Mobile Payment Adoption in Vietnam: A Two-Staged SEM-ANN Approach

Luan-Thanh Nguyen, Tien-Thao Cong Phan, Duc-Viet Thi Dang, and Thuy-Thanh Thi Tran

Abstract By extending the newly proposed mobile application adoption paradigm to include prospect theory and flow theory and to make the behavioral purpose clearer, this study examines the adoption of mobile payments in Vietnam. Data from mobile payment consumers who have utilized mobile payment services was collected using a self-administered questionnaire. The behavioral intention to accept mobile payments is positively and meaningfully correlated with mobile social influence, mobile structural assurance, mobile facilitating condition, mobile performance expectancy, mobile effort expectancy, mobile perceived trust, and mobile perceived hedonic motivation, according to analyses using partial least squares structural equation modeling and artificial neural networks. With the implementation of mobile payment in Vietnam, the results also showed interactions between behavioral intention to use and mobile enabling circumstances. Practical and theoretical implications are subsequently discussed in light of the results.

Keywords The modified UTAUT · Flow theory · Prospect theory · Mobile payment · Vietnam · ANN

1 Introduction

Fintech, a digital revolution of the financial services industry in the Fourth Industrial Revolution, can lead to a cashless society and widespread financial inclusion [1]. Mobile financial services, a Fintech application, have grown rapidly since the

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early 2000s. Mobile banking services are growing due to the COVID-19 pandemic, e-commerce, and ICT. Mobile financial services encompass many money-related activities that users can access on their phones. Mobile financial services are "a variety of apps that enable users to exploit their bank account through their mobile phones," allowing users to make purchases, move payments, and acquire credit and insurance [2]. Each category has three mobile financial services with similarities and distinctions. Mobile payment systems can process purchases at remote stores and near merchants. Mobile payments are mostly used for peer-to-peer (P2P) payments and remittances in developing nations, but are also used for electricity bills and purchases [3].

Cashless and smartphone payment technologies benefit consumers and businesses. Thus Vietnam promotes them. A national financial strategy may incorporate mobile e-payment in Vietnam. Over 60% of rural Vietnamese lack banking services. Mobile financial services enable cashless transactions and give microfinance and loans to the underserved, inspiring them. A cashless world would benefit companies and customers. The study, "ASEAN cash digitization-what it means for future corporate treasurers and customers," found that cash payments dominate regional transactions despite electronic payment options [4]. Vietnam's online cash-on-delivery rate is 90.17%, higher than Indonesia's 65.30%. Vietnam has fewer electronic payments than its neighbors. The World Bank reports that 4.9% of non-cash transactions in Vietnam [2]. As it targets a cashless world and financial inclusion, the government should study mobile payment drivers.

Reviewing the existing literature on mobile payment has identified several research gaps. First, previous research has extensively investigated the behavioral intention of individuals who utilize mobile payment services, employing various theoretical frameworks such as the Technology Acceptance Model (TAM) [5], Theory of Planned Behavior (TPB) [6], Unified Theory of Acceptance and Use of Technology [7], Innovation Diffusion Theory (IDT) [3], and Mobile Technology Acceptance Model (MTAM) [8]. However, limited attention has been given to the actual usage and adoption of mobile payment systems, which subsequently impact customer loyalty and are considered a comparative advantage for sustainable development. The discrepancy between user intentions and actual usage of mobile payment services becomes apparent when consumers discontinue their utilization due to encountering challenges or dissatisfaction [4]. There is a need to augment the current literature review on the aforementioned hypotheses by analyzing the factors that contribute to the practical adoption of mobile payment. Second, while a considerable amount of scholarly research on the adoption of mobile payment has predominantly concentrated on the utilization of Information System theories, which predominantly emphasize personal and technological factors, several studies have incorporated additional environmental factors into the traditional framework to enhance the understanding and forecasting of adoption [1, 3, 4, 9], which could not well reveal its complexity. Utilizing mobile technology is a multifaceted and complex phenomenon encompassing personal, technological innovation, and environmental influences [1]. Consequently, it is imperative to conduct a comprehensive examination of the adoption of mobile payment, considering the three distinct categories of

factors concurrently. To effectively harness the potential of mobile technology, it is crucial to embrace a comprehensive strategy that considers the multifaceted aspects of its interaction and adapts to the ever-changing technological landscape. Third, a significant portion of academic research pertaining to mobile payment is frequently carried out in sub-Saharan African countries, including Ghana and Kenya, as well as in regions encompassing America (Brazil, U.S.), Europe (Spain, Italy), and South and East Asia (China, Indonesia, Malaysia) [1]. There is a necessity to conduct research pertaining to the practical implementation of mobile payment systems within various regions of developing nations, encompassing Vietnam.

In order to fill the aforementioned gaps, this research will investigate the factors that influence the utilization of mobile payment in Vietnam, taking into account many viewpoints, including technological, human, and environmental factors. In order to accomplish this objective, it is necessary to integrate the Unified Theory of Acceptance and Use of Mobile Technology (UTAUMT), Flow theory, and Prospect theory. The study question focuses on the elements that have an impact on Vietnam's adoption of mobile payments. The investigation will make three important contributions by responding to this question. By analyzing mobile payment from a variety of angles, the current study seeks to add to the body of literature already on the topic. This study provides insightful information and findings that can help those involved in the mobile payment service business create campaigns to encourage the adoption of mobile payments. Additionally, it can help government organizations create incentives and rules that will ease the transition to a cashless society.

The remainder of the paper is divided into the following sections. This paper's second section offers a thorough evaluation of the UTAUT model, prospect theory, and flow theory. The research hypotheses that will be examined in the analysis that follows are also included in this part. The research techniques used for this study are described in Sect. 3 of the document. The data analysis and discussion of the findings are presented in Sect. 4. The analysis of the research contributions, limitations, and suggestions for additional research are included in Sect. 5 of the paper.

2 Literature Review

2.1 The Unified Theory of Acceptance and Use of Mobile Technology, UTAUMT

The coherent theory of technology adoption and use, UTAUT [10–12], incorporates eight models to represent technological acceptance activities and evaluates the most critical criteria for estimating the behavioral purpose to utilize a technology. Thus, the authors propose a unified theoretical model that combines fundamental elements of previous models. Age, gender, experience, and voluntariness of use affected two direct drivers of use activities (Behavioral Intention and Facilitating Conditions) and three direct determinants (Performance Expectation, Effort Expectation, and

Social Influence). During a comprehensive analysis of prior research that followed the UTAUT model to explain its logic, merits, and drawbacks, Yan et al. [13] found that many studies did not follow all model constructs and instead used external variables to evaluate a single theory rather than the whole model. UTAUT was criticized for failing to adapt to services and organizations other than its original ones [14]. According to Yuan et al. (2021), invention diffusion theory has two fundamental concepts: the macro mechanism of innovation spread and the micro implementation process. The model's focus on corporate settings and staff technology adoption has also been questioned [15]. Different job kinds and interaction complexity affect technology adoption [16–18]. UTAUT faces additional hurdles when explaining the uptake of mobile studies like mobile payment since potential adopters are niche mobile customers rather than generic technology consumers whose decisions are primarily motivated by their personal past. In light of the above and face validity, the UTAUT will be updated and renamed "the unified theory of acceptance and use of mobile technology" (UTAUMT) based on the most relevant literature review on mobile technology and four constructs similar to UTAUT to recognize its importance in studying IT and IT system adoption or use. Mobile performance and effort, social impact, and enabling conditions will comprise the four constructs.

2.2 Prospect Theory

Kahneman and Tversky [19] developed the prospect principle to explain how individuals analyze and select options that include uncertainties and unpredictable effects. As a theory of cognitive science, prospect theory infers that the of individuals' decision-making is more inclined to benefits and defeats rather than the end consequence. As such, deterrents are often more relevant than drivers in people's decision-making, such as threats [20]. While Prospect theory was initially formulated for psychology and behavioral fields, it has been used to explain threats associated with technology usage in other settings, such as information management analysis. As there are inherent threats to mobile payment systems that may discourage citizens from utilizing the technology, it is important to consider the consequences of these risks. Thus, this study uses the prospect theory in this analysis to decide whether mobile perceived threats of mobile payment affect the usage of innovation by citizens to gain predictive power.

2.3 Flow Theory

Flow was identified by Nakamura and Csikszentmihalyi [21] as a fun experience of paying maximum concentration while performing a task. A person becomes highly focused while witnessing flow and filters out unrelated emotions, impressions, and ideas. The perimeter of their consciousness is increasingly dwindling, and

they respond only to precise objectives and immediate feedback [22]. It is essential to understand the role of flow in implementing mobile payment. This is because mobile payment takes less time to execute a transaction, which could be a cause for enjoyment. The flow principle has been implemented in various studies in recent years to explore the relationship between customers and technology [5]. In general, when conducting an action, the flow has been viewed as a desirable intrinsic reward [23] and thus serves as an essential construct in the mobile payment usage. Although the flow principle is an inherent incentive or hedonic motivation felt by people when utilizing technology [24], it is inserted into the parsimonious UTAUMT to supplement its technical values that only affect the characteristics of mobile technology. The flow principle is operationalized as mobile perceived hedonic motivation in this analysis, analogous to Nguyen et al. [2], to explore the degree of intrinsic enjoyment or hedonic incentive of using mobile payment in financial transactions.

2.4 Hypotheses Development and Proposed Conceptual Framework

Tew et al. [25] coined the term "mobile performance expectancy" (MPE) to describe how much people expect mobile technology to improve their performance. The more useful mobile payment is; the more likely people are to use it. PE significantly improved behavioral intention to use mobile payment services, according to Nguyen and Nguyen [11]. Kang [26] also found that PE best predicts behavioral intention for users and non-users. Mobile payment is contactless and improves payment convenience, check-out speed, and financial management compared to cash and visa/master cards. Mobile payment apps allow users to add up to three credit cards and choose which ones to use on their phones. The results reduce and prevent credit card loss and disease transmission. This hypothesis assumes that customers will accept mobile payment if they see its benefits. The hypothesis is:

H1: Mobile performance expectancy increases mobile payment intention in Vietnam.

Venkatesh et al. found that mobile consumers expect mobile payments to be easy. In the early stages of mobile payment acceptance, ease of use affects consumer adoption. As shown by previous research, MEE and intent to act are firmly linked. Leong et al. [27] found that MEE affects public transportation NFC use. Al-Seadi et al. found that PE improves mobile payment intention [28]. These studies suggest that mobile payment system ease increases behavioral intention to use them. The hypothesis is:

H2: Mobile effort expectancy increases mobile payment intention in Vietnam.

Ooi et al. [28] coined "mobile social influence" (MSI) to describe how social networks affected mobile payment adoption. Mobile payment system users' social links may

influence their decisions. Based on their feelings about their influences, they may change their behavior. Leong et al. [27] found that social influence affected non-users more than users in mobile payment BI. More Vietnamese are losing money using Momo and other third-party mobile payment apps, which may affect their willingness to recommend or use them. The hypothesis is:

H3: Mobile social influence decreases mobile payment intention in Vietnam.

Venkatesh et al. found that MFC quality affects consumers' expectations of mobile payment service convenience, security, and privacy. Facilitating conditions strongly predict mobile payment adoption [29]. Mobile payment services require a smartphone, internet access, and phone control. Mobile users in poor countries like Vietnam, where financial and technology literacy is low, need support to use cash less. The hypotheses are:

H4a: Mobile facilitating condition increases mobile payment intention in Vietnam.
H4b: Vietnamese mobile payment adoption is positively correlated with mobile facilitating conditions.

In technological services, "mobile perceived risk" (MPR) is the fear that something bad will happen if the user uses the service [30]. Ooi et al. [30] say most technological advances are dangerous. Customers' reluctance to use mobile payment services in this study is understandable given the risks of adopting and using cutting-edge technology. Many studies [27, 31] have found a negative relationship between risk perception and mobile payment service use. Increasing risk perception may decrease people's desire to use. The hypothesis is:

H5: Mobile perceived risk decreases mobile payment intention in Vietnam.

Mobile structural assurance is trust in "guarantees, regulations, promises, legal recourse, or other procedures to promote success" (MSA) [32]. Legal and technical safeguards protect mobile payment users' personal and financial data. Thus, if structural assurance is high, people feel safer using their phones to buy things and use mobile payments. This allows us to form a hypothesis:

H6: Mobile structural assurance increases mobile payment intention in Vietnam.

The intuitive belief that others will keep their promises and not act dishonestly when they want a mobile purchasing service is called "mobile perceived trust" (MPT). Kind, open, and knowledgeable retailers increase mobile payment usage [14, 25, 32, 33]. The lack of physical contact during online interactions causes this reaction. Thus, mobile perceived trust is crucial for online and smartphone purchases. Qualitative interviews showed that m-payment systems with trusted suppliers reduced risk [25]. Tew et al. [25] found that mobile payment confidence increases online purchase intent in China. Teo et al. [34] found a strong correlation between mobile users' perceived trust and their mobile payment propensity. The hypothesis is:

H7: A positive relationship exists between mobile perceived trust and mobile payment service use.

Mobile perceived hedonic motivation includes intrinsic, hedonic, and satisfaction from mobile device use. Research suggests that hedonistic incentives may influence technology adoption and market acceptance [11]. Mobile payment makes financial more manageable and modern, which consumers like. The hypothesis is:

H8: Hedonic motivation and behavioral intention to use mobile payment services are positively correlated.

Behavioral Intention (BI) is a user's likely behavior [2]. Making a technology's behavioral goal more ambitious may increase adoption. Technology adoption studies have found a positive correlation between behavioral purpose and use [35]. In most mobile payment research, behavioral intention is the key variable [17, 36]. This means we do not know how much consumers' preferences affect their mobile payment system use. "There is a substantial difference between a technology's behavioral purpose and its actual use," said Venkatesh et al. This suggests the hypothesis:

H9: Mobile payment adoption is positively correlated with behavioral intention.

From the hypotheses, the conceptual model of this study is provided in Fig. 1.

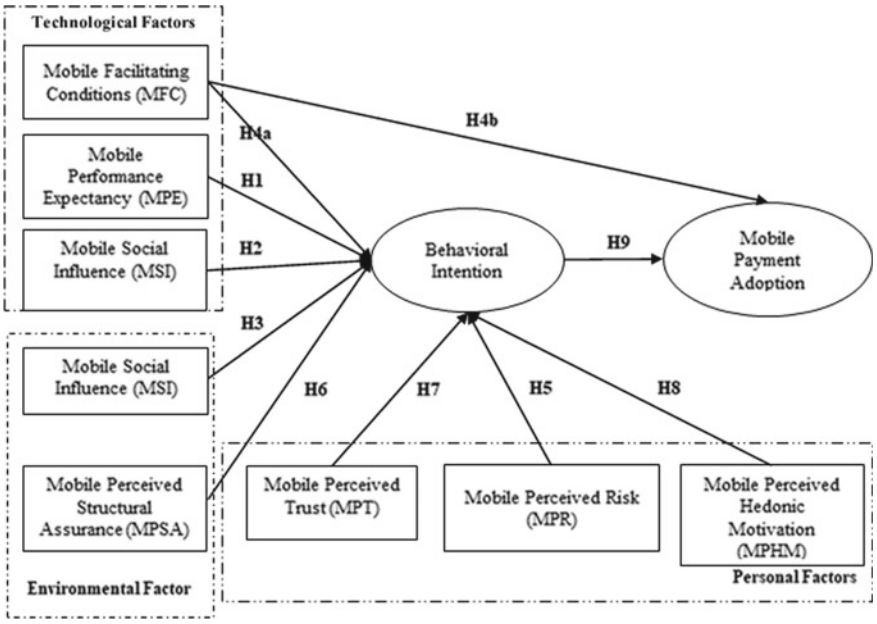

Fig. 1 Conceptual model

3 Research Methodology

From October 2022 to April 2023, three major Hochiminh City retail malls in Vietnam conducted a Google form survey to confirm the study methodology. Hochiminh City was chosen because it has 10% of the Vietnamese population. This study used non-probability sampling because mobile payment users were not sampled. This profile includes respondents with a mobile payment account and made at least one purchase in the past year.

Purposeful sampling provides the minimum sample size for PLS-SEM. G*Power version 3.1 with 0.8 statistical power, 0.05 margin error, 0.15 impact size, and eight predictors was also used to determine the minimum sample size. An outcome sample size of 109 is recommended. The minimum sample size is the minimal sample size needed to confirm or reject a minimum influence on SEM significance and power [37]. In PLS-SEM studies, Ng et al. [38] researchers are expected to use a larger sample size than the minimum because "larger samples more accurately represent the characteristics of the populations from which they are derived". Over 391 questionnaires were available, meeting the sample size needed to confirm or deny a minimum impact.

The survey instrument was based on our review of current and historical literature relevant to the study model. Some wordings were altered to fit the mobile payment environment. The analysis used the seven-point Likert-type scale from "1 (strongly disagree)" to "7 (strongly agree)". Two sub-sections were used in the survey. The first focused on respondent demographics. The second of 31 questions focused on model core constructs. Due to sustainability in science, MPE, MFC, MSI, and MEE were revised using a scale from Venkatesh et al. [10] and Venkatesh et al.'s UTAUT study. Dang et al. [7] developed and verified MPHM measures. Nguyen et al. [12] provided MPSA, MPT, and MPR measurements.

Then, the six-person expert panel was contacted to review the material. Content validity analysis was performed on the instrument to ensure that the selected items accurately represented the construct of interest [39]. Lynn [40] recommends three to ten professionals on the panel. Item-level content validity was first assessed using the content validity index (I-CVI), which is 1.00 for groups of 3–5 experts and 0.83 for groups of 6 experts [40]. The scale's validity was assessed using Universal Agreement (UA) and Ave (Average) and content validity index for scales (S-CVI). For this reason, S-CVI/Ave > 0.90 is preferred [40]. S-CVI/UA may be excessively strict with many specialists.

Table 1 Demographic profiles

Demographic design		Frequency	Percentage (%)
Gender	Male	159	40.66
	Female	232	59.34
Educational level	Bachelor degree	234	59.85
	Master degree	107	27.37
	PhD degree	50	12.79
Age	From 19 to 25 years old	195	49.87
	From 26 to 34 years old	116	29.67
	From 35 to 45 years old	61	15.60
	Above 45 years old	19	4.86
Income level	Less than $400	138	35.29
	From $401 to $800	198	50.64
	From $801 to $1200	24	6.14
	Above $1200	31	7.93
Experience in using MP platforms	Less than 1 year	89	22.76
	1–3 years	195	49.87
	More than 5 years	107	27.37

4 Results and Discussion

4.1 Profile of Respondents

Female make up a larger share of mobile payment users than males. This indicates that women are more likely to use mobile payment methods purchasing online. This is intuitive, given the proliferation of online sales and discounts at the time of the data collection. The data also showed that, on average, respondents were between 19 and 25. In addition, most people who use mobile payments have at least a bachelor's degree; thus, they are highly educated and capable of understanding all facets of the mobile payment system. Table 1 displays the respondents' demographic information.

4.2 Assessing Outer Model

First, evaluate the measurement model (outer model) to determine its utility and applicability before testing hypotheses using the structural model. The outer model evaluation statistical analyses tested internal consistency reliability, indicator reliability, convergent validity, and discriminant validity. Cronbach's Alpha and Composite dependability should exceed 0.7 for internal consistency reliability assessment [41–43]. The table showed that Cronbach's Alpha and Composite dependability were

above 0.7 [44–47]. Therefore, internal consistency reliability is established. Factor loading and average variance will also assess convergent validity—the degree to which construct measurements are conceptually comparable. For factor loading, only indicators with scores above 0.7 will be preserved and those below will be deleted from the final model (MEE1, MFC2) to test fit. Thus, Table 2 factor loading results imply reliability. The table shows all factor loadings exceeding 0.7. The averages above revealed that AVE values are within the acceptable 0.5 range.

Table 2 Reliability and convergent validity

Constructs	Items	Loadings	rho_A	Composite reliability	Average variance extracted (AVE)
BI	BI1	0.837	0.758	0.855	0.663
	BI2	0.789			
	BI3	0.817			
MEE	MEE2	0.919	0.836	0.922	0.856
	MEE3	0.931			
MFC	MFC1	0.826	0.812	0.886	0.722
	MFC3	0.851			
	MFC4	0.871			
MPA	MPA1	0.877	0.798	0.879	0.709
	MPA2	0.802			
	MPA3	0.845			
MPE	MPE1	0.832	0.808	0.880	0.711
	MPE2	0.896			
	MPE3	0.798			
MPHM	MPHM1	0.916	0.894	0.929	0.813
	MPHM2	0.866			
	MPHM3	0.923			
MPR	MPR1	0.811	0.868	0.910	0.771
	MPR2	0.918			
	MPR3	0.902			
MPT	MPT1	0.880	0.838	0.894	0.737
	MPT2	0.851			
	MPT3	0.844			
MSA	MSA1	0.847	0.812	0.887	0.723
	MSA2	0.840			
	MSA3	0.865			
MSI	MSI1	0.781	0.828	0.890	0.730
	MSI2	0.900			
	MSI3	0.877			

Table 3 HTMT criterion

	BI	MEE	MFC	MPA	MPE	MPHM	MPR	MPT	MSA
BI									
MEE	0.771								
MFC	0.641	0.632							
MPA	0.762	0.705	0.608						
MPE	0.662	0.679	0.559	0.558					
MPHM	0.834	0.672	0.622	0.583	0.537				
MPR	0.830	0.679	0.542	0.599	0.588	0.688			
MPT	0.772	0.681	0.539	0.807	0.584	0.696	0.609		
MSA	0.759	0.756	0.718	0.642	0.683	0.799	0.733	0.757	
MSI	0.605	0.621	0.686	0.530	0.478	0.648	0.571	0.585	0.685

In PLS-SEM, assessing discriminant validity is reconsidered. The discriminant validity-heterotrait-monotrait (HTMT) correlation technique ratio is a new way to measure discriminant reliability [46, 48–50]. When the HTMT result is near 1, the test lacks discriminant validity. The HTMT can be compared to predefined criteria. A higher HTMT value than this cutoff may indicate discriminant validity issues. Several researchers recommend a 0.85 score. Table 3 displays HTMT criteria scores above the indicated range and meeting the minimum meaning.

4.3 Examining Inner Structural Model

The structure of the model has been revised after validating the measures model. This requires calculations of the coefficient of determination, path coefficients, and bootstrapping 5000 samples. As shown in Table 4 and Fig. 2, hypothesis testing has been assessed. The findings indicated that mobile social influence, mobile facilitating condition, and mobile structural assurance have insignificant relationships with behavioral intention. Thus H3 ($\beta = -0.033$, $p > 0.05$), H4a ($\beta = 0.062$, $p > 0.05$), and H6 ($\beta = -0.071$, $p > 0.05$) are unsupported. Moreover, mobile perceived risk has a significant negative effect on mobile payment user's behavioral intention to use mobile payment. Hence, H5 ($\beta = 0.293$, $p = 0.000$) is supported. Furthermore, the result revealed that mobile performance expectancy, mobile effort expectancy, mobile perceived trust, and mobile perceived hedonic motivation have a significant positive relationship with behavioral intention to use mobile payment. Therefore, H1 ($\beta = 0.080$), H2 ($\beta = 0.131$), H7 ($\beta = 0.183$), and H8 ($\beta = 0.346$) are supported. Moreover, the relationship between behavioral intention and mobile payment adoption and between mobile facilitating conditions with mobile payment adoption are significantly positive. Thus, H4b ($\beta = 0.253$) and H9 ($\beta = 0.468$) are supported.

Table 4 Hypothesis testing results

Hypotheses	Path	Path coefficients	T Statistics (|O/STDEV|)	P Values	Remarks
H1	MPE → BI	0.080	1.991	0.047	Supported
H2	MEE → BI	0.131	2.676	0.007	Supported
H3	**MSI → BI**	**− 0.033**	**0.774**	**0.439**	**Unsupported**
H4a	**MFC → BI**	**0.062**	**1.104**	**0.270**	**Unsupported**
H4b	MFC → MPA	0.253	5.286	0.000	Supported
H5	MPR → BI	0.293	5.960	0.000	Supported
H6	**MSA → BI**	**− 0.071**	**1.295**	**0.195**	**Unsupported**
H7	MPT → BI	0.183	3.145	0.002	Supported
H8	MPHM → BI	0.346	6.419	0.000	Supported
H9	BI → MPA	0.468	9.068	0.000	Supported

p>0.05: unsupported

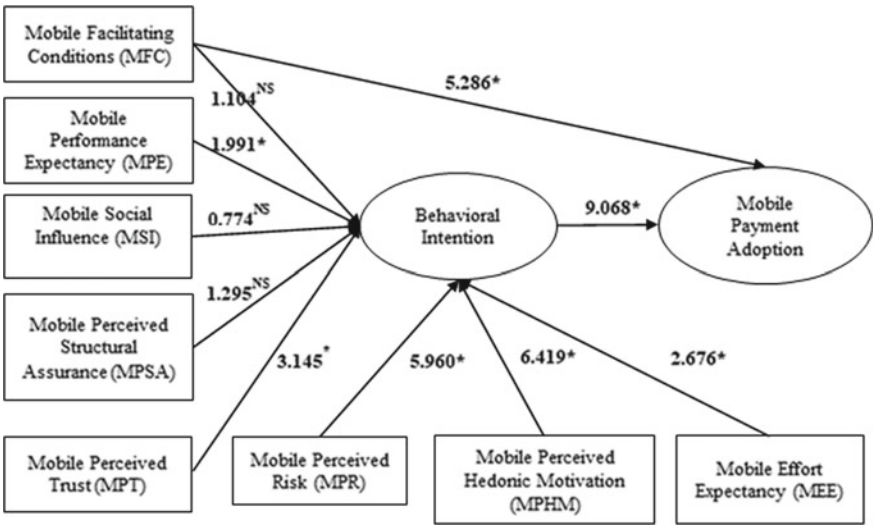

Fig. 2 Structural model testing

4.4 ANN Analysis

This study uses a multi-layer perceptron ANN because feed forward back-propagation reduces analytical errors in ANNs [44, 51]. A ten-fold cross-validation approach used 90% of the data for training and 10% for testing to prevent over-fitting [52]. The number of hidden neurons was automatically generated by SPSS v25 using a sigmoid function as the non-linear activation function for the hidden and

output layers [53]. To assess prediction accuracy and relevance, researchers should calculate root-mean-square error values and count hidden neuron synaptic weights [54]. A small root-mean-square error indicates a good data fit and prediction [33, 48]. After determining predictive accuracy and predictive relevance, a sensitivity analysis was performed to determine the relative significance of exogenous factors to the endogenous variable.

As shown in Fig. 3, each ANN model's non-zero synaptic weights are linked to at least one hidden neuron, indicating predictive significance. Table 5 also shows that these models predict accurately with root-mean-square errors near zero. The sensitivity analysis in Table 6 compares the importance of input neurons (exogenous variables) in each ANN model. This matters because ANN models are accurate and relevant. MPT is the most important factor in ANN Model A's behavioral intention. ANN Model B's analysis of mobile payment adoption ranks BI as the most important factor. However, MPR, MEE, MPE, and MPHM have the greatest impact on mobile payment intention.

4.5 Discussion

The study found no positive impact on Vietnamese users' Mobile Service Innovation (MSI), Mobile Financial Capability (MFC), and Mobile Service Adoption (MSA) for mobile payment. The current study found no statistically significant association between the above criteria and mobile payment service use. Our findings on MSI match those of Senyo and Osabutey [55]. Influencers or prominent individuals may not be the main driver of mobile payment adoption in Vietnam, as the decision to use mobile payment is based on individual preferences and needs. Similar to the mobile enabling condition, the behavioral intention was not statistically significant. This finding supports Senyo and Osabutey [55] but contradicts Loh et al. [9]. The prevalence of mobile payment services and the ease of using mobile devices and payment apps explain their adoption. Mobile structural assurance and behavioral intention in Vietnam are also insignificant. This finding supports Tew et al. [25] but contradicts Nguyen et al. [12]. In Vietnam, people trust the Internet and social media information. Their main concern is understanding mobile payment app legal remedies and rules in case of issues. Mobile communications service providers limit mobile payment users to VND 10 million monthly. However, Fintech applicants must deposit funds from their bank accounts before making payments. Thus, financial loss is rare, and structural certainty in the mobile context is not a significant concern.

This study supports Al-Saedi et al. [56] findings that performance expectations improve. These studies show that individuals are more likely to adopt mobile payment systems if convenient. However, unlike previous studies, this study found no significant influence of mobile payment drivers on behavioral purposes. In Vietnam, most people use mobile payment methods to transfer small amounts of money. The financial risks of investing in mobile apps limit funding. Mobile payment platforms allow up to $1200 in monthly transfers and payments. Thus, the mobile payment system

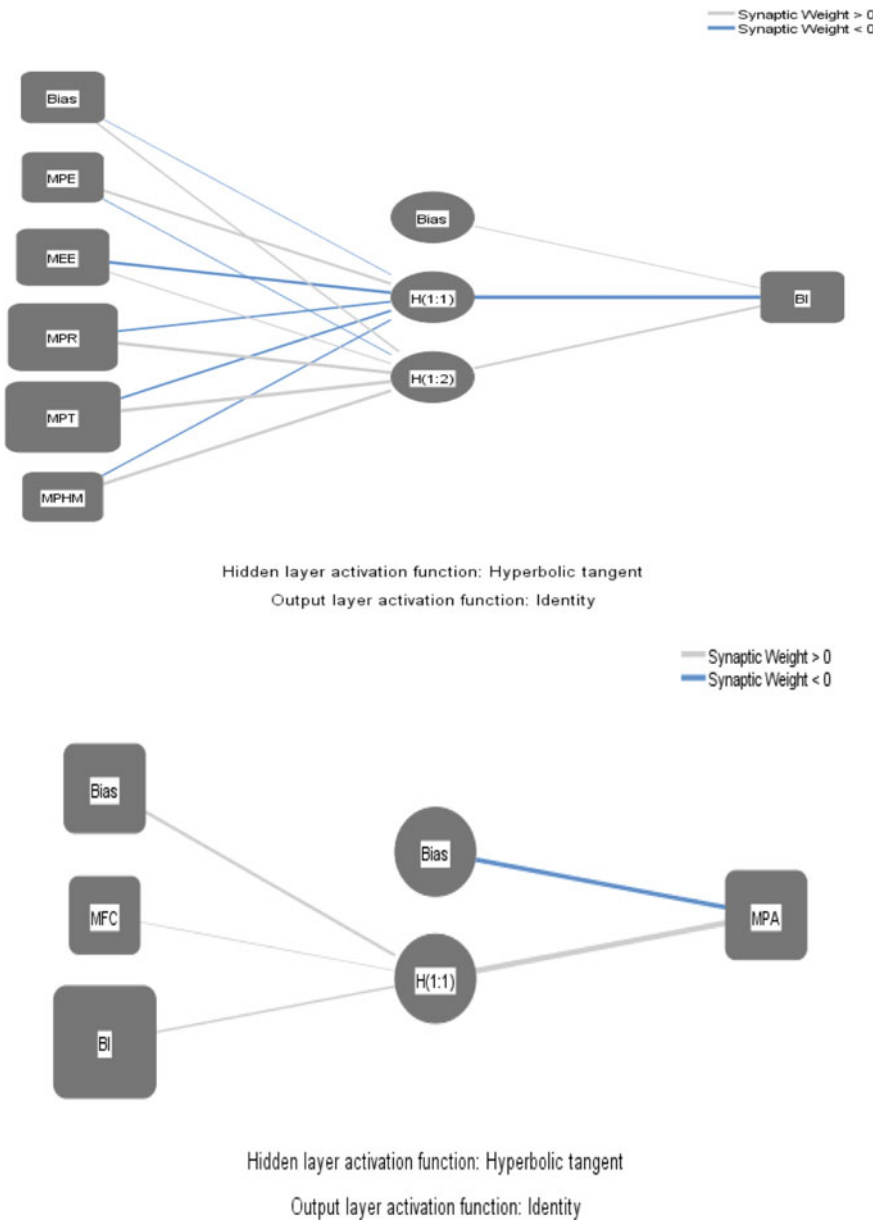

Fig. 3 The ANN models developed

Table 5 Root-mean-square error values incurred during training and testing stages

Neural network	Model A (output: BI)		Model B (output: MPA)	
	Training	Testing	Training	Testing
ANN1	0.376	0.350	0.363	0.250
ANN2	0.357	0.316	0.375	0.442
ANN3	0.356	0.375	0.378	0.319
ANN4	0.363	0.383	0.352	0.543
ANN5	0.337	0.480	0.371	0.293
ANN6	0.334	0.421	0.427	0.388
ANN7	0.346	0.318	0.402	0.364
ANN8	0.357	0.316	0.377	0.306
ANN9	0.343	0.362	0.389	0.244
ANN10	0.369	0.410	0.362	0.375
Means	**0.354**	**0.373**	**0.380**	**0.352**
SD	**0.013**	**0.050**	**0.021**	**0.087**

Table 6 Sensitivity analysis

Neural network	Model A (output: BI)					Model B (output: MPA)	
	MPE	MEE	MPR	MPT	MPHM	MFC	BI
ANN1	0.118	0.151	0.196	0.315	0.219	0.264	0.736
ANN2	0.134	0.167	0.228	0.273	0.199	0.259	0.741
ANN3	0.241	0.049	0.255	0.322	0.134	0.252	0.748
ANN4	0.171	0.081	0.168	0.351	0.229	0.194	0.806
ANN5	0.129	0.113	0.229	0.290	0.240	0.288	0.712
ANN6	0.149	0.121	0.344	0.258	0.128	0.243	0.757
ANN7	0.172	0.063	0.253	0.331	0.199	0.291	0.709
ANN8	0.200	0.169	0.232	0.255	0.143	0.246	0.754
ANN9	0.106	0.160	0.262	0.238	0.233	0.352	0.648
ANN10	0.137	0.101	0.318	0.297	0.146	0.302	0.698
Average relative importance	0.156	0.118	0.249	0.293	0.187	0.269	0.731
Normalized relative importance (%)	46.70	64.40	91.40	100.0	45.00	25.40	100.0

may not be as effective as thought. The effort required to use mobile payment services also affects people's willingness to adopt them. This supports the hypothesis that mobile payment convenience increases adoption. To increase mobile payment adoption in Vietnam, developers should focus on creating user-friendly and manageable apps. The perception of confidence in mobile platforms also affects Vietnamese

people's intention to use mobile payment services. This conclusion agrees with Tan et al. [31]. According to research hedonic motivation is the strongest predictor of mobile payment adoption. Mobile payment apps are a major driver of customer self-motivation, according to Dang et al. [4]. Nguyen et al. [2] suggest that people may be interested in innovative methods that address their hedonic motivation. Therefore, people prefer to acknowledge and embrace specific inventions because they associate them with hedonic pleasure. Additionally, people associate pleasure and escape with their electronics. The software's appealing designs and colors reinforce this association [27]. Nguyen et al. [2] found that smartphone users often feel pleasure and amusement when using mobile payment services. This is because these apps are easy to use, improving customer satisfaction. The traditional banking channel's time-consuming nature frustrates prospective customers [35]. Mobile devices are associated with fun, reducing the stress of traditional banking and improving the customer experience.

The present study defines perceived risk as a major determinant of mobile payment adoption, following Hammood et al. [35]. According to Tan et al. [57], users will adopt mobile payment if service providers provide secure, user-friendly, and satisfactory services. Vietnamese users may be less likely to use apps due to their perception of their risks.

The study found that behavioral intention positively affects mobile payment adoption and use. This finding suggests that people who intend to use mobile payment services will do so. This means that consumer tools and support programs make mobile payment services more appealing. MFC and customers' technology adoption have also been studied [12].

5 Conclusion and Practical Implications

The primary objective of the proposed research is to generate multiple significant theoretical advancements. This study aims to offer a comprehensive understanding of the determinants of mobile payment adoption in Vietnam by incorporating the Unified Theory of Acceptance and Use of Mobile Technology (UTAUMT), Flow theory, and Prospect theory. Integrating of various factors enables a comprehensive comprehension of adoption, encompassing technological acceptance, psychological experiences, and decision-making processes. Classifying factors into technological, environmental, and personal dimensions provides a comprehensive and detailed examination of the diverse influences that impact the process of adoption. By conducting a thorough analysis of empirical usage patterns, this research serves to establish a connection between theoretical frameworks and practical implementation, thereby improving the relevance of theoretical constructs in real-life situations. The study also aims to identify the factors that promote and hinder the adoption of mobile payment, offering a comprehensive understanding of the dynamics involved in the adoption process. The present study possesses the capacity to provide valuable cross-cultural perspectives, enhance existing theoretical frameworks, and make

meaningful contributions to the ongoing development of technology adoption theories. The primary objective of this study is to enhance comprehension regarding the adoption of mobile payment methods and to provide valuable insights for industry stakeholders and governmental organizations in developing effective strategies.

The use of mobile technology in Vietnam has increased. Smartphones have GPS and games that users can quickly access, improving their quality of life and convenience. Wireless connectivity and digital media are replacing physical mediums for financial transactions and remittances. The growing information technology sector in Vietnam offers improved purchasing capabilities and accessibility, supporting the goals of a cashless society and financial inclusion. Mobile phone payment is popular. Thus, these tools are highly beneficial and user-friendly for locals. Examining mobile payment technologies' adoption and use factors. Mobile payment companies, telecommunications providers, merchants, banks, and app developers depend on value research. This study shows mobile payment system designers practical variables to consider. MEE, MPR, MPHM, MPE, MPT, and MFC can affect consumer approval. Therefore, service providers must stay abreast of efforts to reduce costs and improve benefits to increase behavioral intention. For instance, if mobile payment services cost more than alternatives or fail to pay bills or transfer funds, users uninstall the app and complain to others. Mobile payment system developers must also prioritize user-friendliness and consumer benefits. Trust also promotes long-term user engagement with mobile payment services, promoting financial inclusion. Users trust and feel safe using mobile payment systems if their data is secure and confidential.

It is essential to conduct additional research on customer loyalty in the future, considering the constraints of the current study. The present study is impeded by its utilization of a cross-sectional design, which limits the ability to obtain a comprehensive understanding of the evolution of consumer behavior. The tendency of users to discontinue their usage of mobile payment applications as a result of concerns related to security or satisfaction, especially in the presence of technical malfunctions, highlights the significance of implementing enduring relationship strategies.

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