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Research paper

Correlation Analysis Between Factors Influencing NFC Mobile Wallet Proximity Payment and the Intention to Use

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Abstract

The rapid evolution of mobile technologies and increasing diffusion of smartphones have given opportunity 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 wide coverage on mass consumer acceptance of mobile payments, lack of effort made on the study related to acceptance of NFC mobile wallet proximity payment that considers both the human and security perspectives. The purpose of this study is to identify the factors influencing the secure use of NFC mobile payment system. The study proposed an acceptance model to help in mitigating the vulnerabilities of NFC technology thus builds understanding on how to improve the uptake rate of the technology. Aconceptual model was developed considering two main dimensions containing eight independent factors, which are: Perceived Ease of Use, Perceived Usefulness, Ubiquity, Awareness, Perceived Risk, Structural Assurance, Security and Privacy, and Trust. The study conducts a survey questionnaire that involves 209 valid respondents to evaluate the proposed conceptual technology acceptance model of NFC mobile wallet proximity payment system. The result of the analysis shows that all the independent variables (Perceived Ease of Use, Perceived Usefulness, Ubiquity, Awareness, Perceived Risk, Structural Assurance, Security and Privacy, and Trust) have significant influence to the acceptance of NFC Mobile Wallet Proximity Payment in Malaysian environment. All factors are found to have positive influence on the acceptance except for Perceived Risk entailing future works to be conducted qualitatively to obtain a more in-depth meaning of the result of this study.

Keywords: *NFC; Mobile Wallet; Technology Acceptance; Human Perspective; Security Perspective*

1. Introduction

1.1 Overview

Mobile phones have recently played an important and significant role in our life. We have utilized the mobile technology not only for communication but also for other services that allow information distribution and exchange such as mobile commerce, mobile identity, mobile payment, and mobile banking[1][2][3]. Mobile phones have also gained a global interest especially with the introduction of the Near Field Communication (NFC) technology that opens up various opportunities to enable mobile users to use their mobile devices for payment in retail stores, ticketing counters, access control and other aspects of their daily life[4][5].

Mobile wallet is one of the technologies that utilizes NFC chip through smart phones to enable users to perform safe and secured financial transaction[6]. It has been defined as a new technology that facilitates the convenience of carrying out daily financial transactions [7].

Mobile wallet with the technology of NFC has introduced an easy and effective method of payment. Nevertheless, This technology is still having some security concerns leading to a slow pick up of acceptance among users[8].

Even though, NFC mobile payment is simple to use and beneficial to consumers, its acceptance among consumers in Malaysia is still at the beginning stage and the acceptancerate is relatively lower compared to other countries across the globe[1]. It is vital to persuade consumers to adopt this payment system since huge amount of money has been spent by various parties such as banks, mobile phone manufactures and merchants in building up the infrastructure[1].Thus, this study is carried out with the aim to identify the factors that affect the Malaysianconsumers' intention to adopt the NFC mobile payment from the human and security perspectives.

2. Literature Review

2.1 NFC Mobile Wallet Proximity Payments

Mobile wallet is one of the greatest benefits of smartphones that utilized the technology of NFC chip inside the smartphones to allow the customers to make in-store payments quickly and securely without having to deal with cash or locate credit or debit cards[9][10].

2.1.1 Near Field Communication (NFC)

Near Field Communication (NFC) has been defined as a communication channel between devices known as (Initiator and Target) that uses a Radio Frequency (RF) signals of 13.56 MHz, with a bandwidth not more than 424 Kbits to exchange data in short-range of 5cm by generating a peer-to-peer wireless communication[11][12].

2.1.2 Mobile Wallet

Mobile Wallet has been defined as an application stored in smartphones enabling consumers to perform various mobile financial transaction[13]. In other words, mobile wallet is a provided service that allows the consumers to security access, manage and use identification and payment instruments in order to initiate payments[14][15].Mobile wallet is basically the use of a mobile phone for financial transactions between two devices known as sender and receiver to purchase goods or pay bills[16].

2.1.3 Proximity Payment

Proximity Payment is expressed as a payment method that uses the proximity technology such as Near Field Communication (NFC) or Quick Respond (QR) to establish a communication between a mobile device and a point of interaction device[10][17]. In other words, Proximity Payment is a method where the user and the merchant are in the same location communicating directly using contactless radio technologies such as NFC for data transmission[9].

2.2 Theoretical Review of Models of Secure Mobile Payment

Theory model done by Yan and Yangin 2014 stated that as results of theuncertainties and perceived risk associated with the use of mobile payment, it is essential for service providers to build user's trust. Perceived ease of use, perceived usefulness, structure assurance and ubiquity have important effect on users' trust, which further affect users' usage intention. Therefore, mobile service providers need to give more attention and concern to trust to facilitate users' acceptance and usage of mobile payment services[18].

In addition, Pham and Ho in 2014 also mentioned that the intention of adopting NFC mobile payment systems is affected by product-related factors (perceived usefulness, perceived ease of use, compatibility, perceived security and privacy risk, trialability, perceived cost of use and additional value of NFC mobile payment), trust-based factors, personal-related factors (personal innovativeness in new technologies, absorptive capacity), and attractiveness of alternatives[8].

Furthermore, Negash in his theory model in 2011 emphasizes that customers' intention of using mobile banking is alike to their intention of using Internet banking[19]. Technology acceptance model (TAM) has been used in many Internet banking research and yet it has received a considerable attention and empirical support among researchers[20]. However, in this study the author has extended the TAM2 model and he came up with a model that consists of seven constructs, which are perceived usefulness, perceived ease of use, perceived enjoyment, mobile network quality, security and privacy, trust, awareness, and finally regulation and compliance[20].

Moreover, Liu, Min, and Ji in their theory model in 2009 stated that technology acceptance model (TAM) among all the technology acceptance theory is considered to be the most frequently used as a theoretical foundation due to its conciseness and validity [21]. Thus, the author has integrates trust into TAM model to improving the acceptance of mobile banking.Trust mainly works as an advance indicator of customers' intention to adopt mobile banking through its impact on perceived usefulness (PU). In addition, the author stated that there are three main dimensions are mainly affecting the individual's overall trust, which are trust in technologies, trust in vendors and structural assurance, where structural assurance is the most significant facets of individual's overall trust.

2.3 Concluding Results

Table 1shows the result of reviewof related studies. It represents onlythe related deduced factors that potentially influencethe acceptance of NFC mobile wallet proximity payment.

Table 1: Related deduced factors

Factors	Authors
1- Perceived Ease of Use	[8],[18],[20],[22],[23][8],[18],[20],[22],[23]
2- Perceived Usefulness	[18]
3- Ubiquity	[23]
4- Awareness	[8]
5- Perceived Risk	[18],[22],[24]
6- Structural Assurance	[20],[25]
7- Security and Privacy	[8],[20],[22],[23]
8- Trust	

Although there have been several studies donein regard to consumer acceptance of mobile payments, there is a lack of existing literature on the acceptance of NFC mobile wallet proximity payment alone.Moreover, some factors were not considered in the previous NFC mobile wallet proximity payment acceptance study. Therefore, this study proposed a conceptual model comprising two main dimensions namely human and security. Theory model by Pham & Ho (2014) was chosen as a base model which consists of perceived ease of use, perceived usefulness, perceived risk, and trust. However their model was not considering ubiquity, awareness, structural assurance, and security and privacy as factors influencing the acceptance of NFC mobile wallet. Hence, this study proposed perceived ease of use, perceived usefulness, ubiquity, awareness, perceived risk, structural assurance, security and privacy and trust to be used to examine the acceptance of NFC mobile wallet proximity payment in Malaysian environment. These eight factors were mainly derived from four related model done by the following researchers, Yan and Yang (2014), Pham and Ho (2014), Negash (2011), and Liu, Min, and Ji (2009).

3. Proposed Conceptual Secured Model

In conceptualizing the model of interest, two main dimensions have been proposed containing eight independent factors of the secured NFC mobile wallet proximity payment, namely human and security.

3.1 Human Factors

3.1.1 Perceived Ease of Use (PEU)

An easy-to-use mobile payment with well-designed interfaces and powerful navigation will reflect service providers' ability and benevolence, thus affecting user trust. In other words, perceived ease of use is a perception about operating a technology with less effort[18][8][20][22]. This implies that perceived ease of use is expected to have a positive influence on users' perception of credibility in their interaction with mobile payment systems[23].

3.1.2 Perceived Usefulness (PU)

Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance and it will provide him or her with new features that secured and facilitate the performance[8][18][20]. The ultimate reason for exploiting mobile wallet proximity payment systems among mobile users is that they find the systems useful to their payment transactions[22][23].

3.1.3 Ubiquity (UB)

Ubiquity refers to the concept in which users can access mobile payment at anytime and anywhere. Ubiquity is considered to be one of the main advantages of mobile payment compared to traditional and online payment. Therefore, ubiquity is found to have a positive effect on users' trust on a service provides and yet reflect on improving the acceptance rate of a new technology[18].

3.1.4 Awareness (AW)

The acceptance of NFC mobile payment is determined by the customers' awareness about the vulnerabilities of such product and the awareness level on how to mitigate those vulnerabilities. Furthermore, awareness is considering the first line of defense in mobile security as it prevents a great number of threats. Thus, if a consumer has no enough information about the vulnerabilities of the technology, there would be high possibility of slowing down the rate of acceptanceof the technology due to the security concern[20].

3.2 Security Factors

3.2.1 Perceived Risk (PR)

Mobile banking services are found to be more risky than banking services as mobile services are rated to have high level of uncertainty[26]. Prior research revealed that perceived risk was considered as a major factor in causing customers not to adopt mobile payment systems[27].Therefore, perceived risk of using NFC payment has emerged to have a negative effect on the intention to adopt NFC mobile payment [8][24].

3.2.2 Structural Assurance (SA)

Structural assurance as an institution-based trust mechanism can build users' trusteffectivelyand decrease their perceived risk with online transactions [18]. Structural assurance means that there are some existing adequate technological and legal structures to ensure payment security. Therefore, if there are enough existing structural assurances such as certification and regulations to ensure payment security, users can build their trust in mobile payment [21][25].

3.2.3 Security and Privacy (SP)

Customers will not adopt NFC mobile wallet proximity payment unless it is safe and secure. In the same time, customers are so concern about their privacy and they are worry that the emergence of "mobile wallet" technology will leave them with more vulnerable than ever to identity theft and invasive data collection. Privacy and security were found to be significant obstacles to the acceptance of NFC Mobile wallet proximity payment[20][23][26].

3.2.4 Trust (TR)

Trust refers to the concept of a willingness to be vulnerable to the actions of another person or third party. This is based on the expectations that the other person or third party will act in a responsible manner[8][20]. Mobile payment trust enables favorable expectations that the mobile payment system is reliable and predictable and that no harmful consequences will occur while using it[21][22].

3.3 Formulation of Hypotheses

The proposed conceptual model derived from a consideration ofintegrated previous related models in the acceptance of NFC mobile payment. In particular, this study aims to extend theprevious model of NFC mobile payment by considering two aspects namely the human and security perspectives.
Human aspects includes perceived ease of use, perceived usefulness, ubiquity, awareness, and security aspect includes perceived risk, structural assurance, security and privacy,trust. The final proposedconceptual model is illustrated in Fig. 1.

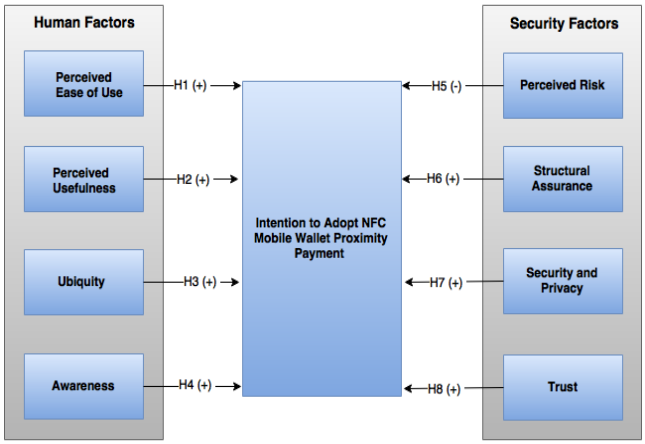

Fig. 1: Proposed Conceptual Model

Hence, eight hypotheses have been constructed in this study.The research hypotheses of the proposedfactors towards secure NFC mobile wallet proximity payment are as follow:

Perceived ease of use has asignificant effect on users' trust and it is considered to be one of the main components of technology acceptance model (TAM)[18].As part of perceived ease of use, user-friendly interface plays an important role in user's acceptanceand yet it decreases the users' effort spent on learning how to use the mobile payment system[18].Therefore hypothesis 1:
H1**:** Perceived ease of use has a positive effect on consumer intention to adopt NFC mobile wallet proximity payment.

The intention of adopting NFC mobile payment systems is affected by some factors such as perceived usefulness as it determine the degree to which an individual believes that using secured mobile proximity payment system would enhance his or her payment performance and experience[18]. Therefore hypothesis 2:
H2:Perceived usefulness has a positive effect on consumer behavioral intention to use NFC mobile wallet proximity payment.

Ubiquity provides users with the ability to use mobile proximity payment system at anytime and anywhere. In the same time, ubiquity is considered to be one of the main advantages of mobile proximity payment compared to traditional and online payment[18]. Therefore hypothesis 3:
H3: Ubiquity positively affects user trust, which leads to users' acceptanceof NFC mobile wallet proximity payment.

Awareness is considering the first line of defense in mobile security as it prevents a great number of threats[20].Customers' awareness about the vulnerabilities of NFC mobile payment systemhelps customers in mitigating those vulnerabilities. Therefore hypothesis 4:
H4:Awareness about the vulnerabilities of NFC mobile payment has a positive effect on consumer acceptancefor the technology.

Perceived risk was considered as a major factor in causing consumers not to adopt an innovation in general and mobile payment in particular[8]. Therefore hypothesis 5:
H5: Perceived risk of using NFC payment has a negative effect on the intention to adopt NFC mobile wallet proximity payment.

Structural assurance as an institution-based trust mechanism can effectively build users' trust in and decrease their perceived risk with using mobile proximity payment system[28].Therefore hypothesis 6:
H6**:** Structural assurance positively affects user trust on NFC mobile wallet proximity payment, which improves their intention to adopt the technology.

Security and privacy have a positive effect on customers' acceptance of mobile payment[20]. Mobile payment will not be adopted unless customer considered it secure. Privacy and security were found to be significant obstacles to the acceptance of mobile proximity payment[25]. Therefore hypothesis 7:
H7**:** Security and privacy have a positive effect on consumer intention to adopt NFC Mobile wallet proximity payment.

Users trust enables favorable expectations that the mobile payment is reliable and predictable and that no harmful consequences will occur if the mobile payment consumer uses it as a method of payment[8]. In Addition, mobile payment trust positively influences the consumer's attitude toward mobile proximity payment[20][22][23].Therefore hypothesis 8:
H8**:** Mobile payment trust positively influences the consumer's attitude toward adopting NFC Mobile wallet proximity payment.

4. Methodology

The research has been conducted using the quantitative survey method mainly focusing on obtaining correlation findings between factors being hypothesized in the earlier proposed conceptual model and intention to adopt the NFC mobile walletamong bank users.The research methodology is presented in Fig. 2.

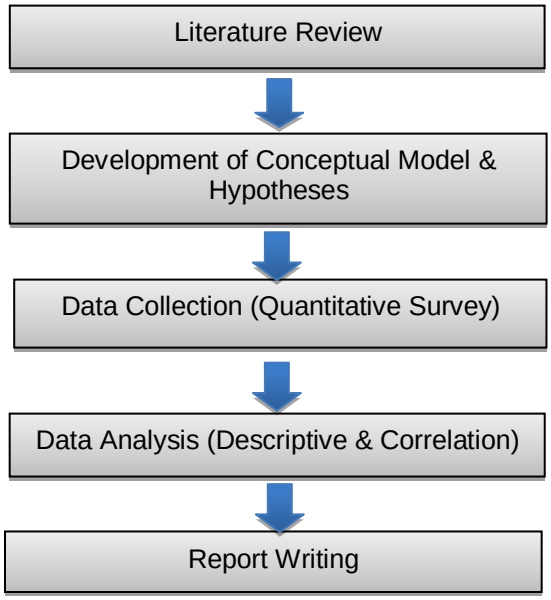

Fig. 2: Research Methodology

A random selection technique was used fordata collection involving mobile users in Kuala Lumpur. . The population of this study were chosen among bank users who use mobile wallet throughsmartphone in Kuala Lumpur, Malaysia.The study has appliedthe probability sampling. The sample size for the unknown population has been determined to beabove 209. Thereason for choosing respondents size was to get a correlation ρ of .1 and a critical point of stability (POScrit) of 95% of confidence and a widths (w) of .15 based on the sample size selection table provided by Schönbrodt & Perugini [29]. The statistical correlation analysis was performed on 209 valid questionnaires. The data analysis was be done using SPSS software version 22. The datawere analyzed mainly using statistical analyses such as descriptive and correlation.

5. Result

A total of 250 questionnaires were distributed, a total of 221 responses have returned back, and a total of 12 responses were excluded. Hence, a total of 209 nine valid responses are the selected sample size of the analysis.
Cronbach's alpha (α) was used to measure the reliability of the instrument items. The reliability coefficient finding shows the reliability test results to be 0.845, 0.774, 0.756, 0.901, 0.728, 0.753, 0.859, and 0.789 respectively.

Table 2 Cronbach Alpha and Overall Mean

Variables	**Cronbach Alpha Value**	**Overall Mean**
Perceived Ease of Use	0.845	4.07
Perceived Usefulness	0.774	3.92
Ubiquity	0.756	3.95
Awareness	0.782	3.90
Perceived Risk	0.901	2.41
Structural Assurance	0.728	3.71
Security and Privacy	0.753	3.9
Trust	0.859	3.86
Intention to Adopt NFC Mobile Wallet Proximity Payment	0.789	4.08
All Variables	0.908	

Cronbach Alpha minimum level 0.7

Based on the results in Table 2, the participants reported high level of scores toward perceived risk followed by trust respectively and low level of scores toward structural assurance.

Correlation analysis is used to indicate the direction and strength of the linear relationship between variables. Pearson correlation coefficient can varies from -1 to +1. Positive sign indicates a positive correlation between two variables meaning that if one variable increase, so will the other. Meanwhile, negative sign indicates negative correlation between two variables meaning that if once variable increase, the other will decrease and value between 0 and 1 represents the strength of the relation. A correlation of 0 indicates no relationship between two variables [30].

Table 3 determines the correlation between all the variables of the proposed conceptual model using Pearson's correlation coefficient (r) in order to measure the level of association between two variables. The study come up with eight independent variables and one dependent variable to determine whether the hypotheses made for this research are accepted or not. Table 3 shows that there are positive and negativelinear correlations between eight independent variables and intention to adopt NFC Mobile Walllet Proximity Payment.

i. The correlation between the Perceived Ease of Use and Intention to Adopt NFC Payment is significant (pvalue<0.001) with strong positive linear correlation (r =0.975)
ii. The correlation between the Perceived Usefulness and Intention to Adopt NFC Payment (pvalue<0.001) with strong positive linear correlation (r =0.696)
iii. The correlation between the Ubiquity and Intention to Adopt NFC Payment (pvalue<0.001) with strong positive linear correlation (r =0.712)
iv. The correlation between Awareness and Intention to Adopt NFC Payment is significant (pvalue<0.001) with strong positive linear correlation (r =0.740)
v. The correlation between the perceived risk and Intention to Adopt NFC Payment is significant (pvalue<0.001) and moderatenegative linear correlation (r =-0.301)
vi. The correlation between Structural Assurance and Intention to Adopt NFC Payment is significant (pvalue<0.001) with weak positive linear correlation (r =0.235)
vii. The correlation between Security and Privacy and Intention to Adopt NFC Payment is significant (pvalue<0.001) with medium positive linear correlation (r =0.466)
viii. The correlation between Trust and Intention to Adopt NFC Payment is significant (pvalue<0.001) with strong positive linear correlation(r =0.609)

Table 3: Correlations of Factors

	N	EBI	Correlation Strength&Direction
PEU	Correlation Sig. (2 tailed)	.975** .000	Strong Positive
PU	Correlation Sig. (2 tailed)	.696** .000	Strong Positive
UB	Correlation Sig. (2 tailed)	.712** .000	Strong Positive
AW	Correlation Sig. (2 tailed)	.740** .000	Strong Positive
PR	Correlation Sig. (2 tailed)	-.301** .000	Moderate Negative
SA	Correlation Sig. (2 tailed)	.235** .000	Weak Positive
SP	Correlation Sig. (2 tailed)	.466** .000	Moderate Positive
TR	Correlation Sig. (2 tailed)	.609** .000	Strong Positive

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

As a whole, all proposed hypotheses are supported in this study. Positive signs from the correlation coefficient indicate all independent variables have positive influence on the acceptance of NFC Mobile Wallet Proximity Payment except for Perceived Risk.

6. Conclusion

NFC mobile payment has introduced an easy and effective method of payment. However, the study revealed that the acceptance of this technology is negatively correlated with the perceived risk of the technology. This indicates that the acceptance ofNFC Mobile Wallet Proximity Payment can be established by reducing perceived risks of NFC Mobile Wallet Proximity Payment among mobile users.On the other hand, further qualitative study need to be embarked within the same setting in Malaysian banking environmentin order to gain more in-depth explanation and interpretationwith regard to the result of this study.

In summary, eight hypothesesfrom the proposed conceptual model were found to be significantly influencing the intention to adopt NFC mobile wallet proximity payment system.

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