

國立交通大學

資訊管理研究所

博士論文

NFC-Micro SD 於行動服務應用之關鍵因素

Critical Criteria of using NFC-Micro SD technology in NFC mobile services



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中華民國 102 年 07 月

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N F C - M i c r o S D 於 行 動 服 務 應 用 之 關 鍵 因 素

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中文摘要

近年來，手機從單純受話發展至集通訊、行動運算及娛樂於一身，行動裝置包括智慧型手機、平板、及任何適用新型無線通訊技術之相關產品，其中一個新技術為近場通訊，提供簡單且安全的通訊。

近場通訊是新的短距無線通訊技術，其允許近場通訊裝置彼此之間進行非接觸式、安全且直覺的點對點通訊，近場通訊的出現，也帶來一些基於短距通訊的有趣應用。

本研究針對近場通訊技術NFC之行動服務應用進行探討，透過線性結構模型方法提出TRAUM模型，該模型從使用者角度進行探討，認為在導入初期，企業應投資資源於行銷及教育上，並提供便利和安全的服務，讓使用者隨手可及，透過社群的影響力，可強化使用者的接受程度及使用意願。本研究並同時透過DEMATEL方法，從專家的角度進行分析，當中發現安全，驗證，合作夥伴間的能力配合，以及提供之服務是影響決策的關鍵要素。

同時從TRAUM及DEMATEL之網路圖來做分析，發現使用者與專家都同時認為使用便利性，安全性，提供之服務等關鍵因素為導入初期之關鍵要素。本研究並同時以NFC-Micro SD為個案，以TRAUM及網路圖之結論作為依據，來討論相對應之策略，及以NFC行動付款服務作為相關之策略應用。

本研究所提出的TRAUM模型及與DEMATEL網路關係圖相搭配的研究模式，不僅對於NFC行動服務關鍵因素及其策略有良好的解釋，更可以應用在相關的領域，包括科技產品導入，電子服務，行動服務等之研究探討，以在策略擬定時，得以全面了解，進而提升決策品質。

關鍵詞：近場通訊，NFC-Micro SD技術，TRAUM模型，DEMATEL，商業策略，行動服務，近場通訊行動付款，科技接受，行為意圖

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ABSTRACT

In the last decade, the mobile phones are evolved from pure voice phone application to data communications, mobile computations, and entertainment. Mobile devices such as smart phones, pads, or the like gradually incorporate new wireless technologies. One of such new technology is Near Field Communication (NFC) which provides the simplicity and security communication.

Near Field Communication (NFC) is a new short-range wireless communication technology that enabled contactless, safe and intuitive peer-to-peer communication between NFC-enabled devices. The advent of NFC has given rise to several interesting applications under short-range radio technology.

Many literatures focus on discussing the information developing in NFC field. However, research which has empirically documented the link among NFC mobile services, business model and business strategy is scant. Therefore, the aim of this article attempts to explore the critical criteria of using NFC technology in NFC mobile services. This research involved the quantitative methods and qualitative methods. The quantitative analysis of the questionnaires was conducted through Structural Equation Modeling methodology and DEMATEL methodology in order to indicate the critical criteria based on the opinions of the users and the experts.

Results of this study proposed TRAUM model by structural equation modeling methodology. The model was based on the users' opinions. In the emergence period, the promotion and education for the consumers, the service in convenience and security were necessary. The enterprise should also focus on the affection of the

community because the community can enhance the acceptance and using willingness. The DEMATEL network relationship map based on the experts' opinions found security, authentication, capabilities of the partners, and service offering were the critical criteria of decision making.

The two quantitative analyses obtained the consistent results that the enterprise should put more resource in the convenience, service offering, infrastructure, security, and provide the corresponding NFC environment. The infrastructure should be based on the service providing.

This study applied the finding of TRAUM and DEMATEL network relationship map to discuss the business strategy of NFC mobile services. The study also took NFC-Micro SD technology as the case to discuss the NFC mobile payment services. The patent of NFC-Micro SD technology provides both the convenience and security for the consumers. It tallies with the results of the TRAUM model and DEMATEL methodology.

To conclude, this study may be of importance in explaining the business model in NFC field, as well as proposing TRAUM model, the combination with the DEMATEL network relationship map to offer the holistic view of business strategy. TRAUM model provides the better explanation about the technology acceptance and mobile services. The analytic model and TRAUM can apply to evaluate the similar research fields, such as technology acceptance, technology product promotion, e-service, mobile services and so forth. The study provides the researcher and the enterprise with a better understanding of critical criteria and business strategy in order to improve the decision quality.

Keywords: Near Field Communication (NFC), NFC-Micro SD Technology, TRAUM, DEMATEL, Business Strategy, Mobile Service, NFC Mobile Payment, Technology Acceptance, Behavior Intention

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1. Introduction

1.1 Background

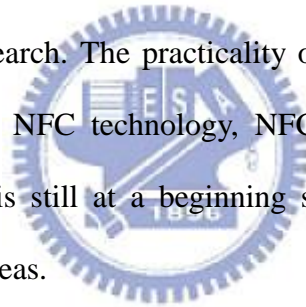
With the growth of consumer electronics, Near Field Communication (NFC) is an emerging and compelling technology nowadays. It is characterized as a short-range radio communication technology with many potential applications. The users can communicate to each other with NFC-enabled devices. The users only simply put the NFC-enabled devices close to each other, wave them, or touch them, the transaction will be finished. The act of communication is called “to tap and go” or “tap-in”(Yaquub & Shaikh, 2012). NFC allows users to exchange the data and service between two NFC-enabled devices by identification passing. It also can apply to payments, retailing, ticketing, electronic key, healthcare, commercial applications and many applications in life.

The market for NFC-enabled devices is greatly huge. According to the research by Juniper Research, it is estimated the market of NFC will facilitate transactions value at US \$74bn by 2015 (Snow, 2012), and reach US \$110bn in 2017 (Clark, 2012). Frost & Sullivan anticipates that NFC-enabled mobile phones will reach 863 million units in 2015 and NFC-enabled mobile phones will represent more than 53% of the overall market in mobile phones (Sullivan, 2011). The huge market emphasizes the importance of NFC, and attracts more and more enterprises to promote NFC applications to get the bigger market share.

There are three main NFC applications: Authentication, Payments, and Data exchange. Among the applications, mobile payment is the first application in NFC field. Mobile payments are the payments through mobile devices in wireless environment, and are considered as the accelerator of M-commerce. The potential

profits from implementing mobile payments in the marketplace are huge. Juniper Research (2012) (Holden, 2012) found that the NFC retail payments market will exceed \$180bn globally by 2017, more than a seven-fold increase over 2012. NFC payments become the next popular application in NFC field.

Most academic literatures focus on the NFC technical issues and consider NFC mobile services with the bottleneck to promote, such as higher cost, indefinite profit model, and low promotion willingness of key players. Common sense seems to indicate its importance, but we lack empirical support. Therefore, this study seeks to contribute to our growing understanding of the critical criteria of using NFC technology. By the quantitative finding, it may lead to a better understanding of strategies making of NFC solution. Analysis results are of great interest both for application and scientific research. The practicality of the proposed methodology is demonstrated through a new NFC technology, NFC-Micro SD technology. While research on these questions is still at a beginning stage, findings will have broad implications in a number of areas.



1.2 Research Objective

With the increasing usage of mobile services, the requirements for NFC technology have become more and more critical. The main objective of this research was to understand the critical criteria of using NFC technology and make the appropriate strategy. To that end, the following issues were posed:

- (1) The critical criteria of using NFC mobile services based on the users' concepts.
- (2) The critical criteria of promoting NFC mobile services based on the experts' opinions.
- (3) A conceptual framework for linking user acceptance and experts' decision making.
- (4) To recommend promising application strategy for the new NFC solution, NFC-Micro SD technology.



1.3 Overview

For these objectives to be achieved, the paper is structured as follow:

The first section of the study is a review of the literature, addressing both empirical and theoretical aspects of NFC technology, NFC-Micro SD technology, main NFC mobile service, business model, UTAUT (Unified Theory of Acceptance and Use of Technology), Technology Readiness, and Post-Acceptance Model. This is followed by the research methodology with full details of the participants in the research, and of the instrument and procedures used. The results for the various analyses are then presented, with a thorough description. Finally, conclusions are presented and suggestions are made for further research.

The structure is as shown in Fig. 1:



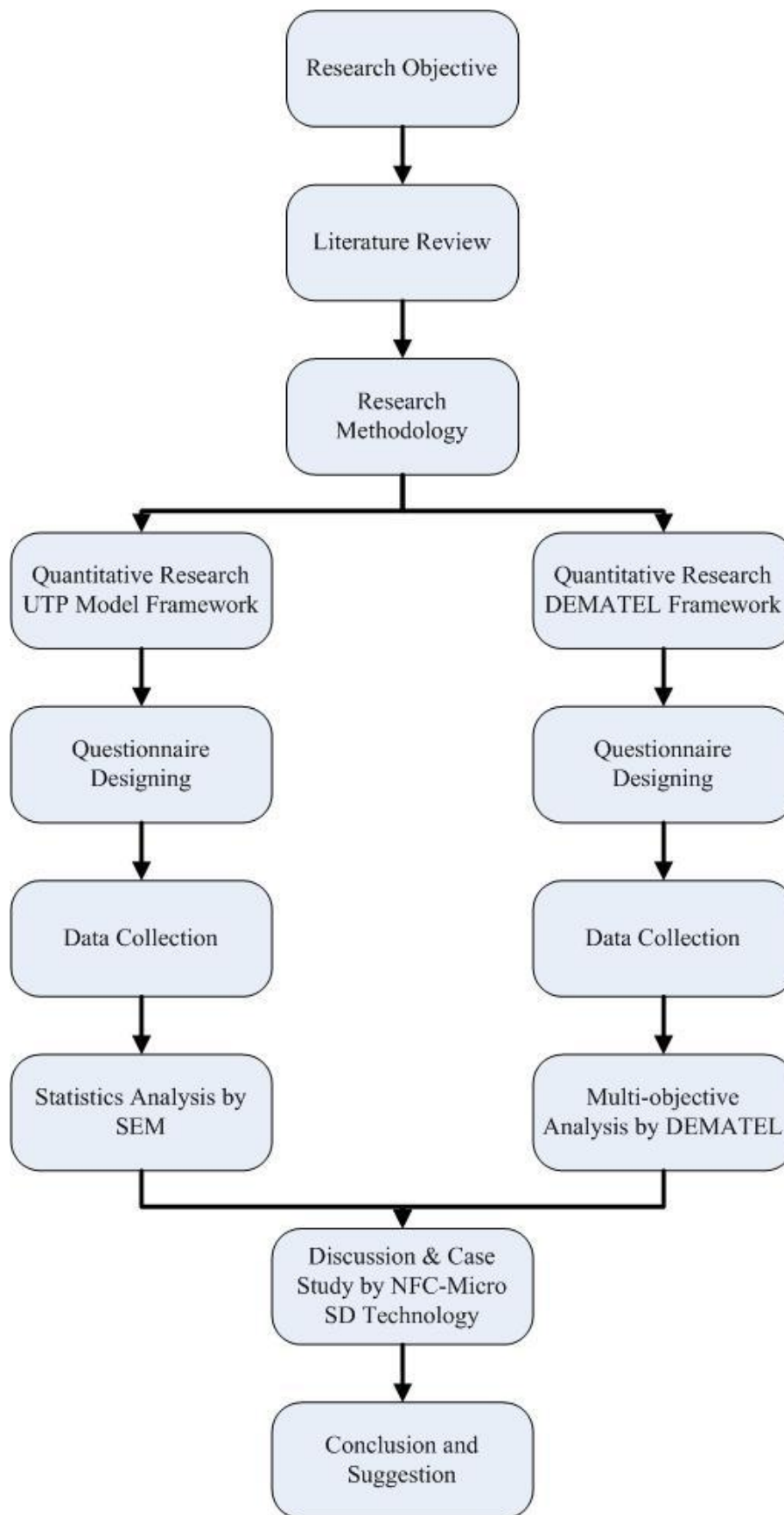


Figure 1 Research Process

2. Literature Review

2.1 Near Field Communication

2.1.1 Overview

Near Field Communication (NFC) is a standard based short-range wireless connection technology that enabled simple and safe peer-to-peer interconnections between electronic devices (Agrawal & Bhuraria, 2012) (ECMA, 2005). Based on the Radio Frequency Identification (RFID), it uses the magnetic field induction to communicate between electronic devices (it also called contactless target or simply tag) and the transceiver (it also called read-write-device or simply reader or writer) (Falke, Rukzio, Dietz, Holleis, & Schmidt, 2007). RFID is an asymmetric technology because only the reader/writer device can initiate the data transmission (Jürgen Morak, Kollmann, & Schreier, 2007). On the contrary, NFC allows the two-way communication between the two devices.

NFC is based on RFID technology and use the same communication mechanism. It combines the benefits of RFID and wireless communication technologies, included Bluetooth, WLAN, IrDA (FRCGP et al., 2005). The NFC standards (NFC Forum, 2013) were proposed in 2003. It operates in the unlicensed frequency band of 13.56MHz. The data transmission rate of NFC is up to 424 kBit/s between devices over a 10 centimeter (4 inches) distance. The transmission module inside can operate as the reader/writer component to access the tags, and the contactless smartcards based on proximity-card standard (ISO 14443), like Mifare (included NXP, Gratkorn, Austria) and Felica (included Sony, Tokyo, Japan) products (Jürgen Morak et al., 2007). It combines the smartcard interface and the reader in a single device. NFC devices could communicate with the existing smartcards, the contactless readers, and

support two-way communication between the other NFC-enabled devices in active and passive mode.

NFC devices can send and receive the data at the same time. The basic idea of NFC is to introduce a communication session by an intuitive, easy to operate, and secure way. Users only simply wave the NFC-device closed the reader device or point to the reader device which can receive the NFC signals, the transaction can be completed immediately. Therefore, NFC is appropriate to be integrated in the consumer electronics devices, like mobile phones, Tablet PC, MPs, Personal Digital Assistants (PDA), watch, digital camera and so on. NFC really has a wide application in every aspect.

Nokia made the first available mobile phone with NFC technology (Nokia, 2004). To enable the NFC technology, users have to equip a special NFC shell with the mobile phone. It makes the mobile phone can read data from RFID tags as well as communicate with other NFC-enabled devices. As the service is provided, the built-in application is initiated for a phone call, sending the SMS, or connecting to a defined web service.

2.1.2 Goal of NFC

The current situation of the mobile communication and consumer electronics can be characterized by the convergence of devices and the growing needs for connecting the devices. Simplicity and security are the two primary goals. The main driver for creating the Near Field Communication Interface and Protocol (NFCIP-1) is to make the users able to create a connection between two devices without any special knowledge about the network, and any NFC-enabled device could be connected securely. As the two devices identify each other, they can exchange their configuration data via NFC and the devices can set up and continue communication either with NFC or via other communication channels (e.g. Bluetooth or WiFi). The concept that brings the devices together or makes them touch to communicate is greatly simple.

Users only put the NFC-enabled devices close to each other to establish the communication between the NFC-compliant devices easily. Also, one action taking the devices away can cut the communication. The simple actions yield the inherent security. As long as there are no other NFC-devices with a 10-centimeter radius, there's no communication. Another important benefit of NFC is the support for the passive communication mode. Thus, the complete communication can be powered from one side only.

The NFC protocol is also compatible with the widely used contactless smart card protocols. Thus, NFC-enabled devices can be work with the smart cards and can be used instead of the smart cards.

2.1.3 NFC Standard

In fall 2002, NXP technologies (Philips Semiconductor Operator) and SONY reached agreement to develop NFC technology. The two companies submit the draft specifications to ECMA International, which is responsible for standardizing information and communication system. NFC is an open platform technology which is standardized in ECMA 340 (ISO/IEC 18092), ECMA 352 (ISO/IEC 21481), ECMA 356 (ISO/IEC 22536), ECMA 362 (ISO/IEC DIS 23917) and ECMA 373. The standards are as follows:

(1) ECMA 340 (ISO/IEC 18092)

The standard specifies modulation schemes, codings, transfer speeds, and frame format of the Radio Frequency (RF) interface, and anti-collision. It also specifies the active and the passive communication modes and data exchange methods for wireless interconnection between the close devices and access to mechanism to detect and select one communication mode out of three possible communication modes.

(2) ECMA 352 (ISO/IEC 21481)

The standard specifies the mechanism to detect and select one communication mode out of three possible communication modes.

(3) ECMA 356 (ISO/IEC 22536) and ECMA 362 (ISO/IEC DIS 23917)

The two standards specify RF-test methods for ECMA 340 devices with antennas fitting within the rectangular area of 85mm by 54mm.

(4) ECMA 373

The standard specifies the signal wires, binary signals the state diagrams and the bit encodings for three data rates between a transceiver and a front-end.

In March 2004, NXP, Sony and Nokia founded a non-profit NFC Alliance, NFC Forum. It contains more than 150 members included intelligent chip manufacturer, bank, credit card issuers and so on. Its major members: HP, NXP (Philips), Sony, Texas Instruments, Nokia, NEC, Samsung, Motorola, MasterCard, VISA, Panasonic, Microsoft, Gemalto, Vodafone, Siemens, Giesecke & Devrient, Infineon; in other words, it contains the key players of the mobile communication and consumer electronics market. NFC Forum also establishes 15 important specifications and is authenticated by ISO, IEC, ETSI and ECMA.



2.1.4 Operation Mode in NFC

NFC technology provides three operating modes and each mode differs from one another in terms of communication and data processing model. Each mode has distinguishable characteristic. Thus, each mode can offer different possible business opportunities and different value-added activities. The three operating modes are Card Emulation mode, Reader/Writer mode, and Peer-to-Peer mode (NFC Forum, 2013):

(1) Card Emulation mode

In Card Emulation mode, the data is transferred from mobile device to NFC reader. NFC-enabled device can act as the RFID card, and other NFC-enabled devices can read the data from the NFC-enabled devices. Therefore, there's not the need of NFC tag or RFID card, and the mode can store information in NFC-enabled devices for the further operations.

The most important benefit of the mode is identified as elimination of carrying a physical object, such as credit card, cash, physical keys, etc. NFC technology also can provide access control, since it provides an authentication mechanism. Attendance control is another example of access control provided (Miraz, Ruiz, & Gómez-Nieto, 2009). It authenticates students while attending to class. Therefore, the identified benefits of the mode are elimination of carrying a physical object and obtainment of access control.

(2) Reader/Writer mode

In Reader/Writer mode, the data is transferred from NFC tag to mobile device or from mobile device to NFC tag. The NFC tag is the passive tag and enabled by NFC devices. The passive tag doesn't need any source of power. Active NFC-enabled device can create magnetic inductive coupling and transfer the power to the smart card. While the smart card is powered, the data communication begins. The speed of

data communication can increase up to 106 Kbit/s in the operating mode.

Many applications are developed in Reader/Writer mode because so many scenarios can be adapted to NFC applications by using this mode. Smart poster applications are one of the most important of the mode. Users can read data from NFC-enabled posters using their NFC-enabled mobile devices and gain mobility from the process. Users can also read their exclusive mobile coupon for shopping. Visitors can read the guidance in the museum or scenic spot by their NFC-enabled devices. The patients can upload their medical information (Jurgen Morak, Schwetz, Hayn, Fruhwald, & Schreier, 2008) (J Morak, Hayn, Kastner, Drobits, & Schreier, 2009) by NFC technology and get the advice from the doctor at once. Reader/Writer mode can provide less physical effort usage and more convenience.

(3) Peer-to-Peer mode

In Peer-to-Peer mode, the data is transferred between two NFC-enabled devices. The mode is standardized on ECMA 340 (ISO/IEC 18092) standard, and allows data speed up to 424 Kbit/sec.

The applications of the mode are fewer than other modes. The study is generally for data transfer operations, such as exchange business cards (ECMA, 2005). The file transfer between the NFC-enabled mobile phone and NFC-equipped computer is also permitted. Thus, peer-to-peer mode provides easy data exchange between devices.

The benefit of the three modes is listed in the following table:

Table 1 Benefits of NFC Operating Modes (Ok, Aydin, Coskun, & Ozdenizci, 2010)

	Card Emulation Mode	Reader/Writer Mode	Peer-to-Peer Mode
Benefits	<ul style="list-style-type: none"> (1) Elimination of carrying a physical object (2) Access control 	<ul style="list-style-type: none"> (1) Increases mobility (2) Decreases physical effort (3) Ability to be adapted by many scenarios (4) Easy to implement 	<ul style="list-style-type: none"> Easy data exchange between devices



2.1.5 Comparison to NFC and Existing Wireless Communication

Technology

The near distance communication technologies contain Bluetooth, Zigbee, Near Field Communication (NFC), and so on. They all have the characteristics of each, included the transit speed, the communication distance, and the unique specification. In Table 2, we could see the comparison between them.

Table 2 Comparison to the near distance communication technologies

	NFC	Zigbee	Bluetooth
Price	\$3 US	\$4 US	\$5 US
Security	Highest	Medium	High
Transmit Speed	106-424 Kbps	10-250 Kbps	1 Mbps
Distance	0~20 cm	10~75 m	0~10 m
Frequency	13.56 MHz	2.4 GHz	2.4 GHz
Standard	ISO/IEC 18092 ISO/IEC 21481 ECMA 340 ECMA 352	IEEE 802.15.4	IEEE 802.15.1X
Consumer Experience	Touch and wave	Get Information	Configuration needed

In the comparison, we find NFC is a better technology as compared to existing near distance wireless communication technology in terms of lowest price of the chip, the highest security, the minimal interaction with display and keypad, and the consumer experience of using NFC.

For the consumer electronic market, the consumer experience is the most important characteristics for the consumer. For the consumer, NFC has the highest security and better consumer experience. It will elevate the willingness of the consumers to use, especially as a new function of the mobile phone.

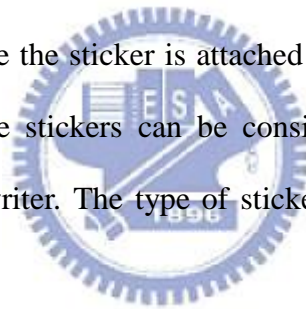


2.1.6 NFC Technology Developments

NFC technology is considered the mainstream technology of the next generation for mobile phone products. Many organizations collaborate with the NFC Forum actively (Clark, 2013). The handset manufacturers and mobile network operators both invest in NFC field and launch the NFC-enabled products to get the bigger market share. The competitive condition results in several kinds of the NFC products to apply in mobile phones. There are multiple ways by which the mobile devices can be made NFC-enabled, included NFC-Tag, NFC-Mobile Phone, NFC-SIM, NFC-SWP SD and NFC-Micro SD as follows:

(1) NFC-Tag

It's a form of sticker. While the sticker is attached to the device, it can be used as the NFC-enabled device. The stickers can be considered read-only, read/write, or write through a special tag writer. The type of stickers is according to the intended use.



(2) NFC-Mobile Phone

The handset manufacturers place NFC chips into the mobile phones in manufacturing process and install the NFC program in advance. The process makes the mobile phone as NFC-enabled device.

(3) NFC-SIM

The flexible NFC chip is added on the subscriber's original SIM card which could provide additional NFC services and use the application and services from the third party developers. However, the chip is sensitive to the electromagnetism, especially the battery of the mobile phone. To solve the problem of the electromagnetism, the flexible flat cable has to add on the NFC chip to block the impact of the battery.

(4) NFC-SWP SD

The technology integrates NFC chip into Micro SD card. Because the NFC chip integrated is with no antenna module, the integrated Micro SD card must add additional RF contacts on it. The additional RF contacts can communicate with RF antenna in mobile phones to transmit NFC signals.

(5) NFC-Micro SD

The most important feature is NFC chip packages the antenna module inside in advance and is built-in the Micro SD card. Therefore, NFC-Micro SD technology doesn't have to change the size of NFC chip and Micro SD card, and can apply in every kind of phones.

Among the technologies, NFC-Mobile Phone, NFC-SIM, NFC-SWP SD and NFC-Micro SD all have created the applicable products. It's as shown in following figure.

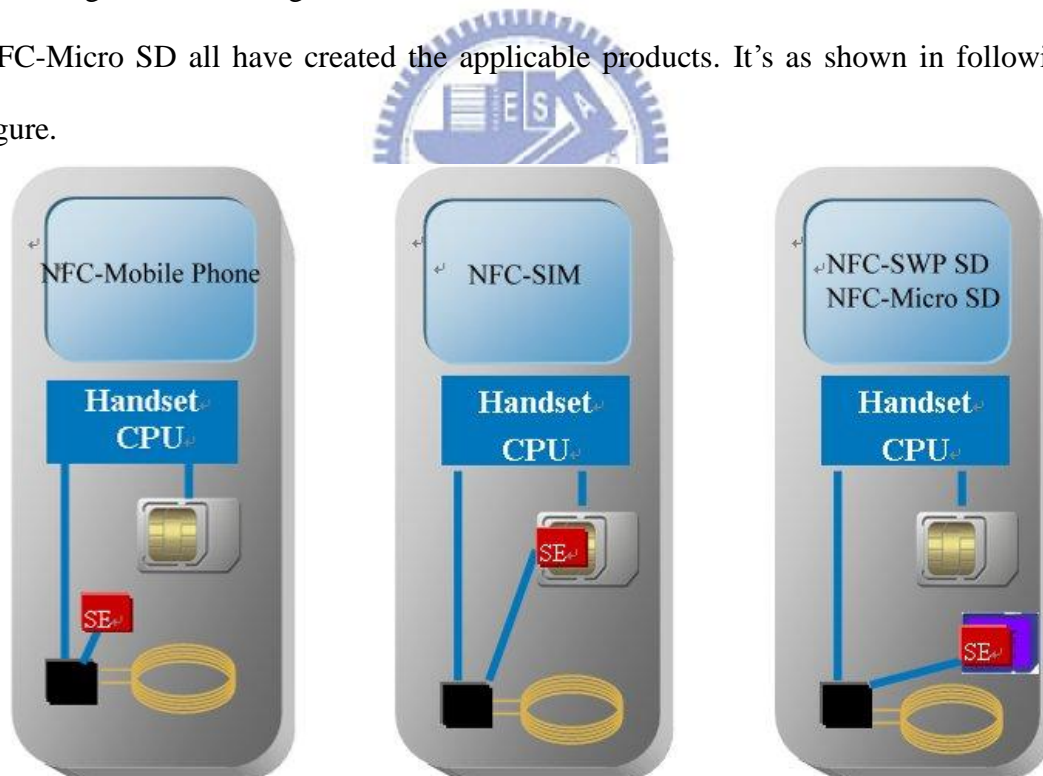





Figure 2 The four NFC-enabled mobile devices (Source: AboMem Corp.)

The comparison of the four NFC technologies is shown as follows:

Table 3 Comparison to the NFC Technology

	NFC-Mobile Phone	NFC-SIM	NFC-SWP SD	NFC-Micro SD
Size	Mobile Phone Specifications	-	11x15x1.1mm	11x15x1.1mm
Input Voltage	Mobile Phone Specifications	3.3V	3.3V	3.3V
ISO 7816	Support	Support	Support	Support
ISO 14443	Support	Support	Support	Support
Frequency	13.56MHz	13.56MHz	13.56MHz	13.56MHz
Antenna	NFC Mobile Phone	External flexible cable	NFC Mobile Phone	Built-in
Memory Capacity	Mobile Phone Specifications	N/A	4/8 GB	4/8 GB
Distance	<10 cm	<10 cm	<10 cm	<10 cm
Supported Device	Special Mobile Phone	Special Mobile Phone	Special Mobile Phone	All Mobile Phone
Card Issuer	Handset Manufacturer	Telecom Operator	Bank	Bank
Acceptance	low	less	medium	high
Cost	high	high	low	low
Picture				

2.1.7 NFC-Micro SD Technology

2.1.7.1 The advantage of NFC-Micro SD technology

Embedding NFC function into the mobile phone is the main trend. The key to promote the acceptance degree is widely applied in mobile phones. It's also the challenge in NFC field.

In mobile phone market, the trend is the slim and light phones with more functions. The consumers like the new and interesting mobile phones, the phenomenon results in such high replacement rate of mobile phones. The two NFC technologies, NFC-Mobile Phone and NFC-SIM, both limit to the special mobile phone types. It will make the consumers feel bored and reduce their willingness to use. So the two technologies have the few acceptances for the users.

Micro SD card is applied in mobile phones and other consumer electronics widely and has lower cost. Thus, combining NFC chip and Micro SD card not only has the lower cost, but also keeps the original convenience of Micro SD card for users. As long as the users own the Micro SD card with NFC function, they can make the favorite mobile phone to become NFC-enabled phone by inserting the integrated card. No doubt, it has become the trend in NFC field.

The two technologies, NFC-SWP SD and NFC-Micro SD, both correspond to the trend that combining NFC chip into Micro SD card. In section 3.1, we discussed the characteristics of the two technologies. NFC-SWP SD technology has no antenna module integrated, and has to depend on the RF function of mobile phone to transmit NFC signals. The technology has to add additional antenna attached to enable NFC function. However, there are parts of mobile phones with RF function. It also causes finite acceptance of users.

Compared to NFC-SWP SD technology, NFC-Micro SD technology has the antenna modules packaged inside. It's the unique patent. With the patent, there's no additional antenna attaches on the chip to communicate with RF function of mobile phones. On the contrary, the NFC-Micro SD technology could transmit the message by the built-in antenna. Thus, the technology can maintain the size of Micro SD card, and apply in all kinds of mobile phones. Users could only insert the NFC-Micro SD card into the phone, and the NFC function is enabled. Then users can use the application program to active the NFC function. So NFC-Micro SD technology is not only the trend in NFC technology, but also the leader in NFC field.

2.1.7.2 Structure of NFC-Micro SD Technology

Every NFC chip contains four blocks on the substrate, included Die 1, Die 2, Die 3, and Antenna module, as shown in the following figure.

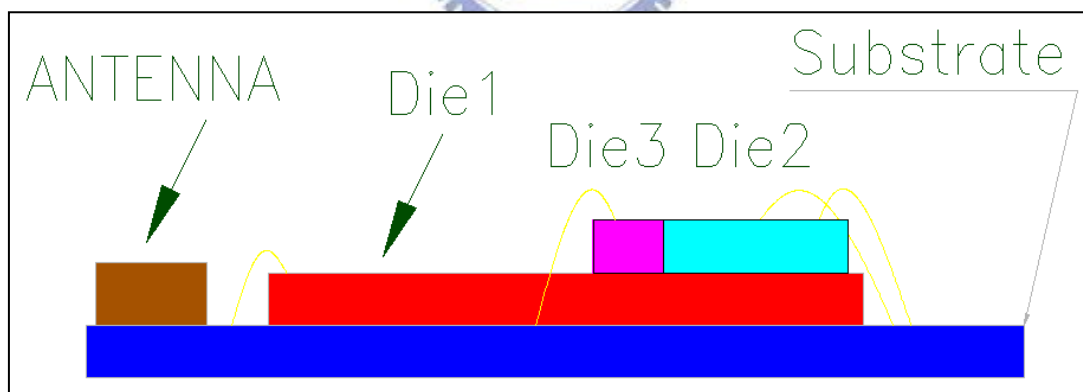


Figure 3 NFC-Micro SD card structure (Source: AboMem Corp.)

The first block (Die 1) is the memory, standard NAND Flash. It processes the reading and the storing of the data. The second block (Die 2) is Memory Card Controller with OTA (Over-The-Air) Support. It controls the data flow. The third block (Die 3) is the SmartCard Controller. It operates encryption, decryption and

transmit the corresponding payment ways. The fourth one is the miniature Antenna module and it's responsible for transmitting the signals.

The block diagram is as shown in the following figure.

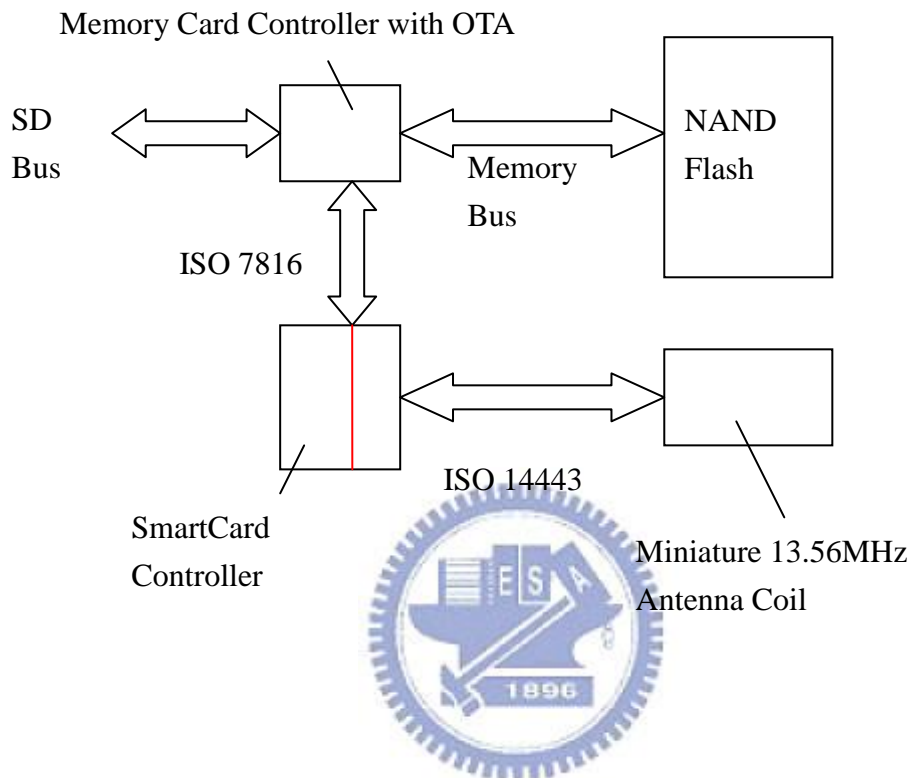


Figure 4 Block diagram of NFC-Micro SD card (Source: AboMem Corp.)

The most important characteristic of NFC-Micro SD is the unique patent. The patent is packaging the antenna module in the chip. To package the antenna module in the chip, NFC-Micro SD technology uses the miniature 13.56 MHz Antenna Coil in order to solve the problem of the limited space in the chip. The miniature module packaged in NFC chip has no any effect for electromagnetic induction and reducing signal decay.

In NFC chip, SmartCard Controller is the main and special component. SmartCard is responsible to store the confidential personal information and SmartCard Controller executes encryption and decryption, the preprocedure of the data. SmartCard

Controller is also responsible to execute NFC transaction, such as choosing the corresponding payment way, doing the identification directly, and transmitting the NFC signal by Antenna Coil module. SmartCard Controller can execute the two-way communication with Miniature Antenna Coil module by ISO 14443 to provide the safer communication.

The NAND Flash is the main storing center except the confidential personal data. The storing mechanism for SmartCard and NAND Flash can block the private personal data away the normal data effectively and operate independently. Memory Card Controller can control the direction of data flow. While the information transmitted by SD Bus, Memory Card Controller can judge the attribute of the data. If the data belongs to the normal data, it transmits to NAND Flash by Memory Bus. If the data is about NFC, it transmits to SmartCard Controller by ISO 7816. Memory Card Controller is supported by OTA (Over-The-Air), without needing for SDIO or McEX.

To enhance the security of the card, NFC-Micro SD card has the additional hardware mechanism, OTP (One-Time-Password). The OTP is generated based on the chip serial number and follows the sequence based approach. When OTP generated by the NFC-Micro SD card is as the same as OTP generated by the server, the transaction is valid and can be continued. Through the corresponding of hardware security mechanism and software security mechanism, NFC-Micro SD technology can provide a safer environment for transaction and attract more users to use.

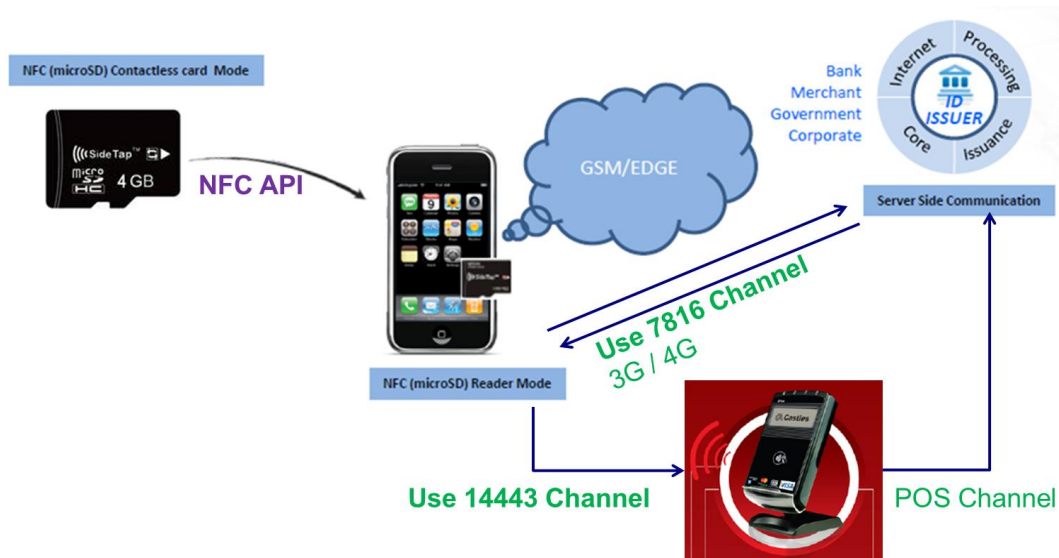


Figure 5 Application process by NFC-Micro SD protocol

The whole application process contains NFC-Micro SD card, smart phone, POS machine, and the issuers, as shown in Fig. 5. to execute NFC function, NFC-Micro SD card should be inserted into the smart phone. NFC-Micro SD card can communicate with smart phone with 13.56 MHz frequency by NFC API. There are two transaction modes, contactless transaction mode and contact transaction mode. In contactless transaction mode, the users only put the NFC-Micro SD phone close to the POS machine to transfer the data by using ISO 14443 channel. The POS machine will connect to the issuers by the existing fixed channel. In the contact mode, NFC-Micro SD phone need to touch the POS machine and transfer to the issuers by using ISO 7816 protocol, 3G/4G channel. Generally speaking, the issuers should be the bank, the Government, and the organizations which own the confidential personal information.

For the function of the NFC-Micro SD technology, it contains several functions as follows:

(1) JCOP

In the chip, JAVA Card OpenPlatform (JCOP) is embedded. There is the Virtual Machine (VM) of Java Card inside, included NXP IC encryption module. It makes the

chip to encrypt the data by the highest encryption standard of hardware ZAL5++ while it transmits. The encryption algorithm contains DES/ AES/ RSA/ PKI/ SHA-1/ SHA-224/ SHA-256/ MD5/ CRC and so on.

(2) Perso Function

Perso Function means upload the personal data, included the identification data, the finance data and so on. It uploads the data on the chip by Applet/ APDU in JCOP.

(3) Mifare Function

Mifare is the NXP-owned trademark of a series of chips widely used in contactless smart cards and proximity cards. It covers proprietary technologies based upon various levels of the ISO/IEC 14443 Type A 13.56 MHz contactless smart card standard. By Mifare function, the intelligent chip could provide the more applications and communicate to each other.

(4) Over-The-Air (OTA) Function

The function improves the enterprises (e.g. the issuers) to identify the users directly without the complicated procedures, and the convenient communication/transaction for the consumers.

By the unique processing and design, NFC chip with antenna module can be integrated into Micro SD card successfully and provide the security environment in application. The feature makes NFC-Micro SD technology as the leader in NFC field.

2.2 Business Model

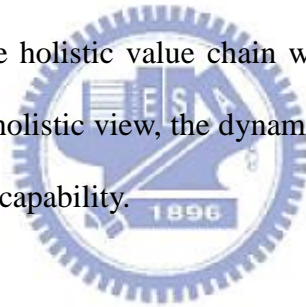
2.2.1 Overview

The term “business model” has been created in practice during the 1990s and it gradually has been researched by the scientific community (Morris, Schindehutte, Richardson, & Allen, 2006). For a long time, the research focused on industry (Porter, 1980) and resources (Wernerfelt, 1984) (Barney, Wright, & Ketchen, 2001). The business model has to be seen as the replacement of traditional unit of analysis as a result of the environment of traditional unit of analysis as a result of the environmental conditions changed (Amit & Zott, 2001). The business condition now is determined by technological progress, service orientation, the digitalization of products as well as increasing relevance of cooperation and ecosystems of different companies, which blur the boundaries of the individual enterprise. The unit of analysis must be the holistic and comprehend various aspects. The business model can increase the competitive capability of a company by offering a logic and consistent approach to the innovative design and business execution (Bucherer & Uckelmann).

Although the term “business model” is usually used in research and practice, a common definition is lack (Morris, Schindehutte, & Allen, 2005). One of the most cited definitions is from Timmers. Timmers (1998) emphasized the technology elements and considered business model is a framework which contains the product, service, and information flows. A business model includes the description of various business actors, potential benefits among the various business actors, and sources of revenues. Chesbrough and Rosenbloom (2002) considered the business model describes what a company focuses on making money and creating customer value. Bouwman et al. (2008) considered the business model is as a blueprint that includes a

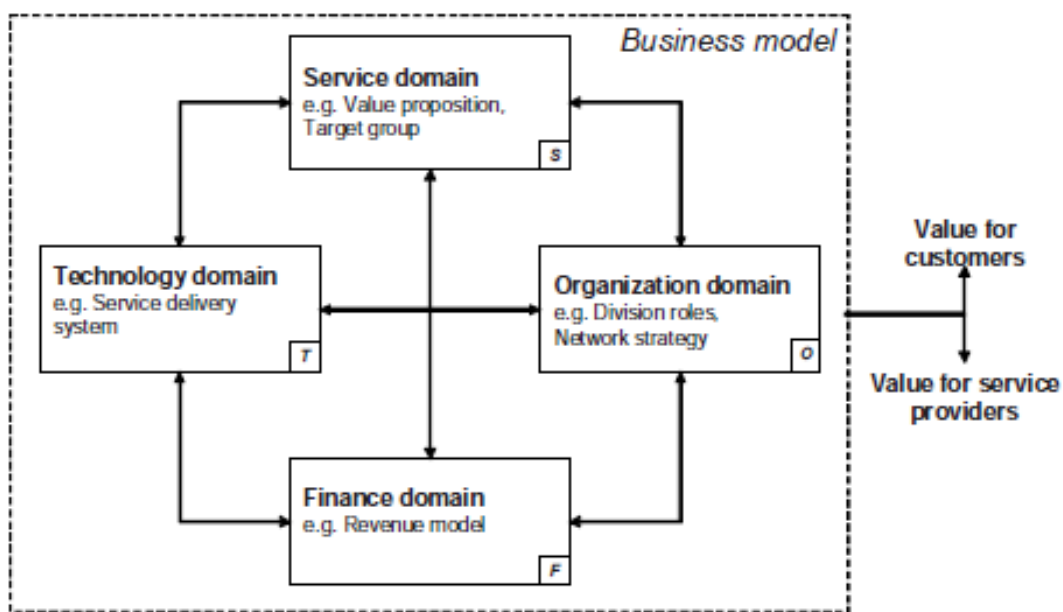
delivered service, the service definition, the intended value of the target group, the sources of revenue, and a framework for the service delivery. The business has to adjust their business model to copy with the challenge in the market (Linder, 2000). According to Afuah and Tucci (2000), a business model can be conceptualized as a system that is made up of components, linkages between the components and dynamics. Components refer to the elements to be addressed by a business model. Besides, Business model should be seen as a dynamic system (Morris et al., 2005). A business model is not static but must be managed and developed over time (Hedman & Kalling, 2003).

For our research, we define the business model as a dynamic system. Every business activity can be reduced to its core elements to explain the value proposition, the technological element, the holistic value chain with the partners and customers, and the profit. Following the holistic view, the dynamic business model can be shown and stood out the competitive capability.



2.2.2 STOF Business Model

The Service Technology Organization and Finance (STOF) business model is a theoretical framework of Bouwman et al. (2008) for the description of business models, which provides an analytic tool to identify critical issues related to different participants. The model emphasizes in depth approach to evaluate the business model. The STOF framework comprises four interrelated domains, included service domain, technology domain, organization domain, and finance domain. By analyzing the four domains can create a holistic business model and the value for both the customers and value network. The model also emphasizes in depth evaluation of a service at the emergence period of its design. Thus, it can detect the critical issues in advance and design the service in the way to address it. The STOF model is shown as follows.



(Source: (Juntunen, et al., 2010; Bouwman et al., 2008)

Figure 6 STOF business model domains

The service domain focuses on the customer value of the service. The domain analyzes the value proposition of the service, included customer and market segmentation, pricing, ease of use, context of use and the service offering. The domain also compares the services with the existing similar and previous services.

The technology domain focuses on the technical functionality based on the requirements of the service domain. The technology domain consists of technological architecture, applications, devices, security, authentication, and management of user profiles.

The organization domain describes the structure of the value network to realize the service offering. The value network is composed of partners who have resources and capabilities. The partners of the value network perform the value activities based on their own strategies and vision.

The finance domain describes the finance issues in the value network, and shows how the partners get monetary value from a particular service offering. The domain focuses on creating a financially profit for all partners and balance the benefits and costs. The key points in the domain include revenue, cost, risks, capital, and the resources.

The four domains are linked and interact to each other. The business model describes the holistic value network by the four domains. STOF business model is used to analyze the electronic service because of the holistic view. Therefore, by STOF business model, it is easier to analyze the innovative NFC-Micro SD technology and the value network of the innovative NFC solution.

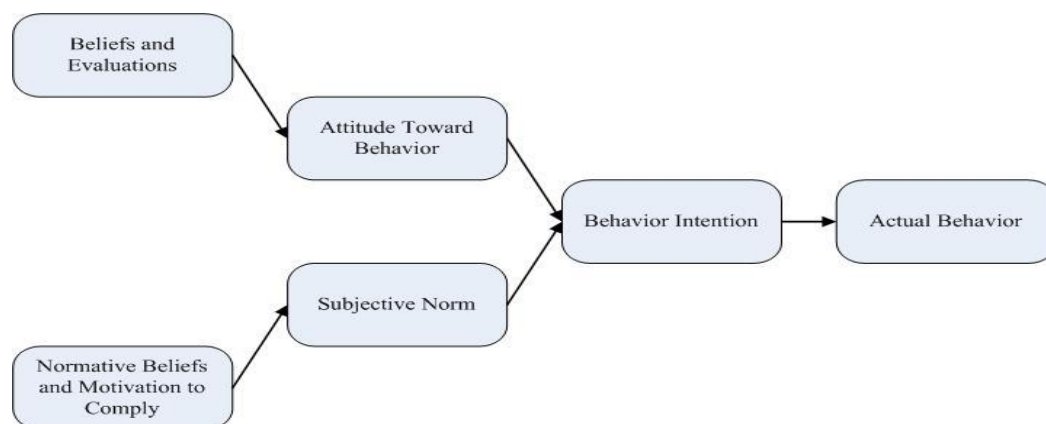
2.3 Technology Acceptance Behavior

A lot of research works have been done in this field to seek for the factors of technology acceptance, included Theory of Reasoned Action, Theory of Planned Behavior, Technical Acceptance Model, and so forth.

2.3.1 Theory of Reasoned Action

Fishbein & Ajzen (1975) proposed Theory of Reasoned Action (TRA). According to the hypothesis of TRA, people usually decide their behavior reasonably (Peter & Olson, 1999; Igarria et al., 1995). The other hypothesis of TRA is that people decide their behavior voluntarily.

The TRA model is as shown as Fig. 7. Behavior Intention (BI) means the personal willingness to behave. Behavior Intention results in the real behavior and is composed by attitude toward behavior and subjective norm. The attitude toward behavior means personal positive or negative feeling with the special behavior. The subjective norm means the social pressure given to the person with the special behavior. It means personal belief affects personal attitude, and results in the behavior intention to have the real behavior.

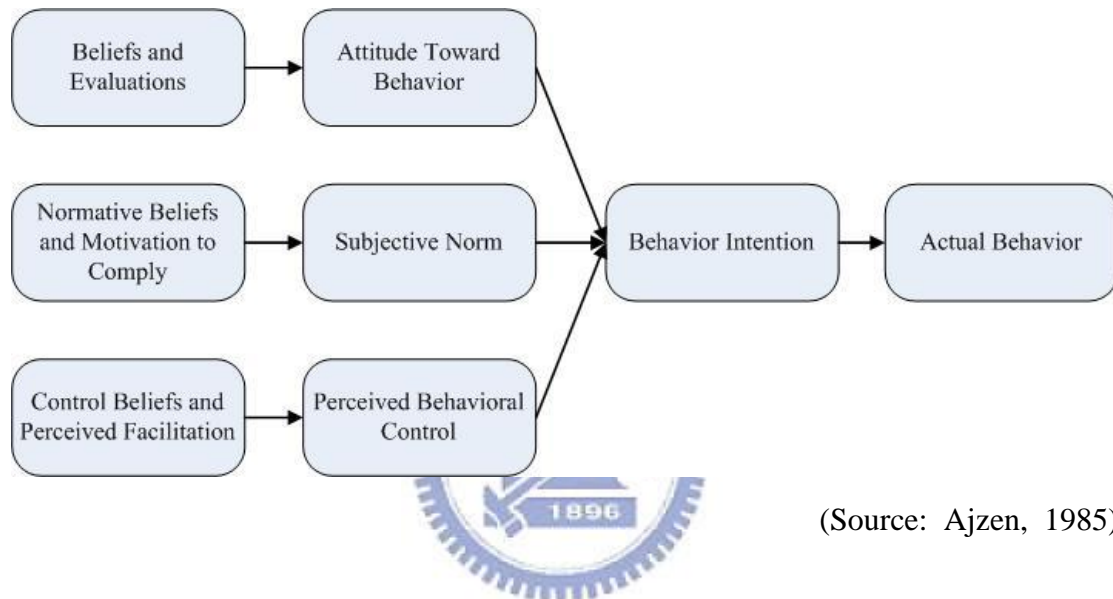


(Source: Fishbein & Ajzen, 1975)

Figure 7 Theory of Reasoned Action

2.3.2 Theory of Planned Behavior

Ajzen (1985) proposed Theory of Planned Behavior (TPB) based on TRA. He considered the Perceived Behavioral Control (PBC) is the important factor in the model. The TPB model is shown as Fig. 8. The study suggests PBC affects the behavior and the behavior intention. PBC is composed by control beliefs and perceived facilitation.

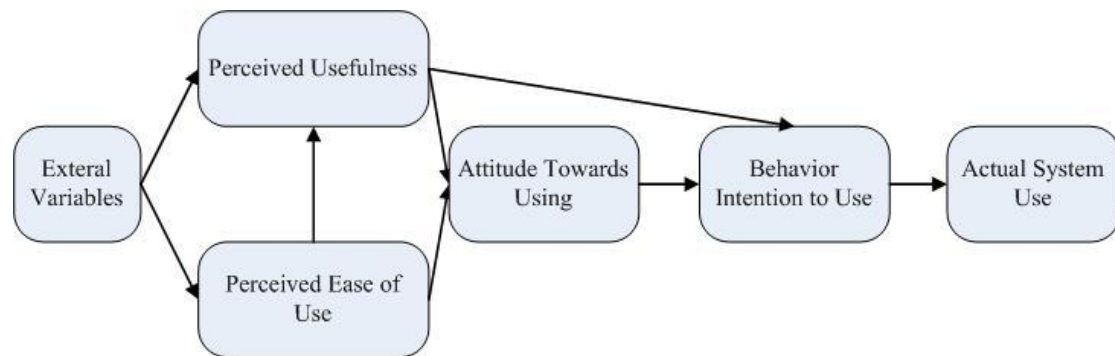


(Source: Ajzen, 1985)

Figure 8 Theory of Planned Behavior

2.3.3 Technology Acceptance Model

Davis (1986) proposed Technology Acceptance Model (TAM) based on TRA and TPB. TAM considers external variable can affect Perceived usefulness, perceived ease of use and attitude towards using. The acceptance of actual system use can be predicted. By TAM, the manager can analyze and make the strategy for the new technology. TAM framework is shown as Fig. 9:



(Source: Davis et al., 1989)

Figure 9 Technology Acceptance Model

TAM has the five constructs as follows:

(1) Perceived Usefulness, PU: Perceived Usefulness means the subjective cognition that using the special technology product can improve the performance of the work. The external variable has the positive effect on Perceived Usefulness, e.g. the correction of the technology product, visual interface design, the characteristics. The regression equation is shown as follows:

$$U = EOU + \text{external variable}$$

(2) Perceived Ease of Use, PEOU: Perceived ease of use means the subjective cognition of using easily. The function of the technology products can improve the ease of use of the technology product. The document can also affect the ease of use (Bewley, Roberts, Schoit & Verplank, 1983). The regression equation is shown as

follows:

EOU = external variable

(3) Attitudes, A: The attitude is affected by the objective belief and the result of the behavior (Fishbein & Ajzen, 1975). Perceived Usefulness construct has the positive effect to the attitude. Perceived ease of use provides more self-efficacy and has the positive effect to the attitude of using the technology products. The regression equation is shown as follows:

$$A=U+EOU$$

(4) Behavior Intention, BI: The users can use the products if they believe the special technology products can advance the working performance. The regression equation is shown as follows:

$$BI = A+EOU$$

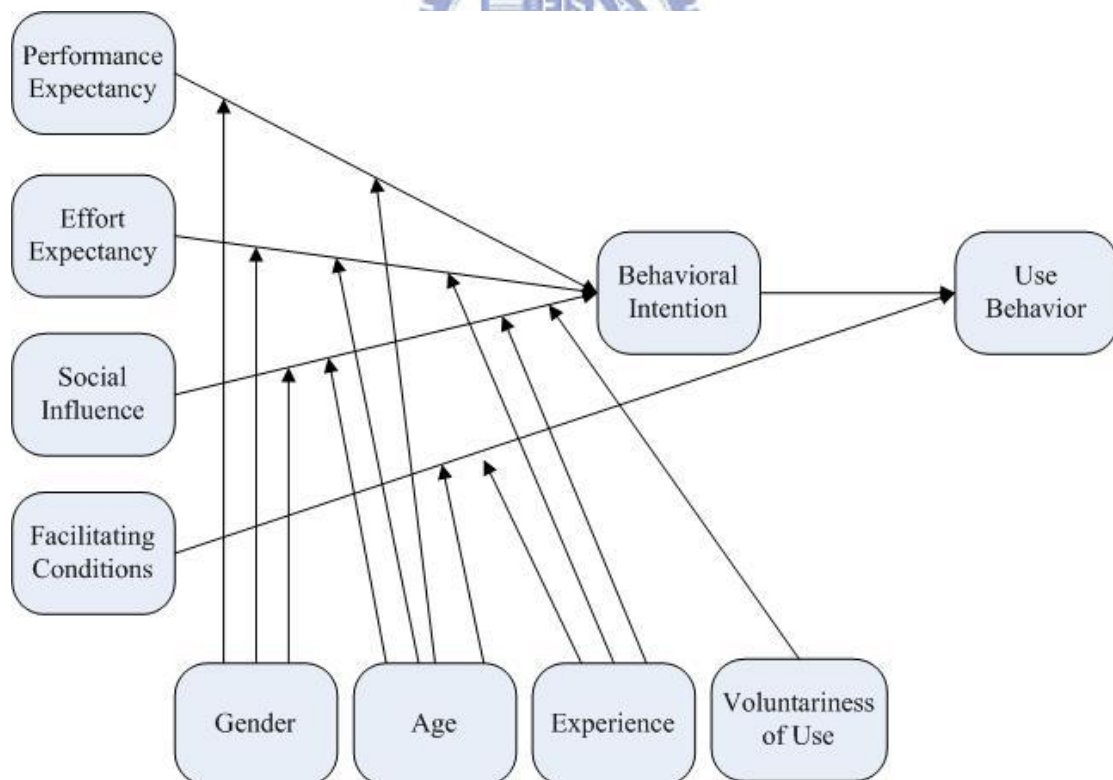
(5) Actual System Use: The behavior intention affects the actual behavior of using the system.



2.3.4 Unified Theory of Acceptance and Use of Technology

Venkatesh et al. (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) based on the relative research of technology acceptance behavior, included TRA, TAM, TAM2, TPB, C-TAM-TPB, Model of PC Utilization, Motivational Model, Innovation Diffusion Theory, Social Cognitive Theory. UTAUT has the higher explanation about the technology using behavior than other technology acceptance theory.

The four core determinants are Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and Facilitating Conditions (FC). These core determinants are affected by the control variables, included gender, age, experience, and voluntariness of use. The UTAUT framework is shown as follows:



(Source: Venkatesh et al. 2003)

Figure 10 Unified Theory of Acceptance and Use of Technology

Venkates et al. (2003) considered the aim of UTAUT is a tool for the manager to evaluate the new technology before introducing the new technology in the organization. It can also provide the forecast and explanation about the acceptance behavior of the users to evaluate the system.

The index of UTAUT is shown as follows:

Table 4 UTAUT Index

Performance Expectancy	<ol style="list-style-type: none"> 1. I would find the system useful in my job. 2. Using the system enables me to accomplish tasks more quickly. 3. Using the system increases my productivity. 4. If I use the system, I will increase my chances of getting a raise.
Effort Expectancy	<ol style="list-style-type: none"> 1. My interaction with the system would be clear and understandable. 2. It would be easy for me to become skillful at using the system. 3. I would find the system easy to use. 4. Learning to operate the systems is easy for me.
Social Influence	<ol style="list-style-type: none"> 1. People who influence my behavior think that I should use the system. 2. People who are important to me think that I should use the system. 3. The senior management of this business has been helpful in the use of the system. 4. In general, the organization has supported the use of the system. 5. People in my organization who use the system have more prestige than those who do not. 6. People in my organization who use the system have a high profile. 7. People in my organization who use the system have a high profile. 8. Having the system is a status symbol in my organization.

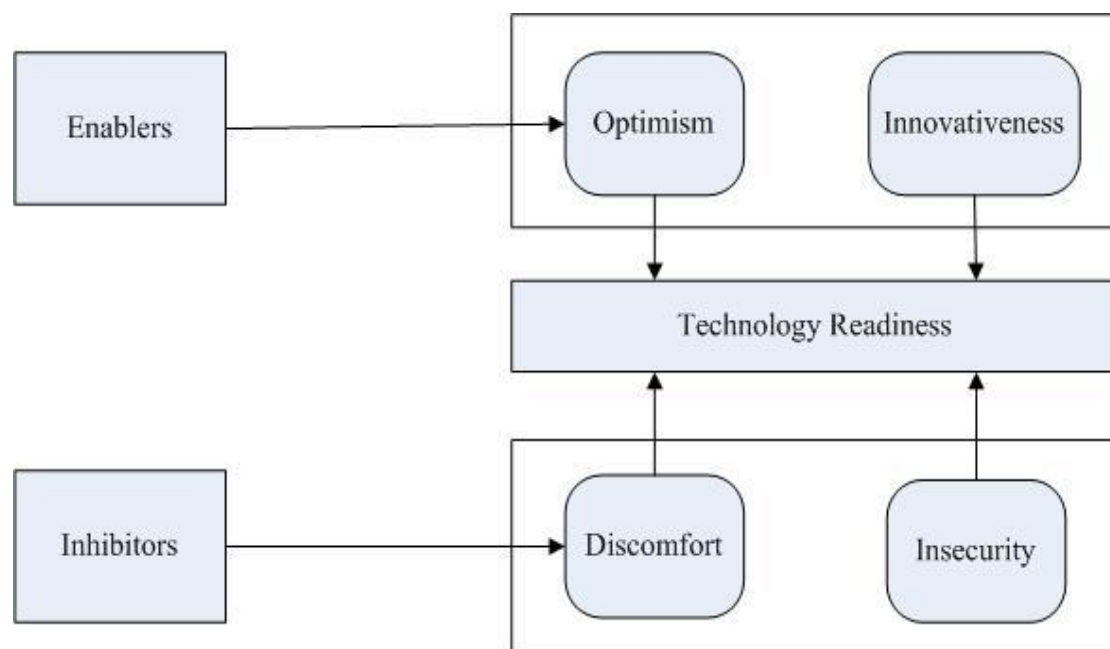
Facilitating Conditions	<ol style="list-style-type: none"> 1. I have the resources necessary to use the system. 2. I have the knowledge necessary to use the system. 3. The system is not compatible with other systems I use. 4. A specific person (or groups) is available for assistance with system difficulties.
Behavioral intention to use the system	<ol style="list-style-type: none"> 1. I intend to use the system in the next <n> months. 2. I predict I would use the system in the next <n> months. 3. I plan to use the system in the next <n> months.

(Source: Venkates et al., 2003)



2.4 Technology Readiness

Parasuraman (2000) defined Technology Readiness (TR) as “the tendency toward accepting and using new technology to complete the goal of the life or work”. The framework includes the two opposite categories, the enablers and the inhibitors. The enablers category includes Optimism and Innovativeness. The inhibitors category includes Discomfort and Insecurity. The framework is as shown as follows:



(Source: Parasuraman, 2000)

Figure 11 Technology Readiness Framework

Parasuraman cooperated with Rockbridge Associates to interview the customers of Rockbridge Associates. He summarized the four feelings of the customers, included Optimism, Innovativeness, Discomfort, and Insecurity.

(1) Optimism: The users have the positive attitude for the technology. They think the technology can increase the controller, convenience, flexibility, and effectiveness in the life.

(2) Innovativeness: The users like to learn and research the new technology. They tend to be the leader of using the technology.

(3) Discomfort: The users feel the impotent and fear for the new technology. They think they can't control the new technology.

(4) Insecurity: The users don't believe the corrective working of the technology. They're also afraid of the information security, the failure machines.

Mick and Fournier (1998) explored the response to the technology by the qualitative research. They found that people exist eight contradictions for the technology: (1) controlled and uncontrolled; (2) freedom and constraint; (3) newer and out-of-date; (4) competent and incompetent; (5) efficiency and inefficiency; (6) satisfaction and needs; (7) assimilation and isolation; (8) participation and separation. Thus, the two studies have suggested that people have the positive and negative thought in technology at the same time.

Parasuraman developed the Technology Readiness Index (TRI) according to the result of the interview. TRI is as shown as follows:

Table 5 Technology Readiness Index

Optimism	Discomfort
<ol style="list-style-type: none"> 1. Technology gives people more control over their daily lives. 2. Products and services that use the newest technologies are much more convenient to use. 3. You like the idea of doing business via computers because you aren't limited to regular business hours. 4. You prefer to use the most advanced technology available. 5. You like computer programs that allow you to tailor things to fit your own needs. 6. Technology makes you more efficient in your occupation. 7. You find new technology to be mentally stimulating. 8. Technology gives you more freedom of mobility. 9. Learning about technology can be as rewarding as the technology itself. 10. You feel confident that machines will follow through with what you instructed them to do. 	<ol style="list-style-type: none"> 1. Technical support lines are not helpful because they don't explain things in terms you understand. 2. Sometimes, you think that technology systems are not designed for use by ordinary people. 3. There is no such thing as a manual for a high-tech product or service that's written in plain language. 4. When get technical support from a provider of a high-tech product or service, you sometimes feel as if you are being taken advantage of by someone who know more than you do. 5. If you buy a high-tech product or service, you prefer to have the basic model over one with a lot of extra features. 6. It is embarrassing when you have trouble with a high-tech gadget while people are watching. 7. There should be caution in replacing important people tasks with technology because new technology can breakdown or get disconnected. 8. Many new technologies have health or safety risks that are not discovered until after people have used them. 9. New technology makes it too easy for government and companies to spy on people. 10. Technology always seems to fail at the worst possible time.

Innovativeness	Insecurity
<ol style="list-style-type: none"> 1. Other people come to you for advice on new technologies. 2. It seems your friends are learning more about the newest technologies than you. (Reverse Scored) 3. In general, you are among the first in your circle of friends to acquire new technology when it appears. 4. You can usually figure out new high-tech products and services without help from others. 5. You keep up with the latest technological development in your areas of interest. 6. You enjoy the challenge of figuring out high-tech gadgets. 7. You find you have fewer problems that other people in making technology work for you. 	<ol style="list-style-type: none"> 1. You do not consider it safe giving out a card number over a computer. 2. You do not consider it safe to do any kind of financial business online. 3. You worry that information you send over the Internet will be seen by other people. 4. You do feel confident doing business with a place that can only be reached online. 5. Any business transaction you do electronically should be confirmed later with something in writing. 6. Whenever something gets automated, you need to check carefully that the machine or computer is not making mistake. 7. The human touch is very important when doing business with a company. 8. When you call a business, you prefer to talk to a person rather than a machine. 9. If you provide information to a machine or over the Internet, you can never be sure it really gets to the right place.

(Source: Parasuraman, 2000)

2.5 Technology Readiness and Acceptance Model

Lin et al. (2007) proposed the TRAM (Technology Readiness and Acceptance Model) which integrates Technology Readiness and TAM (Technology Acceptance Model). TRAM has a better explanation for e-service. The research considered that Technology Readiness provided a framework for users' tendency to use the technology, but it couldn't explain the acceptance behavior for the technology products and system. Therefore, TRAM was proposed for the using intention of for e-service.

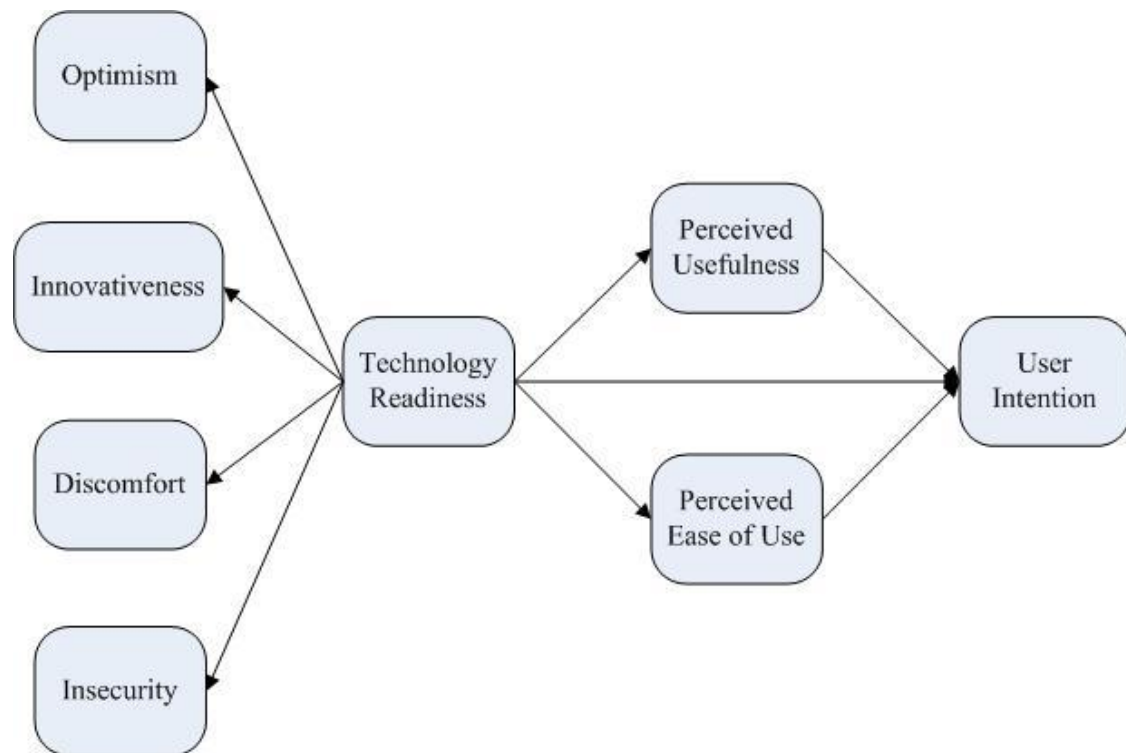
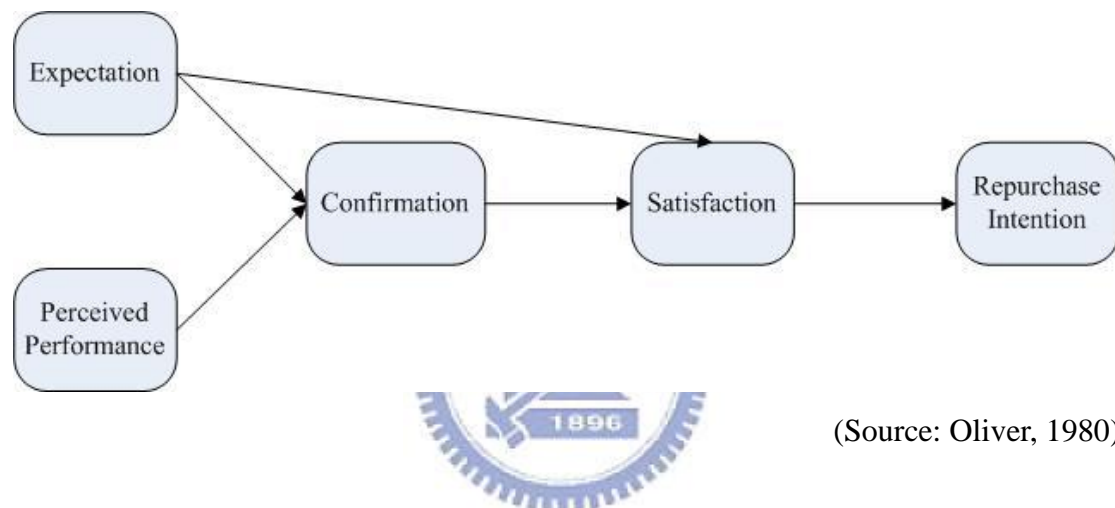


Figure 12 Technology Readiness and Acceptance Model

2.6 Expectation-Confirmation Theory and Post-Acceptance Model

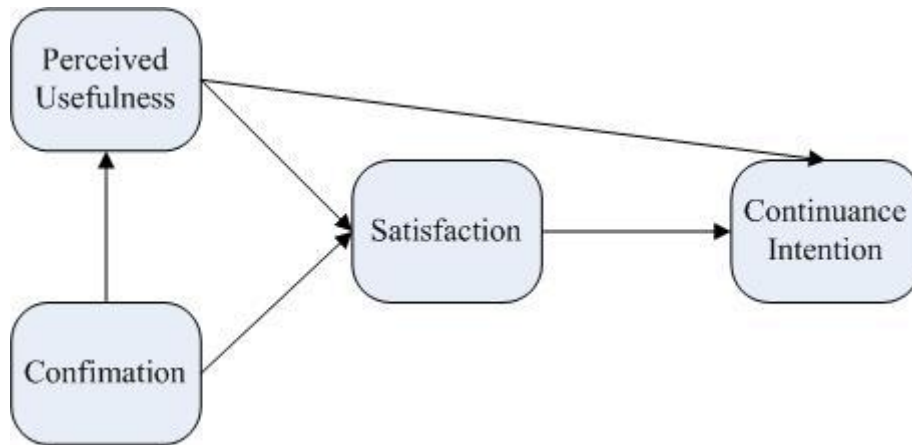
To understand the repurchase intention for the users, Oliver (1980) presented Expectation-Confirmation Theory (ECT). The theory noted that the satisfaction comes from the confirmation which is the comparison between the expectation and the perceived performance of the consumers. The satisfaction also affects the repurchase intention of the consumers. The research model is shown as follows:



(Source: Oliver, 1980)

Figure 13 Expectation-Confirmation Theory

Bhattacharjee (2001) indicated Expectation-Confirmation Theory has considered the consumer's expectation before the purchasing, but lack of the expectation after the purchasing, especially for the information system. Thus, Bhattacharjee proposed Post-Acceptance Model which includes the expectation after the purchasing and the perceived usefulness from TAM to discuss the Continuance Intention (CI) of the consumer.



(Source: Bhattacharjee, 2001)

Figure 14 Post-Acceptance Model



2.7 Summary

A fairly large body of literature exists on the technology acceptance behavior. However, within that literature there is a surprising lack of information on the linking between expectation /satisfaction and the behavior intention. And common sense of NFC seems to indicate its importance, but we lack empirical support. Therefore, in the research, we combined UTAUT, TR, and Post-Acceptance Model and proposed an integrated model for the technology in the emergence period. The research applied in NFC technology to provide the holistic view for its business model.

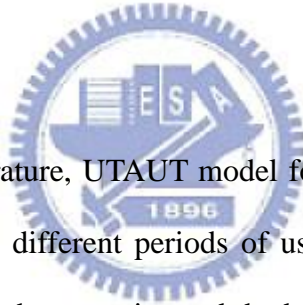


3. Method

In this study, we use the following two quantitative methodologies, Structural Equation Modeling (SEM) and Decision Making Trial and Evaluation Laboratory (DEMATEL). In order to evaluate the business model of NFC technology and mobile services, the two quantitative methods can execute the holistic evaluation based on the opinions of consumers and experts simultaneously. Then, we can get the integral business model and is helpful to the strategies making.

3.1 Structural Equation Modeling Methodology

3.1.1 Research Model



Based on the reviewed literature, UTAUT model focused on the acceptance of the technology and compared the different periods of using the technology. It provides more than 70% explanation to the e-service and the behavior of the technology using. Thus, we used UTAUT model as the main component of the research model. But UTAUT model didn't discuss the user's tendency for the technology or system. According to TRAM model, it has the better explanation of e-service based on the users' tendency and acceptance. But the TRAM model didn't contain the social influence, facilitating condition and other factors in UTAUT. To evaluate the business model of NFC technology and NFC mobile services based on the users' view, we integrated UTAUT and Technology Readiness based on TRAM model.

In the research model, we also integrated the post-acceptance model. The post-acceptance model proposed the evaluative factors, such as satisfaction and continuance intention, to understand the expectation of the users. For the technology

in the emergence period, such as NFC, the expectation satisfaction and continuance intention are important to establish the business model and make the business strategy. Therefore, we contained the post-acceptance model in our research model.

NFC is the technology in the emergence period. Based on NFC technology, more mobile services are provided to the users with the consumer electronics. In the emergence period, the business model of NFC mobile services is not exact and needs more analysis from the different aspects, such as the acceptance, the behavioral intention, the technology tendency, the expectation satisfaction, the facilitating condition and so forth. Therefore, the theoretical research architecture in this paper needs to be confirmed and modified through empirical evidence.

According to the research background and the reviewed literature, the theoretical research architecture is as following figure.

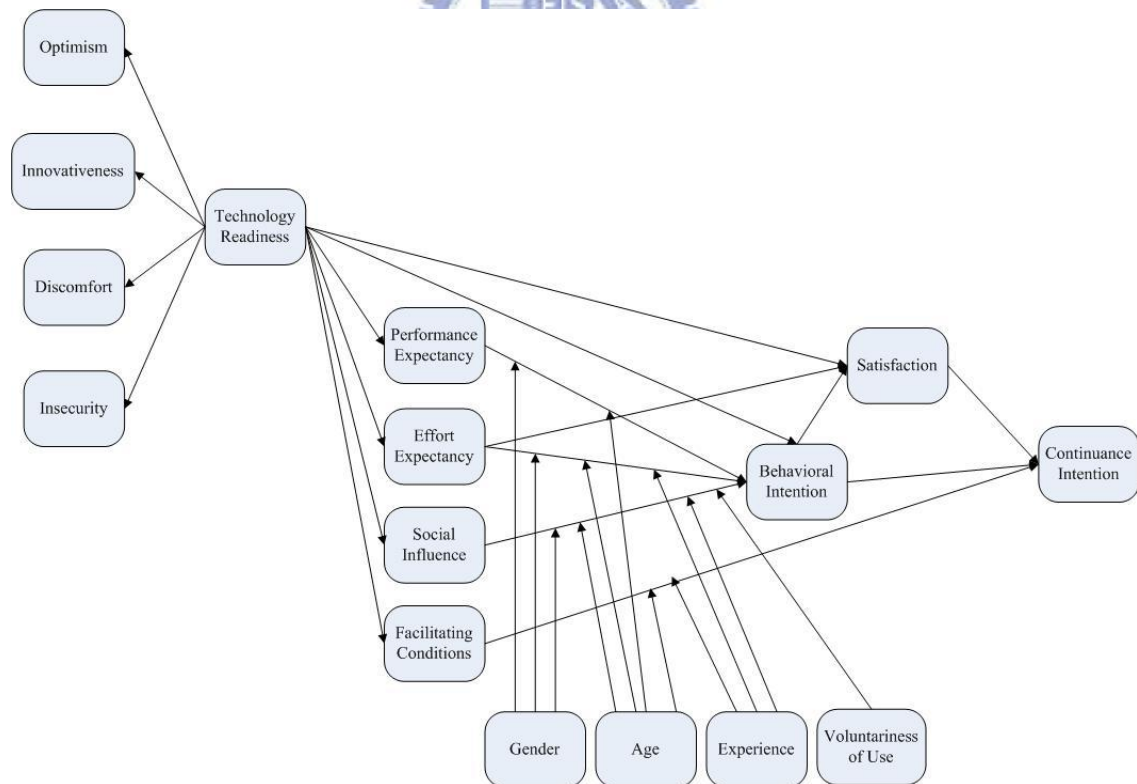


Figure 15 Theoretical Research Framework

The following figure is the theoretical research architecture with hypothesis. Because the paper integrated three models, included UTAUT, TR (Technology Readiness), and Post-Acceptance Model. Thus, the research had to test all the casual relationship in the theoretical research architecture.

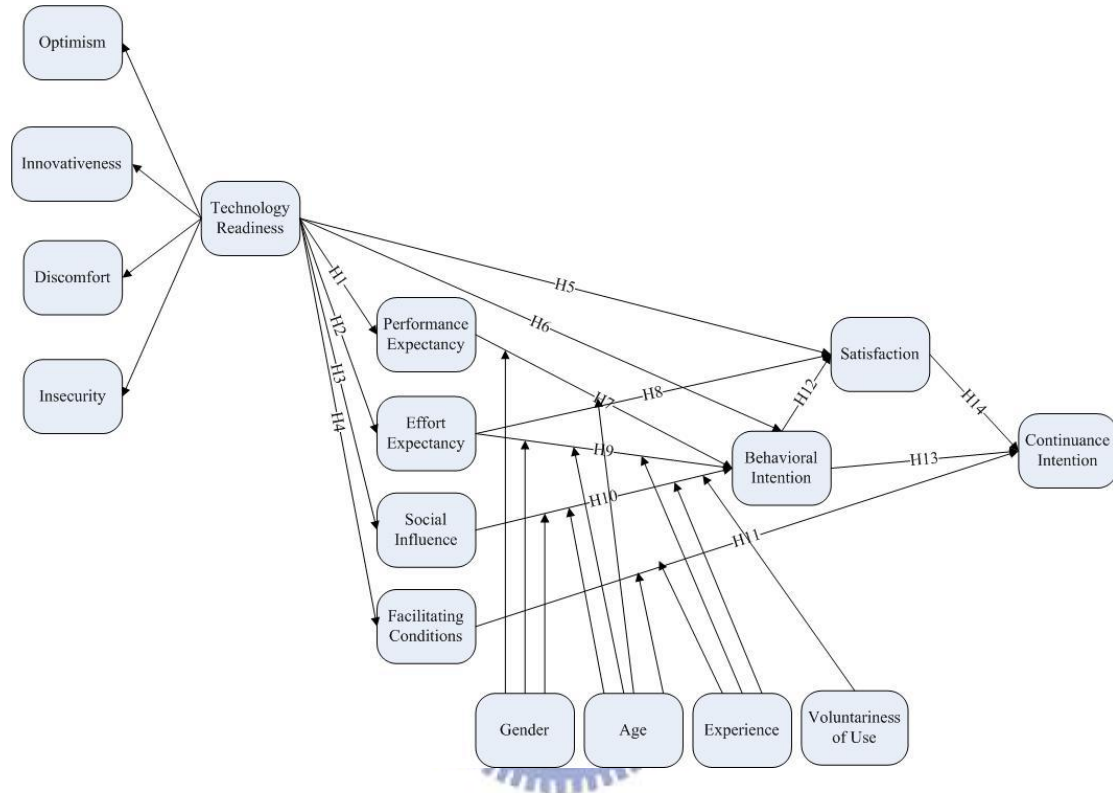


Figure 16 Theoretical Research Framework with Hypothesis

The hypothesis of the research is listed as follow:

H1: Technology Readiness has the positive influence on Performance Expectancy.

In TRAM model, the construct of technology readiness has the positive influence on perceived usefulness. In UTAUT model, the construct of performance expectancy contained the construct of perceived usefulness. Thus, the research tested the hypothesis in the theoretical research architecture.

H2: Technology Readiness has the positive influence on Effort Expectancy.

In TRAM model, the construct of technology readiness has the positive influence on perceived ease of use. In UTAUT model, the construct of effort expectancy contained the construct of perceived ease of use. Thus, the research tested the hypothesis in the theoretical research architecture.

H3: Technology Readiness has the positive influence on Social Influence.

The casual relationship between the construct of technology readiness and the construct of social influence was not discussed in the literature. The research tested the hypothesis in the theoretical research architecture.

H4: Technology Readiness has the positive influence on Facilitating Conditions.

The casual relationship between the construct of technology readiness and the construct of facilitating conditions was not discussed in the literature. The research tested the hypothesis in the theoretical research architecture.

H5: Technology Readiness has the positive influence on Satisfaction.

The casual relationship between the construct of technology readiness and the construct of satisfaction was not discussed in the literature. The research tested the hypothesis in the theoretical research architecture.

H6: Technology Readiness has the positive influence on Behavioral Intention.

The casual relationship between the construct of technology readiness and the construct of behavioral intention was not discussed in the literature. The research tested the hypothesis in the theoretical research architecture.

H7: Performance Expectancy has the positive influence on Behavioral Intention.

In UTAUT model, the construct of performance expectancy has the positive influence on the construct of behavioral intention. The research tested the hypothesis

in the theoretical research architecture.

H8: Effort Expectancy has the positive influence on Satisfaction.

The casual relationship between the construct of effort expectancy and the construct of satisfaction was not discussed in the literature. The research tested the hypothesis in the theoretical research architecture.

H9: Effort Expectancy has the positive influence on Behavioral Intention.

In UTAUT model, the construct of effort expectancy has the positive influence on the construct of behavioral intention. The research tested the hypothesis in the theoretical research architecture.

H10: Social Influence has the positive influence on Behavioral Intention.

In UTAUT model, the construct of social influence has the positive influence on the construct of behavioral intention. The research tested the hypothesis in the theoretical research architecture.

H11: Facilitating Conditions has the positive influence on Continuance Intention.

In UTAUT model, the construct of facilitating conditions has the positive influence on the construct of use behavior. But NFC technology is in the emergence period, so the data of use behavior is lack. The research adopted the construct of continuance intention in post-acceptance model substituted for the construct of use behavior. The research tested the hypothesis in the theoretical research architecture.

H12: Behavioral Intention has the positive influence on Satisfaction.

The casual relationship between the construct of behavioral intention and the construct of satisfaction was not discussed in the literature. The research tested the hypothesis in the theoretical research architecture.

H13: Behavioral Intention has the positive influence on Continuance Intention.

In UTAUT model, the construct of behavioral intention has the positive influence on the construct of use behavior. But NFC technology is in the emergence period, so the data of use behavior is lack. The research adopted the construct of continuance intention in post-acceptance model substituted for the construct of use behavior. The research tested the hypothesis in the theoretical research architecture.

H14: Satisfaction has the positive influence on Continuance Intention.

In post-acceptance model, the construct of satisfaction has the positive influence on the construct of continuance intention. The research tested the hypothesis in the theoretical research architecture.

Gender, Age, Experience, and Voluntariness of use are the moderators.

In UTAUT model, the moderators, such as gender, age, experience, and voluntariness of use, have the moderation effect to the model. The research tested the moderation effect in the theoretical research architecture.

3.1.2 Research Design

According to the research architecture in this research, the scale consists of 75 items and is divided into four parts, included the technology acceptance evaluation, the technology readiness evaluation, the actual using evaluation, and the basic data. The scale consisted of three theories, included UTAUT, TR, and Post-Acceptance Model.

In UTAUT model, the behavior intention construct was designed for investing the using intention in the different time period. Thus, the research revised the items based on the items in TAM. The use behavior construct in UTAUT is also not considered in the research; because of the NFC technology is in the emergence period. So the construct is not appropriate for NFC technology. Thus, in the research we used continuance intention construct based on the Post-Acceptance Model to understand the expected intention.

The UTAUT model evaluates the using behavior based on comparing the different using periods. As discussed above, NFC technology is in the emergence period. So the research made the analysis about one period in the emergence period.

The scale uses 7-point Likert-type scale.

3.1.3 Analytical methods

Following Anderson and Gerbing (1998), the hypotheses were tested using a two-stage structural equation model. First, Confirmatory Factor Analysis (CFA) evaluated reliability and validity. Second, a path analysis was performed for testing the hypotheses. The past-analytic procedure has become popular for studies where a small sample size restricts the use of full structural equation models.

3.1.4 Pre-Test

To improve the quality and the validity of the scale, the paper uses the small sample for the pre-test. To prevent the misunderstanding of translation, the research interviewed the people who had the experience in NFC or mobile services, and modified the expression of the items.

The pretesting studies a total of 155 questionnaires were issued, recovering valid questionnaires 145 shares and the rate of return was 93.5%. The pretesting used IBM SPSS Statistics 21 software to analysis the responded questionnaires.

In the reliability, the paper used Cronbach's α value to test the internal consistency. The Cronbach's α value was 0.918. It meant the scale corresponded the internal consistency.

3.1.5 Sampling and respondents

The primary research subjects were people who use the mobile phones in Taiwan. In order to collect more sampling, the questionnaires were issued on MySurvey web. The information was also issued in the bbs forum (ptt.twbbs.cc) and Facebook.

The paper received a total of 800 questionnaires from MySurvey web. The collecting period was from 2013/05/28 to 2013/06/13. Of these, 33 questionnaires were deleted because the respondents gave “non-applicable” answer to the majority of the questions. The final number of responses was thus 767 valid questionnaires, corresponding to a valid return rate of 95.88%.



3.2 DEMATEL Methodology

3.2.1 DEMATEL Methodology Introduction

Decision Making Trial and Evaluation Laboratory (DEMATEL) was developed by Battelle Geneva Institute in 1971 A.D. It is used to analyze the complex world problems dealing mainly with interactive man-model techniques and evaluate qualitative and factor-linked aspects of societal problems (Gabus & Fontela, 1972). The application is widespread, included industrial planning and decision-making to urban planning and design, regional environmental assessment, analysis of world problems, and so on. This paper uses DEMATEL not only to detect complex relationships but also to obtain the influence levels of each element to make the decision.

Hall (1969) proposed a system engineering method by three-dimension structure. The study emphasized the activity of system engineering included seven stages and seven logic steps. DEMATEL is one of the seven steps. It reduced the completed question to several relative and simpler criteria. The criteria become the cause and effect group, in order to better understand causal relationships. The criteria should satisfy the following assumptions:

- (1) Clarify the character of the problem: It is important to clarify the character of the problem in the planning stage to setup the problem correctly.
- (2) Clarify the relationship among the problems: Using 0~4 to express the relationship between criteria.
- (3) Understand the nature of the criteria: Describe the nature of the criteria after analysis.

The DEMATEL method is based upon graph theory, enabling us to plan and solve problems visually. Directed graphs (also called digraphs) are more useful than directionless graphs, because digraphs will demonstrate the directed relationships of sub-systems. A digraph typically represents a communication network, or a domination relationship between individuals. Supposed a system contains a set of elements, $S = \{s_1, s_2, \dots, s_n\}$, and particular pair-wise relationships are determined for modeling, with respect to a mathematical relationship, MR. Next, portray the relationship MR as a direct-relation matrix that is indexed equally in both dimensions by elements from the set S. Then, extract the case for which the number 0 appears in the cell (i, j), if the entry is a positive integral that has the meaning of: the ordered pair (s_i, s_j) is in the relationship MR; it has the kind of relationship regarding that element such that s_i causes element s_j . The digraph portrays a contextual relationship between the elements of the system, in which a numeral represents the strength of influence, as shown in following Fig. The elements $s_1, s_2, s_3,$ and s_4 represent the factors that have relationships. The number between factors is influence or influenced degree. The DEMATEL method can convert the relationship between the causes and effects of criteria into an intelligible structural model of the system (Chiu et al., 2006).

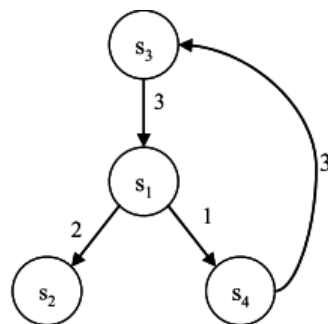


Figure 17 An example of the directed graph

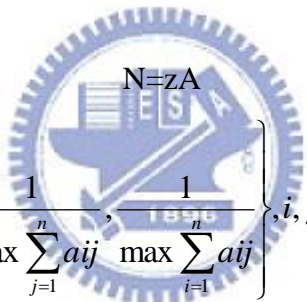
Definition 1: The pair-wise comparison scale may be designated as eleven levels, where the scores 0,1,2,...,10 represent the range from ‘no influence’ to ‘very high

influence'.

Definition 2: The initial direct relation/influence matrix A is an $n \times n$ matrix obtained by pair-wise comparisons, in terms of influences and directions between the determinants, in which a_{ij} is denoted as the degree to which the i th determinant affects the j th determinant.

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix}$$

Definition 3 The normalized direct relation/influence matrix N can be obtained through the following equation, in which all principal diagonal elements are equal to zero.



$N = zA$

$$z = \min \left\{ \frac{1}{\max \sum_{j=1}^n a_{ij}}, \frac{1}{\max \sum_{i=1}^n a_{ij}} \right\}, i, j \in \{1, 2, \dots, n\}.$$

In this case, N is called the normalized matrix. Since $\lim_{\epsilon \rightarrow \infty} N^\epsilon = [0]$.

Definition 4: Then, the total relationship matrix T can be obtained using the following equation, where I stands for the identity matrix. $T = N + N^2 + \dots + N^\epsilon = N(I - N)^{-1}$, where T is a total influence-related matrix; N is a direct influence matrix and $N = [x_{ij}]_{n \times n}$.

Definition 5: The row and column sums are separately denoted as r and c within the total-relation matrix T through the following equations.

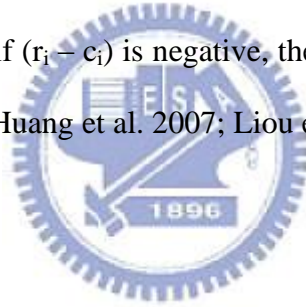
$$T = [t_{ij}] \quad i, j \in \{1, 2, \dots, n\}$$

$$r = [r_i]_{n \times 1} = \left(\sum_{j=1}^n t_{ij} \right)_{n \times 1}$$

$$c = [c_j]_{1 \times n} = \left(\sum_{i=1}^n t_{ij} \right)_{1 \times n}$$

Where the r and c vectors denote the sums of the rows and columns, respectively.

Definition 6: Suppose r_i denotes the row sum of the i th row of matrix T . Then, r_i is the sum of the influences dispatching from factor i to the other factors, both directly and indirectly. Suppose that c_j denotes the column sum of the j th column of matrix T . Then, c_j is the sum of the influences that factor i is receiving from the other factors. Furthermore, when $i=j$, $(r_i + c_i)$ is the degree of the central role and factor i plays in the problem. If $(r_i - c_i)$ is positive, then factor i primarily is dispatching influence upon the strength of other factors; and if $(r_i - c_i)$ is negative, then factor i primarily is receiving influence from other factors (Huang et al. 2007; Liou et al. 2007; Tamura et al. 2002).



3.2.2 Research Design

The questionnaire design of DEMATEL was based on the four constructs of STOF business model, included service, information, finance, and organization. The criteria of the constructs are based on the criteria of the four constructs and revised by the experts in NFC field to design the questionnaire. The construct and criteria is shown as follows:

Table 6 Description Statistics

Construct	Criteria
Service	S1: Customer Segmentation S2: Ease of Use S3: Pricing S4: Service Offering
Finance	F1: Revenue and cost F2: Risk F3: Resource
Information	I1: Security I2: Authentication I3: Application I4: Technological Architecture
Organization	O1: Value network O2: Collaborative strategies of the partners O3: Capabilities of the partners

The questionnaire consists of the four main parts, included the importance of the criteria, the compare effect between the criteria, the fuzzy scale invention, and the basic data. The paper used 0~4 scales to represent the important degree. 4 means strongly affect, and 0 means no affect.

4. Discussion

In this chapter, we divided the following sections to discuss. In the first section, we used Structural Equation Modeling methodology to test the research framework. In the second section, we used DEMATEL methodology to establish the relationship graph based on the experts' opinion. In the third section, we analyzed the results from the statistics test and the relationship graph.

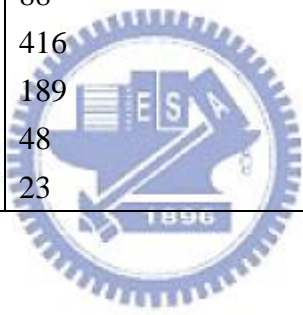
4.1 Structural Equation Modeling

4.1.1 Description Statistics

The structure of the sample was sufficiently diverse and heterogeneous. In terms of gender, 502 (65.45%) were male, and 265 (34.55%) were female. In terms of using NFC mobile service, 470 (61.28%) had never used NFC mobile services, and 297 (38.72%) had used NFC mobile services. In terms of education, 380 (49.54%) were bachelor degree, 273 (35.60%) were master and PhD degree, and 114 (14.86%) were high school degree. In term of age, 416 (54.23%) were 26~35 years old, 189 (24.64%) were 36~45 years old, 88 (11.47%) were 18~25 years old, 48 (6.26%) were 46~55 years old, 23 (3.00%) were more than 56 years old, and 3 (0.40%) were less than 18 years old.

Table 7 Description Statistics

Variable	Number	Percentage
Gender		
Male	502	65.45%
Female	265	34.55%
Using NFC mobile service		
Yes	297	38.72%
No	470	61.28%
Education		
Bachelor degree	380	49.54%
Master and PhD degree	273	35.60%
High school degree	114	14.86%
Age		
Less than 18 years old	3	0.40%
18~25 years old	88	11.47%
26~35 years old	416	54.23%
36~45 years old	189	24.64%
46~55 years old	48	6.26%
More than 56 years old	23	3.00%



4.1.2 Reliability and Validity Analysis

The following tables are evaluating results for the reliability and validity by Confirmatory Factor Analysis.

Table 8 Reliability and Validity Analysis

Constructs	Item-construct loading		Cronbach's alpha	AVE
	Standardized	t-value		
Performance Expectancy				
PE1	0.61	29.80	0.86	0.70
PE2	0.63	29.82		
PE3	0.64	5.53		
PE4	0.61	19.71		
Effort Expectancy				
EE1	0.63	7.22	0.87	0.769
EE2	0.68	27.96		
EE3	0.71	29.91		
EE4	0.64	26.90		
Social Influence				
SI1	0.93	34.71	0.94	0.847
SI2	0.86	32.99		
SI3	0.81	20.65		
SI4	0.71	19.92		
Facilitating Conditions				
FC1	0.74	27.87	0.77	0.741
FC2	0.82	31.53		
FC3	0.63	25.70		
FC4	0.60	22.94		
Behavioral Intention				
BI1	0.60	25.10	0.86	0.729
BI2	0.68	23.29		
BI3	0.83	30.46		

Satisfaction				
SA1	0.83	30.02	0.86	0.839
SA2	0.72	34.97		
SA3	0.91	31.47		
SA4	0.90	31.95		
Continuance Intention				
CI1	0.60	25.47	0.76	0.652
CI2	0.61	25.15		
CI3	0.93	30.00		

Table 9 Reliability and Validity for Technology Readiness

Construct	Factor Loading	Cronbach's alpha	AVE
Technology Readiness		0.823	0.501
Optimism	0.749	0.859	
Innovativeness	0.757	0.858	
Discomfort	0.600	0.667	
Insecurity	0.710	0.785	

4.1.2.1 Reliability Analysis

An inspection of the values of Cronbach's alpha revealed that all the constructs were greater than 0.70, indicating acceptable reliability. These results supported the unidimensionality of the scales.

4.1.2.2 Validity Analysis

(1) Content Validity

All the constructs and the items are based on the literature. The research revised the content to avoid the misunderstanding in the translation. Thus, the scale has satisfied the content validity.

(2) Convergent Validity

Convergent validity can be assessed by determining whether the estimated coefficient of each indicator on its proposed underlying construct is significant (greater than twice its standard error). Convergent validity can also be assessed by the factor loading and Average Variances Extracted (AVE) value. If the factor loading is more than 0.6, then the convergent validity is significant (Hair et al., 1998). If the AVE is more than 0.5, then the convergent validity is significant (Fornell and Lacker, 1981).

In the table 8 and 9, examination of indicator loadings that all factor loadings were more than 0.6, all AVE values were more than 0.5, and all Cronbach's alpha values are more than 0.7. The results show the scale has good convergent validity and internal consistency.

(3) Discriminant Validity

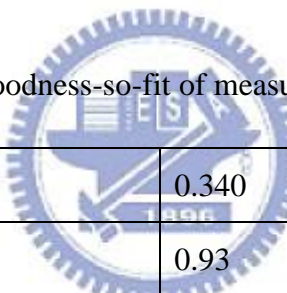
The common test of discriminant validity is that the confidence interval around the correlation between any two latent construct is less than 1 (Smith & Barclay, 1997). None of the correlations between latent constructs reached 1. A more conservative test of discriminant validity involves comparison of model values that either free or constrain the phi value to a value of 1, then test whether the constraint causes a significant decrease in fit (Bagozzi, 1992). Again, in all cases the overall fits were significantly diminished by constraint of the correlation to 1. Therefore, the discriminant validity was acceptable for the measurement model.

4.1.3 Measurement Model

The proposed model was analyzed using LISREL 8.8. Result revealed reasonable overall fit between the model and the observed data. CFAs were applied to establish construct validity. The overall fit was $\chi^2/df= 3.440$, GFI = 0.93, CFI = 0.96, NFI= 0.94, RMSEA=0.093, RMR=0.04, p=0.00.

The value of χ^2/df is between 1 and 5 (Carmines and Mciver, 1981). GFI, NFI, and CFI exceed the recommended 0.90 threshold levels. In addition, RMSEA is lower than 0.80 as recommended by Hair et al (1998). RMR is lower than 0.05 and 0.08 as recommended by Bagozzi and Yi (1988). The fit values satisfied the recommended standard. The overall fit is shown as follows.

Table 10 Goodness-so-fit of measurement model



χ^2/df	0.340
GFI	0.93
CFI	0.96
NFI	0.94
RMSEA	0.093
RMR	0.04
p	0.000

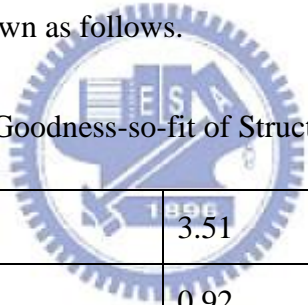
4.1.4 Hypothesis testing

4.1.4.1 Structural model

The following table presents the overall model fit and the test of each hypothesis. As shown, the results of path analysis indicated an adequate fit: $\chi^2/df = 3.51$, GFI= 0.92, CFI= 0.94, NFI= 0.93, RMSEA= 0.064, RMR=0.033, p= 0.011.

The value of χ^2/df is between 1 and 5 (Carmines and Mciver, 1981). GFI, NFI, and CFI exceed the recommended 0.90 threshold levels. In addition, RMSEA is lower than 0.80 as recommended by Hair et al (1998). RMR is lower than 0.05 and 0.08 as recommended by Bagozzi and Yi (1988). The fit values satisfied the recommended standard. The overall fit is shown as follows.

Table 11 Goodness-so-fit of Structural model



χ^2/df	3.51
GFI	0.92
CFI	0.94
NFI	0.93
RMSEA	0.064
RMR	0.033
p	0.011

The test of the hypotheses is shown as follows.

Table 12 Testing Results

Causal path	Hypothesis	Expected sign	Coefficient	t-value	Assessment
Technology Readiness → Performance Expectancy	H1	+	0.30**	3.3	Significant
Technology Readiness → Effort Expectancy	H2	+	0.53**	9.6	Significant
Technology Readiness → Social Influence	H3	+	0.48**	5.6	Significant
Technology Readiness → Facilitating Conditions	H4	+	0.13**	3.3	Significant
Technology Readiness → Satisfaction	H5	+	0.08	0.96	Non-significant
Technology Readiness → Behavioral Intention	H6	+	0.11	1.35	Non-significant
Performance Expectancy → Behavioral Intention	H7	+	0.46***	10.13	Significant
Effort Expectancy → Satisfaction	H8	+	0.51**	17.41	Significant
Effort Expectancy → Behavioral Intention	H9	+	0.62**	12.2	Significant
Social Influence → Behavioral Intention	H10	+	0.18**	3.5	Significant
Facilitating Conditions → Continuance Intention	H11	+	0.34**	5.79	Significant
Behavioral Intention → Satisfaction	H12	+	0.66**	12.82	Significant
Behavioral Intention → Continuance Intention	H13	+	0.87***	17.41	Significant
Satisfaction → Continuance Intention	H14	+	0.53***	14.7	Significant

Note: *p<0.05 **p<0.01 ***p<0.001

The testing result suggests technology readiness has no direct effect to satisfaction and behavioral intention construct. The research model, TRAUM (Technology Readiness Acceptance and Use Model) is shown as following figure.

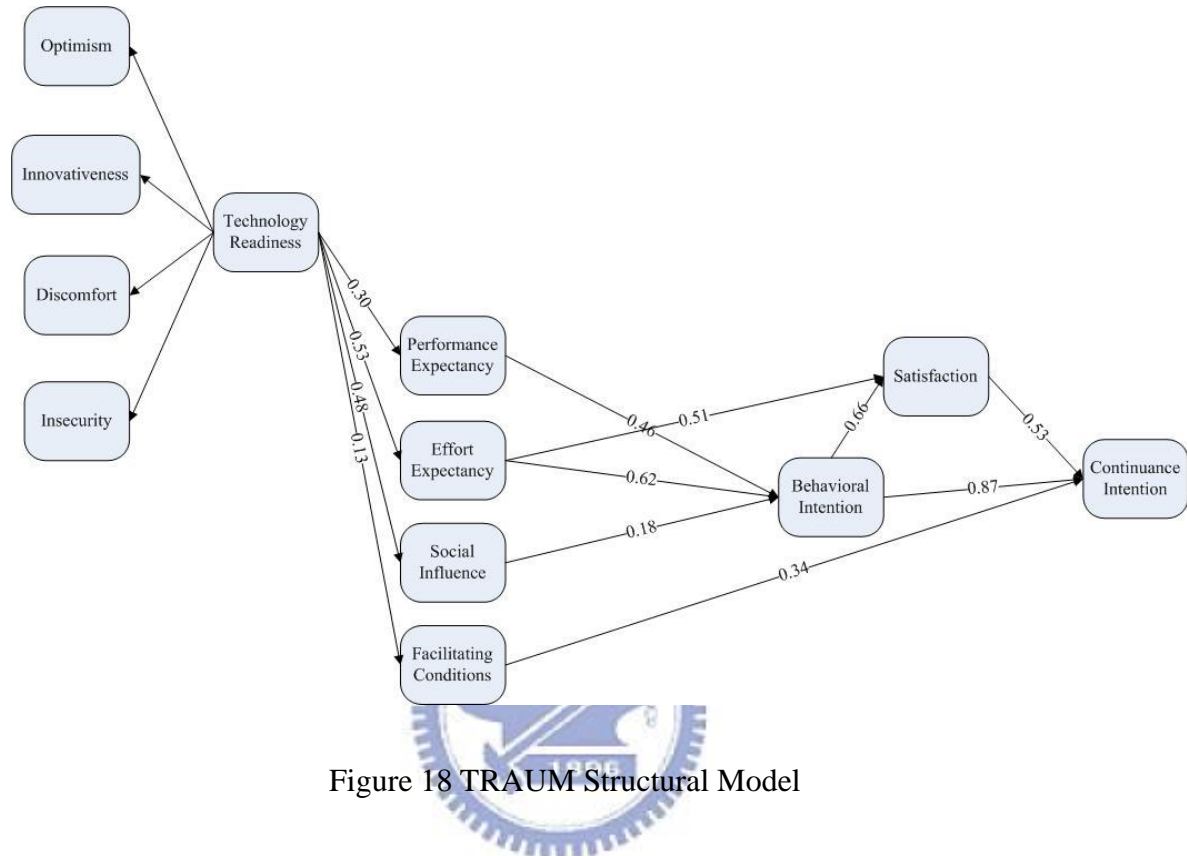


Figure 18 TRAUM Structural Model

H5 (Technology Readiness → Satisfaction) was not supported in the test. For the technology and e-services in the emergence period, like NFC technology and NFC mobile services, the users usually have the conservative expectant satisfaction with the technology and e-services. Users with the characteristics of technology readiness, such as optimism, innovativeness, discomfort, and insecurity, tend to consistency of the expectant satisfaction and have no significance on the construct of satisfaction. Thus, the hypothesis was not supported in the test.

H6 (Technology Readiness → Behavioral Intention) was not supported in the test. For the technology and e-services in the emergence period, the users always keep the conservative view of behavioral intention on them. Users with the characteristics of technology readiness, such as optimism, innovativeness, discomfort, and insecurity,

tend to have no significance on the construct of behavioral intention. Thus, the hypothesis was not supported in the test.

The most consumers always keep the conservative attitude on the new technology and e-services based on product life cycle theory. Thus, in the emergence period, the lack of the information about the technology and e-services is the key factor of the intention and expectant satisfaction. Thus, the enterprise should put more resource in promoting the technology and e-services in the emergence period. The strategy can strengthen the expectant attitude of the consumers and is helpful to the promotion.



4.1.4.2 Moderation effect

The moderation effect was based on the UTAUT model. In this research, we proposed the moderation effect to the structural model, included gender, age, experience, and voluntariness of use.

In the following analysis, we used Analysis of variance (ANOVA), T-test, and regression to test the moderation effect in the research model.

(1) Gender Moderation Effect

The structure of the subjects in gender moderation, 65.18% was male and 34.82% was female. The following table is the gender moderation effect to the three constructs, performance expectancy, effort expectancy and social influence.

Table 13 Gender Moderation Effect

	Gender	mean	S.D	F Test	Significance	Difference
Performance Expectancy	Male	14.15	1.42	12.414	0.000***	Female>male
	Female	14.67	2.67			
Effort Expectancy	Male	15.97	2.58	0.011	0.917	nonsignificant
	Female	15.96	1.69			
Social Influence	Male	19.53	3.01	13.602	0.000***	Female>male
	Female	20.36	2.90			

Note: *p<0.05 **p<0.01 ***p<0.001

For the new wireless technology, NFC, the test showed that the significant difference was between male and female. By the difference comparison, the performance expectancy in NFC technology for female was higher than the male. The female were affected by social influence more than the male.

The path coefficient from the external variables to behavioral intention is shown as follows.

Table 14 Path Coefficient with Gender Variable

Gender	Male		Female	
R ² Value	R ² = 0.537		R ² = 0.624	
	β	p	β	p
Performance Expectancy	0.181***	0.000	0.203***	0.000
Effort Expectancy	0.482***	0.000	0.038	0.076
Social Influence	0.107***	0.000	0.368***	0.000

Note: *p<0.05 **p<0.01 ***p<0.001

For the behavioral intention, the male and the female had significant effect of performance expectancy and social influence. The female had no significant effect of effort expectancy, but the male had significant effect of effort expectancy.

The structural relationship is shown as following figure. The gender variable had a significant moderation between the external variables and behavioral intention.

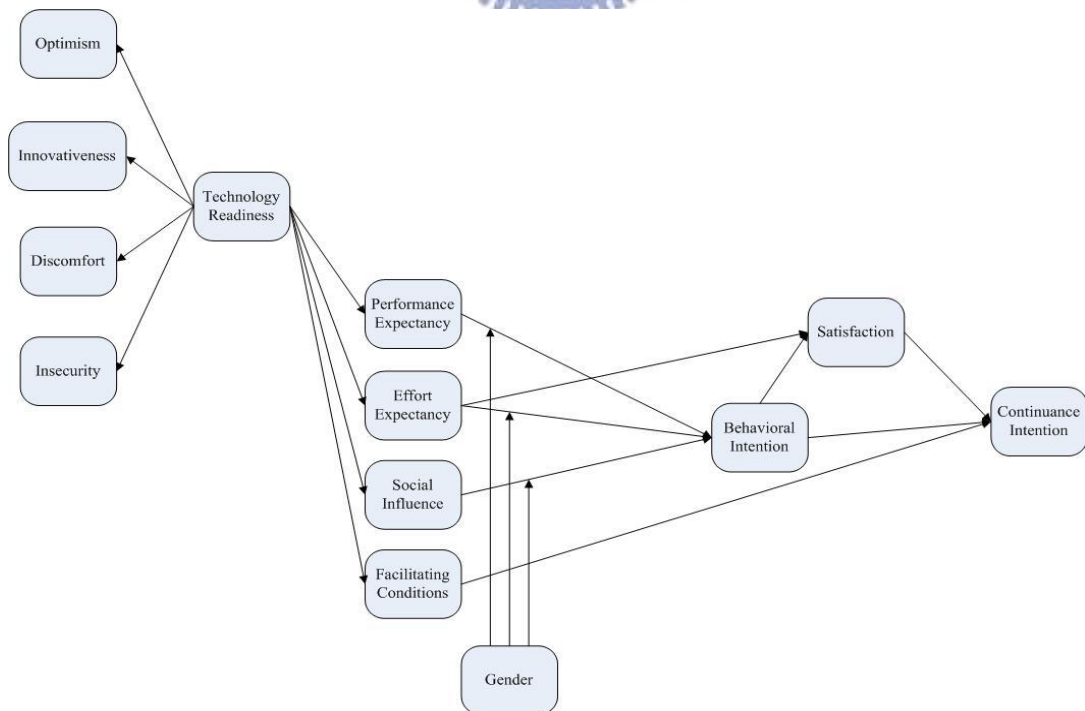


Figure 19 TRAUM with gender moderation

(2) Age Moderation Effect

The structure of the subjects in age moderation, 53.70% were 26~35 years old, 26.65% were 36~45 years old, 11.09% were 18~25 years old, 4.67% were 46~55 years old, 3.31% were more than 56 years old, and 0.58% were less than 18 years old. Because of the less population of 46~55 years old and over 56 years old, the research combined the two age level with 36~45 and named over 36 years old. The age level of less than 18 years old also combined with 18~25 years old and named less than 25 years old. The following table is the age moderation effect to the three constructs, performance expectancy, effort expectancy, social influence and facilitating condition.

Table 15 Age Moderation Effect

	Age	mean	S.D.	F Test	Significance	Difference
Performance Expectancy	(1) <25	13.78	1.37	4.601**	0.010	(3)>(2)>(1)
	(2) 26~35	14.36	2.38			
	(3) >36	14.49	1.24			
Effort Expectancy	(1) <25	15.12	2.33	8.457***	0.000	(3)>(2)>(1)
	(2) 26~35	15.96	1.61			
	(3) >36	16.27	3.08			
Social Influence	(1) <25	18.74	2.86	10.371***	0.000	(3)>(2)>(1)
	(2) 26~35	19.72	2.99			
	(3) >36	20.35	2.96			
Facilitating Condition	(1) <25	16.19	2.23	3.412*	0.033	(3)>(2)>(1)
	(2) 26~35	16.21	2.17			
	(3) >36	16.62	1.87			

Note: *p<0.05 **p<0.01 ***p<0.001

For the new wireless technology, NFC, the analysis indicated that the significant difference was among the three age groups. For the three age groups, age variable had a significant effect of the four external variables, included performance expectancy, effort expectancy, social influence, and facilitating condition. The third group (older than 36 years old) had more significant effect than others groups.

The path coefficient from the external variables to behavioral intention and continuance intention is shown as follows.

Table 16 Path Coefficient with Age Variable

Age	< 25 years		26~35 years		> 35 years	
R ² Value	R ² = 0.428		R ² = 0.560		R ² = 0.598	
	β	p	β	p	β	p
Performance Expectancy	0.671***	0.000	0.111***	0.000	0.250***	0.000
Effort Expectancy	0.145*	0.043	0.366***	0.000	0.051*	0.021
Social Influence	0.104	0.055	0.203***	0.000	0.292***	0.000
Age	< 25 years		26~35 years		> 35 years	
R ² Value	R ² = 0.303		R ² = 0.441		R ² = 0.419	
	β	p	β	p	β	p
Facilitating Condition	0.476***	0.000	0.524***	0.000	0.587***	0.000

Note: *p<0.05 **p<0.01 ***p<0.001

For the behavioral intention, the three age groups had significant effect of performance expectancy, effort expectancy and social influence. The age group 1 (younger than 25 years old) had no significant effect of social influence. The age group 1 (younger than 25 years old) and group 3 (older than 36 years old) had the minor significant effect of effort expectancy. For the continuance intention, the three age groups also had significant effect of facilitating condition.

The structural relationship is shown as following figure. The age variable had a significant moderation among the external variables and behavioral intention and continuance intention.

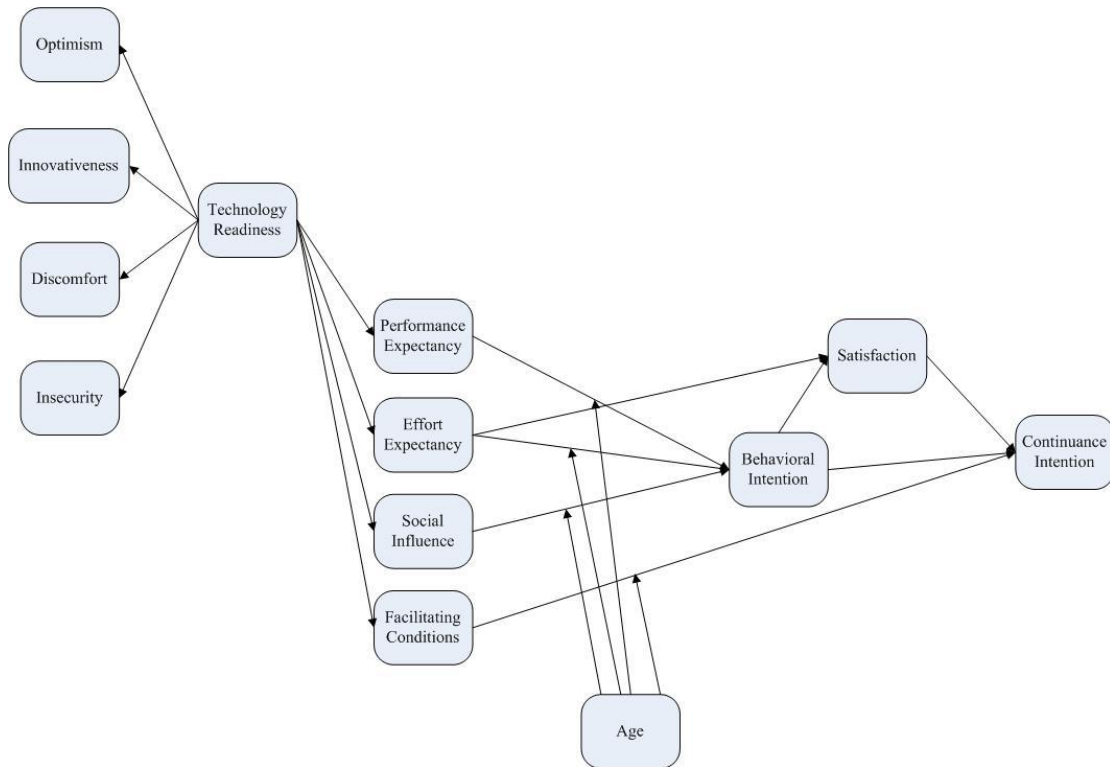


Figure 20 TRAUM with age moderation

(3) Experience Moderation Effect

The structure of the subjects in experience moderation, 35.21% had used NFC technology and 64.79% had no experience to use NFC technology. The following table is the experience moderation effect to the three constructs, effort expectancy, social influence, and facilitation condition.

Table 17 Experience Moderation Effect

	Experience	mean	S.D	F Test	Significance	Difference
Effort Expectancy	(1)No	16.31	1.20	26.642***	0.000	(1)>(2)
	(2) Yes	15.43	3.34			
Social Influence	(1)No	20.56	2.37	81.612***	0.000	(1)>(2)
	(2) Yes	18.65	3.48			
Facilitating Condition	(1)No	16.74	1.53	44.949***	0.000	(1)>(2)
	(2) Yes	15.73	2.62			

Note: *p<0.05 **p<0.01 ***p<0.001

For the new wireless technology, NFC, the test showed that the significant difference was between the experiences in using NFC technology. By the difference comparison, the group had no experience in using NFC technology was more significant than had experiences.

The path coefficient from the external variables to behavioral intention is shown as follows.

Table 18 Path Coefficient with Experience Variable

Experience	Yes		No	
R ² Value	R ² = 0.522		R ² = 0.366	
	β	p	β	p
Effort Expectancy	0.123***	0.000	0.381***	0.000
Social Influence	0.318***	0.000	0.222***	0.000
Experience	Yes		No	
R ² Value	R ² = 0.400		R ² = 0.351	
	β	p	β	p
Facilitating Condition	0.511***	0.000	0.498***	0.000

Note: *p<0.05 **p<0.01 ***p<0.001

For the behavioral intention, the experiences had significant effect of effort expectancy and social influence. For the continuance intention, the experiences had significant effect of facilitating condition.

The structural relationship is shown as following figure. The experience variable had a significant moderation among the external variables, behavioral intention and continuance intention.

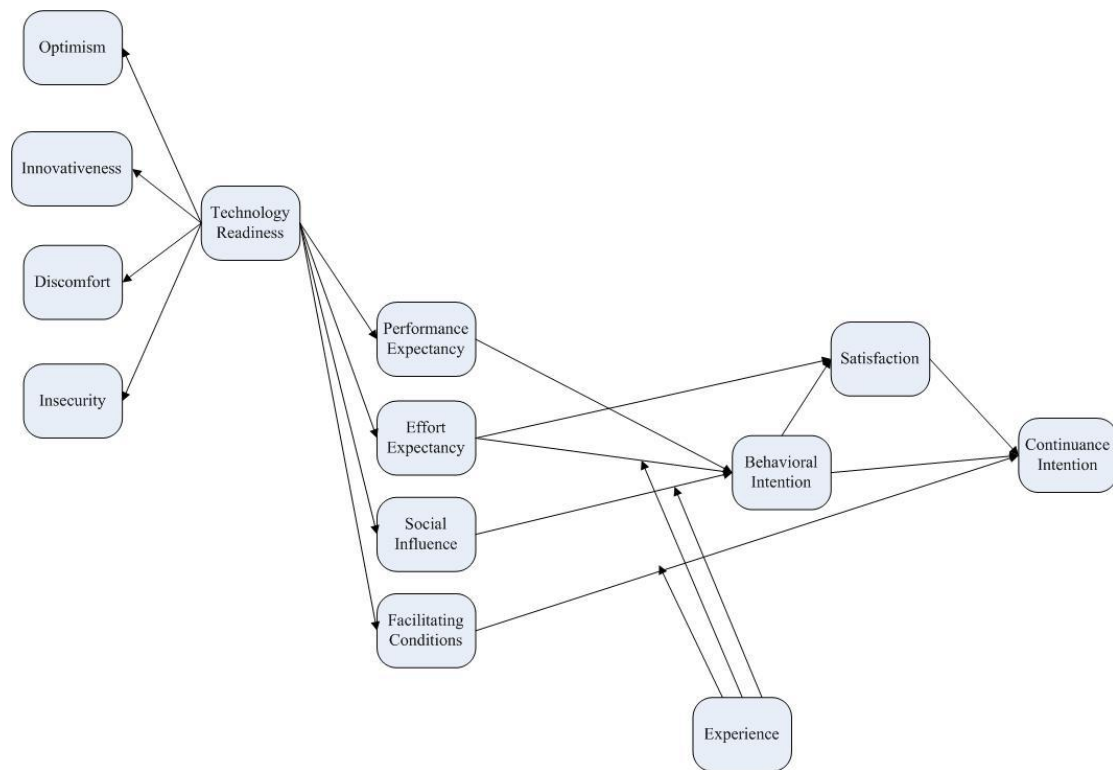


Figure 21 TRAUM with experience moderation

(4) Voluntariness of using Moderator

According to the structure of the valid sample, the voluntariness of using contained seven levels: (1) 45.72% was mostly agree; (2) 37.74% was agree; (3) 9.14% was minor agree; (4) 5.45% was normal; (5) 0.97% was minor disagree; (6) 0.39 was disagree; (7) 0.58% was mostly disagree. In order to simplify the research, we combined (1) and (2) as high voluntariness, (3), (4), and (5) as middle voluntariness, (6) and (7) as low voluntariness. The following table is the voluntariness of using moderation effect to the social influence constructs.

Table 19 Voluntariness of using Moderation Effect

	Voluntariness	mean	S.D	F Test	Significance	Difference
Social Influence	(1) high	3.04	0.75	10.345***	0.000	(1)>(2)>(3)
	(2) middle	2.73	0.71			
	(3) low	2.35	0.72			

Note: *p<0.05 **p<0.01 ***p<0.001

For the new wireless technology, NFC, the test showed the significant difference was among the groups of voluntariness of using NFC technology in social influence

The path coefficient from the external variables to behavioral intention is shown as follows.

Table 20 Path Coefficient with Voluntariness of using Variable

Voluntariness of using	(1) high		(2) middle		(3) low	
R ² Value	R ² = 0.417		R ² = 0.442		R ² = 0.585	
	β	p	β	p	β	p
Social Influence	0.451**	0.009	0.147	0.144	-0.080	0.716

Note: *p<0.05 **p<0.01 ***p<0.001

For the behavioral intention, the voluntariness of using had significant effect of social influence. The value of β means the understand degree in the construct. The high voluntariness group had significant effect of social influence.

The structural relationship is shown as following figure. The voluntariness of using variable had a significant moderation between the external variables and behavioral intention.

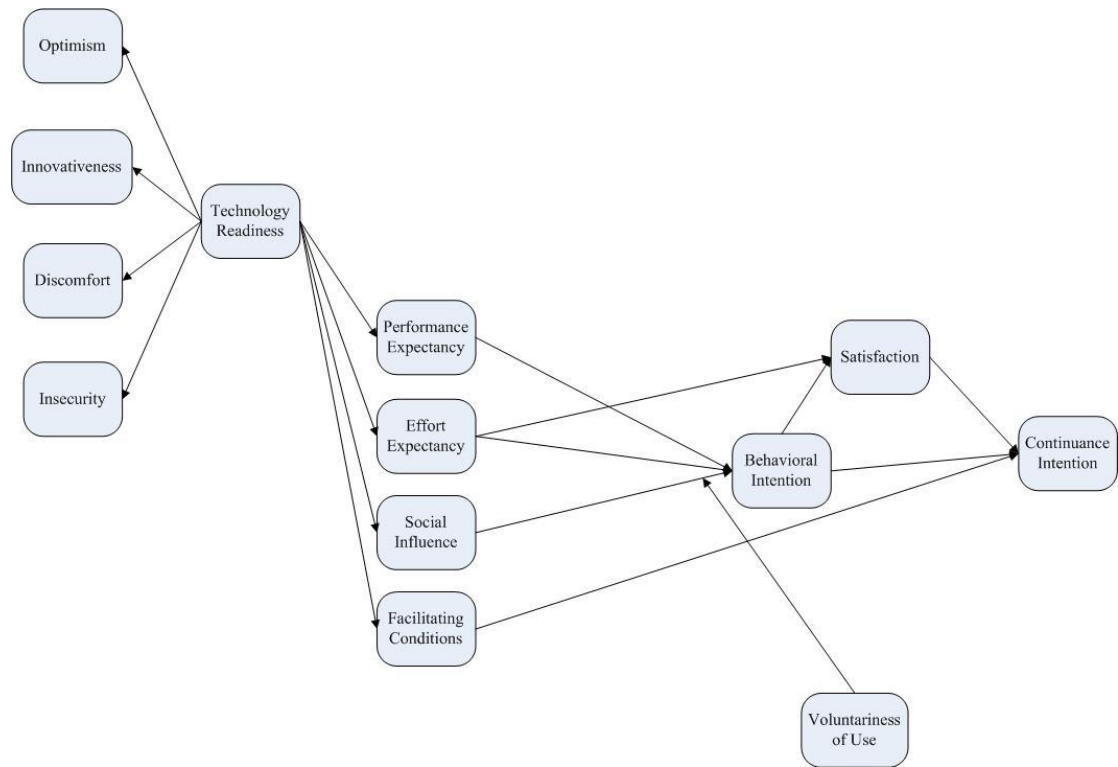


Figure 22 TRAUM with Voluntariness of using moderation



4.1.4.3 TRAUM Model

According to the test of structural model and moderation effect, we removed the non-supported causal relationship and get the TRAUM (Technology Readiness, Acceptance and Using Model) model. The TRAUM model is shown as follows.

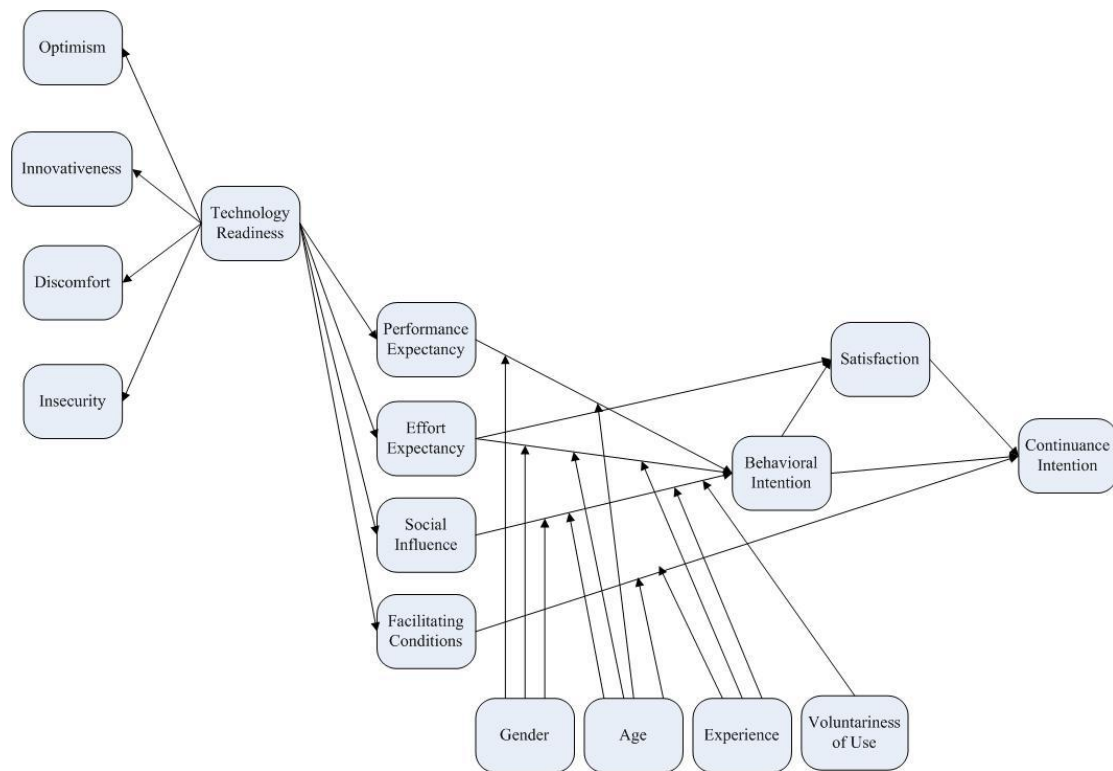


Figure 23 TRAUM Model

4.2 DEMATEL

4.2.1 Data Collection

The primary criterion for selecting participants was that they are the experts in NFC field and the collaborative partners. There are ten experts were selected. The collecting period is from 2013/05/30 to 2013/06/15. All the questionnaire received are valid responses, corresponding to a valid return rate of 100%.

Of the ten participants enrolled in the program, seven participants were male and three were female. They came from various specialized fields, included NFC R&D, NFC manufacturing, NFC marketing, and finance. Their ages ranged from twenty-eight to forty-six years. The ten participants involved in this study can be further categorized by their specialized fields, three being classified as NFC R&D, two as NFC manufacturing, three as NFC marketing, and two as finance field according to the specialized fields. The ten participants are as follows:

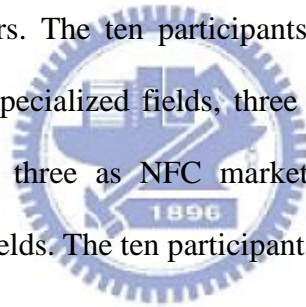


Table 21 Basic data of the expert participants

Number	Education	Job title	Professional Field	Seniority(NFC)	Age
1	Bachelor	Senior Engineer	R&D	9	36
2	Master	Manager	R&D	6	42
3	Master	Executive Officer	R&D	8	38
4	Master	Project Manager	Manufacturing	7	35
5	Bachelor	Senior Engineer	Manufacturing	9	40
6	Bachelor	Sales Manager	Marketing	6	28
7	Master	General Manager	Marketing	8	46
8	Master	Special Assistant	Marketing	8	36
9	Bachelor	Section Chief	Finance	5	32
10	Master	Manager	Finance	7	37

4.2.2 Decision problem network relation map structuring

At first, the direct relationship/influence matrix A is introduced. After that, the direct relation/influence matrix A is normalized. The normalized matrix A is shown as the following table:

Table 22 Normalized matrix A

	S1	S2	S3	S4	F1	F2	F3	I1	I2	I3	I4	O1	O2	O3
S1	0	0.086	0.036	0.048	0.066	0.086	0.032	0.045	0.032	0.048	0.063	0.088	0.045	0.027
S2	0.070	0	0.063	0.070	0.054	0.068	0.084	0.054	0.066	0.052	0.066	0.086	0.048	0.068
S3	0.057	0.086	0	0.038	0.041	0.068	0.050	0.084	0.045	0.036	0.043	0.068	0.045	0.045
S4	0.066	0.043	0.066	0	0.068	0.045	0.025	0.048	0.066	0.045	0.025	0.045	0.027	0.025
F1	0.066	0.086	0.057	0.070	0	0.059	0.061	0.088	0.063	0.066	0.054	0.063	0.057	0.050
F2	0.088	0.063	0.036	0.043	0.086	0	0.045	0.068	0.066	0.084	0.032	0.048	0.086	0.063
F3	0.052	0.050	0.068	0.050	0.036	0.084	0	0.036	0.043	0.045	0.066	0.036	0.068	0.045
I1	0.070	0.090	0.090	0.077	0.084	0.059	0.070	0	0.070	0.070	0.090	0.070	0.070	0.088
I2	0.090	0.088	0.054	0.068	0.057	0.088	0.090	0.070	0	0.068	0.050	0.068	0.061	0.048
I3	0.048	0.068	0.086	0.041	0.052	0.043	0.043	0.045	0.045	0	0.041	0.088	0.032	0.068
I4	0.077	0.066	0.054	0.070	0.063	0.090	0.090	0.070	0.072	0.068	0	0.061	0.066	0.059
O1	0.027	0.025	0.025	0.045	0.027	0.048	0.068	0.045	0.086	0.045	0.066	0	0.027	0.025
O2	0.057	0.059	0.048	0.061	0.054	0.086	0.068	0.068	0.063	0.063	0.045	0.057	0	0.054
O3	0.068	0.043	0.086	0.086	0.050	0.070	0.070	0.066	0.086	0.050	0.086	0.048	0.057	0

Finally, the total relationship matrix T is deducted. The total relationship matrix T is shown as the following table. In the following table, “r” means the influence degree, and “d” means the influenced degree.

Table 23 Total relationship matrix T

	S1	S2	S3	S4	F1	F2	F3	I1	I2	I3	I4	O1	O2	O3	d
S1	0.189	0.272	0.206	0.219	0.231	0.280	0.212	0.222	0.214	0.216	0.225	0.271	0.201	0.180	3.138
S2	0.291	0.229	0.266	0.272	0.252	0.304	0.293	0.263	0.279	0.251	0.259	0.303	0.234	0.244	3.740
S3	0.247	0.277	0.177	0.215	0.212	0.269	0.233	0.259	0.230	0.208	0.212	0.256	0.205	0.200	3.201
S4	0.224	0.209	0.209	0.148	0.209	0.215	0.178	0.199	0.216	0.188	0.166	0.206	0.161	0.155	2.683
F1	0.289	0.312	0.262	0.274	0.203	0.296	0.274	0.294	0.277	0.264	0.250	0.285	0.242	0.231	3.752
F2	0.301	0.285	0.236	0.243	0.276	0.233	0.252	0.270	0.271	0.274	0.223	0.265	0.263	0.237	3.629
F3	0.235	0.236	0.232	0.216	0.201	0.275	0.176	0.210	0.218	0.209	0.222	0.218	0.219	0.192	3.059
I1	0.333	0.356	0.329	0.317	0.315	0.340	0.321	0.252	0.322	0.303	0.317	0.331	0.288	0.297	4.422
I2	0.324	0.326	0.270	0.282	0.268	0.337	0.311	0.290	0.229	0.278	0.257	0.302	0.258	0.238	3.972
I3	0.232	0.255	0.252	0.211	0.215	0.240	0.221	0.220	0.225	0.166	0.204	0.269	0.186	0.214	3.111
I4	0.315	0.310	0.274	0.288	0.277	0.342	0.314	0.293	0.300	0.281	0.212	0.298	0.265	0.251	4.020
O1	0.183	0.183	0.166	0.185	0.165	0.211	0.212	0.188	0.228	0.182	0.196	0.152	0.157	0.149	2.557
O2	0.266	0.272	0.239	0.251	0.241	0.305	0.265	0.262	0.263	0.249	0.228	0.263	0.177	0.222	3.504
O3	0.298	0.280	0.293	0.293	0.256	0.314	0.287	0.281	0.303	0.255	0.282	0.275	0.248	0.187	3.851
r	3.727	3.802	3.412	3.412	3.321	3.962	3.548	3.505	3.576	3.325	3.253	3.693	3.106	2.997	

According to the matrix T , the study calculated the strength of the influence in the following table. $(d+r)$ means the degree of the central role that factor i plays in the problem. $(d-r)$ means the degree of the cause role. The strength of the influence for the criteria is shown as following table:

Table 24 The strength of the influence for the criteria

Criteria	d	r	d+r	d-r
S1 Customer Segmentation	3.811	3.751	7.562	0.060
S2 Ease of Use	3.850	4.479	8.330	-0.629
S3 Pricing	3.780	3.922	7.701	-0.142
S4 Service Offering	3.357	2.936	6.292	0.421
F1 Revenue and Cost	3.672	3.351	7.023	0.322
F2 Risk	4.555	4.810	9.365	-0.255
F3 Resource	3.621	4.152	7.773	-0.532
I1 Security	4.591	4.300	8.892	0.291
I2 Authentication	4.369	3.981	8.350	0.389
I3 Application	3.466	3.647	7.113	-0.181
I4 Technological Architecture	3.967	3.727	7.694	0.240
O1 Value Network	3.136	3.998	7.134	-0.862
O2 Collaborative Strategies of the Partners	3.263	3.323	6.586	-0.061
O3 Capabilities of the partners	4.613	3.674	8.287	0.939

After calculating the strength of the degree of the central role and the cause role, the paper produced the network relationship map based on the strength value. We can present the above network relationship with the flow chart shown as following figure.

The following figure illustrates the network relationship map of the service construct. In the figure, S4 (service offering) affects S1 (customer segmentation), S3 (pricing) and S2 (ease of use). For the enterprise, the service can help them to contact to the customers directly. Therefore, the enterprise should put more resource in the criteria, service offering, in order to improve the other criteria of the service construct.

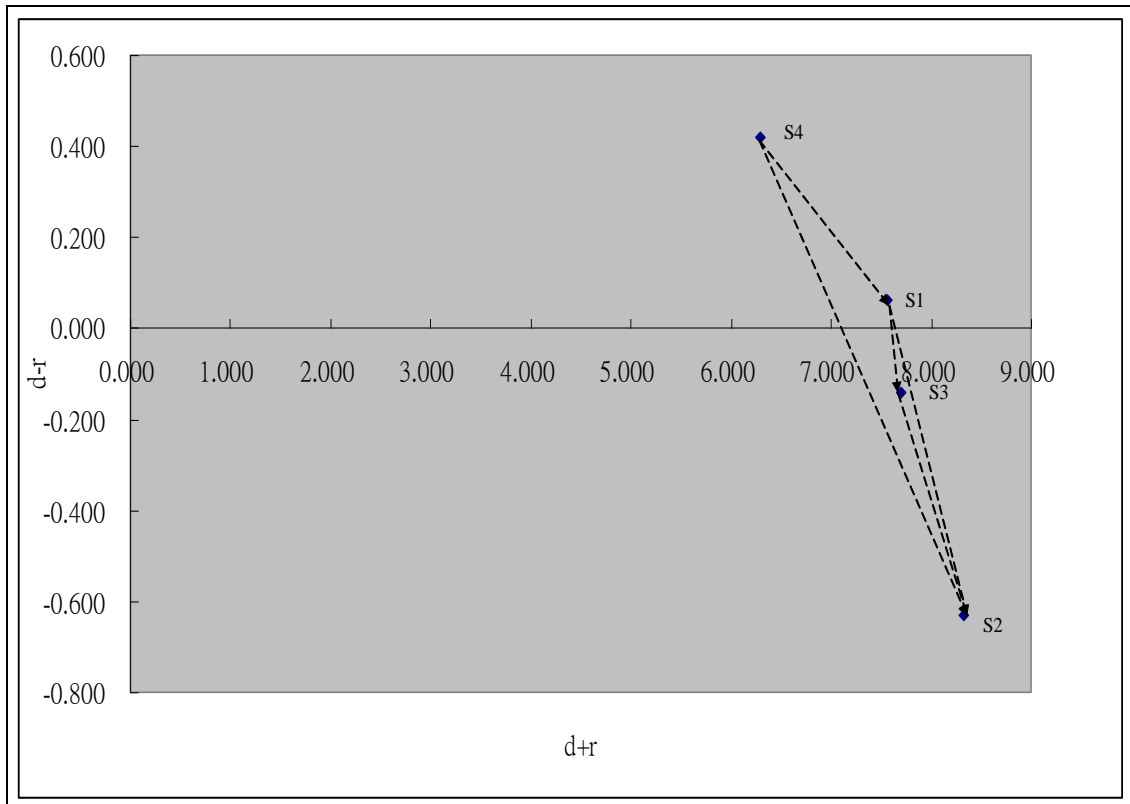


Figure 24 The Network Relationship Map of Service Construct

The following figure illustrates the network relationship map of the Finance construct. In the figure, F1 (revenue and cost) affects F2 (risk), and F3 (resource). The enterprise should focus on the revenue and control the cost in order to improve the other criteria of the finance construct.

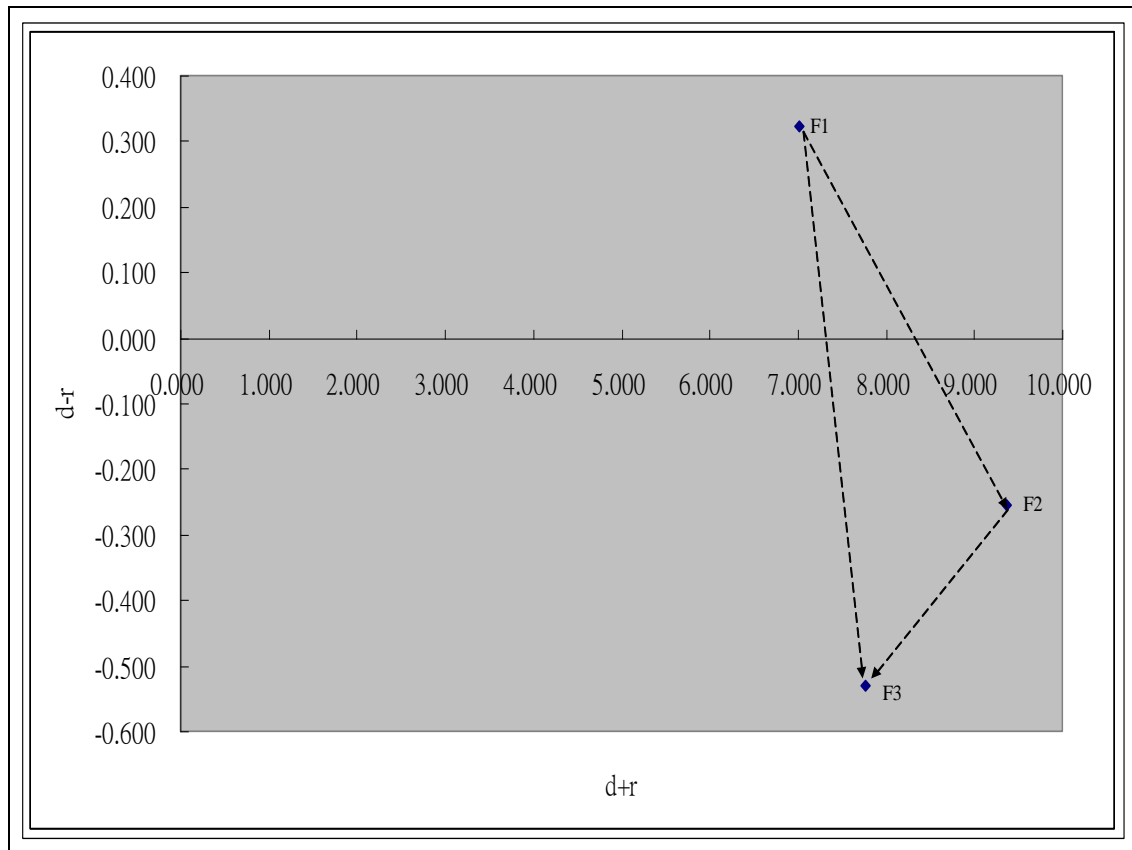


Figure 25 The Network Relationship Map of Finance Construct

The following figure illustrates the network relationship map of the information construct. In the figure, I2 (authentication) affects I1 (security), I4 (technological architecture) and I3 (application). For the enterprise, the criteria, authentication, is the main affecting source. Therefore, the enterprise should focus on the authentication, included the authentication mechanism, authentication system, authentication design and etc. The more resource in the authentication criteria can improve the other criteria of the information construct.

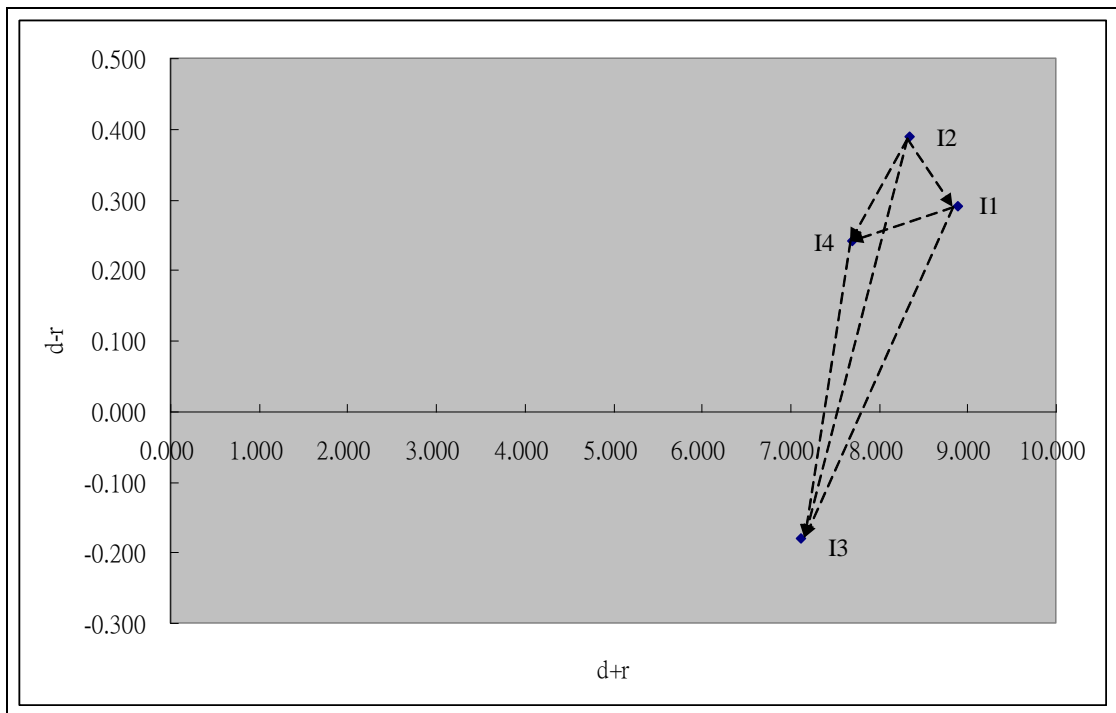


Figure 26 The Network Relationship Map of Information Construct

The following figure illustrates the network relationship map of the organization construct. In the figure, O3 (capabilities of the partners) affects O2 (collaborative strategies of the partners), and O1 (value network). In order to promote NFC solution, the capabilities of the partners is the main affecting cause in the organization construct. The enterprise should focus on the capabilities of the partners, seek for the implementation, and plan well the multiple capabilities. As long as the enterprise put more resource in the criteria, the capabilities of the partners, the other criteria of the organization construct can be improved at the same time.

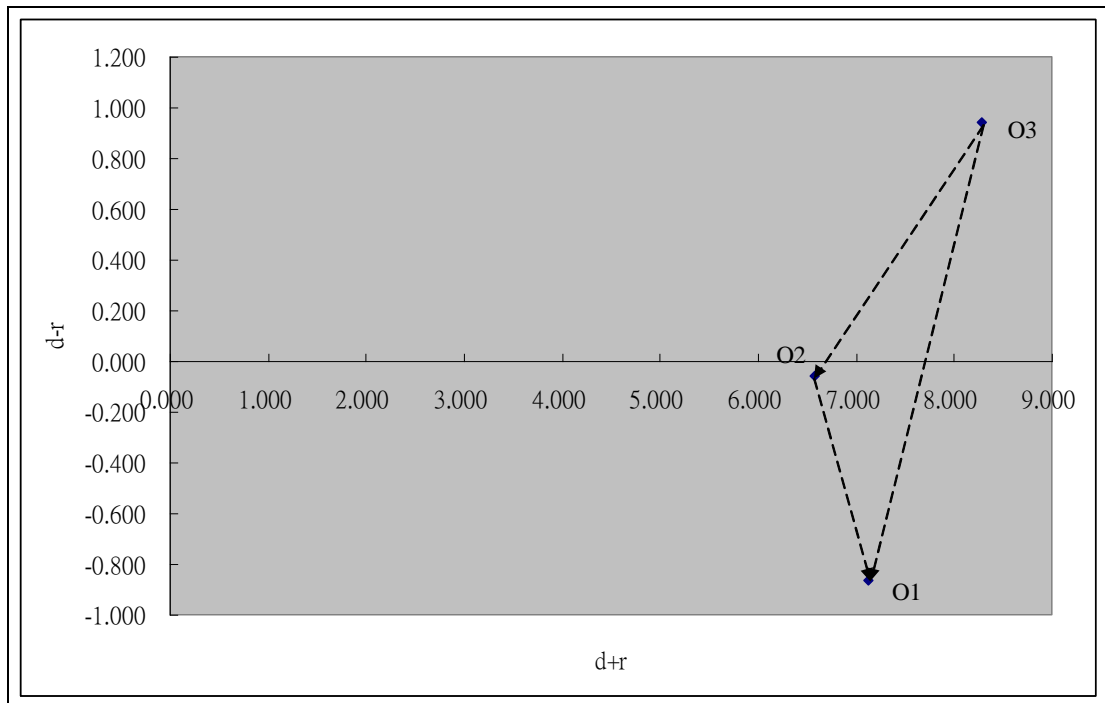


Figure 27 The Network Relationship Map of Organization Construct

The following figure illustrates the total cause network relationship map. We found O3 (the capabilities of the partners) is the main affecting cause. In the stage of promoting NFC solution, the partners and the capabilities of the partners is the most important. The criterion can affect other criteria. The security and authentication criteria are also affecting causes. The enterprise should provide the safer NFC products, especially in the financial transaction. The two criteria are also the important causes. Other important criteria is service offering. One of the key factors for NFC promoting is the service offering. The collaborative partners and the consumers decide to assist NFC solution based on the service offering. The enterprise should focus on the criteria and provide the service which satisfies the needs of the market to get the acceptance.

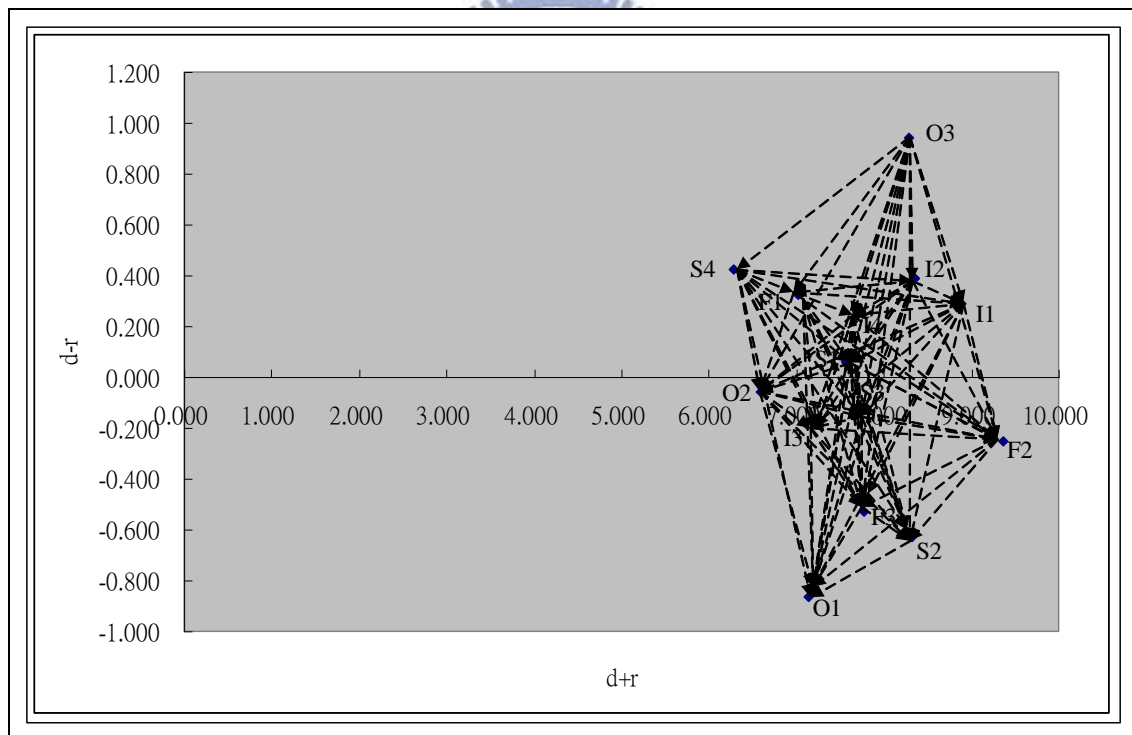


Figure 28 The causal diagram of total relationship

4.3 Review of Research Findings in SEM and DEMATEL

We will begin our discussion by reviewing the empirical findings, and then return to the general theoretical issues.

In SEM analysis, we tested the hypotheses and got the TRAUM model. We also tested the moderation of the four controllers to understand the effect of the structural research model.

In TRAUM model, the technology readiness was significant to the four constructs, included the performance expectancy, effort expectancy, social influence, and facilitating condition. The tendency of the technology results in the personal performance expectancy and effort expectancy. The tendency of the technology also results in the social community and facilitating condition. The higher tendency brings the higher acceptance and using willingness of the users. The performance expectancy, effort expectancy, and social influence were significant to affect the behavioral intention. The results illustrated that the consumers are on the initiative to use NFC mobile services. The community has the positive effect to the consumers. The consumers would like to share the experience in the community and are affected by the willingness of the community.

Technology readiness construct contains the four types of the characteristics, included optimism, innovativeness, discomfort, and insecurity. The four characteristics are existing in the consumers. The result of the analysis interprets the four characteristics support the expectancy, social influence, and facilitating condition by the technology readiness construct. It means the high acceptance of the consumers whatever the characteristics they have. On the other words, the result is helpful to the promotion in NFC mobile services.

The enterprise should put more resource in the soft strategy to strengthen the needs of the consumers and enhance the effect of the community. In the emergence period of NFC mobile services, the enterprise should also put the resource in the promotion and education. The promotion and education can increase the good imagine of the users. The consumers will share their views in the community and search the opinions in the community. The strategies are helpful to the understanding and acceptance of the consumers.

The factors of services provided and ease of use are the important criteria for the consumers. The consumers will make the decision based on the services provided, ease of use, and the performance expectancy in order to increase the behavioral intention, satisfaction and continuance intention.

The construct of facilitating condition was significant to affect the continuance intention. The result explains the importance of the infrastructure. The infrastructure includes the NFC electronics, NFC environment, security, authentication, clouding establishment, and so forth. Providing the establishment of the NFC facilitating environment is helpful to the acceptance, the using willingness and the continuance intention of the consumers. The enterprise should provide the appropriate facilitating condition based on the NFC mobile services and the behavior of the consumers. For example, for NFC mobile payment, the enterprise should provide the NFC mobile payment environment, the safe and convenient environment and the corresponding mechanism. Providing the appropriate facilitating condition based on the NFC mobile services is one of the important strategy for promotion.

Following the analysis, the behavioral intention has effect of satisfaction and continuant intention. The results illustrates the strategies planned for the overall services, included the infrastructure, the services, the corresponding mechanism, the convenience, and etc., is the most important issues in the early stage. NFC technology

is in the emergence period and needs the completed developed strategies based on the business model.

The TRAUM model proposed in this research provides the better explanation to the acceptance, intention and behavior of the consumers in technology using, e-services and mobile services. For the technology and e-services in the emergence period, the preference of the consumers is quite important to make the promotion strategy. The TRAUM model offers a holistic view for evaluation and making the appropriate strategies.

In DEMATEL analysis, we proposed the network relationship map based on the opinions from the experts. In the analysis, the main affecting cause is the capabilities of the partners' criteria, especially in the emergence period. The result emphasizes the importance of the partners choosing and the implementation of the multi-source capabilities from the partners. In planning the strategies, how to allocate the capabilities to gain the more benefit for the collaborative partners is also the most important things. It will affect the following strategies.

The service offering is the second main affecting cause. The services contact the consumers more directly and understand their needs. The consumers in the different areas have the different preference in service offering based on the behavior and the culture. For example, for the consumers in Europe, NFC mobile services focus on the electronic keys, mobile learning, healthcare and mobile tickets at first. For the consumers in United States, NFC mobile services focus on mobile tickets, controlling system in the organization, and mobile learning. For the consumers in Japan, NFC mobile services focus on the minor mobile payment. According to the investigation, for the consumers in Taiwan and China, NFC mobile services focus on the minor and major mobile payment at first. The NFC mobile payment service can attract more consumers to use it and strengthen their continuance intention.

The following main affecting causes are security and authentication. For the service offering, safer environment is helpful to the promotion. Thus, the enterprise should focus on the design of security and authentication mechanism, included the product design, and the transaction environment design. The security and authentication mechanism are also the critical criteria in promoting.

The result shows the criterion of value network is the main affected cause. While the partners setup a great environment, attracting services, the better benefit for the partners, and the collaborative mechanism of the partners. The value network can be organized well spontaneously.

The result interprets the criterion of ease of use is the second main affected cause. It is because the criterion needs other factors to affect, included the finance, information, organization, and service. Thus, the enterprise should put the resource in the service offering, information security, finance revenue, and the collaborative partners' allocation first. By the resource above, the criteria of ease of use can be achieved.

The research used the two quantitative research methods to do the analysis based on the consumers and experts. It can provide the views from the consumer's needs and the experts' opinions in decision making. Because these studies complement each other, the compatibility of the results is all the more impressive.

The two studies obtain the same conclusion and both emphasizes the important of services and information construct. The service offering in DEMATEL method can enhance the performance expectancy, effort expectancy, social influence and satisfaction of the consumers in SEM analysis. The enterprise can focus on the service offering and the corresponding mechanism provided. The community managed is also important to strengthen the using willingness of the users. The criteria of security and authentication can enhance the facilitating condition and continuance intention constructs. The experts and the consumers both focus on the information security

mechanism. Therefore, the NFC products, mechanism, and the environment with the high security are the key successful factors. The enterprise should put more resource in developing the NFC mobile services with high security and the promotion strategies.



4.4 Application in Business Strategy and NFC Mobile Payment

In the session, the research applied the finding to the business strategy and NFC mobile payment which is the main NFC mobile services based on TRAUM and network relationship map.

4.4.1 Business Strategy

We separated four domains to discuss the business strategy of NFC mobile services based on STOF business model and the quantitative finding. The four domains are service domain, information domain, finance domain, and organization domain.

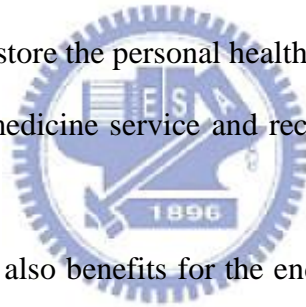
4.4.1.1 Service Domain

In service domain, the research separated two issues to discuss, included the value proposition for end user, and market segmentation. For NFC mobile services, the two issues are important to promote. Based on the finding, the services can affect the using willingness directly.

(1) Value proposition for end user

Franco Bernabe considered that NFC is an important innovation, and can advance the development of mobile services and applications, such as mobile ticketing, mobile payment, mobile coupon, information/context exchange, and etc (Bernabe, February 25, 2013). The end users are more likely to take the mobile phones with them all the times. The mobile services based on contactless NFC technology offer numerous benefits for end users compared to previous solutions. By the mobile services provided by mobile phones with NFC-Micro SD technology, users need to carry the plastic cards and keys with them no longer.

The series of mobile services include mobile payment service, mobile ticketing service, healthcare service, electronic key, promotional m-coupon, data transmission, mobile learning materials and etc. The users can only carry their mobile phones with NFC-Micro SD cards. They can receive the exclusive m-coupon by OTA, purchase anything they want with the NFC-enabled mobile phones. The users can only choose the payment ways by the phones and don't have to find a shop or a certain place to top up their plastic cards. While the users want to travel, they can order the tickets with the phones. The order will update on their calendar immediately, with the route planning and the schedule suggestion. The users also can receive the key of the hotel room ordered by OTA function, and it ensures the users can take the phones as the electronic key without the complicated check-in process in their trip. Besides, NFC-Micro SD card also can store the personal health record. It ensures that users can monitor their health by Telemedicine service and receive the health advice from the doctors at once.



Besides, the data exchange also benefits for the end users. The users can use NFC technology to print the documents and photos with putting the phones close to the printer. Based on NFC technology, the users also can receive the guidance and information while they're in the museums, the scenic resorts and etc. The benefit of mobile learning is also obvious and can help many people to learn anytime and anywhere.

(2) Market Segmentation

With many entities, such as banks, mobile operators, transport companies and merchants involved, service complexity is a challenge in each NFC rollout. Compared to the previous solutions, a NFC-based service can add value by offering more options (e.g. different payment methods, and applications). For the end users, if the operating approaches are seen as too complicated or slow by the users, they would resist to use

it. NFC-Micro SD solution provides more flexibility, such as applying in all kinds of the phones. About the interface, it also has to offer a simpler and friendlier interface for the users. These considerations can enhance the willingness in using.

After the users have become familiar with the services, it could be possible to encourage these users to adopt the advanced options of NFC mobile services. This approach can attract more users to adopt NFC mobile services. Besides, NFC mobile services also can combine with the intelligent housing to offer the safer and more convenient mechanism in the future. This application will be the great benefit to the end users and constitutes the majority of the users.

4.4.1.2 Technology Domain

In technology domain, the research separated two issues to discuss, included the NFC-enabled devices availability, and security issues. The two issues are also the critical criteria for user to accept the NFC mobile services.

(1) NFC-enabled devices availability

In the past, the deployment of NFC is slow because of the limited availability of NFC handsets (Huomo, 2008). According to Juniper Research (Wilcox, 2011), at least 1 in 5 smartphones worldwide has NFC contactless functionality. Juniper forecasts almost 300 million NFC-enabled smartphones worldwide by 2014, and North America will account for half of all NFC smartphones in 2014. Therefore, the mobile phone manufacturers are optimistic about the future of NFC-enabled phones, and release more NFC-enabled phones.

Among the several NFC solutions, NFC-Mobile Phone, NFC-SIM, NFC-SWP SD, and NFC-Micro SD, NFC-Micro SD solution is the eminent solution. It corresponds to the features of NFC field, such as simplification, convenience, easy to use, and low-cost. Unlike other solutions, NFC-Micro SD solution can apply in all types of

mobile devices. Thus, consumers can choose their favorite smartphone and insert NFC-Micro SD card to enable NFC function. Besides, there are more and more NFC services to be provided nowadays. The more convenient mobile services bring about the needs of the end consumers. With the increasing needs of the end consumers, NFC-Micro SD solution becomes a popular and important solution in the mobile markets. By NFC-Micro SD solution, the market can provide more NFC-enabled devices with the low-cost for end consumers in the short time.

Besides the smartphones, the consumers tend to use other consumer electronics, such as mp3s, tablet PC, digital camera and so forth. Applying NFC function on the consumer electronics brings the more convenience for the consumers. The consumers can choose their favorite consumer electronics with you to use NFC mobile services. By NFC-Micro SD solution, it can reach the goal easily and improve the using willingness of the users.

(2) Security issues

Each role of the value chain regards the security issues as the most important things in NFC field. The security issues include the secure element and the security mechanism.

Secure element means a hardware component which is the safe storage place for storing confidential information and handling confidential data (Juntunen, Luukkainen, & Tuunainen, 2010). The confidential information includes the sensitive personal information, the transaction of the mobile services (e.g. mobile payment, mobile ticketing, etc.) In order to give consideration to the standardization and compatibility, NFC-Micro SD solution is considered the most promising solution for secure element. Micro SD card is the removable, secure, and standardized memory card. It can be also compatible among different handsets. The block structure contains two partitions to store the different data, SmartCard Controller and NAND Flash.

SmartCard Controller is secure element in NFC-Micro SD solution; It is responsible to store confidential information and execute the NFC transaction. NAND Flash is responsible to store the normal data. The mechanism can provide not only a safe way for the confidential information, but also the memory to store the normal data. It can strengthen the using willingness of the consumers.

The security mechanism contains the software security mechanism and the hardware security mechanism. For the software security mechanism, NFC-Micro SD solution provides the safer encryption algorithm, such as DES/ AES/ RSA/ PKI/ SHA-1/ SHA-224/ SHA-256/ MD5/ CRC and etc. Besides, the issuing process can be executed by the OTA (Over-The-Air) function. The issuers can verify the user's identification directly without the complicated process. The consumers also can download the transaction programs safely by OTA mobile network and finish the setup. For the hardware security mechanism, it makes the chip to encrypt the data by the highest encryption standard of hardware ZAL5++ while it transmits. If someone loses his mobile phone with NFC-Micro SD card, nobody can use his card to execute NFC transaction. The security mechanism give consideration to safe, convenience and easy to use.

4.4.1.3 Finance Domain

The most significant issue in the NFC ecosystems is the possible revenue logics for the operators. The operators will consent to not receiving any transaction-based revenue from the transaction organizations, such as banks, transport service providers and etc (Balaban, 2008). Unlike NTT DoCoMo in Japan can issue its own credit brand and have the transaction-based revenue, the common operators of other NFC solutions (e.g. handset manufacturers of NFC-Mobile Phone solution, and mobile network operators of NFC-SIM solution) can't receive any transaction-based revenue.

Besides, the cost will be increased as much as \$10 to \$30 per handset while NFC chip is added into the mobile phone directly. The more cost and less revenue result in the difficulty in promotion NFC solution.

In the research, we proposed the new NFC solution, NFC-Micro SD solution. NFC-Micro SD cards can replace the plastic cards and reduce the wastage of the plastic cards. NFC-Micro SD cards also have less cost than other NFC solutions. For the manufacturer of NFC-Micro SD cards, the revenue is from the card manufacture, not the transaction-based revenue. The issuers also can ask for the customization with more expense. Following the solution, the original revenue model not only has no change, but also increases the finance value to the existing roles. The convenient mobile services will increase the transaction, and increase the transaction-based revenue for the issuers, and the merchant. Information Service Provider will receive the extra profit according to the development of appropriate Apps. For consumers, NFC mobile services are the more convenient, time-saving and interesting services. It is estimated to increase the sale volume of the mobile phones, and increase the benefit for mobile network operators. In summary, NFC-Micro SD solution can increase the profit of each role in the value network. The players can accept the solution more easily and would like to promote NFC-Micro SD solution.

4.4.1.4 Organization Domain

NFC is the emerging and popular technology nowadays. The handset manufacturers and mobile network operators would like to produce NFC-enabled products, such as NFC-Mobile Phone and NFC-SIM, and promote it. But the bottleneck to promote is the key players, such as the financial institution, the government, and the organizations which own the confidential personal information. In order to keep the security, the key players are adverse to disrupt the original process to issue the card.

NFC-Micro SD solution provides a holistic value network without changing the original safe process. The holistic value network is as shown in following figure.

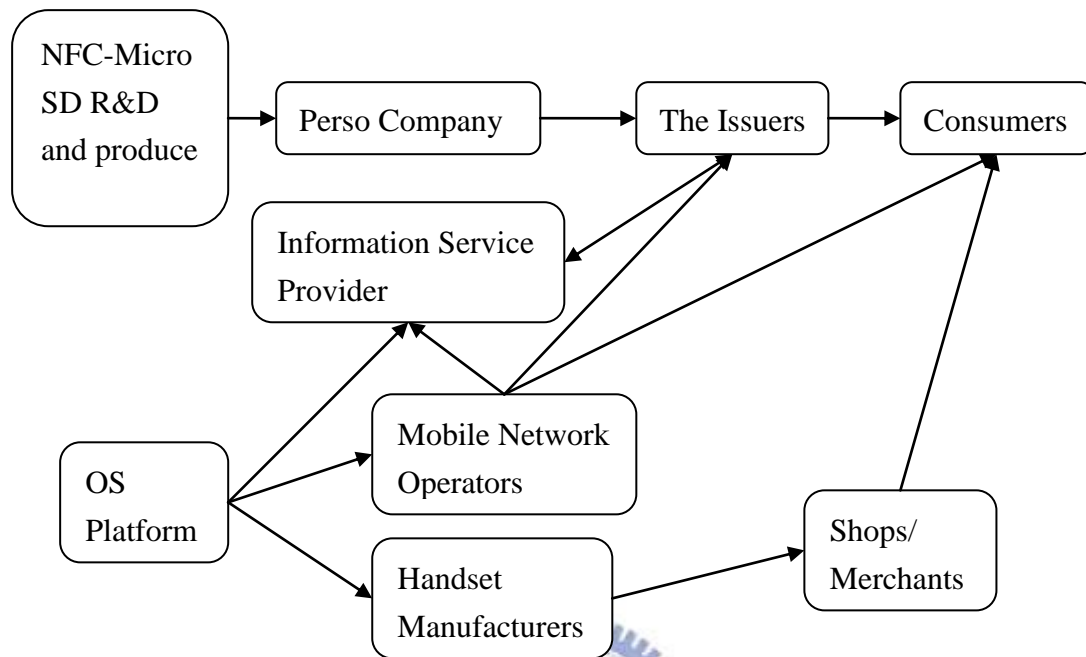


Figure 29 The holistic value network

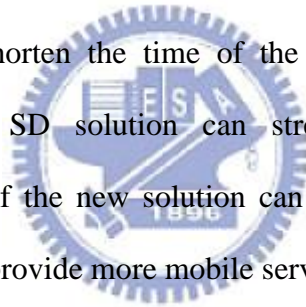
The issuers here mean the key players who own the confidential personal information. In the original process, Perso Company is responsible to upload the confidential personal information for the issuers. The difference between the original value network and the new value network is that the manufacturer of NFC-Micro SD technology replaces the traditional plastic card manufacturers. It doesn't have to change the existing security mechanism which has been established for years. For the issuers, they would like to use and promote the solution without overmuch changing.

Consumers can get NFC-Micro SD card from the issuers directly, buy the mobile phones in the shops, and insert the cards into the phones to enable NFC function. Mobile network operators also provide the mobile network for the issuers and the consumers as the network infrastructure. In order to active NFC function, consumers must use the Apps in the mobiles phone. The role, Information Service Provider, is

responsible to develop the Apps on the several OS platforms according to the requirement of issuers and maintains the web platform. The three roles, issuers, information service provider, and mobile network operators, become the collaborative partners in providing a holistic service network for consumers. So consumers can download the appropriate Apps by OTA to active NFC transaction.

By the holistic service network provided and NFC-Micro SD cards with confidential personal information, consumers can execute the private transaction, such as mobile payment, mobile ticketing, health care, m-coupon, electronic key and more private mobile services.

In the new value network, NFC-Micro SD solution enhances the value of each role, and provides the convenient solution for consumers. By OTA, the issuers can identify the consumers directly to shorten the time of the original process. The security mechanism of NFC-Micro SD solution can strengthen the existing security mechanism. The advantage of the new solution can attract the players to invest in NFC-Micro SD solution and provide more mobile services for the consumers.



4.4.2 NFC Mobile Payment

There are three main NFC applications: Authentication, Payments, and Data exchange. Among the applications, mobile payment is the first application in NFC field in Taiwan. Mobile payments are the payments through mobile devices in wireless environment, and are considered as the accelerator of M-commerce. In the session, we take the important application, mobile payment, to show the applied process.

Comparing to traditional payment and online payment, the main advantage of mobile payment is ubiquity. The traditional payment is the transaction via the credit cards and cash. The users have to bring more credit cards and use it based on the different preferences of the credit cards. The credit cards service brings not only the convenience but also the trouble in life.

With mobile payment, the users can conduct payment via their mobile devices anytime and anywhere. However, slow responses and the security mechanism are the difficulties to promote mobile payment. The contactless technology, NFC-Micro SD, not only provides the security mechanism with it, but also can apply in every type of mobile phone with the unique patent by inserting the NFC-Micro SD card. the consumers can transact by NFC-enabled device without carrying many credit cards.

About the credit card operation, it involves in the confidential personal data. The card issuers are usually the banks and hardly to give the sensitive personal data to other enterprises, such as handset manufacturers, and mobile network operators. Therefore, NFC-Micro SD solution takes the procedure as shown in Fig. n. The procedure keeps the original card issue procedure, and improves the willingness and acceptance of the card issuers.

NFC-enabled Credit Card issued procedure

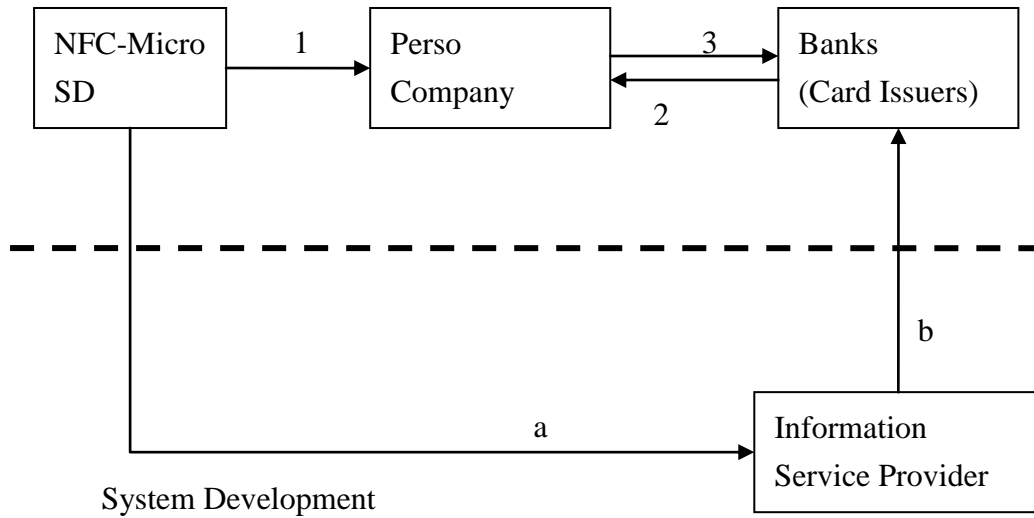


Figure 30 Collaborative mobile payment in NFC-Micro SD solution

In order to keep the original procedure of card issuing, NFC-Micro SD solution provider only provides the empty NFC-Micro SD cards and specific burning machines to the Perso Company, like line 1 in Fig. n. In the original card issue procedure, the banks (the card issuers) entrusts the regional Perso Company to input all personal data into the credit cards. In Fig. 11, as the original procedure, the banks provide the confidential personal data to Perso Company, like line 2 shown. Perso Company will upload the personal data in the SmartCard Controller in NFC-Micro SD card according to the requirement of the banks. After Perso Company finish uploading, Perso Company will give the cars to the banks, like line 3 shown. With the procedure, NFC-Micro SD solution can enter in the financial industry without more obstacles.

By OTA (Over-the-Air) function NFC-Micro SD provides, the bank can do the identity authentication directly, without identifying face-to-face or by telephone. The OTA function saves more cost and time for the card issuers. The OTA function also helps the consumers can not only consume in the physical stores, but also enjoy the

virtual shopping in Apps online shopping mall.

In every NFC-Micro SD card, there are several credit cards inside. It depends on apps to choose the credit card would like to use. In Fig. 11, the whole procedure also contains the system development. In system development procedure, the participators are NFC-Micro SD solution provider and information service provider. NFC-Micro SD solution provider is responsible to assist the information service provider to develop the system and apps, like line a shown. The information service provider will develop the apps and managed interface for the end users according to the requirement of the banks, like line b shown. The platforms of apps contain Android, iOS, and etc. to support all types of mobile phones.

The consumers choose the App (e.g. ICash) on their mobile phones, and open the App. After inputting the account name and password the consumers defined in advance, the consumers can choose the function (e.g. credit card transaction, mobile bank, ticketing, etc.) and the credit card would like to use. Then the consumers can put the cellular phones close to the reader and conduct payment immediately or operate the mobile bank. The flow chart of App transaction is as shown in Fig. 12. With the easy use and convenient apps, the software can improve the interest and willingness of the consumers.

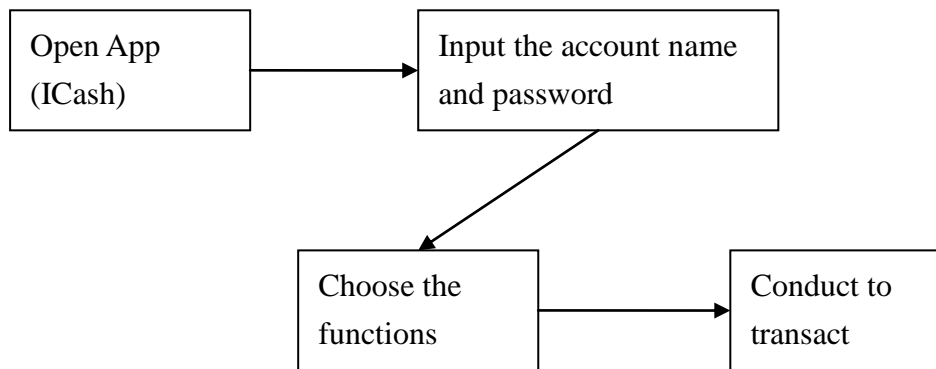


Figure 31 Flow chart of App transaction

NFC-Micro SD solution provides two operation modes to help mobile payment:

(1) Passive Mode

In passive mode, NFC-Micro SD solution is responsible to send the signals. While the users want to execute the transaction, they have to put the mobile phones close to the flexible POS machine or make the mobile phones touch the flexible POS machine. The flexible POS machine uses the communication network with the banks, and executes the transaction.

For the existing stores, the original flexible POS machines and the original network to the banks don't have to change. It can follow the security mechanism currently. It will improve the loyalty of the consumers, the merchants, the banks and the partners in the payment chains.

(2) Active Mode

In active mode, NFC-Micro SD solution can not only send the signals, but also receive the signals. The difference between passive mode and active mode in mobile payment is that the flexible POS machines can be inexistent. The merchants can use the NFC-Micro SD mobile phones as the mobile POS machine and execute the transaction. The active mode is well received by more merchants for micro-payment.

Besides, the active mode supports the transferring accounts operation easier. While one user want to transfer accounts in bank to the other users, they can use the active mode and execute the transaction without the flexible ATM machines.

Therefore, NFC-Micro SD solution is suitable for the mobile payment, especially integrating with credit cards, and mobile banks operations. The solution is helpful to the macro-payment and micro-payment, and can provide the ubiquitous mobile payments.

The benefit of the collaborative partners is as follows:

(1) For the banks

The banks don't have to change the original flow chart and existing security mechanism. They only exchange the plastic credit cards to NFC-Micro SD cards, and release the mobile payment operation soon. By the security mechanism of NFC-Micro SD technology and the NFC mobile payment chain, it provides the safer security mechanism and avoids the confidential personal data to be distributed to any third parties.

(2) For Perso Company

The Perso Company is the segment of the original value chain. In mobile payment chain, it increases the volume of the credit cards maing and creates its value in the mobile payment value chain.

(3) For Information Service Provider

The information service provider can not only provide the existing information service to the banks, but also develop the systems and apps for the users according to the requirement of the banks. The management and maintenance of the information systems can improve the value in the mobile payment chain and the willingness of collaboration.

(4) For NFC-Micro SD solution provider

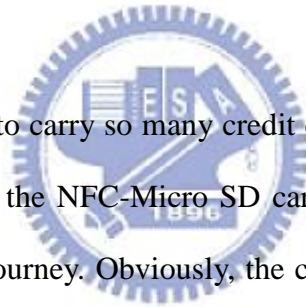
The solution provider only provides the empty cards to Perso Company without changing the original process. It also can develop the customization empty cards according to the requirement of the banks, included the volume of the Micro SD cards, the special specifications for the certain banks. In system development stage, the solution provider can be close to the information service provider and provide the friendly system together in order to improve the willingness of the consumers.

(5) For merchants

The solution can accelerate the speed of the transaction without exchange the existing equipment. The solution also provides the more convenient transaction and process for the merchants.

(6) For consumers

The consumers don't have to carry so many credit cards and cash with them. What the consumers do is apply to the NFC-Micro SD cards into the mobile phones, and enjoy their mobile payment journey. Obviously, the convenient way can improve the using willingness of the consumers.



5. Implication

5.1 Conclusion

People carry the mobile phones with them all the time, many daily services like payments, identifications, etc., could be provided through NFC-enabled mobile devices. Incorporating NFC technology in mobile phones offers numerous valuable new mobile services to end users, while generating profits for the players in the holistic value network.

The research discussed the business model of NFC solution. In the SEM analysis, we proposed the TRAUM model based on the UTAUT model, technology readiness model, and post-acceptance model to understand the user intention for the strategy in business model. With the results, the performance expectancy, effort expectancy, social influence, and facilitating condition are significant to affect the behavioral intention and continuance intention. It means the enterprise can put more resource in the soft strategy to strengthen the needs in user's mind and enhance the effect of the community. It can strengthen the using willingness of the consumers. Providing the security facilitating environment can also strengthen the using willingness of the consumers.

Based on the moderation effect, the enterprise should focus on the female group older than 36 years old group, and with the high voluntariness of use group. The research found the consumers of the three groups have the higher acceptance than other groups.

The TRAUM model offers the better explanation for the technology, e-services and mobile services. By the holistic analysis, the researcher can evaluate the intention, performance and discuss the appropriate strategies. The moderation effect can help

the researcher to understand the group of the consumers and make the segmentation marketing strategies.

In the DEMATEL analysis, we proposed the opinions from the experts. For the experts, the capabilities of the partners are the main affecting cause, especially in the emergence period. It focuses the importance of the implementation and allocation of the multi-source capabilities. The service offering is also important. The consumers will be attracted by the service offering and strengthen their continuance intention to use. On the other words, the service offering can enhance the performance expectancy, effort expectancy, social influence and satisfaction of the consumers. The security and authentication are also the important causes for the experts and the users. It is the facilitating condition construct in SEM analysis that the consumers care about.

TRAUM model can apply to the similar research field, such as technological application, mobile services, and electronics services. It discusses the tendency of the consumers, the acceptance intention, using behavior, and continuance intention for the consumers at the same time. It can help the scholar and the managers to understand the intention of the consumers easily and comprehensively.

In order to get the holistic view for NFC mobile services, the research combined the SEM methodology and DEMATEL methodology based on the opinions of users and experts. By the study, we can consider the opinions of the users and the experts to make the decision. For the decision making and business strategy, the holistic evaluation is necessary. The research considers the two different aspects and applies to the business strategy making. Results of the present study represent the most complete documentation to date in obtaining estimates of aspects of a complex event for using NFC mobile services.

These findings are in line with previous studies, although no previous study has asked this question in detail. Because these analyses complement each other, the

compatibility of the results is all the more impressive. We applied the results to the business strategy. In the discussion, we separated the business strategy as four domains based on the STOF business model and the quantitative findings. STOF business model is the most popular business model analyzed in mobile commerce.

In the research, we discuss the NFC business strategy and NFC mobile payment for NFC-Micro SD solution, the innovative solution in NFC field. The competitive advantage of NFC-Micro SD technology is the patent of packaging antenna module. It can provide the more convenient and cheaper solution, and apply in all the consumer electronics. The patent can also widen the gap between the competitors. The highly compatible feature is the most important key factor to get the bigger market share and offer more mobile services in the short time. The feature is also accepted more easily by the key issuers and the end users.

NFC-Micro SD solution keeps the original value network by replacing traditional plastic cards manufacturers and brings more profit to the roles in the new value network. It combines the NFC ecosystem and original service ecosystem successfully.

NFC mobile services offer a clear value proposition to end users and there is notable service demand for end users. In mobile services, mobile payments have the rapid growth in emerging markets. To improve the mobile payments ecosystem service providers, included the banks (the card issuers), the Perso Company, the information service providers, merchants, etc. By NFC-Micro SD solution, the players in value network generate the collaborative partners' relationship. The collaborative relationship can improve the loyalty of the partners and willingness to promotion.

In summary, the present research enhances the previous studies' findings by providing a much more detailed examination of NFC solution. This study has taken a step in the direction of defining the relationship between consumer's intention and business model in NFC field. The research also showed the multiple opinions from

the consumers and the experts. The two research approaches correspond to the business model qualitative analysis can have the most holistic view to evaluate the business model and the strategy to NFC mobile services. The research mode and TRAUM model can also apply in the similar research field, such as technological product promotion, electronics service, mobile services and so forth. By the TRAUM model and the research mode in this study, the scholar and the enterprise can easily to obtain the holistic intention, acceptance and the business strategy based on the analyses.



5.2 Limitation of the Study

In the research, we illustrated the business model by the several research methods, included SEM, DEMATEL, qualitative research, and so on. Although the present study has yielded findings that have both theoretical and practical implications, its design is not without flaws.

The first limitation is rooted in the short time allowed for the treatment. It is not within the scope of this paper to provide a long-term discussion of NFC business model and the strategies.

The second limitation concerns the emergence period of the NFC technology that there are not more users to contact with NFC technology. It is limited to our interpretations.

Another problem that often arises in data gathering has to do with the fact that such studies are often based on the survey, that is, the data are gathered through questionnaires, interviews, and so forth. Despite the large number of participants and the variety of this research, the design of the present study is not without limitations. The research is limited to compare the results of the various sessions and provide a more holistic view in NFC business model.

5.3 Recommendation for Future Research

Future studies should be alerted to the limitation of this study, but this is an exciting first step. The results of the present research suggest the following dimensions that might profitably be addressed by future researchers in the area.

- (1) The questionnaires are subject to constant revision and changes in order to be improved.
- (2) According to the technology readiness construct, the more participants are needed to classify the four groups and analysis their difference in the intention and behavior.
- (3) This research used DEMATEL to analysis the decision strategy based on the opinion of the experts. The future research can propose the priority of the decision making to provide the more useful reference for the practice.
- (4) This study does suggest that the detailed study of the intention of the users over time is a promising line of inquiry.
- (5) An additional interesting avenue of investigation might be to consider the more NFC mobile services developed.

While this study has its limitation, it is hoped that it can serve as a basis for further study in NFC business model and strategies.

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Appendix A: Constructs and measurements of TRAUM

壹、手機近場通訊服務應用之指標

※請依序填答，就您的看法分別圈選 7-1 等級，由同意(高 or 7)—不同意(低 or 1)

	現況						
	同意	←————→					不同意
預期的績效							
1. 我預期使用手機 NFC 進行行動服務是有用的。	7	6	5	4	3	2	1
2. 我預期使用手機 NFC 可增加行動服務的效率。	7	6	5	4	3	2	1
3. 我預期使用手機 NFC 可幫助我從事行動服務的相關活動。	7	6	5	4	3	2	1
4. 整體而言，我預期使用手機 NFC 所會帶來很滿意的成效。	7	6	5	4	3	2	1
預期的付出							
5. 我可以明瞭手機 NFC 可應用於哪些行動服務應用。	7	6	5	4	3	2	1
6. 對我而言，我預期能熟練的使用手機 NFC 以執行行動服務。	7	6	5	4	3	2	1
7. 對我而言，使用手機 NFC 執行行動服務並不困難。	7	6	5	4	3	2	1
8. 對我而言，學習使用手機 NFC 執行行動服務是容易的。	7	6	5	4	3	2	1
社群的影響							
9. 只要大多數對我有影響的人（同事、客戶、家人、朋友等）認為我可 以使用手機 NFC 來執行行動服務，我就會使用。	7	6	5	4	3	2	1
10. 只要大多數對我很重要的人（同事、客戶、家人、朋友等）認為我可 以使用手機 NFC 來執行行動服務，我就會使用	7	6	5	4	3	2	1
11. 我認為使用手機 NFC 執行行動服務能讓我得到比較多的注目。	7	6	5	4	3	2	1
12. 我認為，我處在的環境與團體會鼓勵支持我使用手機 NFC 來執行行 動服務。	7	6	5	4	3	2	1
配合的條件							
13. 當我要使用手機 NFC 來執行行動服務時，我可以很容易的找到相關 的資源（應用 app、教學資訊等）。	7	6	5	4	3	2	1
14. 我可以輕易的獲取使用手機 NFC 執行行動服務的相關知識。	7	6	5	4	3	2	1
15. 當我想要使用手機 NFC 來執行行動服務時，操作 app 對我而言很容 易。	7	6	5	4	3	2	1
16. 一旦遇到使用上的困難，我可以很快的利用各方面資訊（書籍、朋友、 網站等）來解決問題。	7	6	5	4	3	2	1
使用意願							
17. 我會願意使用手機 NFC 來執行各種行動服務應用。	7	6	5	4	3	2	1

	現況						
	同意	←	→	不同意			
18.當軟硬體與設定都具備時，我樂於使用手機 NFC 來執行各種行動服務應用。	7	6	5	4	3	2	1
19.我預計在未來會使用手機 NFC 來執行各種行動服務應用。	7	6	5	4	3	2	1
科技準備度							
20.我認為手機使我更能駕馭我的日常生活。	7	6	5	4	3	2	1
21.最新科技的手機產品和服務使用起來比較便利。	7	6	5	4	3	2	1
22.我喜歡用電腦處理事情，因為不會受到固定營業時間的限制。	7	6	5	4	3	2	1
23.在所能買到的手機產品中，我喜歡使用先進的手機產品。	7	6	5	4	3	2	1
24.我喜歡根據自己需求而修改電腦設定及軟體。	7	6	5	4	3	2	1
25.手機讓我的工作和生活更有效率。	7	6	5	4	3	2	1
26.新手機能夠吸引我的注意力。	7	6	5	4	3	2	1
27.手機產品帶給我更多的行動自由。	7	6	5	4	3	2	1
28.學習使用手機產品可以帶給我很多益處。	7	6	5	4	3	2	1
29.我相信手機會依照我的指令運作。	7	6	5	4	3	2	1
30.身旁的人（朋友、同事、家人等）會詢問我關於手機等科技產品的建議。	7	6	5	4	3	2	1
31.我認為身旁的朋友比我還熟悉各種新款的手機等科技產品。	7	6	5	4	3	2	1
32.當有新手機出現時，我通常是朋友中最初的使用者。	7	6	5	4	3	2	1
33.我通常不需要他人的幫助，就能理解並使用手機產品及其服務。	7	6	5	4	3	2	1
34.我對於跟上最新手機等科技的發展相當有興趣。	7	6	5	4	3	2	1
35.我很享受手機產品帶給我的各項挑戰。	7	6	5	4	3	2	1
36.我在使用手機產品時，比其他人遇到較少的問題。	7	6	5	4	3	2	1
37.我認為技術服務專線是沒幫助的，因為他們常使用我不懂的詞彙來解釋。	7	6	5	4	3	2	1
38.我認為，手機產品並不是設計給一般大眾所使用的。	7	6	5	4	3	2	1
39.我認為手機產品及相關服務的使用手冊內容難以理解。	7	6	5	4	3	2	1
40.當我從手機等科技產品或服務廠商端得到技術支援時，我有時會覺得自己好像被其他更瞭解技術的人佔了便宜。	7	6	5	4	3	2	1
41.當我要購買手機產品時，我偏好選擇基本款，而非有許多額外功能的智慧型手機。	7	6	5	4	3	2	1
42.當其他人發現我在使用手機等產品時遭遇到問題，我會覺得很尷尬。	7	6	5	4	3	2	1
43.我認為，用科技來取代重要人員的工作時要很小心，因為新科技可能會故障。	7	6	5	4	3	2	1
44.我認為，人們總在使用後才會發現新手機和科技對健康及安全上造成的風險。	7	6	5	4	3	2	1
45.我認為，新手機和服務會讓政府和企業更容易暗中監視著人們。	7	6	5	4	3	2	1

	現況						
	同意	←	→	不同意			
46.我認為，手機在緊急時刻總是會發生故障。	7	6	5	4	3	2	1
47.我認為在電腦上輸入信用卡卡號是不安全的。	7	6	5	4	3	2	1
48.我認為任何線上交易都是不安全的。	7	6	5	4	3	2	1
49.我擔心在網路上所傳送的資訊都會被其他人看見。	7	6	5	4	3	2	1
50.我不信任所有只能在網路上進行的交易。	7	6	5	4	3	2	1
51.我認為，任何線上交易，都必須再以書面形式做最後的確認。	7	6	5	4	3	2	1
52.只要使用線上作業，我都會非常小心的檢查手機或電腦是否出錯。	7	6	5	4	3	2	1
53.在進行交易時，我寧可面對人，而非透過機器。	7	6	5	4	3	2	1
54.當我打電話到客服專線或公司時，我寧可和人員交談，而非語音系統。	7	6	5	4	3	2	1
55.當透過手機或網路傳送資訊時，我無法確定資訊能否正確傳遞。	7	6	5	4	3	2	1
滿意度							
56.我肯定透過手機 NFC 來執行行動服務的功效。	7	6	5	4	3	2	1
57.我認為透過手機 NFC 來執行行動服務是值得信賴的。	7	6	5	4	3	2	1
58.我覺得透過手機 NFC 來執行行動服務是可信賴的。	7	6	5	4	3	2	1
59.我認為使用手機 NFC 來執行行動服務的決定是明智的	7	6	5	4	3	2	1
持續使用意圖							
60.我願意使用手機 NFC 功能去執行行動服務應用。	7	6	5	4	3	2	1
61.當我有需要行動服務時，我會使用手機 NFC 功能來執行。	7	6	5	4	3	2	1
62.我會推薦我的朋友使用手機 NFC 功能來執行行動服務。	7	6	5	4	3	2	1
自願性							
63.我會自願使用手機 NFC 來執行行動服務。	7	6	5	4	3	2	1

貳、手機近場通訊服務應用之狀況

本部分未了解實際應用之狀況，請根據以下題目之敘述，選出最符合您目前的實際狀況：

一、 請問您是否使用過手機 **NFC** 來執行行動服務：有 無

二、 請問您使用過以下哪些行動服務應用？（可複選）：

行動付款（例如：商店購物付款、線上購物付款、電子錢包等）

行動票券（例如：車票、門票、悠遊卡等）

線上轉帳

行動接受優惠訊息

行動接受各項資訊（例如：展覽資訊、旅遊資訊等）

線上教學

電子鑰匙（例如：旅館房門鑰匙、住家房門鑰匙等）

行動醫療服務（例如：掛號、提供個人健康建議、遠距醫療等）

- 智慧生活（例如：直接操控電視、燈光、廚具等家電）
- 行動辦公室
- 其他_____

三、請問您願意使用手機 NFC 來執行哪些行動服務應用？（可複選）：

- 行動付款（例如：商店購物付款、線上購物付款、電子錢包等）
- 行動票券（例如：以手機取代車票、門票、悠遊卡等）
- 行動線上轉帳（例如：手機對手機轉帳、手機對 ATM 轉帳等）
- 行動接受優惠訊息
- 行動接受各項資訊（例如：展覽資訊、旅遊資訊等）
- 線上教學
- 電子鑰匙（例如：旅館房門鑰匙、住家房門鑰匙等）
- 行動醫療服務（例如：掛號、提供個人健康建議、遠距醫療等）
- 智慧生活（例如：直接操控電視、燈光、廚具等家電）
- 行動辦公室（例如：手機打卡、手機直接傳輸資料、手機操控印表機等）
- 其他_____

四、請問您目前使用哪些行動裝置、數位系統、可攜消費性電子產品？（可複選）

- Android 系統手機
- Android 平版
- iPhone
- iPad
- Windows 手機
- 筆記型電腦
- 數位相機
- 數位攝影機
- MP3 播放器（包括播放器、錄放音筆、iPod、iSuffle 等）
- 其他_____



參、基本資料

以下資料僅做為整體分析之用，不會作個別之展示，敬請詳細填答，謝謝！

- 一、您的性別：男 女
- 二、您的教育程度：國中 高中（職） 大學(專科) 碩、博士 其它
- 三、您的年齡：18 歲以下 18~25 歲 26~35 歲 36~45 歲 46~55 歲
56 歲以上
- 四、有關使用行動服務（包括線上購物、手機讀取優惠、手機接收資訊、手機購票、手機上網學習等活動）的經驗：從來沒有 一年以下 一~三年
三~五年 五年以上

本問卷到此全部結束，非常謝謝您的填答

Appendix B: DEMATEL Questionnaire

- 一、構面與準則說明：請寫下您對下列描述的重視程度及滿意程度，說明如下：
完全不重視或完全不滿意 ← 0,1,2,3,4 → 非常重視或非常滿意。

構面	準則	內涵	該準則重要程度 非常不重要為 0 分； 非常重要為 4 分	該準則滿意程度 非常不滿意為 0 分； 非常滿意為 4 分
服務層面	顧客分群	針對所有顧客進行分群，分出主要客群及潛在客群等顧客群，並依之進行策略調整		
	方便使用性	當前提供之服務之便於使用性		
	價格	當前價格是否能吸引特定顧客		
	提供之服務	提供的服務內涵及未來銜接性		
財務層面	營收與成本	營收與成本之間的比例，回本，獲利等議題		
	風險	推出 NFC 服務及產品對財務上造成的風險		
	資源	包括人力，財務，知識等各方面有形及無形的資源，是否足夠運用		
技術層面	安全性	NFC 行動服務之安全性，包括網路安全性，設備安全性，使用安全性等等		
	驗證	NFC行動服務之各項加解密，驗證等機制設立		
	應用	提出之服務應用之技術能力層面是否完備		
	設備	NFC設備之普及性，便於取用性，相關配套設備之提供是否廣泛，與其他橋接設備之銜接應用，與現有設備是否易於銜接等NFC基礎建設		
層面 組織	價值鏈	整體的價值鏈是否健全，運作之流暢度		

合作伙伴之 協同策略	合作伙伴之間對於 NFC 產品 及其行動服務推廣，是否有相 對應之協同策略，運作時程， 以及策略目標等		
合作伙伴之 能力	合作夥伴之專長與能力是否能 夠相互配合，並充分發揮		

二、構面與準則相互間影響關係(兩兩比較)填寫方式說明

範例-填寫指標說明：0.無影響；1.低影

響；

2.中影響；3.高影響；4.極高影響

*若市場層面對於技術層面的影響

程度為極高影響，則在位置上填入 4

構面	市場層面	財務層面	技術層面	組織層面
市場層面		4		
財務層面				
技術層面				
組織層面				

(一)、構面影響關係之評比

構面	市場層面	財務層面	技術層面	組織層面
市場層面				
財務層面				
技術層面				
組織層面				

(0.無影響；1.低影響；2.中影響；3.高影響；4.

(二)、準則影響關係之評比 (0.無影響；1.低影響；2.中影響；3.高影響；4.極高影響)

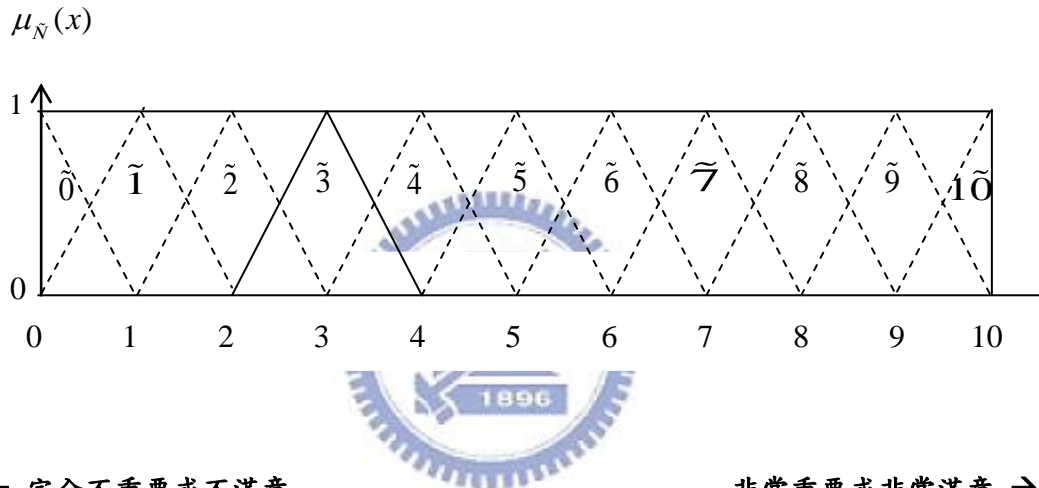
準則	顧客分群	方便使用性	價格	提供之服務	營收與成本	風險	資源	安全性	驗證	應用	設備	價值鏈	合作夥伴之協同策略	合作夥伴之能力
顧客分群	■													
方便使用性		■												
價格			■											
提供之服務				■										
營收與成本					■									
風險						■								
資源							■							
安全性								■						
驗證									■					
應用										■				
設備											■			
價值鏈												■		
合作夥伴之協同策略													■	
合作夥伴之能力														■

三、主觀感想模糊尺度調查：

「0~4」尺度之主觀感想

- 「0~4」尺度是本設定不同重要性程度的數值，而此部分填寫的意義，是我們可根據自己本身感認，對於不同重要性程度設定不同的數值填寫。如某人本身感認所謂的稍重要設定的區間數值為 (2, 3, 4)，即 $\tilde{3} = (2, 3, 4)$ 。
- 若感認的重要性所要設定的數值不是很明確，可填寫出區間值(低值，中值，高值)，若很明確則在填寫(低值，中值，高值)格子時，就填寫相同的數字。

圖示如下：



如 ← 完全不重要或不滿意

非常重要或非常滿意 →

請問您心目中主觀感認之 0-4 分，其每一個分數其實際的區間為何？。

例題： $\tilde{5} = (4, 5, 6)$

請問您主觀感認之三角模糊數的區間為：

$\tilde{0} = (\quad , \quad , \quad)$ $\tilde{1} = (\quad , \quad , \quad)$, $\tilde{2} = (\quad , \quad , \quad)$, $\tilde{3} = (\quad , \quad , \quad)$, $\tilde{4} = (\quad , \quad , \quad)$,

四、個人基本資料

1. 性別：男性 女性
2. 教育程度：專科 大學 碩士 博士
3. 服務部門：_____
4. 職務名稱：_____
5. 年齡：_____
- 30歲（含）以下 30~35歲（含） 35~40歲（含） 40~50歲（含）
50歲以上
7. 工作年資：_____
- 1年以內（含） 2~3年（含） 4~5年（含） 5~10年（含）
10年以上

問卷到此結束，麻煩您再次查閱是否全部作答完成，十分感謝您撥冗填寫，謹深致謝忱！

