

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/278160667>

The effects of product-related, personal-related factors and attractiveness of alternatives on consumer adoption of NFC-based...

Article in *Technology in Society* · June 2015

DOI: 10.1016/j.techsoc.2015.05.004

CITATIONS

11

READS

389

2 authors:



[Thanh-Thao T. Pham](#)

Yuan Ze University

1 PUBLICATION 11 CITATIONS

SEE PROFILE



[Jonathan C. Ho](#)

Yuan Ze University

29 PUBLICATIONS 138 CITATIONS

SEE PROFILE



The effects of product-related, personal-related factors and attractiveness of alternatives on consumer adoption of NFC-based mobile payments



Thanh-Thao T. Pham^{*}, Jonathan C. Ho

College of Management, Yuan Ze University, 135, Yuan-Tung Road, Chung-Li 32003, Taiwan

ARTICLE INFO

Article history:

Received 22 May 2015
Received in revised form
2 November 2015
Accepted 3 November 2015
Available online 10 June 2015

Keywords:

NFC mobile payments
Diffusion of innovations
Additional values of NFC mobile payments
Personal innovativeness in new technologies
Attractiveness of alternatives

ABSTRACT

The rapid evolution of mobile technologies and the increasing diffusion of smartphones have given significant opportunities for innovative companies to create new payment solutions and offer value-added services to their customers. Near Field Communication (NFC) mobile payment has been emerging as a noticeable phenomenon that can enable consumers to turn their smartphones into digital wallets. Although there has been a lot of coverage on consumer acceptance of mobile payments, there are only few researches providing guideline to interpret NFC-based mobile payments adoption.

Taking into consideration of theoretical backgrounds of innovation diffusion and specific characteristics of NFC mobile payments, this study proposes a research framework to provide a profound understanding of factors facilitating or impeding the adoption of NFC-based mobile payments among Taiwanese consumers. The results revealed that intention to adopt NFC mobile payments is affected by most of product-related factors, personal-related factors and attractiveness of alternatives.

This paper is able to advance literature on innovation adoption and facilitate technology marketers in NFC mobile payments. It provides a useful guideline to help researchers investigate issues related to NFC mobile payments. It also brings some managerial implications by assisting relevant parties in NFC mobile payments ecosystem such as mobile network operators, card issuers, payment processing institutions, bank decision makers and merchants when devising their business strategies and marketing campaigns to facilitate NFC mobile payments.

© 2015 Elsevier Ltd. All rights reserved.

1. Introduction

1.1. Motivation

Advances in wireless technology have increased the number of people using mobile devices and facilitated the rapid development of mobile commerce. Mobile commerce has emerged as the most important trend reshaping the retail landscape, and some retailers are even taking one step further to make a payment via a smartphone. In other words, as mobile phone technology becomes more sophisticated, new forms of payment have since appeared within the mobile payment theme. Near Field Communication (NFC) mobile payment has been emerging as a noticeable phenomenon that

can enable consumers to turn their smartphones into digital wallets. In the past, shopping in store has often been associated with either cash or card payments. Instead of using such traditional payment methods, a consumer can make a payment for transport fares and for in-store purchases by using their cell phone with the aid of the NFC technology. With the advancement of mobile devices and the emergence of NFC technology, payment today is a mere wave-of-the-phone.

Traditionally, the mobile telecommunication and financial industries are completely separated, each with their own distinct and defined sectors and markets [1]. However, nowadays, there are some collaboration between Mobile Operators and Banks to offer new kind of payment services. The recent development of NFC technology has enabled the emergence of payment services using mobile phones. Furthermore, this technological innovation initiated an ongoing evolution concerning payment transactions. Mobile devices were predicted to gradually substitute for the prevalent

^{*} Corresponding author. Tel.: +886 921 526 743.
E-mail address: thanhthao0511@gmail.com (T.-T.T. Pham).

function of credit cards [1,2].

According to Phneah [3], mobile payment is the fastest-growing application of NFC within the Asia region, aroused by factors such as high mobile device adoption and business maturity. There are different types of NFC applications today, which comprise identification, proximity payments, smart posters and e-tickets. Mobile payments, hence, are considered as “killer applications” for the region. Taiwan has been known as one of the four booming economies called “Asian Tigers”, the advantages of convenient and secure contactless payment solutions have been taking in this island. In wake of that, six companies in which Chunghwa Telecom plays a main role have formed a joint venture to launch a mobile wallet product in Taiwan. Particularly, MasterCard collaborated with Chunghwa Telecom, Cathay United Bank, China Trust Commercial Bank, Taishin International Bank and E-Sun bank to issue over-the-air to customers’ NFC-enabled SIMs [4].

Since NFC-based mobile payment is still in its infancy [5], it will require enthusiastic consumer adoption before it can truly take off. NFC-based mobile payment renders numerous benefits including quick purchasing of products, transferring of secure information by just touching devices. Such a payment method has allowed consumers to eliminate the use of cash while providing the added values of user-friendliness and fast transaction speed. Even though NFC-based mobile payments are invested by collaboration between mobile network operators (MNOs) and banks; there is still a poor understanding of consumer motivation for using NFC-based mobile payment. In addition, the adoption of NFC mobile payment is still not widespread despite its potential as documented, as indicated by Tan et al. [6].

The customers still hesitate to employ NFC mobile payment method to make a purchase while the companies would like to understand and get more details about the opportunity for new way of doing business stemming from such an NFC-based mobile payment [6,7]. In wake of that, although NFC mobile payment is emerging as a new stream of doing business and is forming a new trend of mobile payment as well, very little attention has been given to understand how to encourage and diffuse the new wave of NFC mobile payment.

Although there has been a lot of coverage on consumer acceptance of mobile payments, there are only few researches providing guideline to interpret NFC-based mobile payments adoption [6]. However, much effort has been conducted to analyze security aspects [8,9]. There is also lack of recommendations for enhancing prospective acceptance towards NFC-based mobile payments. In wake of that, it becomes very important to understand how to encourage the adoption of NFC-based mobile payments while there are a humble number of previous works discussing about this issue. It is necessary to understand factors facilitating or impeding the intention to adopt NFC-based mobile payments. In wake of that, we would like to investigate the antecedents of Consumer Adoption of NFC-based Mobile Payments.

1.2. Research objective and questions

As mentioned earlier, the literature reflects remarkably little effort to develop a framework for understanding the feasibility of NFC-based mobile payments from customers’ perspectives. The research objective is mentioned as following:

- Providing a deeper understanding of factors facilitating or impeding the intention to adopt NFC-based Mobile payments.

In order to achieve the research objective, there are some research questions which should be dealt with as following:

- What are the main factors affecting the intention to adopt NFC-based mobile payments? And how do these factors influence the intention?
- What are the main obstacles that need to be overcome in order to speed up NFC mobile payment adoption?

The remainder of this paper is organized as follows. The first section reviews the literature of innovation adoption theory and briefly describes the proposed research model. The following section presents the methodology used to test and verify the proposed hypotheses. The results are then analyzed using SPSS Statistics 19.0 and AMOS 19.0. Finally, the specific contributions and managerial implications of the paper are discussed.

2. Background of the research and proposed research framework

A variety of theoretical perspectives have been advanced to provide an understanding of the determinants of usage. In other words, the consumers’ intention to use new technology can be explained from various frameworks. Among those, widely accepted frameworks which have been developed include the Theory of Reason Action, TRA (Fishbein and Ajzen [10]), Technology Acceptance Model, TAM (Davis [11]), Theory of Planned Behavior, TPB (Ajzen [12]), Diffusion of Innovations, DOI (Rogers [13]), and the Unified Theory of Acceptance and Use of Technology, UTAUT (Venkatesh et al. [14]). After reviewing existing literature in terms of new technology adoption, we found that Diffusion of Innovations (DOI) and Technology Acceptance Model (TAM), respectively proposed by Rogers [13] and Davis [11] have been widely used as the primary theoretical frameworks for understanding and explaining individuals adoption behavior of new technology.

Davis’s [11] Technology Acceptance Model (TAM) was designed to measure how consumers come to accept and use a technology, but accounted for how perceived usefulness and perceived ease of use affect attitudes. As TAM was originally built to ease managing information system activities in the workplace by measuring the quality of delivered systems (Davis [11]), the primary stress of the TAM-related research perspectives remained confined to interpret adoption process within organizational settings, according to Yang et al. [15]. Although TAM is purportedly used to explicate the technology adoption within organization, the constructs of the model are actually meant to be general and universal, according to Phan & Daim [16]. The authors utilized TAM and integrated the identified factors to formulate their proposed model and then they re-emphasized that perceived ease of use and perceived usefulness are top two factors that affect the adoption of mobile services. In order to give more useful recommendations, Phan & Daim [16] and Benbasat & Barki [17] suggested that more attractive factors should be added to reach more comprehensive understanding of what influences adoption of information systems (IS) in general and mobile services in particular.

The Diffusion of Innovations theory (DOI) which is one of the most influential theories in IS has been widely used to investigate factors that influence an individual’s decision to adopt an innovation or a new technology. The DOI model suggests that individuals will only choose to adopt an innovation if it presents five characteristics, namely relative advantage, compatibility, complexity, observability, and trialability. In wake of that, DOI highlights the importance of technology characteristics in IT adoption and diffusion. Lai et al. [18] stated that the strength of DOI stems from its comprehensive, cumulative experience of innovation characteristic evaluation. DOI is considered as a better model than TAM in predicting the intention to adopt a new technology since it complements TAM in enriching its perceived usefulness and perceived

ease of use constructs, as shown by Plouffe et al. [19].

Taking into consideration of theoretical backgrounds of innovation diffusion and specific characteristics of NFC mobile payments, this study proposed a research framework to provide a profound understanding of factors facilitating or impeding the adoption of NFC-based mobile payments among Taiwanese consumers.

Particularly, this research is based upon well-known Diffusion of Innovations theory (Rogers [13]) and consists of additional factors that are based on the specific characteristics of NFC-based mobile payments to bring a fuller understanding of factors influencing intention to adopt NFC-based mobile payments.

As mentioned earlier, DOI has been widely used to examine factors that influence an individual to adopt an innovation or a new technology such as the use of spreadsheet software or smart card [20]. The DOI recognizes that while the technical attributes of the innovation per se may be not significant, perceptions of technology do matter and are important factors influencing technology adoption. The DOI model suggests that an individual's decision to adopt or reject the innovation is predicated upon five key perceptions about the characteristics of such innovation: relative advantage, compatibility, complexity, observability, and trialability. The concept of "relative advantage" is similar to that of "perceived usefulness" [21–23], mentioned in Davis's [11] TAM and perceived usefulness is used to replace relative advantage in this study. Similarly, "complexity" is replaced by "perceived ease of use" in this study. Moreover, prior works showed that payment transactions are conducted privately [24,25], thus observability is disregarded in the present study. However, this model still cannot bring a comprehensive view to explain the technology acceptance in terms of considering specific characteristics of NFC mobile payments. As the result, this research takes into consideration of theoretical backgrounds of innovation diffusion and specific characteristics of NFC mobile payments to develop a proposed research framework in order to understand factors encouraging or hindering the adoption of NFC-based mobile payments.

This study focuses on perceived innovation attributes, personal-related factors, trust, and attractiveness of alternatives as explanatory and predictive variables for behavioral intention to adopt NFC-based mobile payment. The research model is proposed to address this issue. All variables hypothesized in this study and natures of their expected relationships with intention to adopt NFC-based mobile payment are discussed next.

2.1. Product-related factors and intention to adopt NFC-based mobile payments

2.1.1. Perceived usefulness

The first characteristic of new technology which should be considered is perceived usefulness. Perceived usefulness refers to the degree to which an individual believes that using a particular system would enhance his or her job performance [11].

In order to persuade consumers to adopt NFC payment, this method should disclose more advantages than existing payment methods (e.g., cash, credit card or debit card payment) do. When people realize that mobile payment can deliver values that other payment services cannot offer, they may develop a positive intention to adopt the mobile payment services. According to Tan et al. [6] and Zmijewska [26], the benefit of NFC payment is described in terms of quicker checkout because the transaction is conducted via a wave-of-the-phone and signature is not required.

NFC payment enables consumers to eliminate the use of cash or credit cards while offering the fast transaction speed. According to a report announced by VeriFone [27], contactless payment can cut down individual transaction times by 10–15 s. This speed of service

is attractive enough in busy retail environments. In addition, the speed of NFC payment was announced as six seconds faster than those conducted via PayPass cards [28]. Previous studies have concluded that customers who perceive clear benefits and usefulness offered by e-commerce or mobile payment, they are more likely to form the intention to use it [29–31]. If consumers perceive that the adoption of NFC payment can increase their efficiency in their transaction, they are more likely to use such a payment method. Hence, the following hypothesis is proposed:

Hypothesis 1: The perceived usefulness has a positive effect on the intention to adopt NFC mobile payments.

2.1.2. Perceived ease of use

Another characteristic of new technology which is mentioned in TAM model and DOI theory is perceived ease of use. Perceived ease of use is the degree to which given technology is perceived as easy to understand and operate [32]. An application or innovation perceived to be easier to use than another is more likely to be accepted by users. In line with previous studies conducted by Al-Majali [21], Agarwal [33] and Cheng & Huang [34], we assume that consumers who find m-commerce, mobile tagging system as easy to use will be likely to adopt NFC mobile payments. The following hypothesis is thus proposed:

Hypothesis 2: The perceived ease of use has a positive effect on the intention to adopt NFC mobile payments.

2.1.3. Compatibility

Compatibility refers to how well a technology fits an individual's working style, lifestyle, values and needs [13,35]. Compatibility is posited as one of the main determinants for the innovation spread process with the high compatibility perceived by the individuals leading to the speedy adoption of any new ideas or technologies in general and mobile payments in particular. Prior researches showed that over two-third of the financial transaction services failed to meet the needs of customers since traditional channels did not offer the ubiquity provided by a mobile channel [36,37].

Several researchers posited that compatibility is one of most significant indicators of adoption [15,20,36]. Regarding NFC mobile payment systems, the greater the compatibility of new payment services with users' general habits and their ways to use services with the mobile phone is, the more likely consumers form the intention to adopt it. In other words, when a user can well integrate the new payment services into his or her daily life, the compatibility of NFC mobile payment with the individual's existing lifestyle and habits is expected to have impact on his or her intention to adopt it. Thus, proposed hypothesis is given as below:

Hypothesis 3: An individual's compatibility with using NFC payments to make a purchase has a positive effect on the intention to adopt NFC mobile payments.

2.1.4. Perceived risk & perceived cost of using NFC mobile payments

Due to the higher levels of uncertainty that are associated with services, services are considered to be more risky than products. Previous studies revealed that perceived risk was considered as a major factor preventing consumers from adopting an innovation in general and mobile commerce in particular [29,31]. As shown by Lu et al. [30], approximately 75% of consumers today worry about security and transaction risks. In order to adopt mobile payment services, users have to evaluate the uncertainty and risk related to the adoption of the technology. Perceived risk refers to the subjective expectation of a loss or sacrifice in using a risky technology [38]. Tan and Teo [25] concluded that risk was introduced as an additional dimension in studying diffusion and adoption. If potential customers who perceive NFC payment as a risky activity, they are not willing to adopt NFC payment. Along with perceived

risk, consumers were concerned with costs when using mobile payment services [15,36,39]. Those researches showed that perceived risk and perceived cost are two major barriers to adopt new technology. In this study, perceived cost is defined as the extent to which an individual believes that using NFC mobile payment will cost money. Based on that, the following hypotheses are proposed:

Hypothesis 4: Perceived risk of using NFC payments has a negative effect on the intention to adopt NFC mobile payments.

Hypothesis 5: Perceived cost of using NFC payments has a negative effect on the intention to adopt NFC mobile payments.

2.1.5. Trialability

Trialability is defined as the degree to which an innovation might be experimented on a limited basis [13]. Rogers [13] suggests that the trialability contributes to achieving some sort of comfort among the customers and the users who may be later become more willing to adopt this innovation. Tan and Teo [25] concluded that if the user gets the chance to experiment with a new technology, this will reduce his or her feelings of fear concerning the usage of this technology. Thus, proposed hypothesis is given as below:

Hypothesis 6: Trialability has a positive effect on the intention to adopt NFC mobile payments.

2.1.6. Additional values of NFC mobile payments

According to bankingtech [40], the capacity for NFC mobile payments cannot merely be a solution to a customer problem. Customers currently enjoy a variety of ways to pay for goods, the majority of which are well-known and trusted by consumers. Customers are unlikely to switch to NFC mobile payments unless additional services add value, and give them a reason to do so [41]. Promotion of discounts and offers through customers' mobile phones for payments using NFC could provide one means of delivering this added value, appealing customer to convert to new payment method. As shown by Card Technology Today [42], real-time e-coupon download and customization towards their personal shopping habits are additional values as major advantages of NFC mobile payment. In this research, we assume that if consumers perceive that NFC mobile payment will offer additional values when doing transaction, they are more likely to use this payment method. Therefore, we hypothesize that:

Hypothesis 7: Intention to adopt NFC mobile payments is positively affected by additional values of NFC payments.

2.2. Personal-related factors and intention to adopt NFC-based mobile payments

Interest in the individual differences is growing in the user behavior studies of mobile payments [15,43]. In this study, we will test two individual difference constructs, namely personal innovativeness in new technologies and absorptive capacity that have been deemed important in information system and mobile service literature. From the perspective of mobile commerce, it seems that individual differences have been generally expected to be related to m-commerce usage [44].

2.2.1. Personal innovativeness in new technologies

The study investigates two additional factors: personal innovativeness and absorptive capacity. First of all, personal innovativeness is a key individual difference characteristic influencing the adoption of an innovation, and relates to the users' willingness to embrace a new information technology [45]. Personal innovativeness was defined in the domain of information technology as "the willingness of an individual to try out any new information technology", according to Agarwal and Prasad [33]. Highly innovative

users are more willing to integrate new technologies into their daily routine by confronting with the uncertainty of innovative technologies [46] since they are risk-takers and have high levels of self-confidence about their online purchase behaviors. They are information explorers actively seeking new ideas and accepting the associated dangers and uncertainties [45]. According to Yang et al. [15], difference in consumers' personal innovativeness should be taken into account to facilitate the adoption of mobile payment services. Previous studies showed that innovative users are more likely to explore and adopt different mobile payment services [34,43]. In wake of that, this study argues that individuals with a higher level of innovativeness with respect to new technologies are expected to increase intention to adopt NFC mobile payments. Hence, we propose the following hypothesis:

Hypothesis 8: Personal innovativeness positively affects intention to adopt NFC mobile payments.

2.2.2. Absorptive capacity

Over the last two decades, the researchers have paid considerable attention on the concept of absorptive capacity in the literature. Absorptive capacity was firstly introduced by Cohen and Levinthal [47]. Based on the work of that, many studies employed this concept when doing researches in strategic innovation, organizational learning and information technology [48,49]. Absorptive capacity was defined originally as a firm's ability to identify the value of new, external information, assimilate it, and apply it for commercial purposes [47]. Although the definition differs slightly among researchers, we rely on the definition of user absorptive capacity mentioned by Park et al. [48] and Suh et al. [50]. In those studies, user absorptive capacity refers to the ability of an organizational member to value, assimilate, and apply new knowledge. In wake of that, user absorptive capacity is classified into three interrelated components. The first component is a person's capacity for understanding external knowledge. The user can use prior related knowledge to facilitate this acquisition phase. Second, a user's capacity for assimilating knowledge is the user's ability to internalize new knowledge into his or her task. Finally, a user's knowledge utilization capacity is the ability of individual to apply the new knowledge to the task.

Absorptive capacity is not only applied in researches at organizational level but this concept is also used to study users' adoption of new technology. Particularly, Lee et al. [51] showed that an individual's absorptive capacity directly affects the intention to use mobile financial services. Based on that, Pham & Ho [41] proposed to apply the concept of absorptive capacity to NFC-based mobile payment adoption. In this paper, we argue that the ability of a person to recognize the value of NFC mobile payment, assimilate it, and apply it to make a payment is critical to his or her intention to adopt NFC mobile payment. In other words, we assume that if individuals have prior knowledge of mobile applications and payments and have ability to apply that knowledge in NFC mobile payments, they can more easily understand NFC-based mobile payment technology and more likely to accept NFC mobile payments. Thus, it leads to the hypothesis as following:

Hypothesis 9: Absorptive capacity positively affects intention to adopt NFC mobile payments.

2.3. Trust and intention to adopt NFC-based mobile payments

Trust has long been considered as a catalyst in consumer–marketer relationships since it can facilitate successful transactions [52]. Consumers' perceived trust in e-payment systems refers to consumers' belief that e-payment transactions will be processed in accordance with their expectations [53,54]. Kim et al. [55] showed that increases in trust will directly and positively affect

purchase intentions. According to Kim et al. [55] and Lee [56], trust is especially important element influencing consumer behavior in uncertain environments such as electronic commerce. Unless service providers make customer trust, it is exceedingly difficult to attain widespread acceptance of a new technology or service. In wake of that, we expect that trust is also likely to be a critical factor affecting NFC mobile payment adoption. Based on the arguments above, we propose the following hypothesis:

Hypothesis 10: Customer trust positively affects intention to adopt NFC mobile payments.

2.4. Attractiveness of alternatives and intention to adopt NFC-based mobile payments

Attractiveness of alternatives is defined as the extent to which customers perceive that viable competing alternatives are available in the marketplace [57]. Prior studies found that attractiveness of alternatives has negative effect on behavioral intention to use a technology or service [5,57,58]. Since NFC mobile payment solutions are still in their infancy, established substitutes with strong network externalities (e.g., cash, credit card or debit card) may be a big barrier to their adoption [5,41]. In wake of that, we expected that users' comparative recognition in substitutes of NFC mobile payments can affect the intention to adopt NFC mobile payments [41]. If alternatives have relative advantage in making a payment compared to NFC mobile payments, users are likely to choose and stay in the attractive alternatives. Conversely, if existing substitutes lack necessary appeal to attract and keep customers' loyalty, there is a chance for NFC mobile payments to fill in a gap. The following hypothesis is therefore proposed:

Hypothesis 11: Attractiveness of alternatives negatively affects intention to adopt NFC mobile payments.

Based on those hypotheses, the proposed research model is developed to illustrate the relationships between the independent variables and the dependent variables (As seen in Fig. 1).

3. Methodology

The proposed model was verified using measurement assessments. To examine the measurement instruments, a set of sample

items was generated for each construct. We also conducted exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) for proposed model. The convergent validity and the goodness-of-fit of the research model were also verified, and the structural model was empirically tested to investigate the strength and direction of the relationship between the theoretical constructs.

3.1. Measurements and instrument design

Regarding the operationalization of each construct, multi-item scales for the twelve constructs were primarily adopted from previous studies with wording changes as required to adjust them to NFC mobile payments context. All items were measured on a five-point Likert scale, ranging from strongly disagree (1) through neutral (3) to strongly agree (5). The resulting questionnaire items for the study were shown in Appendix A.

3.2. Data-collection process

In order to test the proposed research model, a survey research was conducted as a research method. The process of data collection consisted of 2 steps, namely pilot survey and main survey. First, a pilot survey was carried out to alert about any difficulties that were not anticipated or should be dealt with before conducting the main survey. Self-administered questionnaire was used as instrument for data collection. Due to the national language, questionnaire was translated into Chinese. In order to avoid any cultural bias and ensure the validity, the questionnaire was modified and pretested on five academicians and ten practitioner customers. They were required to assess the terminology, clarity of instructions and response format. The further problems with the measures and response format thus could be detected. The questionnaire was revised to make it clearer and a main survey was conducted. Sampling method was used in this study is a combination of convenience, judgment and snowball sampling. Data was collected from respondents in Taiwan by a web-based survey. Since NFC mobile payment is still in its early stage of diffusion in Taiwan and it has its own specific characteristics, survey participation was limited to non-NFC mobile payment users with a cell phone and a bank

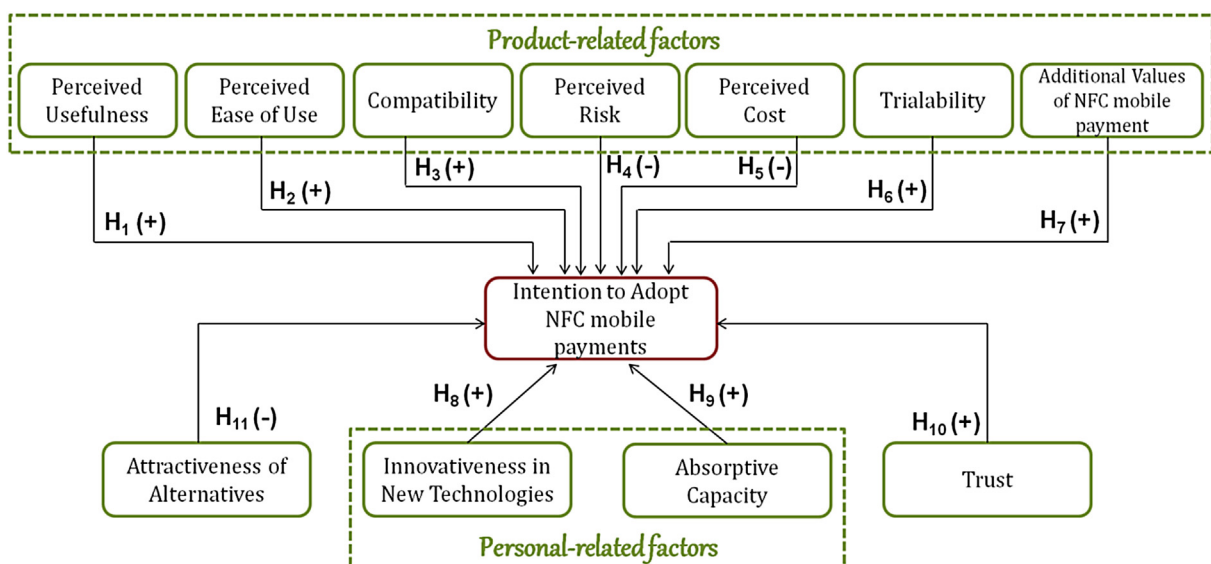


Fig. 1. Proposed research framework.

account. A total of 402 respondents participated between November 5th, 2014, and December 25th, 2014. Demographic profiles of respondents are summarized in Appendix B.

4. Data analysis and results

4.1. Assessing the measurement model

The measurement model consists of relationships among the latent factors and the observed variables underlying each construct. The measurement model must show a satisfactory level of reliability and validity, before testing for significant relationships in the structural model [59,60].

A two-phase analysis was conducted for the measurement

model. The first phase used EFA with principal component analysis and varimax rotation to purify the scales. Based on the recommended value with respect to factor loading suggested by Hair et al. [61], items with loadings less than .50 were discarded. The scales were then subjected to CFA using AMOS with maximum likelihood estimation to assess the construct validity and convergent validity.

First of all, an EFA with varimax rotation was performed and all measures still loaded on their own constructs affecting the intention to adopt mobile banking, and only one of the measures for innovativeness was removed from this step (Table 1). The Kaiser–Meyer–Olkin's (KMO) sampling adequacy and Barlett's sphericity test verified the suitability of conducting an EFA. As the result, eleven factors explaining 78.286% of the total variance have been extracted.

Table 1
Summary of exploratory factor analysis.

	Components											
	1	2	3	4	5	6	7	8	9	10	11	
PU1	.774											
PU2	.797											
PU3	.725											
PU4	.753											
PU5	.714											
PU6	.774											
PEOU1						.744						
PEOU2						.509						
PEOU3						.594						
PEOU4						.712						
PEOU5						.791						
COMPAT1									.710			
COMPAT2									.825			
COMPAT3									.815			
RISK1				-.842								
RISK2				-.859								
RISK3				-.836								
RISK4				-.822								
TRIAL1								.760				
TRIAL2								.753				
TRIAL3								.867				
COST1												.897
COST2												.901
ADDVALU1											.801	
ADDVALU2											.791	
ADDVALU3											.727	
INNOV1								.874				
INNOV2								.788				
INNOV4								.872				
AC1		.817										
AC2		.817										
AC3		.804										
AC4		.837										
AC5		.782										
AC6		.766										
TRUST1			.910									
TRUST2			.858									
TRUST3			.907									
TRUST4			.861									
ATTOFALT1					.869							
ATTOFALT2					.885							
ATTOFALT3					.891							
ATTOFALT4					.866							
Initial eigenvalue	12.647	3.554	3.106	2.917	2.367	2.064	1.790	1.465	1.399	1.236	1.117	
% Variance explained	10.814	9.854	8.289	8.168	7.625	6.846	6.291	5.495	5.467	5.015	4.421	
Cumulative% variance explained	10.814	20.668	28.957	37.126	44.751	51.596	57.887	63.382	68.849	73.864	78.286	
KMO	0.856											
Sig. value	0.000											

Note: COMPAT = Compatibility, PU = Perceived Usefulness, PEOU = Perceived Ease of Use, TRIAL = Trialability, RISK = Perceived Risk, COST = Perceived Cost, ADDVALU = Additional Values of NFC mobile payments, INNOV = Innovativeness in New Technologies, AC = Absorptive Capacity, TRUST = Trust-based Factors, ATTOFALT = Attractiveness of Alternatives.
Bold values mean significant factor loadings.

Table 2
Model goodness-of-fit statistics.

Fit index	Results	Acceptable threshold levels	Suggested by authors
CMIN/df	2.587	<3.0	Hair et al. [61]; Karin & Helfried [53]; Kline [54]
CFI	0.927	>0.9	Hair et al. [61]; Karin & Helfried [53]; Hu & Bentler [55]
RMSEA	0.063	<0.08	Hair et al. [61]; MacCallum et al. [56]; McQuitty [57]
SRMR	0.0425	<0.08	Hair et al. [61]; Hu & Bentler [55]

In the second phase, the measurement model was estimated using CFA to test how well the observed variables represent their own latent factors as well as to examine whether the constructs possess sufficient validation and reliability. Specifically, the adequacy of the measurement model was assessed through examining the goodness-of-fit indices, the convergent validity of the measures associated with each construct, and the discriminant validity of each construct [61].

4.1.1. The goodness-of-fit indices

According to Hair et al. [61], three or four fit indices can be used to provide adequate evidence of model fit. Among these indices, the performance of the Comparative Fit Index (CFI) suffers least affected by sample size [62] and is thus used here. Hence, multiple fit indices including the Chi-Square value and its associated degrees of freedom (CMIN/df), the CFI, the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Residual (SRMR) are used to assess the model's goodness-of-fit, with the final results of the measurement model presented in Table 2.

As seen in Table 2, the results of model goodness-of-fit indicate that the measurement model achieves a good overall fit. In particular, the Chi-Square value relative to degrees of freedom (CMIN/df) is less than the cut-off value of 3.00, suggesting an acceptable fit [63,64]. In addition, the CFI of 0.927 is recognized as indicative of a good fit [61,63,65]. Root mean square error of approximation (RMSEA) also indicates the acceptable fitness of the model since its RMSEA value is below the threshold level of 0.08 [61,66,67]. Finally, Standardized RMR (SRMR) value is below the threshold level of 0.08, indicating a reasonable fit [61,65]. As the result, the measurement model provides good fits to the data.

4.1.2. Convergent validity

Following Hair et al. [61], we use factor loadings, variance extracted and reliability (consisting of Cronbach's Alpha and composite reliability) as indicators to estimate the relative amount of convergent validity.

The reliability coefficient and composite reliability (CR) for all of

constructs exceed 0.7, indicating internal consistency between multiple measurements of a construct [61]. As shown in Table 3, Cronbach's alpha scores exceed the acceptable value of 0.7 and composite reliabilities of constructs range from 0.744 to 0.941. In addition, all average variance extracted (AVE) values, ranging from 0.525 to 0.833, satisfy the criterion of explaining at least 50% of variance extracted among a set of items underlying the latent construct. As a result, the scales for evaluating the constructs are deemed to achieve convergent validity.

4.1.3. Discriminant validity

As seen in Table 4, the requirements of discriminant validity are satisfied since all AVE values are greater than the squared correlation between the constructs in the measurement model [59,61].

4.2. Empirical testing of the structural models

To test the proposed hypotheses, a structural equation model using Amos with the maximum likelihood estimation was used to assess the relationships among the theoretical constructs for the structural model. The results are summarized in Table 5 and Fig. 2.

As shown in Table 5 and Fig. 2, 8 out of the 11 hypotheses are significant. Particularly, perceived usefulness ($\beta = 0.258$, $p = 0.000$), compatibility ($\beta = 0.242$; $p = 0.000$), trialability ($\beta = 0.101$; $p = 0.017$), additional values of NFC mobile payments ($\beta = 0.160$; $p = 0.000$), innovativeness in new technologies ($\beta = 0.114$; $p = 0.002$) and absorptive capacity ($\beta = 0.111$; $p = 0.001$) have positive significant effect on intention to adopt NFC mobile payments while perceived risk ($\beta = -0.148$; $p = 0.000$) and attractiveness of alternatives ($\beta = -0.103$; $p = 0.001$) have negative significant relationships with intention to adopt NFC mobile payments. As the result, hypotheses H₁, H₃, H₄, H₆, H₇, H₈, H₉ and H₁₁ are supported. In wake of that, intention to adopt NFC mobile payments is jointly predicted by these factors and the squared multiple correlations show that the structural model explains 83% of the variance of intention to adopt NFC mobile payments. On the other hand, perceived ease of use ($\beta = 0.054$, $p > 0.05$), perceived

Table 3
Results of convergent validity analysis.

Constructs	Construct identifiers	Cronbach's alpha	CR	AVE
Perceived Usefulness	PU	0.864	0.822	0.607
Perceived Ease of Use	PEOU	0.738	0.744	0.525
Compatibility	COMPAT	0.902	0.882	0.713
Perceived Risk	RISK	0.940	0.941	0.800
Trialability	TRIAL	0.845	0.846	0.733
Perceived Cost	COST	0.842	0.853	0.746
Additional Values of NFC mobile payments	ADDVALU	0.796	0.803	0.672
Innovativeness in New Technologies	INNOV	0.926	0.936	0.833
Absorptive Capacity	AC	0.898	0.898	0.640
Trust	TRUST	0.933	0.921	0.747
Attractiveness of Alternatives	ATTOFALT	0.914	0.924	0.754
Intention to Adopt Mobile Banking	INTENT	0.890	0.890	0.801
Acceptable threshold levels		>0.7	>0.7	>0.5

Table 4
Correlation squared and average variance extracted.

	PU	PEOU	COMPAT	RISK	TRIAL	COST	ADDVALU	INNOV	AC	TRUST	ATTOFALT	INTENT
PU	0.607											
PEOU	0.437	0.525										
COMPAT	0.480	0.263	0.713									
RISK	0.317	0.182	0.299	0.800								
TRIAL	0.322	0.204	0.231	0.113	0.733							
COST	0.019	0.014	0.044	0.035	0.000	0.746						
ADDVALU	0.242	0.280	0.189	0.149	0.127	0.008	0.672					
INNOV	0.151	0.191	0.086	0.170	0.108	0.023	0.232	0.833				
AC	0.163	0.098	0.097	0.089	0.026	0.002	0.035	0.058	0.640			
TRUST	0.078	0.064	0.085	0.067	0.069	0.009	0.084	0.099	0.029	0.747		
ATTOFALT	0.071	0.011	0.067	0.059	0.047	0.005	0.008	0.008	0.006	0.012	0.754	
INTENT	0.503	0.417	0.572	0.438	0.330	0.045	0.367	0.277	0.190	0.107	0.108	0.801

Note: (1) The AVE is shown on the diagonal of the matrix in bold.

Note: (2) The squared correlations are shown off the diagonal.

Table 5
Summary of hypotheses testing results.

Hypothesis	Paths	Standardized estimate	t-Value	P	Supported
H ₁	PU → INTENT	0.258	3.423	0.000*	Yes
H ₂	PEOU → INTENT	0.054	1.068	0.286	No
H ₃	COMPAT → INTENT	0.242	4.442	0.000*	Yes
H ₄	RISK → INTENT	-0.148	-3.617	0.000*	Yes
H ₅	COST → INTENT	-0.063	-1.884	0.060	No
H ₆	TRIAL → INTENT	0.101	2.378	0.017**	Yes
H ₇	ADDVALU → INTENT	0.160	3.556	0.000*	Yes
H ₈	INNOV → INTENT	0.114	3.053	0.002*	Yes
H ₉	AC → INTENT	0.111	3.262	0.001*	Yes
H ₁₀	TRUST → INTENT	0.001	0.044	0.965	No
H ₁₁	ATTOFALT → INTENT	-0.103	-3.278	0.001*	Yes

Note: *p < 0.001, **p < 0.05.

COMPAT = Compatibility, PU = Perceived Usefulness, PEOU = Perceived Ease of Use, TRIAL = Trialability, RISK = Perceived Risk, COST = Perceived Cost, ADDVALU = Additional Values of NFC mobile payments, INNOV = Innovativeness in New Technologies, AC = Absorptive Capacity, TRUST = Trust-based Factors, ATTOFALT = Attractiveness of Alternatives, INTENT = Intention to Adopt NFC-based mobile payments.

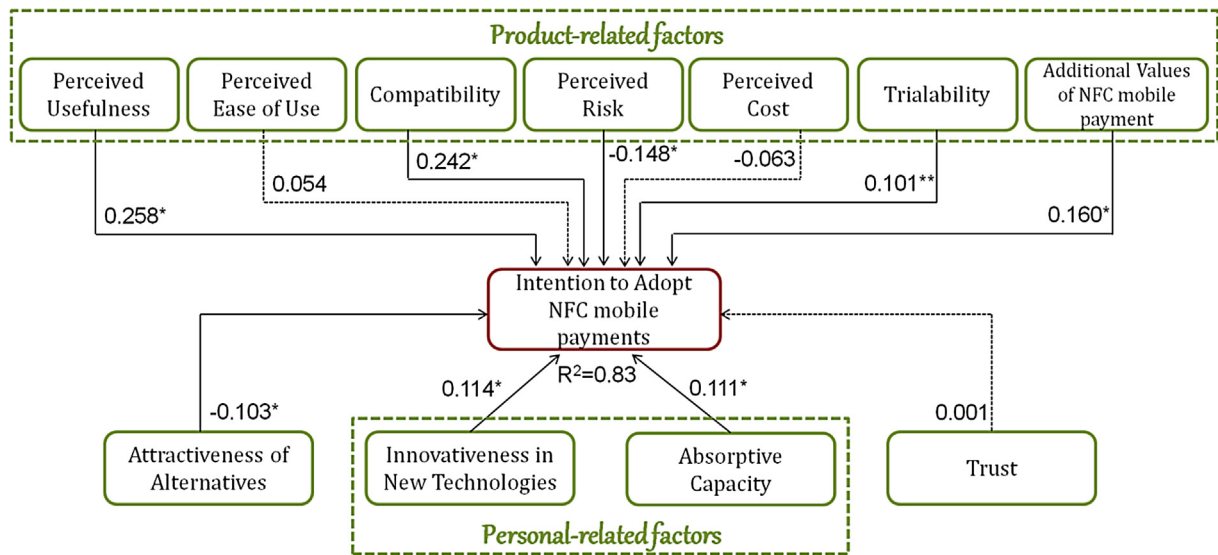
cost ($\beta = -0.063$, $p > 0.05$) and trust ($\beta = 0.001$, $p > 0.05$) insignificantly affect intention to adopt NFC mobile payments. Therefore, hypotheses H₂, H₅ and H₁₀ are rejected.

5. Discussion and conclusion

Based on the results of data analysis, it can be concluded that the study exhibited the appropriateness of the proposed research model and related hypotheses for investigating behavioral intention to adopt NFC mobile payments. The overall explanatory power of the research model achieved an R-square of 83% for intention to adopt NFC mobile payments. As such, behavioral intention to adopt NFC mobile payments was jointly demonstrated by perceived usefulness, compatibility, perceived risk, trialability, additional values of NFC mobile payments, innovativeness in new technologies, absorptive capacity and attractiveness of alternatives. Several insightful findings could be summarized from our research framework. Not surprisingly, perceived usefulness and compatibility appeared to be the most important drivers of the adoption of NFC mobile payments. These findings were consistent with those of previous studies which suggested that perceived usefulness and compatibility with values, beliefs, and past experiences were considered as most influential factors in determining the adoption rate of a particular innovation. Particularly, perceived usefulness was deemed as the most important antecedent of usage intention toward mobile financial services, as concluded by Lee et al. [51]. Similarly, Hanafizadeh et al. [36] indicated that compatibility was proved to have the strongest positive impact on consumers'

intention to adopt Mobile banking, followed by perceived usefulness.

Along with these findings, additional value of NFC mobile payments that was added as a new construct in the proposed research model was found to be the third most important factor of behavioral intention to adopt NFC mobile payments. It is interesting finding emerging from this study. Given these findings, it can be concluded that consumers will not adopt new contactless payment method unless such a payment method offers better performance and uniqueness that cannot be found in any existing payment methods in the marketplace. According to Gemalto – the world leader in digital security [68], along with major banks and operators launching mobile NFC services in Taiwan, the country is all set for mass adoption. In wake of that, there have been previous contactless pilot schemes and NFC-enabled mobile transactions and payments are going to take off in Taiwan. As such, it could be said that NFC-based mobile payment is still in its infancy. In early stage of technology adoption, the early adopters' self-perception about product's utility was demonstrated to be primary driver to technology adoption, as shown by Lee et al. [69]. As the reason, the majority of consumers are unfamiliar with the service and there are established payment methods that also affect consumers' willingness to try NFC mobile payments. In line with this observation, the authors suggest that in order to speed up consumer acceptance of NFC mobile payments, the marketers should invest considerably in building and emphasizing what NFC mobile payments can offer uniquely and better than established substitutes to persuade consumers to adopt it. Otherwise, service providers must try to



Note:
 * p < 0.001; ** p < 0.05
 ———> denotes supported; - - - - -> denotes unsupported.

Fig. 2. Results of the structural modeling analysis.

understand the life styles and needs of their potential customers and try to highlight outstanding characteristics of new payment methods in line with their life styles and needs when designing message and commercializing NFC mobile payments.

Another finding reveals that perceived risk was the fourth most important factor affecting intention to adopt NFC mobile payments. In addition, it was also the most important inhibitor to the adoption of NFC mobile payments, followed by attractiveness of alternatives. This result is similar to the findings presented in previous studies, which indicated that perceived risk is also one of the critical factors that need to be considered when designing, launching and promoting new payment services to their customers (e.g. Refs. [36,53,70]). As the reason, along with the newness of NFC mobile payment method, cultural aspect might be another reason to make perceived risk deserve consideration. Taiwan has high uncertainty avoidance culture, as shown by Hofstede's work on national cultures [71]. Members in such society are more influenced by the perceived risk since they considered the risk of technology important in the decision-making. To decrease perceived risk, service providers should make the necessary investment to ensure a stable and secure NFC payment infrastructure, and otherwise act to dispel customer anxieties about transaction and data security while using this kind of payment method. Minimizing the risk of malfunction and vagueness in transaction process and providing multiple levels of authentication will appeal more to customers' intentions to conduct transaction via NFC mobile payments.

It is interesting that personal-related factors (i.e. personal innovativeness in new technologies, absorptive capacity) were found to be influential drivers of NFC mobile payment adoption. The finding on the relationship between personal innovativeness and NFC mobile payment adoption is consistent with prior studies (e.g. Refs. [6,15]). This indicates that users with a high degree of innovativeness are more likely to explore and adopt NFC mobile payment service. Hence, marketing strategies should be formed to attract innovators and early adopters. Moreover, the absorptive capacity of individuals which was identified as one of two personal-

related factors was taken into consideration to study intention to adopt NFC mobile payments. The study showed that absorptive capacity has significant effect on intention to adopt NFC mobile payments. It implies that service providers should give potential customers more opportunities to learn about the services. If consumers have enough information on state-of-art of NFC mobile payments and know how to apply related knowledge to perform tasks using NFC mobile payments, it might increase their willingness to conduct transactions via NFC mobile payment method.

The study took attractiveness of alternatives into consideration to investigate intention to adopt NFC mobile payments. As the reason, consumers do not only consider product-related factors per se but they also make comparison among different kinds of payment methods to pick up one of them as their choice in the decision-making process. Established alternatives with strong network externalities might be a big obstacle to NFC mobile payment adoption. An interesting finding revealed that attractiveness of alternatives was identified as important factor to impede intention to adopt NFC mobile payments. The relevant parties in NFC payment ecosystem should work together to bring opportunities for consumers to use and become familiar with such a mobile payment method.

Last but not least, trialability appears to contribute to some degree to the intention to adopt NFC mobile payments. Since NFC mobile payment is still in infancy, the customers thus could not imagine how NFC mobile payments work. All of them contribute the necessary of trialability to positive intention to adopt such a new service. The approach that can be taken in this regard is experience marketing. The finding suggests that service providers should allow potential users to test the NFC mobile payment system by providing step-by-step demonstrations in multiple media formats (online, broadcast advertising, promotional literature, etc.) or organizing a marketing campaign to give consumers opportunities to test demo of NFC mobile payments and experiment with proximity "contactless" interaction with nearby contactless terminals and devices to see how NFC mobile payments can facilitate the transaction process.

Perceived ease of use was found to have insignificant effect on intention to adopt NFC mobile payment. This finding is contradictory with previous studies (e.g. Refs. [6,21,34]) that indicated that an application or innovation is perceived to be easy to use, it will lead to positive intention to adopt it. Due to the newness of this payment method in Taiwan, consumers may not be able to form unequivocal perceptions of whether it would be difficult to use.

Contrary to our expectation, perceived cost was found to have no link with intention to adopt NFC mobile payments. This is inconsistent with those of previous studies which concluded that perceived cost had an adverse effect on mobile payment adoption and it discourages consumers from using mobile payments. It might be caused partly by our respondents' demographic profile. There were 52.5% of our respondents own NFC-enabled mobile device. It might contribute to insignificant effect of perceived cost on NFC mobile payments.

One surprising result is that trust was found to insignificantly affect the intention to adopt of NFC-based mobile payments. This finding is contradictory with some previous research (e.g., [53,56,55]). As mentioned earlier, NFC mobile payment is still in its early stage, relevant parties have been working together to form a joint venture to launch NFC mobile wallet product. The possible explanation might be that consumers have not known yet about the roles of different parties involved in NFC payment ecosystems. They might have misgivings about who will be liable and responsible for any errors in transaction process or unauthorized transaction.

6. Contributions, limitations and future research

This work aims to develop an integrated model to predict and explain consumers' behavioral intentions to adopt NFC-based mobile payments. The proposed model incorporated seven product-related factors, two personal-related factors, trust and attractiveness of alternatives to provide a more comprehensive investigation covering both the positive and negative aspects of NFC-based mobile payments. The results revealed that the proposed model has good explanatory power and confirms its robustness in predicting consumers' willingness to adopt such a new payment method.

There are some research contributions of this study for both researchers and practitioners. This study is able to advance literature on innovation adoption and facilitate technology marketers in NFC mobile payments.

6.1. Theoretical implications

From the theoretical perspective, this study has contributed to the existing literature by identifying the key factors affecting NFC mobile payments which have been paid little attention by current scholars. Taking into consideration of theoretical backgrounds of innovation diffusion and specific characteristics of NFC mobile payments, this study proposed a research framework to provide a profound understanding of factors facilitating or impeding the adoption of NFC-based mobile payments among Taiwanese consumers. The research revealed that intention to adopt NFC mobile payments is affected by product-related factors (i.e., perceived usefulness, compatibility, additional values of NFC mobile payments, perceived risk and trialability), personal-related factors (i.e., personal innovativeness in new technologies, absorptive capacity), and attractiveness of alternatives. However, product-related factors seem to have stronger effect on intention to adopt NFC mobile payments than personal-related factors do. With regard to the product-related factors, additional value of NFC mobile payments

was added as a new construct in proposed research framework. In wake of that, we expected to make a difference between perceived usefulness and additional values of NFC mobile payments. Furthermore, attractiveness of alternatives was taken into account to investigate the willingness of consumers to use NFC mobile payments in this study. The study brought a comprehensive understanding about how to encourage and facilitate NFC-based mobile payment adoption. It provided a useful guideline to help researchers investigate issues related to NFC mobile payments.

6.2. Managerial implications

The findings indicated that intention to adopt NFC mobile payments was accelerated by building and increasing perception of usefulness, compatibility, additional values of NFC mobile payments, personal innovativeness, absorptive capacity and trialability. In addition, perceived risk and attractiveness of alternatives were determined as the primary challenging problems that impede the process of adopt NFC mobile payments. As such, service providers will know how to allocate resources to attract potential customers to try and adopt such a service. It also brought some managerial implications by assisting relevant parties in NFC mobile payments ecosystem such as mobile network operators, card issuers, payment processing institutions, bank decision makers and merchants when devising their business strategies and marketing campaigns to facilitate NFC mobile payments.

Since NFC mobile payment solutions are still in their infancy, the study implies that customers are unlikely to adopt NFC mobile payments unless service providers shed some light on the outstanding characteristics and differentiation of NFC-based mobile payments. The marketers should emphasize what NFC-based mobile payments can offer uniquely and better than established substitutes. From the perspective of mobile commerce, it seems that individual differences have been generally expected to be related to NFC mobile payment acceptance. In this study, we tested and demonstrated that two individual differences constructs, namely personal innovativeness in new technologies and absorptive capacity, have been deemed important in information system and mobile service literature. Based on that, we suggest that marketers and service providers should classify the market into different segmentations, customize, promote and offer services to suit the specific needs of consumers.

6.3. Limitations and future research directions

This study suffers from some limitations which should be dealt with in future work. A larger sample size is required in future studies in order to get better model fit indices. Even though the proposed integrated research model provides a clearer explanation on intention to adopt NFC mobile payments, the same research framework can be replicated and examined in different countries. In wake of that, future research should be carried out to empirically verify the proposed research model to see its validity across different cultures.

Continuing with this stream of research, we also plan to examine the applicability of the research model in different categories of product and new technologies. In addition, although trust was found to have no effect to predict intention to adopt NFC mobile payments, we would like to conduct a longitudinal study in the future in order to investigate our research model in different periods of time and make comparisons, thus providing more consistent insight towards consumers' willingness to adopt NFC mobile payments.

Appendices

Appendix A. Measurement items

Constructs or statements	Adopted from:
<p>Perceived usefulness: I perceive that my purchase would be more quickly using NFC payment I perceive that my purchasing tasks would be more easily using NFC payment NFC payment would enhance my effectiveness in purchasing. NFC payment would enhance my efficiency in making a purchase NFC payment would enable me to make better decisions in making a purchase. Overall, I would find NFC payment useful.</p>	Tan et al. (2013); Mallat et al. (2009); Tan and Teo (2000); Davis (1989)
<p>Perceived ease of use: Learning to use NFC payment would be easy for me. NFC payment would be easy to understand. Getting the information I want from NFC payment would be easy. It would be easy for me to become skillful at using NFC payment. (Knowing shortcut keys or advanced options) I would find NFC payment easy to use.</p>	Tan et al. (2013); Luarn and Lin (2005); Davis (1989)
<p>Compatibility: Using NFC payment would be compatible with my lifestyle. Using NFC payment would fit well with the way I like to manage my finances. Using NFC payment to make a purchase would fit into my working style.</p>	Yang et al. (2012); Tan and Teo (2000)
<p>Perceived risk: I think using NFC payment for conducting transaction would have a potential risk. Information concerning my transactions via NFC payment would be known to others. My savings would be in jeopardy if I use NFC payment to purchase. Information concerning my transactions via NFC payment could be tampered with by others.</p>	Brown et al. (2003); Tan & Teo (2000)
<p>Trialability: I want to be able to test NFC mobile payment first. I want to be able to use it on a trial basis first to see what it can do. I want to see a trial demo first.</p>	Brown et al. (2003); Tan & Teo (2000)
<p>Perceived cost: It would cost a lot to use NFC mobile payment. There are financial barriers (e.g., having to pay for handset and communication time) to my using NFC mobile payment.</p>	Yang et al. (2012); Lu et al. (2011); Luarn & Lin (2005);
<p>Additional value of NFC payments: Using NFC mobile payment would help me easily keep up-to-date promotion of discounts and e-coupon. Using NFC mobile payment would facilitate the customization towards my personal shopping habits. Overall, using NFC mobile payment would bring additional value when doing transaction.</p>	Bankingtech (2013); Card Technology Today (2007); Pham & Ho (2014)
<p>Innovativeness in new technologies: If I heard about a new information technology, I would look for ways to experiment with it. Among my peers, I am usually the first to try out new information technologies. In general, I am hesitant to try out new information technologies.[®] I like to experiment with new information technologies.</p>	Yang et al. (2012); Rogers (1995)
<p>Absorptive capacity: I have the necessary knowledge to understand NFC mobile payment services. I have the technical competence to absorb NFC mobile payment services. I have a clear understanding of the goals, tasks, and responsibilities of mobile payment services like NFC mobile payment. I have information on state-of-the art of mobile financial services. I have the capability to achieve the objectives of tasks by using NFC mobile payment. I can apply the knowledge derived from mobile payment to perform tasks using NFC mobile payment.</p>	Lee et al. (2012); Cohen and Levinthal (1990); and Park et al. (2007)
<p>Trust: I trust each participant involved in process of making purchase via NFC payment I trust the security mechanisms of process of making purchase via NFC payment I trust the process of making purchase via NFC payment I trust the information provided during the process</p>	Changsu Kim et al. (2010)
<p>Attractiveness of alternatives: If I need to change payment services, there are other good services to choose from. I would probably be happy with other payment methods than NFC payment. Compared to NFC payment, there are other payment methods with which I would probably be equally or more satisfied. Compared to NFC payment, there are not very many other payment methods with which I would probably be equally or more satisfied.[®]</p>	Jones et al. (2000); Kim et al. (2011)
<p>Intention to adopt NFC payment: I intend to make a purchase via NFC payment in the near future. I intend to increase my use of NFC payment to make a purchase in the near future. I will recommend others to use NFC payment to make a purchase if it is provided.</p>	Tan and Teo (2000); Kim et al. (2008)

Appendix B. Profile of the respondents

Variable	Category	(N = 402)	
		Frequency	%
Gender	Male	210	52.2
	Female	192	47.8
Age	18 – Under 25	128	31.8
	25 – Under 30	151	37.6
	30 – Under 40	85	21.1
	40 – Under 50	35	8.7
	50 and above	3	0.8
Work status	Executive	49	12.2
	White-collar worker	115	28.6
	Worker	47	11.7
	Self-employed	50	12.4
	Student	62	15.4
	Expert	67	16.7
	Retiree	3	0.8
	Other	9	2.2
Education	High school or below	5	1.3
	Junior college	105	26.1
	University	191	47.5
	Post Matric	101	25.1
Kind of cell phone	Basic phone	25	6.2
	Feature phone	103	25.6
	Smartphone	274	68.2
Own NFC-enabled mobile device	Yes	210	52.5
	No	192	47.8
Heard about NFC-based mobile payment	Yes	132	32.8
	No	270	67.2

Appendix C. Exploratory factor analysis

	Rotated component matrix ^a										
	Component										
	1	2	3	4	5	6	7	8	9	10	11
PU1	.774	.132	.095	.085	-.064	.274	.211	.125	.135	-.002	.056
PU2	.797	.107	.047	.128	-.082	.190	.210	.126	.166	.075	-.025
PU3	.725	.186	.073	.238	-.060	.104	-.066	.201	.142	.187	.015
PU4	.753	.194	.036	.254	-.048	.171	.053	.135	.127	.175	.010
PU5	.714	.162	.192	.221	-.109	.101	.018	.087	.084	.019	-.195
PU6	.774	.099	.164	.102	-.076	.195	.062	.169	.245	.059	-.111
PEOU1	.233	.120	.033	.170	-.063	.744	.142	.162	.136	.050	.055
PEOU2	-.013	.032	.003	.100	-.022	.509	-.110	.242	.006	.093	.036
PEOU3	.290	.078	.204	.146	-.076	.594	.101	.013	.133	.180	-.170
PEOU4	.285	.185	.057	.123	-.025	.712	.197	.065	.094	.085	-.090
PEOU5	.271	.117	.106	.072	.011	.791	.182	.076	.155	.156	-.033
COMPAT1	.205	.107	.158	.200	-.092	.133	.126	.174	.710	.065	-.143
COMPAT2	.245	.055	.102	.232	-.121	.141	.027	.118	.825	.092	-.066
COMPAT3	.284	.134	.075	.177	-.094	.187	.023	.147	.815	.115	-.005
RISK1	-.184	-.078	-.124	-.842	.133	-.135	-.130	-.118	-.143	-.026	.058
RISK2	-.199	-.122	-.092	-.859	.016	-.127	-.144	-.042	-.144	-.094	.027
RISK3	-.199	-.074	-.081	-.836	.082	-.136	-.154	-.146	-.121	-.086	.096
RISK4	-.231	-.137	-.024	-.822	.143	-.143	-.138	-.020	-.141	-.089	.035
TRIAL1	.187	.057	.120	.118	-.148	.159	.082	.760	.130	.103	-.029
TRIAL2	.270	.031	.168	.062	-.065	.150	.153	.753	.079	.058	-.019
TRIAL3	.187	.042	.013	.102	-.082	.176	.081	.867	.153	.055	.081
COST1	-.058	-.029	.003	-.043	-.016	-.013	-.077	.033	-.048	-.102	.897
COST2	-.074	.006	.082	-.104	-.057	-.047	-.035	.000	-.081	-.062	.901
ADDVALU1	.023	.054	.178	.099	-.109	.083	.153	.166	.157	.801	-.099
ADDVALU2	.227	.035	.125	.134	.044	.240	.178	.062	.126	.791	.099
ADDVALU3	.167	.113	-.058	.054	.009	.186	.246	.005	-.042	.727	-.277
INNOV1	.104	.121	.196	.161	-.046	.171	.874	.074	.013	.172	-.083
INNOV2	.111	.111	.112	.237	.013	.009	.788	.142	.093	.181	-.007
INNOV4	.149	.106	.168	.151	-.059	.164	.872	.092	.038	.178	-.074
AC1	.178	.817	.109	.084	-.029	.096	.048	.090	.114	-.010	-.036
AC2	.117	.817	.098	.134	.002	.010	.030	.059	.117	.074	.006
AC3	.003	.804	.008	.122	.011	.088	.009	-.087	.047	.082	.023
AC4	.088	.837	.051	-.014	-.075	.072	.109	.034	.081	-.001	-.024

(continued)

	Rotated component matrix ^a										
	Component										
	1	2	3	4	5	6	7	8	9	10	11
AC5	.186	.782	.034	.101	.018	.053	.101	-.049	.006	.056	-.007
AC6	.084	.766	-.104	-.035	-.048	.084	.030	-.114	-.093	-.006	-.015
TRUST1	.081	.022	.910	.107	-.035	.092	.055	.056	.059	.021	.079
TRUST2	.148	.059	.858	.086	-.051	.075	.127	.077	.071	.099	-.005
TRUST3	.078	.061	.907	.097	-.039	.072	.085	.037	.053	.032	.065
TRUST4	.106	.018	.861	-.016	-.064	.015	.139	.098	.075	.069	-.048
ATTOFALT1	-.086	-.047	-.078	-.047	.869	-.033	-.071	-.065	-.111	.013	-.022
ATTOFALT2	-.160	-.021	-.042	-.111	.885	-.013	.064	-.097	-.124	-.053	-.011
ATTOFALT3	-.054	-.016	-.057	-.063	.891	-.094	.011	-.022	-.079	-.025	.068
ATTOFALT4	-.001	-.021	-.007	-.078	.866	.018	-.076	-.079	.074	.000	-.107

Extraction method: Principal Component Analysis.

Rotation method: Varimax with Kaiser Normalization.

Bold values mean significant factor loadings.

^a Rotation converged in 7 iterations.

References

- [1] O.M. Zea, D. Lekse, A. Smith, L. Holstein, Understanding the current state of the NFC payment ecosystem: a graph-based analysis of market players and their relations, *Enfoque UTE 3* (2012) 13–32.
- [2] Wilcox H, 2011, Jan. 27, 2014. NFC mobile payments to drive contactless transactions to reach nearly \$50 billion worldwide by 2014. Available: <http://juniperresearch.com/viewpressrelease.php?pr=246>.
- [3] Phneah E, 2012, Dec. 27, 2013. Mobile payments top NFC application in Asia. Available: <http://www.zdnet.com/mobile-payments-top-nfc-application-in-asia-2062305176/>.
- [4] NFCworld, 2013, Nov. 5th, 2013. Chunghwa launches NFC payments in Taiwan. Available: <http://www.nfcworld.com/2013/05/29/324283/chunghwa-launches-nfc-payments-in-taiwan/>.
- [5] D.L. Amoroso, R. Magnier-Watanabe, Building a research model for mobile wallet consumer adoption: the case of mobile suica in Japan, *J. Theor. Appl. Electron. Commer. Res.* 7 (2012) 94–110.
- [6] G.W.-H. Tan, K.-B. Ooi, S.-C. Chong, T.-S. Hew, NFC Mobile Credit Card: the Next Frontier of Mobile Payment?, *Telematics and Informatics*, 2013.
- [7] A. Shatskikh, Consumer Acceptance of Mobile Payments in Restaurants, Master, Department of Hospitality Administration, College of Hospitality and Technology Leadership University of South Florida, Graduate School Theses and Dissertations, 2013.
- [8] G. Madlmayr, J. Langer, C. Kantner, J. Scharinger, NFC devices: security and privacy, in: *Third International Conference on Availability, Reliability and Security*, 2008, pp. 642–647.
- [9] S. u. Rehman, J. Coughlan, An efficient mobile payment system based on NFC technology, *World Acad. Sci. Eng. Technol.* 78 (2013) 1695–1698.
- [10] M. Fishbein, I. Ajzen, *Belief, Attitude, Intention and Behavior: an Introduction to Theory and Research*, Addison-Wesley, Reading, MA, 1975.
- [11] F.D. Davis, Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Q.* 13 (1989) 319–339.
- [12] I. Ajzen, The theory of planned behavior, *Org. Behav. Hum. Decis. Process* 50 (12/1991) 179–211.
- [13] E.M. Rogers, *Diffusion of Innovations*, third ed., Free Press, New York, 1983.
- [14] V. Venkatesh, M.G. Morris, B.D. Gordon, F.D. Davis, User acceptance of information technology: toward a unified view, *MIS Q.* 27 (2003) 425–478.
- [15] S. Yang, Y. Lu, S. Gupta, Y. Cao, R. Zhang, Mobile payment services adoption across time: an empirical study of the effects of behavioral beliefs, social influences, and personal traits, *Comput. Hum. Behav.* 28 (2012) 129–142.
- [16] K. Phan, T. Daim, Exploring technology acceptance for mobile devices, *J. Ind. Eng. Manag.* 4 (2011) 339–360.
- [17] I. Benbasat, H. Barki, Quo vadis TAM? *J. Assoc. Inf. Syst.* 8 (2007) 211–218.
- [18] V.S. Lai, P.Y.K. Chau, X. Cui, Examining internet banking acceptance: a comparison of alternative technology adoption models, *Int. J. Electron. Bus.* 8 (2010) 51–79.
- [19] C. Plouffe, J. Hulland, M. Vanderbosch, Richness versus parsimony in modeling technology adoption decision – understanding merchant adoption of a smart card-based payment, *Inf. Syst. Res.* 12 (2001) 208–222.
- [20] N. Mallat, M. Rossi, V.K. Tuunainen, A. Öörni, The impact of use context on mobile services acceptance: the case of mobile ticketing, *Inf. Manag.* 46 (4/2009) 190–195.
- [21] M. Al-Majali, N. Kamariah, Modeling the antecedents of internet banking service adoption (IBSA) in Jordan: a structural equation modeling (SEM) approach, *J. Internet Bank. Commer.* 16 (2011) 1–15.
- [22] G.C. Moore, I. Benbasat, Development of an instrument to measure the perceptions of adopting an information technology innovation, *Inf. Syst. Res.* 2 (1991) 192–212.
- [23] S. Taylor, P.A. Todd, Understanding information technology usage: a test of competing models, *Inf. Syst. Res.* 6 (1995) 144–176.
- [24] M. Al-Majali, The use of theory reasoned of action to study information technology in Jordan, *J. Internet Bank. Commer.* 16 (2011) 1–11.
- [25] M. Tan, T.S.H. Teo, Factors influencing the adoption of internet banking, *J. Assoc. Inf. Syst.* 1 (2000) 1–42.
- [26] A. Zmijewska, Evaluating wireless technologies in mobile payments – a customer centric approach, in: *Proceedings of the Fourth International Conference on Mobile Business (ICMB)*, Sydney, Australia, 2005.
- [27] VeriFone, A Cashless Future on the Horizon, 2010. http://www.verifone.co.uk/media/1420610/VeriFone_Cashless_Future_Contactless.pdf.
- [28] Finextra, Motorola and MasterCard to Trial Contactless Mobile Payments, 2004, Jan. 27. Available, <http://www.finextra.com/news/fullstory.aspx?newsitemid=12684>.
- [29] I. Brown, Z. Cajee, D. Davies, S. Stroebel, Cell phone banking: predictors of adoption in South Africa— an exploratory study, *Int. J. Inf. Manag.* 23 (2003) 381–394.
- [30] Y. Lu, S. Yang, P.Y.K. Chau, Y. Cao, Dynamics between the trust transfer process and intention to use mobile payment services: a cross-environment perspective, *Inf. Manag.* 48 (12/2011) 393–403.
- [31] R. Safeena, N. Hundewale, A. Kamani, Customer's adoption of mobile-commerce: a study on emerging economy, *Int. J. e-Educ. e-Bus. e-Manag. e-Learn.* 1 (2011) 228–233.
- [32] H.-F. Lin, An empirical investigation of mobile banking adoption: the effect of innovation attributes and knowledge-based trust, *Int. J. Inf. Manag.* 31 (2011) 252–260.
- [33] R. Agarwal, J. Prasad, The antecedents and consequences of user perceptions in information technology adoption, *Decis. Support Syst.* 22 (1998) 15–29.
- [34] Y.-H. Cheng, T.-Y. Huang, High speed rail passengers' mobile ticketing adoption, *Transp. Res. Part C: Emerg. Technol.* 30 (5/2013) 143–160.
- [35] R. Agarwal, J. Prasad, The role of innovation characteristics and perceived voluntariness in the acceptance of information technologies, *Decis. Sci.* 28 (1997) 557–582.
- [36] P. Hanafizadeh, M. Behboudi, A. Abedini Koshksaray, M. Jalilvand Shirkhani Tabar, Mobile-banking adoption by Iranian bank clients, *Telemat. Inf.* 31 (2/2014) 62–78.
- [37] B. Hourahine, M. Howard, Money on the move: opportunities for financial service providers in the 'Third Space', *J. Financ. Serv. Mark.* 9 (2004) 57–67.
- [38] J.C. Sweeney, G.N. Soutar, L. Johnson, The role of perceived risk in the quality-value relationship: a study in a retail environment, *J. Retail* 75 (1999) 77–105.
- [39] P. Luarn, H.-H. Lin, Toward an understanding of the behavioral intention to use mobile banking, *Comput. Hum. Behav.* 21 (2005) 873–891.
- [40] Bankingtech, NFC Mobile Payments: Overcoming the Barriers for Banks, Available, 2013, <http://www.bankingtech.com/151452/nfc-mobile-payments-overcoming-the-barriers-for-banks/>.
- [41] Pham TTT, Ho JC. What are the core drivers in consumer adoption of NFC-based mobile payments?: A proposed research framework. In: *Management of engineering & technology (PICMET)*, 2014 Portland International Conference on, 2014, pp. 3041–9.
- [42] CardTechnologyToday, Taiwanese survey reveals mobile payment preference over cards, *Card. Technol. Today* 19 (7/2007) 16.
- [43] C.M. Cheah, A.C. Teo, J.J. Sim, K.H. Oon, B.I. Tan, Factors affecting Malaysian mobile banking adoption: an empirical analysis, *Int. J. Netw. Mob. Technol.* 2 (2011) 149–160.
- [44] C. Kim, M. Mirusmonov, I. Lee, An empirical examination of factors influencing the intention to use mobile payment, *Comput. Hum. Behav.* 26 (5/2010) 310–322.
- [45] E.M. Rogers, *Diffusion of Innovations*, fifth ed., Free Press, New York, 2003.
- [46] E.M. Rogers, *Diffusion of Innovations*, fourth ed., Free Press, New York, 1995.

- [47] [W.M. Cohen, D.A. Levinthal, Absorptive capacity: a new perspective on learning and innovation, *Adm. Sci. Q.* 35 \(1990\) 128–152.](#)
- [48] [J.-H. Park, H.-J. Suh, H.-D. Yang, Perceived absorptive capacity of individual users in performance of Enterprise Resource Planning \(ERP\) usage: the case for Korean firms, *Inf. Manag.* 44 \(4/2007\) 300–312.](#)
- [49] [S.A. Zahra, G. George, Absorptive capacity: a review, reconceptualisation, and extension, *Acad. Manag. Rev.* 27 \(2002\) 185–203.](#)
- [50] [H.J. Suh, J.H. Park, H.D. Yang, K.S. Shin, Individual absorptive capacity and the performance of using ERP: knowledge transfer perspective, *Korean Manag. Rev.* 34 \(2005\) 651–681.](#)
- [51] [Y.-K. Lee, J.-H. Park, N. Chung, A. Blakeney, A unified perspective on the factors influencing usage intention toward mobile financial services, *J. Bus. Res.* 65 \(11/2012\) 1590–1599.](#)
- [52] [P.H. Schurr, J.L. Ozanne, Influences on exchange processes: buyers' pre-conceptions of a seller's trustworthiness and bargaining toughness, *J. Consum. Res.* 11 \(1985\) 939–953.](#)
- [53] [N. Mallat, Exploring consumer adoption of mobile payments – a qualitative study, *J. Strateg. Inf. Syst.* 16 \(2007\) 413–432.](#)
- [54] [C. Kim, W. Tao, N. Shin, K.-S. Kim, An empirical study of customers' perceptions of security and trust in e-payment systems, *Electron Commer. Res. Appl.* 9 \(1/2010\) 84–95.](#)
- [55] [D.J. Kim, D.L. Ferrin, H.R. Rao, A trust-based consumer decision-making model in electronic commerce: the role of trust, perceived risk, and their antecedents, *Decis. Support Syst.* 44 \(2008\) 544–564.](#)
- [56] [T. Lee, The impact of perceptions of interactivity on customer trust and transaction intentions in mobile commerce, *J. Electron Commer. Res.* 6 \(2005\) 165–180.](#)
- [57] [M.A. Jones, D.L. Mothersbaugh, S.E. Beatty, Switching barriers and repurchase intentions in services, *J. Retail* 76 \(Summer 2000\) 259–274.](#)
- [58] [H.-W. Kim, Y.-S. Jeon, S. Choi, Attractiveness of Alternatives in Information Systems Continuance: a Case of Wimax, Presented at the the 11th International DSI and the 16th APDSI Joint Meeting, Taipei, Taiwan, 2011.](#)
- [59] [C. Fornell, D.F. Larcker, Evaluating structural equations models with unobservable variables and measurement error: algebra and statistics, *J. Mark. Res.* 18 \(1981\) 382–388.](#)
- [60] [P. Ifinedo, Acceptance and continuance intention of web-based learning technologies \(WLT\) use among university students in a Baltic country, *Electron J. Inf. Syst. Dev. Ctries.* 23 \(2006\) 1–20.](#)
- [61] [J.F. Hair, W.C. Black, B.J. Babin, R.E. Anderson, R.L. Tatham, *Multivariate Data Analysis*, sixth ed., Pearson Prentice Hall, Upper Saddle River, New Jersey, 2006.](#)
- [62] [D. Hooper, J. Coughlan, M.R. Mullen, Structural equation modelling: guidelines for determining model fit, *Electron J. Bus. Res. Methods* 6 \(2008\) 53–60.](#)
- [63] [S.-E. Karin, M. Helfried, Evaluating the fit of structural equation models: tests of significance and descriptive goodness-of-fit measures, *Methods Psychol. Res.* 8 \(2003\) 23–74. Online 2003.](#)
- [64] [R.B. Kline, *Principles and Practice of Structural Equation Modeling*, second ed., The Guilford Press, New York, 2005.](#)
- [65] [L.T. Hu, P.M. Bentler, Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives, *Struct. Equ. Model.* 6 \(1999\) 1–55.](#)
- [66] [R.C. MacCallum, M.W. Browne, H.M. Sugawara, Power analysis and determination of sample size for covariance structure modeling, *Psychol. Methods* 1 \(1996\) 130–149.](#)
- [67] [S. McQuitty, Statistical power and structural equation models in business research, *J. Bus. Res.* 57 \(2004\) 175–183.](#)
- [68] [Gematlo, 2014, December 16, 2014. 27 Banks in Taiwan launch NFC services with Gemalto TSM Hub. Available: <http://www.gemalto.com/press/Pages/27-banks-in-Taiwan-launch-NFC-services-with-Gemalto-TSM-Hub.aspx>.](#)
- [69] [S.-G. Lee, S. Trimi, C. Kim, The impact of cultural differences on technology adoption, *J. World Bus.* 48 \(1/2013\) 20–29.](#)
- [70] [M.-C. Lee, Factors influencing the adoption of internet banking: an integration of TAM and TPB with perceived risk and perceived benefit, *Electron. Commer. Res. Appl.* 8 \(5/2009\) 130–141.](#)
- [71] [G. Hofstede, G.J. Hofstede, M. Minkov, *Cultures and Organizations: Software of the Mind*, Revised and Expanded, third ed., McGraw-Hill USA, New York, 2010.](#)