses (H1 to H4) are defined for the proposed model and have been explained in the previous section.

The development of the conceptual model has been subjected to preliminary reviews by field experts. In order to understand the viability of the research questions and the structural design of the conceptual model, two conference papers were written with Dr Ivan Lai and Professor Ernest Jordan. They have been presented in two international conferences in 2008 and 2009 respectively.

The first conference paper was written at the end of 2008 and the title is "A model for the study of user adoption behaviours of mobile commerce" (Lai et al 2008). It was presented to the international conference of SCMIS 2008 (Supply Chain Management and Information Systems) held in 8th to 10th December 2008 in Tiruchirappalli, India. The objective of the paper was to present the research questions, the conceptual model and the hypotheses. Positive and supportive comments were collected from the field experts at the conference. Subsequently, the conference paper was revised and accepted to be published in the special issue of the *International Journal of Enterprise Network Management* (IJENM) in 2010 (vol. 4, no. 1/2010, pp. 16-25) (Lai et al 2010).

The second conference paper was written at the end of 2009 and the title is "A conceptual model for the study of negative user adoption behaviours of mobile commerce" (Lai et al 2009). It was presented to the 9th international conference of E-Business 2009 (ICEB 2009) held from 30th November to 4th December 2009 in Macau. The objective of the paper was to present the proposed technology acceptance model, the analysis methodology, and the preliminary analysis result. Positive and supportive comments were collected from the field experts at the conference. Although the paper was not selected for the special issue of the conference affiliated journal, the collected feedback was quite helpful for the improvement and enhancement of this research. The conceptual model and the research approach were proved to be viable.

4.5 Research Process

As explained, this is a survey research. The research questions were designed with reference to the published questions for the survey research of the UTAUT model (Venkatesh 2003). A website was constructed to facilitate the collection of user responses. Respondents can freely forward the site address of the survey to others so that the survey can collect responses from people. Respondents are anonymous. It means that the survey includes the collection of the required user profile but not the identity of the respondent in order to avoid any privacy issues and ensure the unbiased analysis of the data.

A pilot test of the questionnaire was conducted in early January 2009 by a group of 20 opportunity samples. It was designed to test the correlation of constructs and verify the validity of the questions. By using CFA, the questions were proved to be appropriate to test the research hypotheses. The relationships of the question sets were proved consistent and correlated. Some minor changes to the grammar and wording of the questions was undertaken for clarification purposes.

Three sets of data were collected in early 2009, 2010, and 2011. A notice was designed and posted on the bulletin boards of the City University of Hong Kong in order to request public users to access the website and fill in the survey questionnaire. Students of my courses were notified with emails to request their participation in the survey. In February and March of 2009, 148 responses were received via the survey-based website. The majority of respondents were undergraduate and postgraduate students of the City University of Hong Kong. Preliminary analysis was undertaken and it was found that the result could support the proposed research model. In order to make the study vigorous and chronologically consistent, the same study was taken in 2010 and early 2011.

The same data collection approach was taken in February and March 2010. A notice was posted on the bulletin boards of the City University of Hong Kong. Students of my courses were notified with emails requesting their participation. There were 155 responses. The same statistical analysis process was applied to these two sets of data separately. Initially, the analysis results were inconsistent against the data of the previous year. After careful study, there were five records with nonsense data that affected the overall results. Those five records

were answered with all "Strongly Disagree" or all "Strongly Agree". After those five nonsense records were removed, the new analysis produced consistent results. Thus, the final data set has only 150 records. They were found to be consistent and matching with the result of the previous set of data. Although some significant differences were discovered, they were not related and did not affect the proposed extension of the structural model. The differences will be discussed in chapter 5. However, the proposed construct of the extended model was proved to be significant and consistent in these two sets of data although these two sets of data are collected from two different years.

In order to ensure the chronological validity of the research, the third data collection was taken in early January and February 2011. The sample procedure was applied and some students joined the survey voluntarily. Due to the time and resource constraints, further responses could not be obtained. Only 97 records were collected and three of them were nonsense records as outlined above. The remaining 94 records were valid data for analysis. Although the record size was smaller, it was sufficient to meet the statistical requirements of this research. The same data analysis was applied and the result was consistent and matching with the result of the previous two years. Some patterns of user behaviours during the three years were found. They will be discussed in chapter 5.

As explained, both PLS and t-tests were used to analyse the three sets of data. Demographic groups, such as gender, age, education level, etc, were analysed with the same PLS approach in order to test if any different behaviours could be found from the different demographic groups. The results are explained in the next chapter. Finally, all data was grouped into a single set and subjected to the same data analysis process. The result is also consistent and satisfactory with the proposed extension to the UTAUT model.

4.6 Conclusion

As discussed in Chapter 3, privacy risk and trust (Ghosh and Swaminaha 2001, Siau and Shen 2003) are some of the key negative factors that cause the slow growth rate of user acceptance. Jarvenpaa et al (2003) conducted a cross-cultural research study involving 32 focus groups with nearly 200 active urban mobile device users in Finland, Japan, Hong Kong, and the US in 2001 to explore both positive and negative user concerns of the adoption of mobile services. Centefelli (2004) introduced the concept of enablers and inhibitors for the study of IT-mediated customer service. Those negative factors are included in the hypothesis relating to the new construct of disturbance concerns. The new construct represents an extension to explain the negative influence on behavioural intention of technology acceptance models in the context of m-commerce.

The development of the conceptual model and the hypotheses are based on the UTAUT model (Venkatesh et al 2003). The conceptual model was presented at two international conferences (SCMIS 2008 and ICEB 2009), where useful feedback was received (Lai et al 2008, 2009). Although the methodology is adopted from the research of the UTAUT model, two special instruments were designed in the process in order to meet the special nature of m-commerce. They are related to web-based applications and native mobile applications. The survey involves 49 questions designed for capturing both user profiles and user behaviour against m-commerce acceptance. A website was constructed to collect user responses. Three separate surveys have been taken from 2009 to 2011 in Hong Kong. Due to limited resources, only behavioural intention was studied. However, comprehensive PLS analysis was applied to the three sets of data, the combined data, and different demographic groups in order to support the validity of the proposed model.

Chapter 5
Analysis and Findings

In this chapter, the results and findings of the research are discussed. Several statistical techniques were adopted for the data analysis. First of all, simple statistics were calculated from the collected demographic profile of the respondents in order to find out the data distribution patterns of the demographic data. To measure the validity and reliability of the structural model, the Structural Equation Modelling (SEM) technique, particularly Partial Least Squares (PLS) regression analysis, was adopted. SEM is a family of statistical techniques for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions. SEM supports both confirmatory and exploratory modelling; meaning SEM is suited to both theory testing and theory development.

In this research, we test a proposed extension of an existing technology acceptance model. The model is extended from the robust model of UTAUT (Venkatesh 2003). The construct of disturbance concerns was added to discover new unexplained factors of the original UTAUT model. Both the measurement model and the structural model are derived and extended from the UTAUT model. Therefore, confirmatory modelling analysis was adequate. Confirmatory modelling usually starts out with a hypothesis that is represented in a causal model. The model is then tested against the obtained measurement data to determine how well the model fits the data.

To test the hypotheses, the traditional t-test method was also used. Using both PLS with the t-test can confirm the results, ensuring validity, reliability and confidence for the results. Finally, the PLS analysis was applied to demographic groups in order to understand the potential variances among the demographic groups.

5.1 Demographic Profile

Data collected over three years were analysed, grouped, and summarised. First of all, it is necessary to understand the demographic profile of the subjects (i.e. the respondents) in order to verify their relevance to this research. Since data were collected anonymously, only gender, age, education level, WiFi-availability in the respondents' phones, internet accessibility of their phones, voluntariness of use of m-commerce, m-commerce experience, and usage frequencies were collected. Table 5.1 shows the summarised data of the demographic profile. The summarised data are divided into four columns. The first three columns are the summarised data of the three surveys conducted in 2009, 2010, and 2011. The final column is the summarised data of the consolidated data of all three years.

Rows are also divided, with the first group of rows showing the number of collected valid records. There are 148 valid records in 2009, 150 records in 2010, and only 94 records in 2011. Thus, the last column of the first row indicates a total of 392 valid records, which is the sum of the records of the three-year data. The second group of rows contains the summarised data of gender, age, and education level. It is notable that the data distributions of these demographic attributes are similar. The next group of rows contains WiFi-availability and internet accessibility of the respondents' phones. The data patterns of internet accessibility across the three years are similar, but the data patterns of WiFi-availability tend to be increasing by increments of 18% in 2010 and 12% in 2011. The final group of rows is about the m-commerce experience and usage frequency of the respondents. The summarised data indicates poor adoption of m-commerce service. More than 70% of respondents have never used the m-commerce activities that were the subject of the questions. The most popular m-commerce service tried or occasionally used by the respondents is m-booking followed by m-ticketing and m-banking. This is consistent with the fact that the acceptance rate of m-commerce is far below the acceptance rate of e-commerce as discussed in Chapter 1. The final collected demographic data is useful in understanding the voluntariness of use in relation to m-commerce. The statistics shows that the majority (76%) of respondents use m-commerce voluntarily, that is they do not use it in their employment. It is consistent with the research objectives that the acceptance of m-commerce is different from the acceptance of other information systems and that the target users are individuals using the services for personal use rather than corporate employees.

P. 100

Period	2009		2010		2011		3 years	
No. of Recrods	**148**		**150**		**94**		**392**	
Gender	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
	67.57%	**32.43%**	**68.67%**	**31.33%**	**61.70%**	**38.30%**	**66.58%**	**33.42%**
Age	*18-25*	*26-35*	*18-25*	*26-35*	*18-25*	*26-35*	*18-25*	*26-35*
	81.76%	**12.84%**	**81.33%**	**14.67%**	**95.74%**	**2.13%**	**84.95%**	**10.97%**
	36-45	*46-55*	*36-45*	*46-55*	*36-45*	*46-55*	*36-45*	*46-55*
	4.05%	**1.35%**	**4.00%**	**0.00%**	**1.06%**	**1.06%**	**3.32%**	**0.77%**
Education Level	*Doctorate*	*Post-Grad.*	*Doctorate*	*Post-Grad.*	*Doctorate*	*Post-Grad.*	*Doctorate*	*Post-Grad.*
	1.35%	**18.92%**	**0.67%**	**11.33%**	**0.00%**	**5.32%**	**0.77%**	**12.76%**
	Under-Grad.	*High School*	*Under-Grad.*	*High School*	*Under-Grad.*	*High School*	*Under-Grad.*	*High School*
	78.38%	**1.35%**	**84.00%**	**4.00%**	**92.55%**	**1.06%**	**83.93%**	**2.30%**
Mobile with WiFi	*Support*	*Not Support*	*Support*	*Not Support*	*Support*	*Not Support*	*Support*	*Not Support*
	47.30%	**52.70%**	**56.00%**	**44.00%**	**62.77%**	**37.23%**	**54.34%**	**45.66%**
internet Access	*Support*	*Not Support*	*Support*	*Not Support*	*Support*	*Not Support*	*Support*	*Not Support*
	74.32%	**25.68%**	**74.67%**	**25.33%**	**72.34%**	**27.66%**	**73.98%**	**26.02%**
m-Commerce Experience:	*Never*	*One-time*	*Never*	*One-time*	*Never*	*One-time*	*Never*	*One-time*
m-Banking	**82.43%**	**4.05%**	**86.67%**	**2.67%**	**82.98%**	**9.57%**	**84.18%**	**4.85%**
m-Bidding	**90.54%**	**3.38%**	**84.00%**	**7.33%**	**90.43%**	**7.45%**	**88.01%**	**5.87%**
m-Booking	**66.22%**	**9.46%**	**67.33%**	**11.33%**	**60.64%**	**13.83%**	**65.31%**	**11.22%**
m-Shopping	**83.11%**	**5.41%**	**85.33%**	**4.00%**	**77.66%**	**7.45%**	**82.65%**	**5.36%**
m-Trading	**89.19%**	**4.73%**	**86.67%**	**4.67%**	**90.43%**	**4.26%**	**88.52%**	**4.59%**
m-Ticketing	**70.95%**	**8.78%**	**75.33%**	**9.33%**	**71.28%**	**13.83%**	**72.70%**	**10.20%**
Other m-trans.	**76.35%**	**6.76%**	**83.33%**	**5.33%**	**75.53%**	**9.57%**	**78.83%**	**6.89%**
m-commerce Experience:	*Occasional*	*Frequent*	*Occasional*	*Frequent*	*Occasional*	*Frequent*	*Occasional*	*Frequent*
m-Banking	**9.46%**	**4.05%**	**8.00%**	**2.67%**	**6.38%**	**1.06%**	**8.16%**	**2.81%**
m-Bidding	**4.05%**	**2.03%**	**8.67%**	**0.00%**	**2.13%**	**0.00%**	**5.36%**	**0.77%**
m-Booking	**18.92%**	**5.41%**	**20.67%**	**0.67%**	**24.47%**	**1.06%**	**20.92%**	**2.55%**
m-Shopping	**10.81%**	**0.68%**	**10.67%**	**0.00%**	**13.83%**	**1.06%**	**11.48%**	**0.51%**
m-Trading	**5.41%**	**0.68%**	**7.33%**	**1.33%**	**5.32%**	**0.00%**	**6.12%**	**0.77%**
m-Ticketing	**18.24%**	**2.03%**	**14.67%**	**0.67%**	**14.89%**	**0.00%**	**16.07%**	**1.02%**
Other m-trans.	**15.54%**	**1.35%**	**10.00%**	**1.33%**	**14.89%**	**0.00%**	**13.27%**	**1.02%**
Purpose of m-commerce	*Job-required*	*Voluntary*	*Job-required*	*Voluntary*	*Job-required*	*Voluntary*	*Job-required*	*Voluntary*
	20.95%	**79.05%**	**21.33%**	**78.67%**	**23.40%**	**76.60%**	**21.68%**	**78.32%**

Table 5.1 The summarised data of the demographic profile

Gender, age, and education level are the three major factors of the demographic profile for this research. It is interesting to note that different demographic groups, such as gender,

age, and education level, have difference perception and attitudes towards the adoption of m-commerce services. However, due to the limitations of the data collected, the sample for this study consists mainly of undergraduate students aged between 18 and 25. Over 78% of respondents are undergraduate students and over 81% are aged between 18 and 25. Around two thirds are male and one third female. While the results are therefore applicable mostly to this group, this demographic is the potential market pioneers of electronic gadgets, and therefore particularly relevant. Admob, one of the world's largest mobile advertising networks and mobile market data companies, surveyed smart phone users in Feburary 2010. As shown in Figure 5.1, Admob highlights six differences between owners of devices running Apple's iPhone OS, Google's Android OS and Palm's WebOS. Based on the survey, 78% of iPod touch users are younger than 25 years, compared with about 25% of iPhone, Andriod and WebOS young users. Of Android users, 54% are younger than 34, compared with about 46% of iPhone and WebOS users. This suggests that young people are the major smart phone users. As shown in Figure 5.2, 73% of Android users are male, compared with about 58% of iPhone and WebOS users. It means the major mobile users are young males. This is consistent with the gender and age of the respondents in this research.

Figure 5.1 Age Group of Smart Phone Users (Admob 2010)

Figure 5.2 Gender Group of Smart Phone Users (Admob 2010)

Admob's report confirmed the suitability of this research's sample – that is, that male respondents under the age of 25 years are the main users of smart phones, and therefore the most likely users of m-commerce. The data from this research will be used to analyse and compare the results by gender, age, and education (see section 5.6).

Although in 2009 only 47% of mobiles were equipped with WiFi, the results for WiFi-availability and internet accessibility show that over 74% of respondents have internet-enabled mobile phones. In 2010 and 2011, the percentages of WiFi-equipped mobile phones increased to 63% although the percentages of internet-enabled mobile phones remained around 74%, suggesting that most smart phones are internet-enabled and equipped with WiFi.

The majority of smart phone users surveyed had never conducted any type of m-commerce transactions. Surprisingly, over 20% of respondents were required to conduct m-commerce due to their work or study. The percentage is almost equivalent to the percentage of those occasional and frequent m-commerce users. It suggests that the m-commerce acceptance rate of the respondents is very low for voluntary use. It is also remarkable that there is no significant growth of acceptance of m-commerce service in the surveyed three

years, but there is dramatic growth in the smart phone market over the same period. As shown in Figure 5.3, the worldwide regional statistical data for monthly growth of internet traffic (AdMob 2011) reflected the significant increase in the adoption of smart phones and the usage of smart phones for internet access around the world (see Table 6.1 for the statistical data in relation to mobile data usage in Hong Kong). The low adoption rate for m-commerce in relation to the high rate for smart phones and internet use on smart phones, suggests that there are some factors that slow down or inhibit the acceptance of m-commerce by mobile users.

Figure 5.3 *Monthly Growth in Internet Traffic since May 2008 (AdMob)*

5.2 Partial Least Square (PLS) for Confirmatory Analysis

Partial Least Squares (PLS) (Chin 1998) is a second generation technique of SEM that enables researchers to answer a set of interrelated research questions by modelling the relationships among multiple independent and dependent constructs simultaneously (Gefen et al 2000). PLS is widely used in social sciences and information systems research to test the statistical quality and standard of result. Because of the robustness and maturity of the PLS technique, this research adopted the PLS methodology for confirmatory analysis. Of the available PLS software (including PLS-GUI, VisualPLS, PLS-Graph, SmartPLS, and SPAD-PLS (Temme et al 2006),) SmartPLS 2.0 was used because of its sophistication in PLS analysis and reporting. It was developed at the University of Hamburg, School of Business (Ringle et al 2005) and has more than 20,000 registered users since summer 2010 (www.smartpls.de).

In PLS analysis, measures are observable and quantifiable scores obtained through some empirical means, such as survey data. They are used to examine constructs, which are abstractions that describe a phenomenon of theoretical interest (Edwards and Bagozzi 2000). Constructs may be used to describe a phenomenon that is observable (e.g. task performance) or unobservable (e.g. attitude); they may focus on outcomes, structures, behaviours, or psychological aspects of a phenomenon being investigated (Petter et al 2007). When measures are used to examine an underlying construct that is unobservable (i.e. a latent variable), measures is referred to as reflective indicators (Edwards and Bagozzi 2000). The unobservable construct is called a reflective construct. Indicators that determine a construct are called formative indicators. Constructs comprised of these causal formative indicators are called formative constructs. A structural model comprised of at least one formative construct is considered to be a formative model. For confirmatory analysis, PLS uses statistical method to calculate the correlations and statistical significance of the reflective and formative constructs.

There are several basic decision rules that can be used to assess whether the relationship between the measures and construct are formative or reflective in a PLS model. The proposed structural model is based on the UTAUT model and the following two basic

rules are applicable for determining the relationships:

1. Direction of causality: If the change in the indicator causes changes in the construct (rather than a change in the construct causes a change in the indicators), the indicator is formative and the construct is reflective. Validity of reflective indicators can be assessed through the measurement model (Bagozzi et al 1991).

2. Interchangeability of the indicators/constructs: If an indicator or a construct is dropped, the construct meaning or nature may be changed. The indicator/construct is formative and the affected construct is reflective.

Thus, the proposed extension of disturbance concerns is a formative construct and the construct of behavioural intention is certainly reflective. It is supposed that the change in the disturbance concerns may cause change in behavioural intention but not vice versa. If the construct of disturbance concerns is dropped, the behavioural intention may not be comprehensively explained. Besides the confirmatory analysis, SmartPLS can calculate several statistics for establishing the validity and reliability of the measures as well as the predictive relevance of the model. They are discussed in the next section.

5.3   Validity and Reliability

Internal consistency is used to assess the tolerable reliability of related measures. The heuristics of SEM to measure internal consistency is by means of Cronbach's Alpha correlations and SEM reliability coefficients (Straub and Gefen 2004). Cronbach's Alpha should be above 0.7 for confirmatory analysis and in PLS. In this study, the PLS analysis statistics of three years data and the combined data have been summarised in Table 5.2. The summary includes the SEM Composite Reliability and Cronbachs's Alpha for each measure. The calculated composite reliability coefficients and the Cronbach's Alpha correlations are all above 0.8 except the Cronbach's alphas of behavioural intention and social influence for 2011 are 0.7563 and 0.7872 respectively. They are still above the acceptable value of 0.7. It implies the statistical reliability of the internal consistency of the measures. For the measures of the studied disturbance concerns, the figures for composite reliability and Cronbach's alpha are significantly higher than the figures for other measures. The figures are all above 0.94, indicating that the measures of the added construct (disturbance concerns) of the extended model are highly reliable.

	Composite Reliability	Cronbachs Alpha	Communality	Redundancy	(BI) Path Coefficient	R Square
	Year 2009:					
BI	0.9047	0.8412	0.7603	-0.0079		0.5175
DC	**0.9591**	**0.9527**	0.7023		-0.2166	
EE	0.9123	0.8718	0.7232		0.3342	
PE	0.9158	0.8777	0.7312		0.3127	
SI	0.8915	0.8377	0.6729		0.2249	
	Year 2010:					
BI	0.8914	0.8159	0.7329	0.0605		0.5226
DC	**0.9541**	**0.9464**	0.6764		-0.2359	
EE	0.9084	0.8697	0.7145		0.1484	
PE	0.9146	0.8748	0.7285		0.1278	
SI	0.8776	0.8120	0.6434		0.4845	

	Composite Reliability	Cronbachs Alpha	Communality	Redundancy	(BI) Path Coefficient	R Square
	Year 2011:					
BI	0.8616	*0.7563*	0.6763	0.0184		0.5274
DC	**0.9469**	**0.9443**	0.6422		-0.249	
EE	0.8849	0.826	0.6656		0.2429	
PE	0.9084	0.8679	0.7140		0.3320	
SI	0.8638	*0.7872*	0.6162		0.2977	
	Combined Data of all 3 Years:					
BI	0.8909	0.8150	0.7320	0.0141		0.4904
DC	**0.9559**	**0.9487**	0.6853		-0.2271	
EE	0.9060	0.8624	0.7085		0.2397	
PE	0.9125	0.8719	0.7231		0.2492	
SI	0.8821	0.8208	0.6526		0.3403	

Table 5.2 PLS Analysis Summary

In PLS, there are some statistics to measure the predictive relevance of the model by reproducing the observed values by the model itself and its parameter estimates. Two kinds of statistics are estimated, cross-validated communality and cross-validated redundancy. Both statistics are obtained through a blindfolding procedure in PLS. The blindfolding procedure ignores a part of the data for a particular block during parameter estimation (a block of indicators is the set of measures for a construct). The ignored data part is then estimated using

the estimated parameters, and the procedure is repeated until every data point has been ignored and estimated (Chin 1998). For communality, a value between 0.5 and 1.0 is acceptable. The calculated communalities are between 0.6 and 0.8, meaning all are acceptable. For cross-validated redundancy, since the proposed structural model is simple and straightforward, all measures are used for predicating only behavioural intention. A very small redundancy value of behavioural intention is acceptable. The calculated redundancies are below 0.1.

The final two columns of the PLS summary in Table 5.2 indicate the path coefficients to behavioural intention and R-squared values. The value of Path Coefficient above 0.2 indicates a statistically significant influence. In the summary table, all path coefficients are above 0.2 except the path coefficients of effort expectancy and performance expectancy for 2010 are 0.1484 and 0.1278 respectively. That means effort expectancy and performance expectancy of the data in 2010 is less significant or has insignificant influence on behavioural intention. Moreover, the social influence in 2010 was extremely significant as the path coefficient is 0.4845, which is very high. Regarding the new construct of disturbance concerns, the path coefficients presented consistent values within the range of -0.2 to -0.25. The negative sign indicated the negative impact on behavioural intention. It matches with the expected results that behavioural intention will be significantly and negatively affected by the new construct of disturbance concerns in addition to the original construct of the UTAUT model. Besides that, the R-squared value is also important. It represents the percentage of explained variance. The R-squared value above 0.5 is acceptable. It indicates that half variance can be explained statistically. The R-squared values of all years and the combined data can reach 0.5. Thus the structural model is acceptable.

Construct validity can be determined by the convergent and discriminant validities among the measures of constructs. In PLS, two indicators are considered: (1) the own-loadings are higher than the cross-loading; (2) the square root of each construct's Average Variance Extracted (AVE) is larger than its correlations with other constructs (Chin 1998). Table 5.3 shows the own-loadings between the constructs and the measures. They are all higher than the cross-loading with other measures. The majority of the own-loadings are above 0.75. Only eleven own-loadings are between 0.70 and 0.75. Only three own-loadings are between 0.65 and 0.70. Only one own-loading is between 0.5 and 0.6. It means all

measures are valid and relevant. Only the measures of EE4, SI4, DC11, and DC14 are rather weak but not significant. The number suffix of the construct indicates the question number.

	Year:	2009	2010	2011	3 Years
EE	EE1	0.8675	0.8911	0.8466	0.8716
	EE2	0.8851	0.8952	0.9090	0.8950
	EE3	0.8882	0.8732	0.9081	0.8831
	EE4	0.7535	0.7070	0.5430	0.7025
PE	PE1	0.8346	0.8475	0.8561	0.8415
	PE3	0.8929	0.8715	0.8796	0.8782
	PE2	0.8396	0.8996	0.9041	0.8793
	PE4	0.8520	0.7917	0.7294	0.8000
SI	SI1	0.8477	0.8265	0.8141	0.8313
	SI2	0.8583	0.8549	0.8881	0.8625
	SI3	0.7864	0.8297	0.7683	0.8039
	SI4	0.7861	0.6864	0.6503	0.7275

	Year:	2009	2010	2011	3 Years
DC	DC11	0.7691	0.6807	0.7376	0.7257
	DC12	0.8697	0.8590	0.7272	0.8448
	DC13	0.9053	0.8863	0.7656	0.8725
	DC14	0.7086	0.7526	0.7498	0.7241
	DC15	0.8358	0.7890	0.7524	0.8038
	DC21	0.8423	0.8233	0.8808	0.8500
	DC22	0.8853	0.8813	0.8980	0.8873
	DC23	0.9028	0.8712	0.8756	0.8928
	DC24	0.7639	0.8267	0.7903	0.8000
	DC25	0.8737	0.8319	0.8130	0.8569
BI	BI1	0.8553	0.8740	0.8232	0.8550
	BI2	0.9234	0.9047	0.9013	0.9110
	BI3	0.8346	0.7852	0.7342	0.7969

Table 5.3 Own-loading Summary

The next criterion is to compare the square root of each construct's AVE against its correlations with other constructs. Table 5.4 indicates the latent variable correlations of the constructs. The square roots of the constructs' AVE are shown in the grey diagonals. They are all above 0.8 and larger than their correlations with other constructs. It can be concluded that the construct validity of this research can fulfil the statistical quality criteria (Chin 1998).

	BI	DC	EE	PE	SI	AVE
	(YEAR 2009)					
BI	0.8720					0.7603
DC	-0.0904	0.8380				0.7023
EE	0.6029	0.1407	0.8504			0.7232
PE	0.5913	0.2151	0.6607	0.8551		0.7312
SI	0.4959	0.0530	0.4112	0.4639	0.8203	0.6729
	(YEAR 2010)					
BI	0.8561					0.7329
DC	-0.2945	0.8224				0.6764
EE	0.4439	0.1212	0.8453			0.7145
PE	0.4879	0.1160	0.7641	0.8535		0.7285
SI	0.6707	-0.1887	0.4673	0.5658	0.8021	0.6434

	BI	DC	EE	PE	SI	AVE
	(YEAR 2011)					
BI	0.8720					0.6763
DC	-0.1773	0.8380				0.6422
EE	0.5686	0.1564	0.8504			0.6656
PE	0.5728	0.1459	0.7309	0.8551		0.7140
SI	0.5205	-0.0494	0.4095	0.3343	0.8203	0.6162
	(Combined 3 YEARS)					
BI	0.8561					0.7320
DC	-0.1586	0.8224				0.6853
EE	0.5292	0.1542	0.8453			0.7085
PE	0.5359	0.1850	0.7109	0.8535		0.7231
SI	0.5698	-0.0430	0.4329	0.4652	0.8021	0.6526

** The diagonal figures are the sqaured root of AVE **

Table 5.4 Latent Variable Correlations and AVE Summary

5.4 Structural Model Analysis

As explained, the structural model includes two instruments to study the effect of disturbance concerns. The first instrument examines the measures of situation 1, in which users understand that their mobile devices are equivalent to desktop computers equipped with an internet browser for surfing the internet. It is equivalent to the study of web-based mobile applications. We labelled these measures DC1. There are five measures in DC1. The second instrument examines the measures of situation 2, in which users are reminded that their personal data can be captured during the conduct of m-commerce. It is equivalent to the study of native mobile applications, which can be installed from the mobile application store. Any information stored on mobile phones is also able to be accessed and captured, creating security and privacy concerns. We labelled the measures DC2. There are five equivalent measures in DC2.

Figure 5.3 The Structural Models for "DC1 or DC2"

Since the research model was designed with two instruments, there are four possible ways to arrange the structural model. First, DC1 and DC2 can be examined separately as shown in Figure 5.3. That means the specified two situations of web-based mobile applications and native mobile applications are examined separately. Second, DC1 and DC2 can be examined together as shown in Figure 5.4. When they are examined together, they can be treated as two distinct constructs (DC1 and DC2) in the model or a single construct combining all ten measures of disturbance concerns (DC = DC1 + DC2).

P. 110

Figure 5.4 The Structural Models for "DC1 and DC2"

Thus, we have four possible ways to define the structural model. In order to determine the structural model, it is necessary to examine their path coefficients to behavioural intention. In Table 5.5, the path coefficients of four possible structural models using the data collected in 2009, 2010, and 2011, are summarised and the data of the three year period combined. There are sixteen potential structural models in total. The corresponding R-squares are between 0.53 and 0.47. Thus, all potential models are acceptable.

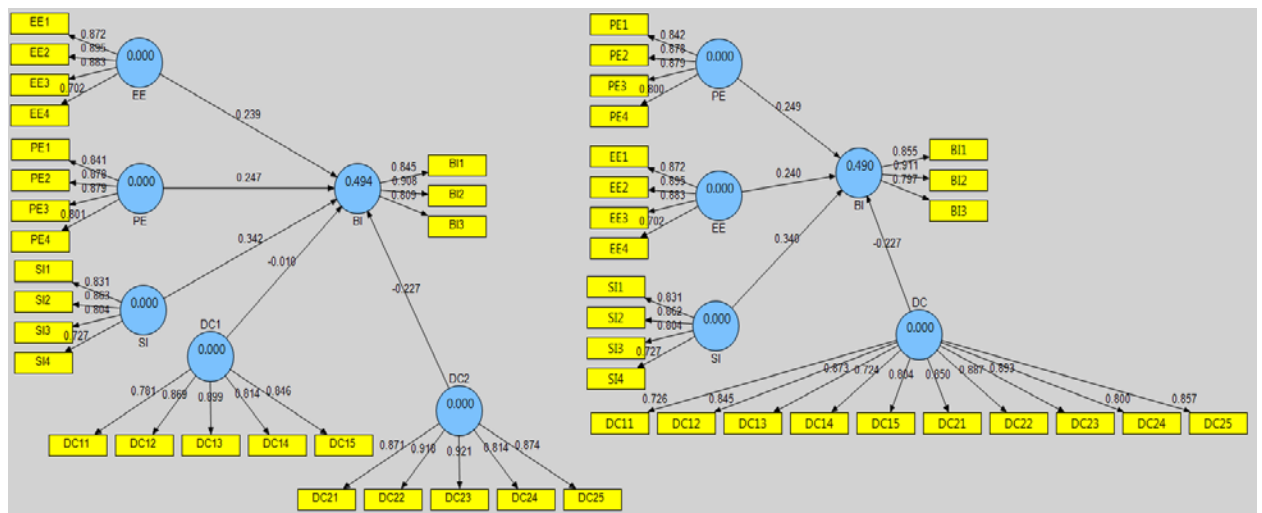| DC1						DC2				
	2009	2010	2011	3 years			2009	2010	2011	3 years
DC1	-0.185	-0.204	-0.223	-0.195		DC2	-0.227	-0.244	-0.248	-0.232
EE	0.336	0.144	0.234	0.236		EE	0.332	0.149	0.243	0.240
PE	0.297	0.117	0.359	0.241		PE	0.322	0.129	0.323	0.249
SI	0.227	0.508	0.301	0.350		SI	0.225	0.476	0.299	0.339
R^2	0.507	0.512	0.513	0.478		R^2	0.521	0.526	0.528	0.492

DC1 and DC2 as two distinct constructs						DC is combined from DC1 and DC2				
	2009	2010	2011	3 years			2009	2010	2011	3 years
DC1	-0.021	-0.014	-0.025	-0.010		DC	-0.217	-0.236	-0.249	-0.231
DC2	-0.216	-0.259	-0.228	-0.227						
EE	0.332	0.148	0.241	0.239		EE	0.334	0.148	0.243	0.257
PE	0.320	0.129	0.320	0.247		PE	0.313	0.128	0.332	0.235
SI	0.227	0.477	0.307	0.342		SI	0.225	0.485	0.298	0.348
R^2	0.522	0.527	0.526	0.494		R^2	0.518	0.523	0.527	0.490

Table 5.5 Path Coefficients of the Constructs to Behavioural Intention

We found that the path coefficients of the models for DC1 alone, DC2 alone, and DC

presented similar patterns. The path coefficients for disturbance concerns were in the negative range of -0.185 to -0.249. The consistent negative values represent the significant and negative influence of disturbance concerns to behavioural intention in the models. The figures also indicate that the effect of DC1 is weaker than the effect of DC2 because the path coefficients are slightly smaller. However, if DC1 and DC2 are put together as two distinct constructs, the effects of DC1 become very insignificant as the path coefficients are only -0.02. This suggests that the surveyed subjects are very worried about the potential disturbance in using native mobile applications. Among the four possible combinations of instruments, it can be concluded that the model combining both DC1 and DC2 is appropriate. There are several reasons:

1. DC1 and DC2 have the same five measures, although they are applied in two different situations of m-commerce.

2. DC1 and DC2 have similar significant and negative influences on behavioural intention, although the effect of DC2 is slightly more significant than DC1.

3. Combining DC1 and DC2 can also produce similar results and patterns as to keeping them (DC1 or DC2) separated.

4. Combining DC1 and DC2 makes no difference to the situations introduced in the instruments. Simply, users are worried about potential disturbance in relation to the use of m-commerce.

It is significant that when we look at the path coefficients of all constructs, only the path coefficients of disturbance concerns present negative figures. It explicitly indicates that disturbance concerns present negative influence on behavioural intention. The negative value above -0.2 are considered to have significant negative influence on behavioural intention. The data strongly supports the proposed extension of the technology acceptance model for m-commerce that includes significant negative factors. Furthermore, the path coefficients of each year are larger than the figures for the previous year. It demonstrates the phenomena of an increasing significance of disturbance concerns.

The data is also examined for each year. When we look at the data for 2009, effort

expectancy has the most significant effect on behavioural intention and the figures are above 0.33. The figures for performance expectancy are slightly below effort expectancy and about 0.31. A possible explanation is that smart phone users in Hong Kong are initially concerned about how easy it is to use internet-enabled smart phones for m-commerce in the introductory stage of smart phones. This was at the time when the iPhone started to become popular in Hong Kong and there was awareness that the iPhone was able to easily access the internet and conduct m-commerce transactions. Users were concerned about the ease of using smart phones (i.e. effort expectancy) for m-commerce. The next consideration was the potential benefits gained from using smart phones (i.e. performance expectancy) for m-commerce in early 2009.

When we look at the data for 2010, social influence has the most significant effect on behavioural intention and the figures are significantly above 0.48. Both effort expectancy and performance expectancy are below 0.15. Social influence almost dominated the effects on behavioural intention. This may be because smart phone users were already aware of the effort expectancy and performance expectancy by 2010, therefore their intentions were highly affected by social factors. By that time, several exciting models of smart phones based on the Android system were released to compete against the market domination of the iPhone 3. Promotions and advertisements were widespread on TV and in newspapers and smart phones were prominently displayed in shops. These aggressive marketing activities may have triggered the social influence identified in this study.

The data for 2011 indicates that performance expectancy has the most significant effect on behavioural intention, with figures of about 0.33. The other constructs are between 0.25 and 0.30. This can be explained by smart phone users' focus by this time on the potential benefits gained from using smart phones for m-commerce. Over the three years of this study, the growth in the smart phone market, with Android based phones in competition with the iPhone, also meant growth in m-commerce in Hong Kong.

When all the data is grouped together, social influence is the most significant, with the coefficient around 0.35. All other examined constructs demonstrate similar significance with the coefficient around 0.25. In summary, all examined constructs demonstrate significant and important effects on behavioural intention. The proposed construct of disturbance concerns

plays an important role, with significantly negative influence on behavioural intention. The analysed results can statistically support the proposed extension of the technology acceptance model for m-commerce acceptance in all stages of the three year study.

A model that combines all measures into a single construct of disturbance concerns is developed because it can generalise the effects of disturbance concerns in different stages across all three years. It represents the effects of disturbance concerns of m-commerce in different situations. In fact, the combined data of DC1 and DC2 can presents similar patterns for all analysed cases. It also matches with the original UTAUT model. The new construct of disturbance concerns can present a significant and negative effect on the behavioural intention of m-commerce acceptance. It statistically indicates that the proposed model is a valid extension of the UTAUT model and that disturbance concerns represent a negative factor of the model for the measurement of m-commerce acceptance. Figure 5.5 shows the structural model.
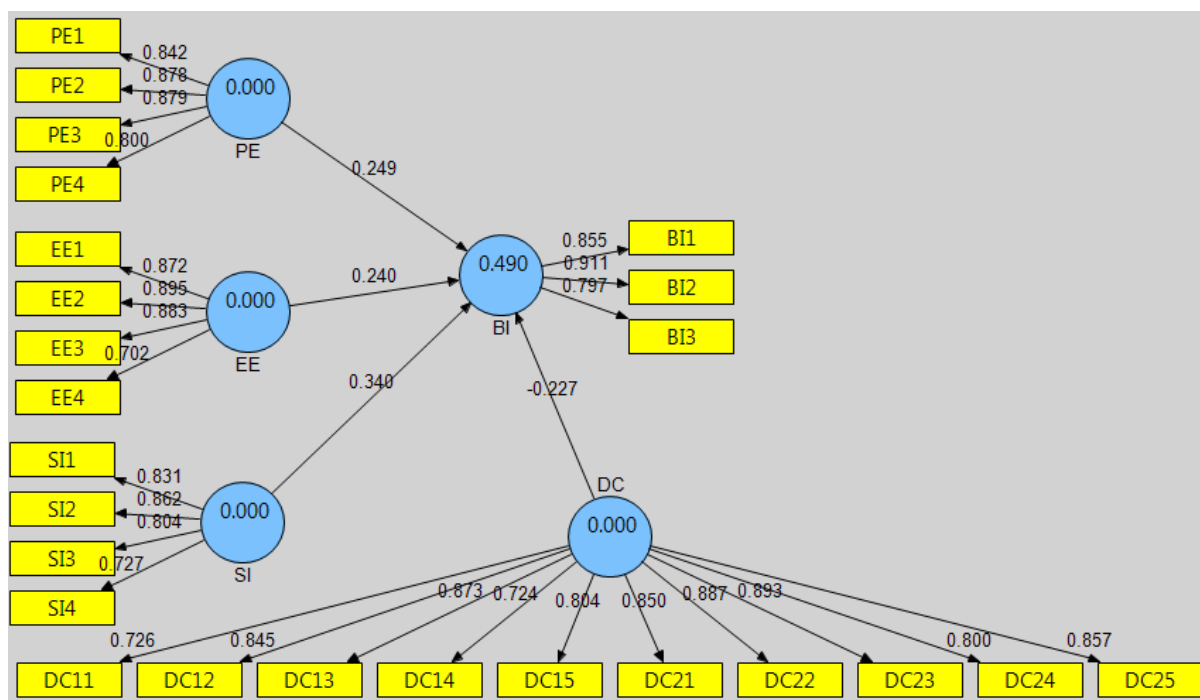

Figure 5.5 The Finalized Structural Model with combined DC1 and DC2

P. 114

5.5 Tests of Hypotheses

After the confirmation of the reliability and validity of the measurement model, the structural model was examined to check the hypothesised links between the constructs and the strengths of the relationships among the constructs. The PLS approach was used to test the structural model and to estimate the path coefficients. The path coefficients indicate the strength of the relationships between the predictors and the dependent variable with the coefficient of determination (R-squared value). The coefficient of determination represents the amount of variance in the dependent variable as explained by the predictors.

Coefficients to Behavioral Intention(BI)		Unstandardized Coefficients		Standardized Coefficients	t-statistics	Significance p < 0.01	Result
		Beta	Std. Error	Beta			
Year 2009	PE	0.221	0.069	0.276	3.210	0.002	Supported
	EE	0.262	0.068	0.314	3.822	0	Supported
	FC	0.094	0.082	0.101	1.158	0.249	* Rejected
	SI	0.164	0.059	0.198	2.788	0.006	Supported
	DC	-0.066	0.018	-0.225	-3.666	0	Supported
Year 2010	PE	0.086	0.075	0.108	1.153	0.251	* Rejected
	EE	0.027	0.071	0.033	0.379	0.705	* Rejected
	FC	0.279	0.079	0.280	3.529	0.001	Supported
	SI	0.344	0.070	0.381	4.882	0	Supported
	DC	-0.083	0.020	-0.247	-4.175	0	Supported
Year 2011	PE	0.116	0.085	0.145	1.368	0.175	* Rejected
	EE	0.136	0.089	0.158	1.527	0.13	* Rejected
	FC	0.351	0.083	0.400	4.224	0	Supported
	SI	0.213	0.067	0.249	3.179	0.002	Supported
	DC	-0.082	0.025	-0.242	-3.321	0.001	Supported
Three Years	PE	0.142	0.043	0.176	3.265	0.001	Supported
	EE	0.135	0.043	0.163	3.139	0.002	Supported
	FC	0.254	0.047	0.269	5.375	0	Supported
	SI	0.227	0.037	0.264	6.080	0	Supported
	DC	-0.079	0.012	-0.248	-6.758	0	Supported

Table 5.6 T-Statistics of the Hypotheses

The assessment of the path coefficients and the R-squared values indicate whether the model is performing adequately. To support the hypothesised relationships, the path coefficients should be significant and they should also be consistent in the direction of the relationships as hypothesised in the research model. To investigate the specific hypotheses, t-statistics for the standardised path coefficients were assessed. The estimation supports most of

the hypothesis. Table 5.6 contains the path coefficients (i.e. standardised coefficients), t-statistics, and the corresponding significance based on the structural model of Figure 5.5.

Table 5.6 includes the t-statistics summary of the data for the years 2009, 2010, and 2011, and the combined three-year data. For the 2009 data, all paths are significant with $p<0.01$, except facilitating conditions. Since facilitating conditions is beyond the current study, the hypothesis tests are satisfied and thus the proposed structural model is supported. For the 2010 and 2011 data, the paths of effort expectancy and performance expectancy are rejected, but the critical path of disturbance concerns is accepted with the significance $p<0.01$. This implies that the proposed extension of the model is supported, but the original constructs in the model are not supported. There may be two reasons for this. First, when the acceptance of a new information system is maturing, users are not focused on efficiency and performance as they understand the usage of the system and the potential benefits gained from usage. Second, there is insufficient data for taking the t-statistics.

Thus, the combined data of all years can produce more reliable and relevant statistics. The final section of Table 5.6 shows the statistics of the combination of all data. All paths are significant with $p<0.01$. All hypotheses are accepted and the structural model is supported. A remarkable significance of the t-statistics indicates that both disturbance concerns and social influence always reach a very significant level of zero for all t-statistics tests. This matches with the previous analysis and significantly supports the proposal of this research. The proposed construct of disturbance concerns is a consistent and vital construct of the technology acceptance model in all situations.

5.6 Demographic Analysis

In this section, the demographic data is analysed. They are grouped according to the different characteristics in order to examine if different characteristics produce different results. Each demographic factor is divided into two main groups of data. Gender is divided into male and female users. Age is divided into 18-25 years and over 25 years. Educational level is divided into undergraduate and non-undergraduate. Mobile phones are grouped by WiFi availability and internet accessibility. M-commerce experience is grouped as neither occasional nor frequent users versus occasional or frequent users. Finally, respondents are divided into voluntary and job-required m-commerce users. The result is summarised in Table 5.7

	Records	% of 392 records	EE	PE	SI	DC	R-squared
Gender: Male	261	66.58%	0.3074	0.1846	0.3243	-0.2370	0.4706
Gender: Female	131	33.42%	0.1414	0.3251	0.3989	-0.2218	0.5521
Age Range: 18-25	333	84.95%	0.2729	0.2378	0.3515	-0.2660	0.5334
Older than 25	*59*	*15.05%*	*0.1171*	*0.3441*	*0.1455*	*-0.1822*	*0.3379*
Education Level: Undergraduates	329	83.94%	0.2482	0.2827	0.3213	-0.2077	0.5263
Education Level: Others	*63*	*16.06%*	*0.2261*	*0.0616*	*0.3813*	*-0.3515*	*0.3805*
Mobile with WIFI	209	53.34%	0.2426	0.1820	0.3588	-0.2211	0.4765
Mobile without WIFI	183	46.66%	0.2278	0.2241	0.3335	-0.2447	0.4731
Mobile can access the internet	290	73.98%	0.2790	0.2264	0.3446	-0.2286	0.5286
Mobile cannot access the internet	102	26.02%	0.1852	0.2733	0.3530	-0.3010	0.4464
Neither Occasional nor Frequent users	258	65.82%	0.2275	0.1928	0.3900	-0.2375	0.5122
Either Occasional or Frequent users	134	34.18%	0.2541	0.2420	0.2713	-0.2140	*0.4351*
Voluntary m-commerce users	307	78.32%	0.3115	0.2161	0.2897	-0.2391	0.4763
Job-required m-commerce users	*85*	*21.68%*	*-0.0629*	*0.3455*	*0.5642*	*-0.2124*	*0.6138*
Overall 3-year data	**392**	**100%**	**0.2397**	**0.2492**	**0.3403**	**-0.2271**	**0.4904**

Table 5.7 PLS Analysis Summary by Demographic Groups

In terms of gender, there are 261 male respondents and 131 female respondents, or two-thirds male. According to the PLS analysis based on the same conceptual model, the statistical validity and reliability of the tested models are highly acceptable. The results indicate that the disturbance concerns of both groups of respondents present significant negative influence on behavioural intention. The total effect of disturbance concerns on behavioural intention are above -0.22. Both groups show that the social influence construct is

the strongest predictor of behavioural intention. The total effects of social influence on behavioural intention are above 0.32. It is interesting that the attitudes of effort expectancy and performance expectancy are opposite. For male respondents, export expectancy is more significant than performance expectancy, which is 0.3074 versus 0.1846. For female respondents, performance expectancy is more significant than effort expectancy, which is 0.3251 versus 0.1414. It can be interpreted that male respondents are more concerned with efficiency when considering adopting m-commerce. Female respondents are more concerned with performance when they consider m-commerce.

The second factor is age. There are 333 respondents in the age group of 18-25 years, compared to 59 for over 25 years. The tested construct of disturbance concerns is a very significant predicator that demonstrates negative influence on behavioural intention. The total effect is -0.266. Other constructs demonstrate positive influence. The most significant factor is social influence (0.3515), followed by effort expectancy (0.2729) and performance expectancy (0.2318). It means all test constructs have vital and significant influence on behavioural intention. The R-square is 0.5334. It means over half of the variation in the response variable can be explained by the explanatory variable. It is an acceptable statistic. For the 59 respondents over the age of 25 years only performance expectancy is significant. It has the total effect of 0.3441. The total effects of the other constructs are less than 0.2. Since the sample size of the group is too small and the R-square is only 0.3379, the results of this group should not be considered because of the low value of explained variation.

The third analysed factor is educational level. There are 329 respondents in the undergraduate group, with only 63 in the non-undergraduate group. The result demonstrates a similar pattern to the age factor. The tested construct of disturbance concerns is a very significant predictor for negative influence on behavioural intention. The total effect is -0.2077. Other constructs demonstrate positive influence. The most significant factor is social influence (0.3213), followed by performance expectancy (0.2827) and effort expectancy (0.2482). It means all test constructs have vital and significant influence on behavioural intention. The R-square is 0.5263. It is an acceptable statistic. The remaining 63 records indicate that both disturbance concerns (-0.3515) and social influence (0.3818) are significant. Effort expectancy (0.2261) is significant but performance expectancy (0.0616) is not. Since the sample size of the group is too small and the R-square is only 0.3805, the result of this

group should not be considered because of the low value of explained variation.

There are 209 respondents (53%) with WiFi equipped mobile phones and 183 respondents (47%) without WiFi equipped mobile phones. The analysis results demonstrate a similar pattern. Social influence is the most significant predictor of behavioural intention. The total effects are 0.3588 and 0.3335 respectively. The disturbance concerns are equally important for effort expectancy and performance expectancy. Their total effects on behavioural intention are between 0.22 and 0.25. Of course, disturbance concerns have a negative influence. Their R-square values are around 0.475.

Accessing the internet can be by means of WiFi or the 3G networks. There are 290 respondents (74%) with mobile phones accessible to the internet and only 102 respondents (26%) with mobile phones not accessible to the internet. Social influence is consistently the most significant predictor of behavioural intention. The total effects are 0.3446 and 0.3530 respectively. All other constructs are also significant. For respondents with mobile phones accessible to the internet, the total effect of effort expectancy (0.28) is stronger than the total effects of disturbance concerns (0.23) and performance expectancy (0.23). The R-square is around 0.53. For respondents with mobile phones not accessible to the internet, the total effect of effort expectancy (0.19) is weaker than the total effects of disturbance concerns (0.30) and performance expectancy (0.27). The R-square is around 0.45. It can be interpreted that respondents with some internet access experience through their mobile phones are more concerned with efficiency.

To analyse m-commerce experience, the respondents are divided into experienced users being "either occasional or frequent users of m-commerce" and non-experienced users being "neither occasional nor frequent users of m-commerce". There are 285 experienced m-commerce users (66%) and 134 non-experienced m-commerce users (34%). Again, social influence is the most significant predictor of behavioural intention. The total effects are 0.3900 and 0.2713 respectively. Disturbance concerns are equally important when comparing effort expectancy with performance expectancy. Their total effects on behavioural intention are between 0.19 and 0.25. Of course, disturbance concerns have a negative influence. Their R-square values are 0.5122 and 0.4351.

The final factor for analysis is voluntariness. It is an important factor as this research targets general individuals rather than corporate users. General individuals are voluntary users of m-commerce, without any requirement to use m-commerce for their jobs. Of the respondents, 307 (78%) are voluntary users, and 85 (22%) are non-voluntary users. Thus, the high percentage of voluntary users is expected. For voluntary users, the most important predictor is the construct of effort expectancy (0.3115), followed by social influence (0.2897). It is interesting that effort expectancy outperformed social influence in this grouping. The negative influence of the construct of disturbance concerns (-0.2391) is significant. The lowest influence construct is performance expectancy (0.2161), but it is also significant. The overall R-squared value is 0.4763. For non-voluntary users, the result is inconsistent against others. Social influence (0.5642) is extremely high, while effort expectancy (-0.0629) is extremely low. The influence of performance expectancy (0.3455) is highly significant. The negative influence of the construct of disturbance concerns (-0.2124) is reasonably significant. Although the overall R-squared value (0.6138) is extremely high, the result should not be considered as it relies on only 85 records.

Comparing the overall three-year data, the patterns are consistent, except for those groups with fewer than 90 records. Social influence is always the most significant predictor. The other constructs are evenly significant, although disturbance concerns had a negative impact on behavioural intention. In conclusion, the demographic analysis by individual characteristics supports the proposed conceptual model. The data illustrates that the newly proposed construct of disturbance concerns is a viable and critical predictor of behavioural intention. It has significant negative impact on behavioural intention. The R-squared values are around 0.5, which is a satisfactory figure. The only remarkable factor is gender. Male respondents show significant concerns about efficiency instead of performance while female respondents are concerned with performance rather than efficiency.

5.7 Conclusion

This study has two objectives. The first objective is to introduce negative user adoption factors, in addition to those positive factors included by Venkatesh et al (2003) in the UTAUT model, that influence the user acceptance of new technologies. Second, this study aims to suggest business strategies to take account of potential negative user adoption factors and resolve those user rejection factors in order to accelerate the number of mobile transactions through m-commerce with smart phones.

The statistical results fully support the proposed extension of the original UTAUT model for m-commerce acceptance. The validity and reliability of the structural model were supported. It also means that the UTAUT model is relevant to the study of m-commerce acceptance. The proposed construct of disturbance concerns is vital and represents a significant but negative influence on behavioural intention. The total effects of all tests are around -0.2 to -0.25. This is statistically strong, although social influence usually has a high effect of 0.3 or above. It can be concluded that both disturbance concerns and social influence are the two most significant constructs of the technology acceptance model in the study of m-commerce acceptance.

Since disturbance concerns hamper m-commerce acceptance, m-commerce service providers should mitigate or eliminate potential concerns and worries of mobile users, such as privacy, security, spam, etc., in order to accelerate user acceptance.

Chapter 6
Discussion and Conclusion

This research successfully discovered and proved the existence of negative factors that significantly influence the behavioural intention of adopting a new m-commerce service by general mobile users. The conceptual model extended from the robust UTAUT model (Venkatesh et al 2003), which is a unified model of eight prominent technology acceptance models. Although the UTAUT model was widely adopted for information systems research, it cannot effectively explain the acceptance of m-commerce. The main constructs of the UTAUT model are efficiency expectancy, performance expectancy, social influence, facilitation conditions, behavioural intention, and actual behaviour. The constructs of the UTAUT model explained only positive influence on behavioural intention and/or actual behaviour. The introduced construct of disturbance concerns explained the significant negative influence on behavioural intention of m-commerce acceptance.

The results of the comprehensive analysis of this research fully support that behavioural intention is significantly and negatively influenced by the new construct of disturbance concerns. The construct incorporated the general concerns of users, which were identified by a review of the relevant literature (Ghosh and Swaminaha 2001; Siau and Shen 2003; Jarvenpaa et al 2003; Leppaniemi and Karjaluoto 2005; Wu and Wang 2005), such as security, privacy, spam, and any potential loss due to the adoption of m-commerce. This chapter discusses and concludes the implications of the results of this research, the significance of the introduced extension to the UTAUT model, the contribution of the study to information systems research, and potential useful applications of the findings.

Apple introduced the App Store as a digital application distribution platform for iPhone users in July 2008. The App Store offers a unified platform to manage data and money flows for iPhone m-commerce services. The App Store service model is a relevant case study that matches with the proposal and findings of this research. The case study is discussed in section 6.2. Finally, the limitations of this research are explained and further researches are proposed.

6.1 Discussion

The research objective of this thesis was inspired by two issues. First, from the literature review of technology acceptance models, it is found that the development of existing technology acceptance models, including the UTAUT model, was focused on corporate users rather than individuals. While this is relevant for many, if not most, forms of new technology, it is not so for m-commerce, partly because it is aimed at individuals rather than corporate users and because its adoption is voluntary in nature, rather than required in the workplace. Existing technology acceptance models may not be sufficient to explain the reluctance of general users to accept m-commerce. Thus, this research established that additional factors should be introduced to a technology acceptance model in order to evaluate the acceptance behaviour of voluntary individual users.

Second, inspired by the prominent two-factor theory of behavioural science (Herzberg 1968), human intention and behaviour can be influenced by both positive and negative factors. Positive factors motivate people to perform, because people gain satisfaction from positive factors. Negative factors inhibit performance, because the absence of positive factors creates dissatisfaction. As discussed, the current technology acceptance models tend to explore and focus on positive factors. In order to explore the unexplained factors of m-commerce service acceptance, this research focused on the study of the negative factors that may inhibit user acceptance. The new construct of disturbance concerns was thus extended from the UTAUT model. It concludes the negative influence on behavioural intention, and complements the technology acceptance models to explain the acceptance behaviour of the voluntary individuals.

In order to ensure the robustness of this research, the chronological validity of the conceptual model is considered. Therefore, three sets of data were collected in three consecutive years from 2009 to 2011, in order to verify and support the chronological validity of this research. The statistical method of partial least squares (PLS) was adopted to test the conceptual model because of its effectiveness for confirmatory analysis and its wide adoption in social science and information systems research. The sophisticated software of SmartPLS was used to analyse the data because the software is widely used for confirmatory analysis and user-friendly. The hypotheses were verified using the ANOVA analysis. The results fully

support the structure of the proposed model of this research and the significance of the new construct disturbance concerns.

The data proved that disturbance concerns have a significant and negative influence on behavioural intention. Only social influence was more significant than disturbance concerns. There was no statistical evidence to indicate that the construct of disturbance concerns is weaker than the constructs of efficiency expectancy and performance expectancy. Even when all data were combined for analysis, the result was still significant and consistent. This suggests that the proposed construct of disturbance concerns is a viable factor in technology acceptance models for m-commerce service acceptance. The proposed extension of the UTAUT model is essential for explaining the acceptance behaviour of mobile users.

This research was designed to examine user perceptions of both web-based applications and native mobile applications. For web-based applications, the PC equivalent web browsers are used in m-commerce using mobile devices. For native mobile applications, the feature-rich and media-rich native applications are used for m-commerce. These two main mobile application models are significantly different from old and restrictive WAP-based applications. The results provide strong support for both types of mobile application models, although mobile users illustrated stronger disturbance concerns for native mobile applications. The results fully supported the proposed structural model's applicability for modern m-commerce service acceptance.

Demographic analysis included gender, education level, age group, WiFi availability, internet accessibility, m-commerce experience, and voluntariness. The findings of all groups illustrated similar patterns. These patterns indicated that disturbance concerns have significant negative influence on behavioural intention. Only social influence indicated higher significance than disturbance concerns. There was no statistical evidence indicating that the construct of disturbance concerns is weaker than the constructs of efficiency expectancy and performance expectancy for the demographic groups. The only remarkable pattern was found in the gender group. Male mobile users showed significantly higher efficiency expectancy than performance expectancy, whilst female mobile users showed higher performance expectancy than efficiency expectancy. It suggests that male mobile users are concerned more with the process of m-commerce operations, whilst female mobile users are concerned more

P. 124

with the reward or consequences of the service.

The research was undertaken from 2009 to 2011. During this period, the product life cycle of iPhone and similar smart phones, such as Android-powered phones, in the Hong Kong market, was growing from the introduction stage to the mature stage. Figure 6.1 shows the mobile data usage of December 2008 reflecting the acceptance and usage of iPhone and internet-accessible smart phones in early 2009. The monthly data usage was around 133 million Mbytes. In the next year, the monthly data usage grew 4.8 times up to 638 million Mbytes, showing product growth. In January 2011, monthly data usage grew to 2 billion Mbytes, suggesting further growth.

Month	Mobile Data Usage (MBytes)	
	Total	Per 2.5G + 3G Customer
12/2010	1,846,763,831	295.5
12/2009	638,388,712	127.6
12/2008	133,145,730	38.1
12/2007	32,301,563	11.0
12/2006	9,076,723	4.1
12/2005	4,603,736	2.5
12/2004	2,330,444	1.7
12/2003	247,262	0.3
12/2002	42,029	0.2
12/2001	N/A	N/A

Month	Total	Per 2.5G + 3G Customer
1/2011	2,010,074,084	306.8
12/2010	1,846,763,831	295.5
11/2010	1,702,703,907	277.5
10/2010	1,657,557,216	274.6
9/2010	1,462,252,360	245.9
8/2010	1,389,843,235	238.3
7/2010	1,236,076,670	214.1
6/2010	1,196,466,468	213.0
5/2010	1,070,544,670	190.6
4/2010	951,075,621	171.2
3/2010	874,917,059	158.1
2/2010	705,380,136	128.1
1/2010	730,749,130	138.5

Figure 6.1 Key statistics of Mobile Data Usage in Hong Kong
(Source: http://www.ofta.gov.hk/en/datastat/eng_wireless.pdf)

The data collected from these years triangulates the findings. The findings illustrate that both social influence and disturbance concerns are significant across all years. The effects of efficiency expectancy and performance expectancy are significant only in 2009, which is the introductory stage. This can be explained that efficiency and performance of mobile applications becoming norms in the growth stage because mobile users have already developed knowledge about and experience of mobile applications. These expectancies may have less influence on behavioural intention.

It can be concluded that the construct of disturbance concerns in the extended UTAUT model was proven to be a significant construct for m-commerce service acceptance. It is the

only construct with negative influence on behavioural intention. The comprehensive analysis results support the view that the extended UTAUT model of this research is integrally, chronologically, and demographically valid for m-commerce service acceptance study. The disturbance concerns construct is a valid construct to explain m-commerce reluctance during the development of the m-commerce market. Because disturbance concerns were not considered by service providers, mobile users were reluctant to accept m-commerce even though efficiency expectancy, performance expectancy, and social influence were satisfied. This suggests that disturbance concerns must be mitigated, resolved, or balanced against expected gains in order to accelerate the user acceptance.

The findings suggest that users' security concerns must be addressed and their privacy protected. Spam must also be avoided. Potential loss due to the use of m-commerce must be measured or balanced against expected gains. Due to the presence of these disturbance concerns, mobile users will be hesitant in accepting m-commerce. However, the introduction of the iPhone App Store in July 2008 changed acceptance of m-commerce. Its unified platform, ease of use and accessibility meant that mobile application transactions became very popular in a short time. The case study of the iPhone App Store can be mapped to the findings of this research. The following section discusses this in more detail.

6.2 Implications for practice
- App Store and M-commerce

The App Store provides preinstalled application software on Apple's mobile devices including iPhone, iPod Touch, and iPad, allowing users to browse, purchase and download native mobile applications (apps) from Apple's iTunes Store. The applications are developed using iOS SDK and available through Apple's App Store, either for free or at a cost. They can be downloaded directly to Apple's mobile devices, or downloaded via Apple's iTunes on PC or Mac computers. Apple provides the unique digital commerce platform for m-commerce service providers with a revenue-sharing scheme. Of the revenue, 30% from the store goes to Apple and 70% goes to the producer of the app.

As of October 2010, there are at least 300,000 apps officially available on the App Store. As of January 2011, Apple announced 10 billion apps have been downloaded from the Apple App Store. The term "App" has become a popular buzzword and the term "App Store" has been used to refer to any similar digital commerce platform service for mobile devices. For example, Google's Android Apps refer to the mobile applications installable into Android powered smart phones. Google's browser Apps refer to the add-in applications installable into Chrome (the web browser of Google).

In the release of the first generation of iPhone, Apple extended the web features of the iPhone web browser to imitate the native iPhone user interface and to support the integration with email, Google maps, etc. Those web pages that support the extended features were known as web applications, or simply web apps. Web apps are accessible through the iPhone web browser without the need for installation, but they tend to have less functionality, such as the lack of rich multimedia features provided by the iPhone.

With the launch of the App Store, native mobile applications with rich and versatile features can be easily searched, downloaded and installed into the mobile devices of Apple by the mobile users. Through their mobile devices, mobile users can also leave comments, feedback, and ratings related to installed apps. Applications can be categorised as business, communication, education, entertainment, finance, lifestyle, media, magazines, news, productivity, reading, shopping, social, sports, travel, etc. Because the market has been

capable of encouraging user participation, companies have rushed to invest in app development creating user awareness. This is the first time that m-commerce has gained significant user acceptance.

Although there has not as yet been any published research investigating the acceptance of the App Store and the phenomenon of m-commerce in relation to the iPhone, we can attempt to apply the extended UTAUT model developed in this research to explain the uniqueness of the App Store. First, the built-in App Store software provides a unique platform and model for searching, downloading, purchasing (if not free), and installing apps. Since the App Store software is integrated with the iPhone OS, the processes of download, registration, installation, and application upgrade take place in the background without any interruption to the operation of the phone. Transactions are recorded and automatically charged against the registered credit card account of the mobile user. The procedure is simple and intuitive, thus fulfilling the efficiency expectancy of mobile users.

Second, apps can be offered for free or at a cost. There are three reasons that apps are provided for free. The first reason is that those apps are developed for fun and the developers would like to share the apps with others. The second reason is the revenue of those apps will come from other sources, such as advertising or future transactions. The third reason is those apps are developed to test market acceptance. The collected user feedback from the App Store is useful for developing the production versions of the apps that will be offered with some cost attached. Mobile users can freely install an app and if they decide they do not want to keep it, they can easily uninstall it. If they find an app useful, they can purchase a better, paid version. This fulfils the performance expectancy of mobile users because all installed apps are perceived to be useful and with value. Otherwise, they are removed.

Third, it has been explained that the marketplace of the App Store encourages user participation. Users may leave comments, feedback, and ratings of the installed apps. Simply through the same App Store software, users may search and select for useful or interesting apps according to download popularity, overall rating, and user reviews. The marketplace creates a unique social community that can influence user acceptance of an app. Besides that, there are many magazines and web forums discussing apps. Social influence has a strong impact on user participation in the marketplace of the App Store.

P. 128

How does the App Store tackle the negative factors of disturbance concerns? Although efficiency expectancy, performance expectancy, and social influence have been well facilitated, there are concerns and worries that can cause user reluctance in accepting m-commerce, such as security, privacy, spam, and any potential loss. Apple designed the App Store to be the "middleman" in all m-commerce services provided through the iPhone. It manages the data and transactions. Mobile users only pay money and provide personal data directly to the App Store of Apple, not the companies of the apps, giving users confidence in a trusted brand. There have been no significant incidents or complaints about data protection and financial transactions of the App Store.

As explained by Dion Hinchcliffe (a co-author of Web 2.0 Architectures for O'Reilly) in 2010, the App Store is a digital distribution and delivery platform controlled by the platform owner. M-commerce applications are stored and can be downloaded in this self-contained application directory. The app store centralises data flow and payment processing. Because all transactions take place with one provider, disturbance concerns of mobile users are mitigated. It also creates an application community to drive feedback and quality, in turn, it promotes social influence. Due to the success of the App Store, Google released an Android market for Android phones and devices in August 2008, which is equivalent to the App Store. In February 2011, Google unveiled its Android Market web store, a web portal that lets users browse and purchase apps from the Android Market without requiring a smart phone. In March 2011, Amazon launched its app store. Many companies are adapting to the digital business model by entering the world of mobile apps and app stores.

6.3 Limitations of this Research

There are several limitations to this research. Since the project involved an empirical study, there were some constraints with regards to the distribution of the survey to a wider range of general mobile users. The major sample was restricted to university students, who participated on a voluntary basis.

Moreover, the numbers of responses was unpredictable. In the first two years, there were around 200 responses received, but in the third year there were only 100 responses received due to time constraints. Also, some invalid responses were found that may distort the analysis results. These records were removed.

A significant issue is that, due to privacy, the surveys did not collect the identities of the subjects. In turn, this meant that the subsequent behaviour of the subjects could not be tracked. There is no way to measure if the subjects will accept and use m-commerce even though they have behavioural intention. For this reason, the research can study the influence on behavioural intention but not extend the study to include actual usage behaviour. However, the results comprehensively support the validity of the proposed structural model in which the new construct of disturbance concerns is vital to m-commerce acceptance. It significantly and directly influences behavioural intention. Thus, the data collected is sufficient to answer the research question.

6.4 Further Research

Further research could be extended to include mobile operators. The extended UTAUT model could be adopted for formulating their business strategies. The research subjects can be extended to include any mobile users, rather than the limited sample used in this study. Further research could also target mobile users according to their monthly usage patterns. The profile of these subjects would be more comprehensive because their mobile usage behaviours, such as their monthly internet access and their m-commerce preference, are recorded by the mobile operators,

This research demonstrates that the technology acceptance models for voluntary individual users can have different constructs when compared with corporate users. Here, the construct of disturbance concerns is vital for general mobile users to accept m-commerce. Further research can apply the same model to other information systems. It is trusted that the proposed construct is an essential extension of technology acceptance models, which can make the models more robust. As the mobile market is huge and segmented, cultural difference can also be an interesting topic for further study.

6.5 Conclusion

The goal of this research has been to explore and prove the proposed structural model to be robust and able to explain and predict the acceptance behaviour of m-commerce by voluntary mobile users. Although the proposed model is extended directly from the UTAUT model, the model maintains the robustness of the original UTAUT model and introduces the construct of disturbance concerns to explain the negative factors that may affect the adoption of m-commerce. The factors of disturbance concerns include security, privacy, spam, and concerns about potential losses due to the acceptance of m-commerce.

The research method employed was a quantitative research using survey questions. Two conference papers were published to gain feedback while developing the conceptual model and the research methodology. Three sets of data were collected from 2009 to 2011. This approach indicates the findings were chronologically valid and verifiable. The findings of all years demonstrated consistent results. Since the confirmatory analysis was successful, the Partial Least Squares (PLS) analysis method was adopted and the t-statistics method used to confirm the hypothesis measurements. The dual-analysis approach triangulates the findings.

The findings illustrated that both social influence and disturbance concerns have a significant impact on behavioural intention. Social influence exhibited positive influence; whilst disturbance concerns always showed negative influence. There was no significant evidence indicating that the construct of disturbance concerns was weaker than efficiency expectancy or performance expectancy. "Disturbance concerns" was found to be an essential construct of technology acceptance models for m-commerce acceptance. It is worthy of further research to examine its applicability to other information systems, especially when the subjects are voluntary individual users. This research contributes a new insight into the negative factors that can be identified by technology acceptance models. It contributes both to companies aiming to improve their strategic planning when introducing new information systems and to the academic literature. Disturbance concerns of potential users should be one of the considerations when introducing new technology, including m-commerce.

Appendix A: Survey Questions

1. **Gender:** Male / Female

2. **Age:** 16-25 / 26-35 / 36-45 / 46-55 / 56-65

3. **Highest Education:** Doctorate / Post-Graduate / Under-Graduate / High School / Others

4. **Does your mobile support Wi-Fi?** Yes / No

5. **Can your mobile connect to the Internet?** Yes / No

Remark: Online transactions means the commercial activities, such as banking, bidding, booking, shopping, trading, and ticketing, which are conducted through the Internet.

6. **Are you willing to use the mobile device/phone for Banking?** Yes / No

7. **Are you willing to use the mobile device/phone for Bidding?** Yes / No

8. **Are you willing to use the mobile device/phone for Booking?** Yes / No

9. **Are you willing to use the mobile device/phone for Shopping?** Yes / No

10. **Are you willing to use the mobile device/phone for Trading?** Yes / No

11. **Are you willing to use the mobile device/phone for Ticketing?** Yes / No

12. **Are you willing to use the mobile device/phone for other kinds of transactions?**
    Yes / No

13. **Experience on using the mobile device/phone for Banking:**

    Never / One-time / Occasional user / Frequent user

14. **Experience on using the mobile device/phone for Bidding:**

    Never / One-time / Occasional user / Frequent user

15. **Experience on using the mobile device/phone for Booking:**

    Never / One-time / Occasional user / Frequent user

16. **Experience on using the mobile device/phone for Shopping:**

    Never / One-time / Occasional user / Frequent user

17. **Experience on using the mobile device/phone for Trading:**

    Never / One-time / Occasional user / Frequent user

18. **Experience on using the mobile device/phone for Ticketing:**

    Never / One-time / Occasional user / Frequent user

19. **Experience on using the mobile device/phone for other kinds of transactions:**

    Never / One-time / Occasional user / Frequent user

20. **Does your work/study require you to conduct any kind of mobile transactions?**
    Yes / No

Please use this Scale Design for the following questionnaire:

1: Strongly disagree (SD)   **2: Moderately disagree**   **3: Somewhat disagree**

4: Neutral (N)   **5: Somewhat agree**   **6: Moderately agree**

7: Strongly agree (SA)

Performance Expectancy:

21. Mobile devices are useful tools for conducting online transactions

22. Using mobile devices enable me to conduct online transactions easily

23. Using mobile devices for online transactions increase my efficiency

24. I can do transactions faster in mobile devices than using desktop computers

Effort Expectancy:

25. It would be easy for me to understand the operation of online transactions in the mobile device

26. It would be easy for me to adapt to using the mobile device for online transactions

27. I would find the mobile transactions are easy to conduct

28. Learning to conduct mobile transactions is easy for me

Social Influence:

29. People who influence my behavior (such as teachers, friends, actors, singers, etc.) think that I should use the mobile device for online transactions

30. People who are important to me (such as family members, supervisors, friends, etc.) think that I should use the mobile device for online transactions

31. I do mobile transactions because many people are doing

32. In general, Hong Kong people support the mobile devices for online transactions

Facilitating conditions:

33. The general mobile devices are well equipped (including hardware, software, network, etc) for doing online transactions

34. It is easy to get the knowledge (such as from leaflet, manual, user guide, internet, etc) necessary to do mobile transactions

35. The mobile transactions are generally compatible with the online transactions through the desktop computer.

36. I think service providers will arrange customer service to help people to do mobile transactions

37. Given that I have a smart mobile phone capable of accessing the Internet, I would use the mobile for online transaction.

38. If I can use my mobile phone for online transactions, I want to use it as much as possible.

39. Given that I do NOT have a smart mobile phone for online transactions, I plan to get a smart mobile phone and conduct online transactions in the next 6 months.

Disturbance concern:

(Please think about the two specified scenarios when you answer the following questions.)

Situation 1: If your mobile device (such as your phone) can use an internet browser to surf the Internet,

40. I worry about being spammed when using the mobile device to conduct online transactions

41. I worry about losing privacy data (such as my location, my phone number) when using the mobile device to conduct online transactions

42. I worry about my personal information (such as address, bank account, etc) being stolen or leaked if I use the mobile device for online transactions

43. The mobile transaction is not as secure as the traditional electronic commerce.

44. I worry that using the mobile device for online transactions may result unexpected interrupts or disturbances.

Situation 2: If your mobile device (such as your phone) can install some applications for taking online transactions and those applications can access your privacy information (such as phone number and contacts) and your current location (such as by means of GPS or A-GPS),

45. I worry about being spammed when using the mobile device to conduct online transactions

46. I worry about losing privacy data (such as my location, my phone number) when using the mobile device to conduct online transactions

47. I worry about my personal information (such as address, bank account, etc) being stolen or leaked if I use the mobile device for online transactions

48. The mobile transaction is not as secure as the traditional electronic commerce.

49. I worry that using the mobile device for online transactions may result unexpected interrupts or disturbances.

Appendix B: List of Published Conference and Journal Papers

B.1

Topic: "A conceptual model for the study of negative user adoption behaviours of mobile commerce in Hong Kong"

Authors: LAI, C F D, LAI, K W I and JORDAN, E

Conference: Proceedings of 6th International Conference on Supply Chain Management and Information Systems (SCMIS 2008), Supply Chain Management and Information Systems Consortium, Tiruchirappalli, India, 8-10 December 2008.

B.2

Topic: "An Extended UTAUT Model for the Study of Negative User Adoption Behaviours of Mobile Commerce"

Authors: LAI, C F D, LAI, K W I and JORDAN, E

Conference: Proceedings of 9th International Conference on Electronic Business, Macau, PRC, 30 November - 4 December 2009.

B.3

Topic: "Negative user adoption behaviours of mobile commerce: An empirical study from Chinese college students"

Authors: LAI, K W I and LAI, C F D

Conference: Proceedings of 2010 8th International Conference on Supply Chain Management and Information Systems: Logistics Systems and Engineering, Hong Kong, Hong Kong, PRC, 6-8 October 2010.

B.4

Topic: "A model for the study of user adoption behaviours of mobile commerce"

Authors: LAI, C F D, LAI, K W I and JORDAN, E

Journal: International Journal of Enterprise Network Management,
               Vol 4(1), 2010, pp 16-25.

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