THE ROLE OF TRUST IN MOBILE PAYMENT ADOPTION: A CASE STUDY OF THAILAND

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Abstract

This study is motivated by unsettling research results for the diffusion of innovation theory (DOI) and the rapidly growing popularity of mobile payments (m-payments) in Thailand. User satisfaction was considered as prior studies have focused only on m-payment adoption. The purpose of the study is to investigate whether the diffusion of innovation theory and the effect of trust as a mediating factor toward the security and m-payment satisfaction relationship are substantiated. A survey was conducted among 450 Thai consumers who regularly use m-payment. Confirmatory factor analysis and structural equation modelling were used to analyze the data. The findings showed that the innovation adoption factors proposed in the diffusion of innovation theory, namely trust and security, directly influence satisfaction in the adoption of m-payment. Security had an indirect effect on satisfaction through trust. The research findings can provide empirical evidence for m-payment providers that a secure and reliable system affects not just the initial adoption decision but also satisfaction. Security protocol, as the linkage to trust, should be publicized to ensure user satisfaction with the adoption of m-payment, as well as to attain more potential adopters. For further research, it may be interesting to compare adoption factors in developed and developing countries.

Keywords: Mediating Effect, M-Payment Adoption, Satisfaction, Perceived of Trust, Security

INTRODUCTION

Despite the growing ubiquity of mobile payment (m-payment) usage, m-payment is a relatively new technology. With its earliest roots in Internet banking systems and PayPal in 1990s, the use of mobile devices and wireless communication technologies as an approach to payment was developed in early 2000s (Liu, Kauffman, & Ma, 2015). In fact, with the help of mobile devices and wireless networks, users can utilize m-payment to check account balances, transfer money, pay bills, and conduct financial transactions, from anywhere at anytime. However, such technologies were not widely adopted until 2008. Although there were several successful stories such as Kenya's M-PESA system, which significantly increased customer access to banking services, the adoption of m-payment worldwide has been slow, as this mode of payment was considered to be inferior to the traditional payment methods used in advanced economies (Mbiti & Weil, 2011). Considering the low adoption rate of m-payment in some areas, service providers must try to understand the factors affecting the behavior of m-payment users. By the mid-2010s, this situation had changed. Due to the growing security concerns with traditional

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magnetic strip payment cards, and general lack of confidence in electronic payments, Europe and even more so the United States have experienced lower m-payment adoption rates, along with many other countries around the world (Morosan & DeFranco, 2016). However, it was anticipated that at least 1 billion people around the world would be using m-payment via an application by 2020 and grow to 1.31 billion by 2023 (MerchantSavvy, 2020). At present, major platforms such as Alipay and WeChat have over a billion users each, while Apple Pay, the third-largest m-payments system, has approximately half a billion users (MerchantSavvy, 2020). Thus, on a global scale, m-payment has solidly taken its place in the industry.

There are several studies concerned with users' adoption of m-payment (Phonthanukitithaworn, 2015; Phonthanukitithaworn, Sellitto, & Fong, 2016), identifying the effects of trust, perceived usefulness, and perceived ease of use, on customer usage. Issues of trust have been found to affect the adoption of m-payment in several Asian countries such as Thailand (Rotchanakitumnuai & Speece, 2003). Examining the role of trust, therefore, may shed light on how Asian countries can increase the adoption of m-payment. Recent studies on Thai consumers have seldom examined the effect of user's internal factors such as trust, but instead focus on dimensions such as performance, effort expectancy, online support, and convenience (Sombultawee, 2017), or innovation adoption factors such as relative advantage, social influence and convenience, or compatibility and knowledge (Ruangkanjanases & Sirikulprasert, 2018). It is not clear whether findings from previous studies would be applicable to the current growth and adoption of mainstream m-payments, or if they would be able to confirm a relationship between the role of trust and user satisfaction. This leaves a gap in the research and a necessity to explore the extent of user satisfaction with m-payment systems in Thailand, and to evaluate the innovation adoption factors such as trust and security on customer satisfaction in the m-payment context. In addition, this study will investigate trust as a mediator between security and m-payment satisfaction. The findings can offer a foundation for conceptualizing trust as it relates to developing countries. The research findings will not only allow practitioners to gain knowledge for use in the marketing of m-payments, but will also allow academics to improve their understanding of the position of m-payment systems in Thailand.

LITERATURE REVIEW

Mobile Payment (M-payment)

M-payment can be formally defined as "any payment in which some kind of a mobile device is used to initiate, authorize, and confirm, an exchange of financial value in return for goods or services" (Liu, Kauffman, & Ma, 2015, p. 373). Early m-payment systems typically used transactional authentication via mobile phones, tablets, or other mobile devices, to fixed systems, i.e., by linking the device to a bank account or credit card or by charging directly to the telecommunication bill (Bryson, 2013). Nowadays, there are several types of m-payment systems which use different communication technologies, such as SMS-based systems, NFC-based systems, and QR-based systems (de Luna, Liébana-Cabanillas, Sánchez-Fernández, & Muñoz-Leiva, 2019). SMS is the remote system that is most commonly used today.

Although the m-payment market is smaller in comparison to other markets, the number of m-payment users is beginning to increase in Thailand. The most recent statistics from the Bank of Thailand indicate that the use of electronic payments (including mobile banking) has grown by 90% in the past three years. Users are now making an average of 169 mobile payment transactions per person per year (Bank of Thailand, 2020). At the same time, credit card payments in Thailand have grown relatively slowly, at just 7.5% annually over the past six years with a ratio of 1:7 of card to non-card holders

(Jedsadayanmeta, 2020). Therefore, it is important for service providers to have a better understanding of their client perception to gain a competitive advantage over their competitors.

M-payment Satisfaction and Diffusion of Innovations (DOI)

Customer satisfaction is important for the success of any new technology. To adopt m-payments, users must be satisfied with the service provided, as this will highly affect the adoption of online transactions. Therefore, consumer satisfaction with m-payment can be defined as the extent to which the user experience with m-payment meets or exceeds their expectancy, which is subjective measurement (Kar, 2021). There are several theoretical models that aim to clarify the relationship among user attitudes, behavior, intentions, and actual use, such as TAM, TRA, TPB, and UTAUT (Davis, Bagozzi, & Warshaw, 1989; Natarajan, Balasubramanian, & Kasilingam, 2017; Zhang, Zhu, & Liu, 2012). In this research, the Diffusion of Innovations (DOI) theory was adopted, as it has more individual dimensions in innovation adoption than other adoption models.

The Diffusion of Innovations (DOI) theoretical perspective argues that at the individual level, there are several characteristics encouraging adoption of an innovation (Rogers, 2003). These characteristics include relative advantage, compatibility, complexity, trialability, and observability (Li, Hanna, & Kim, 2020). This study considers cost as a separate dimension of the innovation, due to substantial evidence which confirms that cost is a separate determinant of adoption (Chen, Carpenter, Li, Chen, & Hung, 2018), although it is typically included as part of comparative advantage (Rogers, 2003).

Relative Advantage: Relative advantage is the benefit the user gains by adopting the innovation compared to existing solutions (Rogers, 2003). For example, relative advantage for m-payment could be that it is faster or easier than card or cash-based payment systems (Eriksson, Gökhan, & Stenius, 2021). However, one of the main reasons for not adopting m-payment is that there is little or no perceived advantage over existing systems (Li, Hanna, & Kim, 2020).

Compatibility: Compatibility refers to the innovation's compatibility with existing products, services, or other solutions (Rogers, 2003). In the context of m-payment, compatibility is managed on the back end by system providers who have integrated their payment technologies and standards for internal compatibility (Hedman & Henningsson, 2015). Compatibility with existing systems is nonetheless a factor in consumer adoption (Pham & Ho, 2015).

Complexity: Complexity refers to the amount of effort needed to use the system (Rogers, 2003). M-payment processes have meant that consumers are faced with growing numbers of possible payment choices (Hedman & Henningsson, 2015); i.e., complex registration procedures, maintenance and control, and complex service codes limit adoption, even though contactless and one-click payments can reduce complexity overall (Bezhovski, 2016).

Trialability: Trialability refers to whether the innovation is easy to experiment with prior to committing to a full adoption (Rogers, 2003). Trialability was shown to be a significant factor in adoption of m-payment in a few studies (Pham & Ho, 2015) while other studies did not show that it was a significant factor (Kaur, Dhir, Bodhi, Singh, & Almotairi, 2020). Therefore, the role of trialability in m-payment is unsettled.

Observability: Observability is the extent to which a user can see the innovation in action (Rogers, 2003). In the context of m-payment, observability refers to how visible the payments are (Kaur, Dhir, Bodhi, Singh, & Almotairi, 2020). Kaur, Dhir, Bodhi, Singh, & Almotairi (2020) found that observability influenced both the intention to adopt m-payment and the intention to recommend m-payment, although it was a minor factor. In another study of QR-based m-payments, observability significantly affected attitudes, which contributed to usage, though a direct link to satisfaction was not tested (Lou, Tian,

& Koh, 2017).

Cost: Cost refers to the financial and time related investment needed to adopt the innovation (Rogers, 2003). Cost of usage has been identified as a factor in m-payment usage and/or satisfaction in several studies (Kar, 2021; Li, Hanna, & Kim, 2020; Lou, Tian, & Koh, 2017) including switching costs (Eriksson, Gökhan, & Stenius, 2021).

In summary, there is a limited amount of evidence regarding some innovation adoption factors, while there is also evidence suggesting that some or all of these factors may affect m-payment satisfaction. Therefore, the following hypothesis is proposed:

H1: The adoption factors have an impact on satisfaction with m-payment adoption.

Trust and M-payment Satisfaction

As a general concept, commercial trust in a system refers to the consumer expectation that the system will perform as intended. This can extend to factors such as shared information trust, confidential trust, and integrity trust. Trust is known as a significant factor in willingness to engage in E-commerce and the adoption of m-payment (Fang, Qureshi, Sun, McCole, Ramsey, Lim, & Echanisms, 2014). For example, some non-adopters resist adoption because they do not trust the applications to work effectively, requiring backup payment systems (Eriksson, Gökhan, & Stenius, 2021). Other studies have also confirmed that trust significantly influences adoption (Bezhovski, 2016; Slade, Williams, Dwivedi, & Piercy, 2015). Another study did not show any influence of trust on adoption intentions (Pham & Ho, 2015). Although there is a gap in the literature in that the relationship of trust and satisfaction has been rarely studied, in one study, trust had a significant effect which was one of the stronger influences on satisfaction (Kar, 2021). In another study on mobile banking (a related technology), a strong effect of trust on satisfaction was found (Masrek, Halim, Khan, & Ramli, 2018). These studies lead to the following hypothesis:

H2: Trust has an impact on satisfaction in the adoption of m-payment.

Security and M-payment Satisfaction

The final factor considered is the role of security. The perceived security of the system can include aspects like confidentiality of personal data, integrity of systems, and system availability, all of which ensure customer data is protected and secure (Ardiansah, Chariri, Rahardja, & Udin, 2020). Security is one of the major risks in the adoption of m-payment and one of the main reasons why it may not be adopted (Ardiansah, Chariri, Rahardja, & Udin, 2020; Chen, Carpenter, Li, Chen, & Hung, 2018; Morosan & DeFranco, 2016). Studies have also shown that perceived security does have an effect on consumer satisfaction with m-payment systems (Nan, Kim, Park, & Kim, 2020). A qualitative study in China also indicated that user satisfaction with an m-payments system was influenced by the perceived security and security risks of the system (Chen, Carpenter, Li, Chen, & Hung, 2018). Furthermore, perceived security can have a direct influence on whether users trust the system (Bezhovski, 2016). This research builds on these insights to investigate the role of security in both trust and m-payment satisfaction, including the possibility of an indirect relationship. Therefore, the two following hypotheses are proposed:

H3: Security has an impact on trust in the adoption of m-payment.

H4: Security has an impact on satisfaction in the adoption of m-payment.

The final hypothesis addresses the mediating effect of trust among security, adoption factors, and satisfaction with m-payment. There is evidence that perceived security is a factor in the adoption of m-payment (Ardiansah, Chariri, Rahardja, & Udin, 2020; Kar, 2021; Morosan & DeFranco, 2016). There is also evidence that security can influence trust in the system (Bezhovski, 2016), which in turn influences satisfaction in the system (Eriksson, Gökhan, & Stenius, 2021; Kar, 2021; Masrek, Halim, Khan, & Ramli, 2018;). Taken into consideration, this suggests a potential indirect effect of

security on satisfaction through trust, which has not been tested in any study as yet. Therefore, the final hypothesis, which is an exploratory investigation of this potential mediating effect, is proposed as follows:

H5: Security has an indirect impact on satisfaction with the adoption m-payment through m-payment trust.

The conceptual framework in Figure 1 summarizes the internal relationships incorporated into the proposed hypotheses.

METHODOLOGY

Research Design and Data Collection

The research targeted specific groups to ensure that the respondents could provide the information necessary for the research, by selecting those who matched certain set criteria. The respondents were recruited online from consumer forums on social networks such as Facebook and Line due to their popularity in Thailand. The criteria for respondent selection were Thai, had paid for products or services they had bought by utilizing m-payment at least once during the previous six months. The target population in this study was comprised of all male and female Thai individuals over the age of 18 years having experience in the use of m-payment.

In order to test the proposed model, a questionnaire was developed. Data collection was conducted through an online questionnaire using Google Forms, and the link shared on social media such as Facebook and Line. Respondents were directed to a website containing the questionnaire via the shared link, for its self-administration. Respondents were instructed to respond based on their m-payment experiences during the last six months

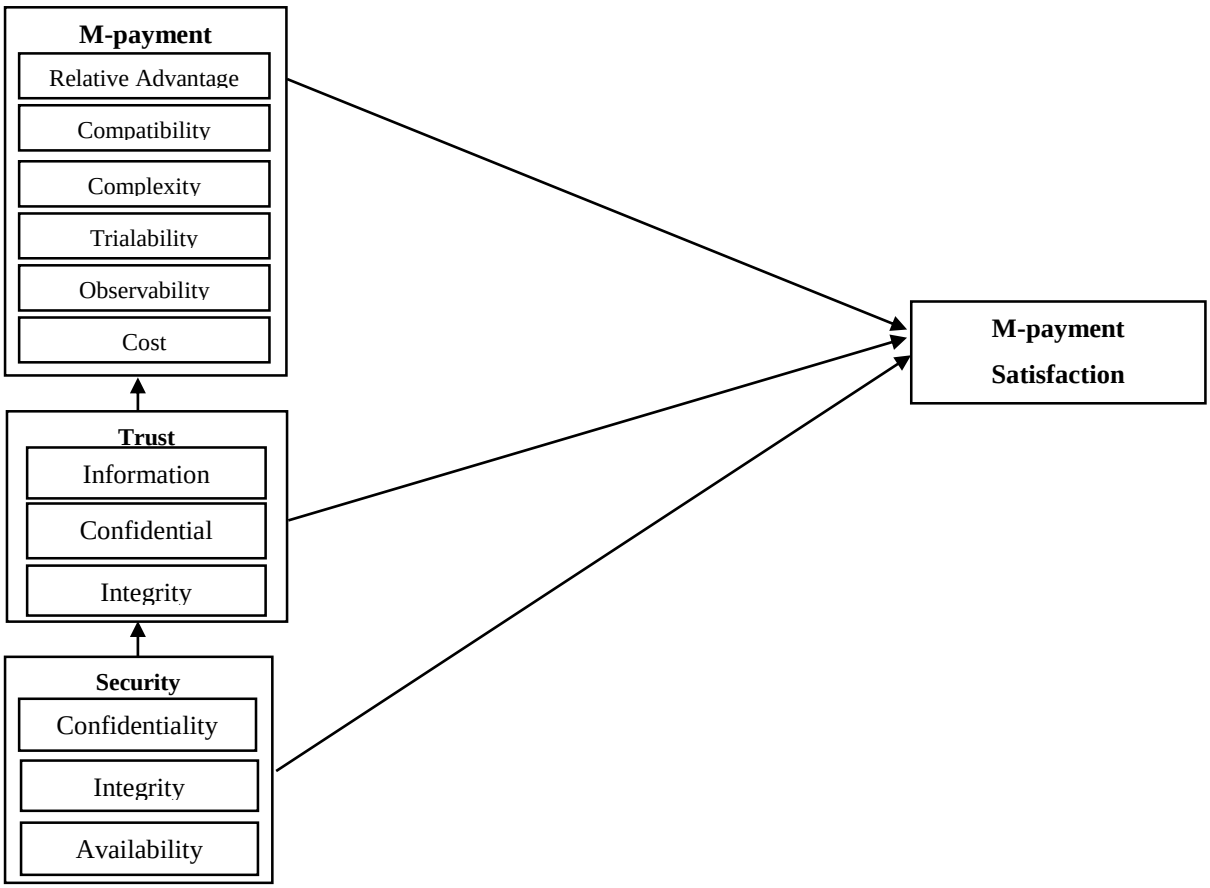

Figure 1: Conceptual Framework of the Study

.Data Analysis

The questionnaires collected data on innovation adoption factors, trust, security, and satisfaction with m-payment adoption. A total of 43 items were included in these measures using five-point Likert-scale items. Data were analyzed through SPSS, including the SPSS AMOS structural analysis package using descriptive statistics and Confirmatory Factor Analysis (CFA). The CFA process was designed to assess the measurement model, or how well the individual observed variables represented the latent variable. Structural equation modeling (SEM) was used to assess the relationships between the latent variables using the aggregated observed variables. The variable names were changed; for example, from RA1, RA2 and RA3 in the CFA model, RA in the SEM model. Discriminant validity was tested using measures including Composite Reliability (CR > 0.70) and Average Variance Extracted (AVE > 0.50). Finally, the hypotheses were tested using the structural equation modelling (SEM) process.

Results and Discussion

The sample was split between male (48%) and female (52%) respondents. A chi-square test indicated that each set was not significantly different from a uniform distribution ($\chi^2 = 0.720$, p = 0.396). The majority of respondents were aged 18 to 25 (36.9%) or 26 to 33 years (32.2%). Most participants had a Bachelor's (69.3%) or Master's (28.4%) degree. The majority lived in Bangkok (55.6%) or the Southern region (20.9%). In summary, the demographics of the participants were consistent with expectations for gender, but were younger, more highly educated and more urban than the Thai population overall.

Confirmatory Factor Analysis (CFA)

The measurement model was assessed using Confirmatory Factor Analysis (CFA). Fit indices were summarized as shown in Table 1. Fit measures including χ^2/df, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI, also called the Non-Normed Fit Index or NNFI), Standardized Root Mean Square Residual (SRMR) and Root Mean Square Error of Approximation (RMSEA), were evaluated using standard fit thresholds. All of the measures were either above or below the required values as expected, indicating the goodness of fit was adequate (χ^2/df = 3.35, CFI = 0.92, TLI = 0.90, SRMR = 0.06, RMSEA = 0.07).

The factor loadings shown in Table 2 were above 0.40, the minimum level that can be accepted for the measure. There were a few observed variables that were below 0.60, which is another point where many authors accept items (Brown, 2015). These variables were investigated for removal, but this did not improve either the model fit or reliability significantly. Therefore, they were retained. In terms of reliability, the CR values for all proposed constructs met the required level (CR > 0.70). Additionally, AVE was also above the required level (AVE > 0.50). Therefore, all measures showed adequate discriminant validity.

Table 1 Fit Indices for the Measurement Model

Fit Indices	Suggested Value	Actual Value	Sources
χ^2/df (CMIN/DF)	< 4.00	3.35	Schumacker & Lomax, 2010
CFI	≥ 0.90	0.92	Hair, Black, Babin, & Anderson, 2013
TLI	≥ 0.90	0.90	Hair, Black, Babin, & Anderson, 2013
SRMR	< 0.08	0.06	Hair, Black, Babin, & Anderson, 2013
RMSEA	< 0.08	0.07	Hair, Black, Babin, & Anderson, 2013

Table 2 The Confirmatory Factor Analysis Model

Variable	Factor Loading	AVE	CR
Relative Advantage (RA)		0.533	0.773
RA1: Using m-payment will help me to achieve my personal goals.	0.729		
RA2: Using m-payment services will enhance my effectiveness in financial management.	0.651		
RA3: Using m-payment services will be useful to me.	0.803		
Complexity (Complex)		0.608	0.860
Complex1: My transactions with m-payment services will be clear and understandable.	0.634		
Complex2: Learning to use m-payment services will be easy for me.	0.811		
Complex3: Interacting with m-payment services will not require a lot of mental effort.	0.759		
Complex4: The using process of m-payment services will be easy.	0.893		
Compatibility (Compat)		0.695	0.901
Compat1: M-payment services will be compatible with all aspects of my life.	0.784		
Compat2: I think m-payment services would fit well with the way I like to work.	0.823		
Compat3: M-payment services will fit into my lifestyle.	0.894		
Compat4: Using m-payment services seems to be relevant to me.	0.830		
Trialability (Trial)		0.600	0.750
Trial1: I want to be able to use m-payment services on a trial basis to see what it can do.	0.727		
Trial2: Using m-payment services will fit well with the way I like to manage my payments.	0.820		
Observability (Observe)		0.503	0.798
Observe1: I became interested in m-payment services when I saw other people using them.	0.782		
Observe2: Some of my colleagues have benefited from using m-payment services.	0.764		
Observe3: Other people using m-payment services like using them.	0.593		
Observe4: M-payment services are very visible in my school or my workplace.	0.674		
Cost (Cost)		0.501	0.749
Cost1: The device cost (smart phone or tablet) influences my decision to use m-payment services.	0.655		
Cost2: The promotions which are offered in m-payment (such as discount) influence my decision to use m-payment services.	0.688		
Cost3: The service fees related to m-payment (such as internet connection, etc.) influence my decision to use m-payment services.	0.773		
Trust Confidential (T_confi)		0.533	0.820
T_confi1: My service provider does not disclose my personal information to others without my permission.	0.756		
T_confi2: I would not deal with service providers who do not keep my personal information confidential.	0.743		
T_confi3: I prefer to provide my personal information on a confidential basis.	0.727		
T_confi4: Some personal information that I gave to my service provider is incorrect.	0.693		

Table 2 (Continued)

Variable	Factor Loading	AVE	CR
Trust Integrity (T_intri)		0.521	0.765
T_intri1: My service provider brings high standards to his/her work.	0.749		
T_intri2: My service provider is honest.	0.679		
T_intri3: I prefer to deal with a service provider who has high integrity.	0.736		
Trust Information Shared (T_infor)		0.504	0.835
T_infor1: My service provider shares common information to help me.	0.694		
T_infor2: Information sharing on important issues has become a critical element to my relationship with my service provider.	0.787		
T_infor3: I make decisions based on the information that I have received from my service provider.	0.632		
T_infor4: My service provider shares confidential information with me.	0.697		
T_infor5: The service provider promptly provides any kind of information that I want.	0.731		
Security Confidentiality (Sec_conf)		0.762	0.865
Sec_conf1: I am confident that my data and transactions in m-payment will be kept secure.	0.848		
Sec_conf2: I trust in the security policy of the m-payment services.	0.897		
Security Integrity (Sec_intri)		0.669	0.801
Sec_intri1: My m-payment transactions have not been altered or corrupted by another or unauthorized person.	0.778		
Sec_intri2: The information in my m-payment transactions is kept with integrity.	0.856		
Security Availability (Sec_avai)		0.630	0.835
AVAIL1: The security process of the m-payment services is good enough to verify authorization.	0.792		
AVAIL2: I am satisfied with the level of security in accessing m-payment services.	0.892		
AVAIL3: M-payment services do not allow users to reject the performed transaction during the transaction.	0.684		
Satisfaction of M-payment Usage (Mpay_sat)		0.534	0.847
Mpay_sat1: I am satisfied with the way that transactions are carried out through m-payment.	0.545		
Mpay_sat2: I think that I made the correct decision to use m-payment.	0.796		
Mpay_sat3: I am satisfied with the service I have received from m-payment.	0.578		
Mpay_sat4: I strongly recommend m-payment to others.	0.822		
Mpay_sat5: Overall, I am satisfied with m-payment	0.854		

The results of the discriminant validity analysis are shown in Table 3. Since all estimated ρCFA values including their upper bounds were lower than 0.800, no significant effects could be seen (Rönkkö & Cho, 2022). In other words, all constructs in Table 3 were theoretically supported, widely used, and massively gathered. Thus, the analysis was continued without merging factors.

Structural Model and Hypotheses

The goodness of fit indices (Table 4) for the research model indicated that the initial fit of the model was valid, with all measures meeting the fit requirements. The value of

χ^2/df (3.833) was less than the suggested value of < 4. When other fit indices were considered with the required value higher or equal to 0.90, it was found that all the indices such as Goodness of Fit Index (GFI=0.906), Normed Fit Index (NFI= 0.909), Incremental Fit Index (IFI = 0.931), and Comparative Fit Index (CFI=0.931), could be deemed adequate in relation to the suggested fit indices. The remaining fit indices, i.e. the Root Mean Residual (RMR=0.032), Root Mean Square Error of Approximation (RMSEA=0.079), and the Adjusted Goodness of Fit (AGFI=0.865) also indicated a good fit according to their respective recommended cut-off points (< 0.05, < 0.08, and ≥ 0.80 respectively).

The adjusted model was used in the SEM process. Factor loadings (see Table 5) and t-tests were used to assess the loading of the observed variables on the latent constructs. The factor loadings were adequate in all cases, and the t-tests were significant at a level of at least $p < 0.05$ for all factors. Therefore, following adjustment, the variables fit adequately. Table 6 summarizes the relationships of the path analysis. The relationships of security → trust and trust → adoption were direct, significant, and positive. The effect of security → adoption was indirect, positive, and significant. The findings supported the proposed internal relationships. The effect of security, trust, and adoption, were assessed in respect of m-payment satisfaction. The results show the relationships of adoption → m-payment satisfaction (MPay-Sat) and trust → m-payment satisfaction were significant and positive. The direct effect of security in the security → m-payment satisfaction relationship was negative. However, when trust was introduced as a mediator in this relationship, it resulted in a positive total effect. The result of the mediator was confirmed by the indirect effect of trust

Table 3: Discriminant Validity Using CI_{CFA}

	Estimated ρ_{CFA}	Lower ρ_{CFA}	Upper ρ_{CFA}	p-value	Degree of Problem
Security → M-payment Adoption	0.738	0.676	0.799	0.000	very low
Security → Trust	0.675	0.598	0.752	0.000	very low
Security → M-payment Satisfaction	0.433	0.328	0.538	0.000	very low
M-payment Adoption → Trust	0.616	0.539	0.693	0.000	very low
M-payment adoption → M-payment Satisfaction	0.632	0.553	0.712	0.000	very low
Trust → M-payment Satisfaction	0.484	0.400	0.567	0.000	very low

Table 4: Model Goodness-of-Fit Tests

Fit Indices	Threshold	Estimate	Sources
χ^2/df CMIN/DF	< 4	3.833	Schumacker & Lomax, 2010
GFI	≥ 0.90	0.906	Hair, Black, Babin, & Anderson, 2013
AGFI	≥ 0.80	0.865	Schumacker and Lomax, 2010
NFI	≥ 0.90	0.909	Hair, Black, Babin, & Anderson, 2013
IFI	≥ 0.90	0.931	Hair, Black, Babin, & Anderson, 2013
CFI	≥ 0.90	0.931	Hair, Black, Babin, & Anderson, 2013
RMR	< 0.05	0.032	Hair, Black, Babin, & Anderson, 2013
RMSEA	< 0.08	0.079	Hair, Black, Babin, & Anderson, 2013
Summary		Well fitted	

Table 5: The Validity Analysis Results in Each Element of the Structural Equation Model

Latent Variables	Observed Variables	Factor Loadings				
		b	S.E.	B	t	R^2
Security	Sec_conf	1.000		0.855		0.732
	Sec_intri	0.918	0.041	0.844	22.157*	0.713
	Sec_avai	0.894	0.037	0.893	23.978*	0.798
Trust	T_confi	1.000		0.504		0.254
Trust	T_intri	1.159	0.103	0.576	11.292*	0.331
	T_infor	1.505	0.135	0.688	11.185*	0.474
Adoption	RA	1.578	0.211	0.722	7.466*	0.521
	Compat	2.425	0.327	0.881	7.411*	0.776
	Complex	1.992	0.266	0.823	7.475*	0.677
	Observe	1.588	0.222	0.624	7.166*	0.390
	Trial	1.710	0.233	0.672	7.325*	0.452
	Cost	1.000		0.390		0.152
Mpay_sat	Mpay_ sat1	1.000		0.551		0.303
	Mpay_ sat2	1.214	0.105	0.789	11.512*	0.623
	Mpay_ sat3	1.306	0.111	0.830	11.789*	0.689
	Mpay_ sat4	1.100	0.097	0.579	11.399*	0.336
	Mpay_ sat5	1.214	0.117	0.851	11.913*	0.725

*P<0.05

Table 6: The Result of the Path Analysis in the SEM

		Cause variance		
Effect variance	Influence	Security	Trust	Adoption
Trust	Direct effect	0.888*		
(R^2= 0.788)	Indirect effect	-		
	Total effect	0.888*		
Adoption	Direct effect	-	0.815*	
(R^2= 0.664)	Indirect effect	0.723*	-	
	Total effect	0.723*	0.815*	
Mpay_Sat	Direct effect	- 0.597*	0.799*	0.415*
(R^2= 0.503)	Indirect effect	1.010*	0.338*	-
	Total effect	0.413*	1.138*	0.415*

*P<0.05

Table 7: The Result of Defined Parameters for the Mediator Test

IE Effect	Estimate	z-value	p-value	S.E.
Security → Trust → M-payment Satisfaction	0.077	2.391	0.017	0.032

*P<0.05

(shown in Table 7). The SEM model demonstrated significant direct and indirect relationships between security and m-payment satisfaction with trust as a partial mediator. In other words, trust partially mediated the effect of security on m-payment satisfaction (Hayes & Scharkow, 2013).

The innovation adoption factor and trust have a significant and positive effect on m-payment satisfaction. Thus, both Hypothesis 1 and Hypothesis 2 are supported. Security also has a positive impact on m-payment trust; therefore, Hypothesis 3 is supported. M-payment with a high level of security may

contribute to user confidence in the system but it may have a reverse effect leading to a decrease of satisfaction in the system adoption. Hypothesis 4 is supported. Additionally, when trust was introduced as a mediator between security and satisfaction, there is a stronger positive result on m-payment adoption, which supports Hypothesis 5.

The results of this study demonstrate the mediating effect of trust on the relationship between security and m-payment satisfaction, which is the primary interest of the study. It is interesting to note that the direct effect of security on m-payment satisfaction indicates a negative relationship, which contradicts previous literature (Chen, Carpenter, Li, Chen, & Hung, 2018; Nan, Kim, Park, & Kim, 2020). It is more common that the higher the level of security, the higher the level of customer satisfaction. However, there might be other confounding factors that contribute to a decrease in satisfaction while the level of security is still highly maintained. A complicated process for authentication (Owusu, Bekoe, Addo-Yobo, & Otieku, 2021; Verhoef, Stephen, Kannan, Luo, Abhishek, Andrews, Bart, Datta, Fong, Hoffman, Hu, Novak, Rand, & Zhang, 2017) and a low level in computer literacy are main reasons that contribute to a low level of m-payment satisfaction (Aburub & Alnawas, 2019; Deen-Swarray, 2016; Elhajjar & Ouaida, 2019). Nevertheless, the mediating role of trust in the full model shows a positive indirect relationship between security and m-payment satisfaction. Furthermore, the indirect effect of security on m-payment user satisfaction through trust is higher than the direct effect between security and m-payment satisfaction. This indicates that with user trust, the higher the level of security the higher the level of user satisfaction. Trust is a matter of interplay between reality and perception (Eriksson, Gökhan, & Stenius, 2021; Fang, Qureshi, Sun, Mccole, Ramsey, Lim, & Echanisms, 2014; Kar, 2021; Masrek, Halim, Khan, & Ramli, 2018; Slade, Williams, Dwivedi, & Piercy, 2015). Although service providers make every effort to guarantee maximum payment security, it does not contribute to satisfaction if users fail to perceive it. However, if there is no security at all, it is extremely difficult, if not impossible, to gain customer trust. Therefore, establishing the trust of users in service providers is a key factor in making security positively contribute to m-payment satisfaction. The other indirect path of effect from security to m-payment satisfaction is through two variables, trust and adoption. This path incorporates the effects of security on trust and of trust on adoption, before affecting m-payment satisfaction. The effect of these indirect paths adds to the total indirect effect, making it higher than that of the direct effect. Thus, it is clear that when trust is in place, users are more likely to adopt m-payment and become more satisfied.

CONCLUSION

The results of this study show that trust, security, and the adoption of m-payment have a significant direct impact on m-payment satisfaction. However, security was found to have a negative impact on satisfaction. That is to say, a high level of security may result in a low level of satisfaction. However, after introducing trust as a mediator of the security-satisfaction relationship, the result illustrates that the customer perception of trust may increase their level of satisfaction. It is noteworthy to conclude that without trust, as the complexity of the security assurance process increases, this security can reduce user satisfaction. The relationship between security and m-payment satisfaction may not appear in a linear fashion but rather non-curvilinear. The relationship proceeds positively until it reaches the vertex and declines afterwards. An overly-engineered process to guarantee security may result in too much burden on users and create dissatisfaction. However, the significance of system and client security is undeniable and the assurance of security inevitably requires technical complexity. Therefore, it is a challenge for system providers to develop a security system that is able to maintain the balance between efficiency and simplicity. Although service

providers make every effort to guarantee maximum payment security, this will not contribute to an increase in satisfaction if users do not gain a clear perception of this. However, if there is no security at all, it is nearly impossible to gain customers' trust. Therefore, establishing the trust of users in service providers is a key factor in ensuring that security has a positive contribution to m-payment satisfaction. The reputation of service providers through a broad customer base can importantly create trust among potential users (Bezhovski, 2016; Eriksson, Gökhan, & Stenius, 2021). When making a payment, especially of a large sum, users either fear for a fraudulent transaction or the instability of the system, either of which may incur costly mistakes. A trusted and familiar brand of service provider can reduce users' uneasiness. In addition, investment on the stability of the system to minimize the chance of interruptions is crucial in creating trust.

The academic implications of this study revolve around the adoption of the Diffusion of Innovations model (Bezhovski, 2016; Kaur, Dhir, Bodhi, Singh, & Almotairi, 2020; Li, Hanna, & Kim, 2020) in understanding consumer satisfaction with m-payment. The study shows that the innovation adoption factors, as proposed by the DOI theory, can influence not only the initial adoption decision, but also satisfaction. This strongly suggests that the mediating role of trust shows a positive indirect relationship between security, the adoption factors, and m-payment satisfaction**.** The more positive the users' perception of security due to their level of trust, the higher their level of satisfaction may be.

There are also managerial implications of this research. The first and foremost is the importance of security. This factor has a direct influence on satisfaction with the m-payment system as well as an indirect effect through trust. This indicates that the perceived security of the m-payment system is one of the underlying factors that can influence not just adoption, but also user satisfaction. Therefore, from a managerial perspective, it is critical to be able to provide users with a secure and reliable m-payment system that protects their confidentiality and financial data. The system itself must be reliable, and securely protected in the organizational processes, and deemed as a priority by m-payment providers. This message must be explicitly highlighted in plain language in marketing materials, to offer a competitive advantage to customers. Likewise, the benefits of m-payment over cash or credit cards in terms of convenience and security should be promoted for wider customer adoption. To structure further study, it is suggested that qualitative research be conducted to evaluate user satisfaction, using the same factors as investigated in this research. Furthermore, it would be of interest to explore the role of trust in m-payment adoption between developed and developing countries.

REFERENCES

Aburub, F., & Alnawas, I. (2019). A new integrated model to explore factors that influence adoption of mobile learning in higher education: An empirical investigation. *Education and Information Technologies*, *24*(3), 2145–2158.

Ardiansah, M., Chariri, A., Rahardja, S., & Udin, U. (2020). The effect of electronic payments security on e-commerce consumer perception: An extended model of technology acceptance. *Management Science Letters*, *10*(7), 1473-1480.

Bank of Thailand. (2020). *Payment data indicators*. Retrieved from https://www.bot.or.th/English/PaymentSystems/Publication/payment_data_indicators/Documents/Payment Data Indicators_BOT Website_Jul2020_ENG.pdf

Bezhovski, Z. (2016). The Future of the Mobile Payment as Electronic Payment System. *European Journal of Business and Management*, *8*(8), 127–132.

Brown, T. A. (2015). *Confirmatory factor analysis for applied research* (2nd ed.). New York: The Guilford Press.

Bryson, C. (2013). Mobile payments. *Journal of Payments Strategy & Systems*, 7(3), 225–231.

Chen, X., Carpenter, D., Li, X., Chen, C. C., & Hung, S. Y. (2018, January). Why do individuals continue using mobile payments - A qualitative study in China. In *Proceedings of the 51st Hawaii International Conference on System Sciences* (pp. 1452-1461). Hawaii: AIS Electronic Library (AISeL).

Davis, F., Bagozzi, R., & Warshaw, P. (1989). User acceptance of computer technology: A comparison of two theoretical models. *Management Science*. 35, 982-1003.

de Luna, I. R., Liébana-Cabanillas, F., Sánchez-Fernández, J., & Muñoz-Leiva, F. (2019). Mobile payment is not all the same: The adoption of mobile payment systems depending on the technology applied. *Technological Forecasting and Social Change, 146*, 931–944.

Deen-Swarray, M. (2016). Toward Digital Inclusion: Understanding the Literacy Effect on Adoption and Use of Mobile Phones and the Internet in Africa. *Information Technologies & International Development*, *12*(2), 29–45.

Elhajjar, S., & Ouaida, F. (2019). An analysis of factors affecting mobile banking adoption. *International Journal of Bank Marketing*, *38*(2), 352–367.

Eriksson, N., Gökhan, A., & Stenius, M. (2021). A qualitative study of consumer resistance to mobile payments for in-store purchases. *Procedia Computer Science*, *181*, 634–641.

Fang, Y., Qureshi, I., Sun, H., Mccole, P., Ramsey, E., Lim, K. H., & Echanisms, M. (2014). Trust, satisfaction and online repurchase intention. *MIS Quarterly*, *38*(2), 407–428.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2013). *Multivariate data analysis* (7th ed.). New York: Pearson.

Hayes, A. F., & Scharkow, M. (2013). The relative trustworthiness of inferential tests of the indirect effect in statistical mediation analysis: does method really matter? *Psychological science*, 24(10), 1918-1927.

Hedman, J., & Henningsson, S. (2015). The new normal: Market cooperation in the mobile payments ecosystem. *Electronic Commerce Research and Applications*, *14*(5), 305–318.

Jedsadayanmeta, C. (2020). *Credit card business in Thailand.* Retrieved from https://sasinconsulting.com/wp-content/uploads/2020/02/Credit-Card-Business-in-Thailand-CJ_by-Chinnawut–Jedsadayanmeta.pdf

Kar, A. K. (2021). What affects usage satisfaction in mobile payments? Modelling user generated content to develop the "digital service usage satisfaction model". *Information Systems Frontiers*, *23*(5), 1341-1361.

Kaur, P., Dhir, A., Bodhi, R., Singh, T., & Almotairi, M. (2020). Why do people use and recommend m-wallets? *Journal of Retailing and Consumer Services*, *56*, 102091.

Li, B., Hanna, S. D., & Kim, K. T. (2020). Who uses mobile payments: Fintech potential in users and non-users. *Journal of Financial Counseling and Planning*, 31(1), 83-100.

Liu, J., Kauffman, R. J., & Ma, D. (2015). Competition, cooperation, and regulation: Understanding the evolution of the mobile payments technology ecosystem. *Electronic Commerce Research and Applications*, *14*(5), 372–391.

Lou, L., Tian, Z., & Koh, J. (2017). Tourist satisfaction enhancement using mobile QR code payment: An empirical investigation. *Sustainability (Switzerland)*, *9*(7), 1–14.

Masrek, M. N., Halim, M. S. A., Khan, A., & Ramli, I. (2018). The impact of perceived credibility and perceived quality on trust and satisfaction in mobile banking context. *Asian Economic and Financial Review*, *8*(7), 1013–1025.

Mbiti, I., & Weil, D. (2011). *Mobile banking: The impact of MPesa in Kenya*.

Retrieved from https://www.econstor.eu/bitstream/10419/62662/1/668481188.pdf

MerchantSavvy. (2020). *Amazing stats demonstrating the unstoppable rise of mobile payments globally*. Retrieved from https://www.merchantsavvy.co.uk/mobile-payment-stats-trends/

Morosan, C., & DeFranco, A. (2016). It's about time: Revisiting UTAUT2 to examine consumers' intentions to use NFC mobile payments in hotels. *International Journal of Hospitality Management*, *53*, 17–29.

Nan, D., Kim, Y., Park, M. H., & Kim, J. H. (2020). What motivates users to keep using social mobile payments? *Sustainability (Switzerland)*, *12*(17), 1–14.

Natarajan, T., Balasubramanian, S.A., & Kasilingam, D.L. (2017). Understanding the intention to use mobile shopping applications and its influence on price sensitivity. *Journal of Retailing and Consumer Services*. 37, 8–22.

Owusu, G. M. Y., Bekoe, R. A., Addo-Yobo, A. A., & Otieku, J. (2021). Mobile Banking Adoption among the Ghanaian Youth. *Journal of African Business*, *22*(3), 339–360.

Pham, T. -T. T., & Ho, J. C. (2015). The effects of product-related, personal-related factors and attractiveness of alternatives on consumer adoption of NFC-based mobile payments. *Technology in Society*, *43*, 159–172.

Phonthanukitithaworn, C. (2015). User intentions to adopt mobile payment services: A study of early adopters in Thailand. *Journal of Internet Banking and Commerce*, *20*(1), 1–29.

Phonthanukitithaworn, C., Sellitto, C., & Fong, M. W. L. (2016). An investigation of mobile payment (m-payment) services in Thailand. *Asia-Pacific Journal of Business Administration*, *8*(1), 37-54.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: The Free Press.

Rönkkö, M., & Cho, E. (2022). An updated guideline for assessing discriminant validity. *Organizational Research Methods*, 25(1), 6-14.

Ruangkanjanases, A., & Sirikulprasert, N. (2018). Predicting consumer intention to adopt near field communication enabled mobile payment in Thailand. *Journal of Telecommunication, Electronic and Computer Engineering*, *10*(2–7), 147–152.

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modelling* (3rd ed.). London: Routledge.

Slade, E., Williams, M., Dwivedi, Y., & Piercy, N. (2015). Exploring consumer adoption of proximity mobile payments. *Journal of Strategic Marketing*, *23*(3), 209–223.

Sombultawee, K. (2017). Mobile Commerce Switching Intentions in Thai Consumers. *Mediterranean Journal of Social Sciences*, *8*(6), 123–134.

Verhoef, P. C., Stephen, A. T., Kannan, P. K., Luo, X., Abhishek, V., Andrews, M., Zhang, Y. (2017). Consumer Connectivity in a Complex, Technology-enabled, and Mobile-oriented World with Smart Products. *Journal of Interactive Marketing*, *40*, 1–8.

Zhang, L., Zhu, J., & Liu, Q. (2012). A meta-analysis of mobile commerce adoption and the moderating effect of culture. *Computers in Human Behavior*. 28(5), 1902-1911.