Journal of Global Information Management
Volume 29 • Issue 1 • January-February 2021

A Perception-Based Model for Mobile Commerce Adoption in Vietnamese Small and Medium-Sized Enterprises

Ngoc Tuan Chau, School of Business IT and Logistics, RMIT University, Australia & University of Economics, The University of Danang, Vietnam

https://orcid.org/0000-0001-5023-0013

Hepu Deng, School of Business IT and Logistics, RMIT University, Australia & Business and Law School, Foshan University, China

Richard Tay, School of Business IT and Logistics, RMIT University, Australia

ABSTRACT

This paper investigates the critical determinants for the adoption of mobile commerce (m-commerce) in Vietnamese small and medium-sized enterprises (SMEs) from the perspective of managers. A perception-based conceptual model is developed with respect to the technology-organization-environment framework. The conceptual model is then tested and validated using structural equation modelling on the data collected from 513 SMEs in Vietnam. The study shows that perceived benefits, perceived compatibility, perceived security, perceived organizational readiness, and perceived customer pressures are critical for the adoption of m-commerce. As the first study on the critical determinants for m-commerce adoption in Vietnam, these findings are useful for SME managers as well as policymakers in designing policies as strategies to promote the wide development and diffusion of m-commerce in SMEs in Vietnam and other developing countries.

KEYWORDS

Mobile Commerce, Perception-Based Model, SMEs, Technology Adoption, Vietnam

INTRODUCTION

Mobile commerce (m-commerce) is about buying and selling of goods and services through wireless handheld devices such as cellular phones and personal digital assistants (Njenga, Litondo & Omwansa, 2016; Chau & Deng, 2018a). It provides businesses, especially small and medium-sized enterprises (SMEs) with cost-effective ways to promote their products and services online (Hong, 2019). This has numerous benefits including improving productivity, increasing customer satisfaction, and lowering operational costs (Varshney, Malloy, Ahluwalia & Jain, 2004; Chau & Deng, 2018b; Duan, Deng & Luo, 2019). As a result, m-commerce is becoming increasingly popular across the world.

Despite the benefits, the adoption of m-commerce in SMEs in developing countries remains limited (Nafea & Younas, 2014). In Vietnam, for example, only 20% of SMEs have built websites

DOI: 10.4018/JGIM.2021010103

This article, published as an Open Access article on February 4, 2021 in the journal, Journal of Global Information Management (converted to gold Open Access January 1, 2021), is distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0/) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

for promoting their business. About 70% of these websites are difficult to access by mobile devices (VECITA, 2017). Such poor adoption in SMEs is due to the complex adoption process (Stoica, Miller & Stotlar, 2005) in which many factors such as individual attributes (Njenga et al., 2016), technological, organizational, and environmental aspects (Jain, Le, Lin & Cheng, 2011; Njenga et al., 2016), managerial issues (Alfahl, Houghton & Sanzogni, 2017), and trust (Rahman, 2013) affect the adoption of m-commerce. To improve the adoption in SMEs, better understanding the critical determinants for m-commerce adoption is significant.

Numerous studies have been conducted for investigating the adoption of m-commerce under various circumstances (Jain et al., 2011; Lu, Hu, Huang & Tzeng, 2015; Martin & Jimenez, 2015; Alfahl et al., 2017). A comprehensive investigation of such studies reveals that most studies on organizational m-commerce adoption focus on large enterprises, with limited research on SMEs (Chau & Deng, 2018a, 2018b). Since SMEs possess unique characteristics (Duan et al., 2019), the research findings from these studies may not be applicable to SMEs. As a result, more research on SMEs is needed to bridge this gap in the literature.

Understanding the critical determinants of m-commerce adoption requires a comprehensive investigation of the characteristics of m-commerce from the perspective of organizations. Such characteristics can be either primary or secondary (Downs & Mohr, 1976). The primary characteristics are related to m-commerce itself. These characteristics are independent of the perception of the organization. The secondary characteristics are related to the perception of the organization (Downs & Mohr, 1976). Decision-makers usually evaluate the characteristics of specific innovations for adoption (Sutanonpaiboon & Pearson, 2006). Their perception of these characteristics leads to the adoption. Because different organizations perceive the primary characteristics in different ways, their decisions on innovation adoption might differ. This indicates the limitation of primary characteristics in innovations adoption studies. It proves the importance of the perception of organizations in exploring the critical determinants of m-commerce adoption.

This study investigates how the perception of SMEs on m-commerce influences its adoption. It aims to (a) identify a comprehensive set of the perceived characteristics of m-commerce adoption and (b) examine the influence of such characteristics on the adoption of m-commerce in Vietnamese SMEs. To achieve these aims, a perception-based conceptual model for m-commerce adoption in Vietnamese SMEs is developed with respect to the technology-organization-environment framework. The conceptual model is then tested and validated using structural equation modelling (SEM) on the data collected from 513 SMEs in Vietnam.

This study has important implications for both theory and practice. Theoretically, the study contributes to organizational m-commerce adoption literature by developing a perception-based model for identifying the critical determinants in SMEs. Practically, the study identifies the critical determinants for m-commerce adoption, leading to the formulation of specific strategies and policies to facilitate the development of m-commerce in SMEs under various circumstances.

THEORETICAL BACKGROUND

The technology-organization-environment framework (TOE) is often used to examine the overall contextual basis from the organizational perspective for the adoption of technological innovations (Duan, Deng & Corbitt, 2012). It aims to understand how the organizational context influences the adoption of technological innovations (Baker, 2012). This framework states that the adoption of technological innovations is influenced by the technological context, the organizational context, and the environmental context (Tornatzky & Fleischer, 1990). The technological context is about the technologies available. The organizational context concerns the availability of organizational resources for adopting technological innovations. The environmental context is related to the environment in which organizations conduct business. These three contexts present "both constraints and opportunities for technological innovations" (Tornatzky & Fleischer, 1990). A holistic

consideration of these three contexts presents an effective framework for better understanding the adoption of technological innovations in organizations (Baker, 2012). As a result, TOE has become a comprehensive lens for understanding the adoption of technological innovations including enterprise information systems, e-markets, e-business, and e-commerce (Wu & Chuang, 2010; Duan et al., 2012; Sila, 2013; Imre, 2016).

Numerous studies have adopted TOE for understanding the critical determinants in organizational m-commerce adoption under various situations. Doolin & Ali (2008), for example, employ TOE for investigating the critical determinants for the adoption of m-commerce in business in New Zealand, confirming that relative advantage, compatibility, top management support, information intensity, organizational readiness, competitive intensity, and partner influence are critical. Jain et al. (2011) apply TOE for exploring the critical determinants of adopting m-commerce in Indian organizations, indicating that information systems (IS) infrastructure, relative advantage, complexity, trialability, firm size, financial commitment, IS expertise, trading partner readiness, and external IS support are critical. Lu et al. (2015) adopt TOE for exploring the adoption of m-commerce in Taiwanese SMEs, leading to the identification of the critical determinants including data security, network reliability, technology complexity, top management emphasis, employees' IS knowledge, firm size, competitive pressures, partner support, and regulatory support. Martin & Jimenez (2015) employ TOE for investigating the adoption of m-commerce in Spanish firms, leading to the identification of the critical determinants including motivation, perceived benefits, managers' and employees' support, impediments to implement, perceived customer value, competitive pressures, and the propensity to innovation and ICT. Rana, Barnard, Baabdullah, Rees & Roderick (2019) adopt TOE for exploring the barriers to m-commerce adoption in SMEs in UK, leading to the confirmation of perceived cost, perceived risk, inconvenience of use, compatibility, privacy and security, lack of knowledge, forced changes to business strategy, unawareness of benefits, lack of customer trust and confidence, and lack of external pressures as the critical determinants. Such studies demonstrate that TOE is effective for better understanding the adoption of m-commerce under various circumstances.

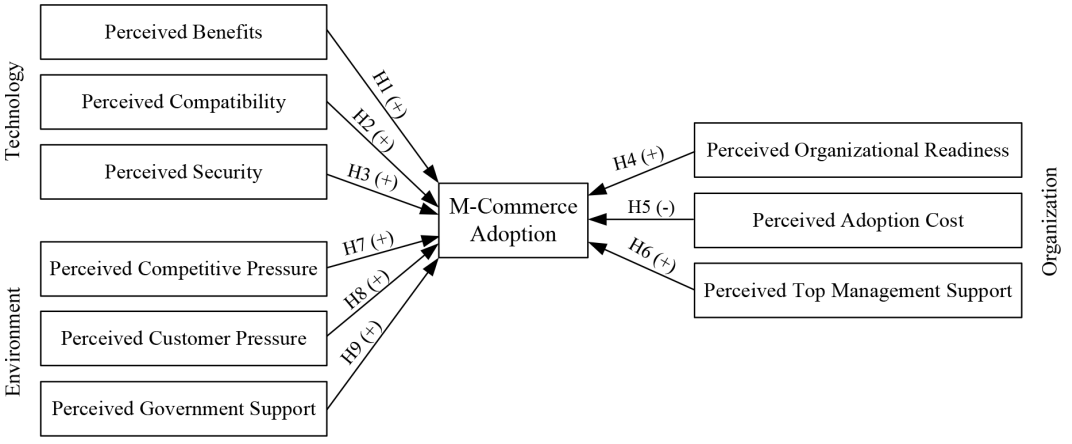
Drawing upon these empirical findings and combined with the theoretical perspective discussed above, this study hypothesizes that TOE is appropriate for investigating the critical determinants for m-commerce adoption in Vietnamese SMEs. This is because m-commerce is a technological innovation in organizations that is made possible by the development of mobile technologies and the internet, driven by organizational readiness, and influenced by environmental factors (Chau & Deng, 2018a, 2018b).

A PERCEPTION-BASED MODEL

The perception of organizations on the benefits of m-commerce from three organizational perspectives has a fundamental impact on organizational adoption of m-commerce. Such perception is related to a holistic consideration of the characteristics of m-commerce (Kuan & Chau, 2001). These characteristics can be classified into primary and secondary ones. Focusing on the primary characteristics of m-commerce without distinguishing between the primary characteristics and the secondary characteristics would create inconsistent findings in adoption studies (Downs & Mohr, 1976). This is because "while so-called primary attributes of innovations can be measured objectively, the meaning of the objective measure of the characteristics is subjective, that is, in the mind of the perceiver" (Tornatzky & Klein, 1982, p. 28).

There are numerous studies that stress the importance of adequately considering the secondary characteristics of innovations in the adoption study. Tornatzky & Klein (1982), for example, show that secondary characteristics are the predictor for the adoption of innovations. Moore & Benbasat (1991) reveal the importance of the perceived characteristics in developing an instrument for studying the adoption of IT in organizations. Kuan & Chau (2001) find five significant "perceived" attributes that influence the adoption of electronic data interchange in small business, including perceived

Figure 1. A perception-based model



direct benefits, perceived financial cost, perceived technical competence, perceived industry pressure, and perceived government pressure. Tan (2010) investigates a perception-based model for adopting innovations in SMEs, leading to the proposition of three dimensions of the perceived characteristics of innovations including perceived impact of technologies, perceived organizational readiness and perceived external environment. These studies prove the suitability of the secondary characteristics for achieving consistent findings in the adoption study.

A perception-based model for m-commerce adoption in Vietnamese SMEs that focuses on the secondary characteristics of m-commerce is developed as shown in Figure 1. In this model, many technological characteristics of m-commerce and organizational characteristics are considered as secondary (Downs & Mohr, 1976). Furthermore, the characteristics of the external environment are also considered as the secondary one (Kuan & Chau, 2001). The model conceptualizes that there are three contexts of m-commerce adoption in SMEs including technological context, organizational context, and environmental context.

Technological Context

The technological context is related to the characteristics of technologies available (Rogers, 2010; Lu et al., 2015). Technology adoption in organizations depends on the availability of technologies and their compatibility with existing technologies (Tornatzky & Fleischer, 1990). There are five perceived technological characteristics used for investigating the adoption of technologies in organizations, including perceived benefits, perceived compatibility, perceived complexity, perceived observability, and perceived trialability (Rogers, 2010). Among these characteristics, perceived benefits and perceived compatibility are the most important factors (Chau & Deng, 2018a). A review of the adoption studies reveals that security affects the willingness of SMEs to adopt ICT (Tan & Eze, 2008). It is the main concern for the adoption of technological innovations in small businesses in developing countries (Tan, Chong, Lin & Eze, 2009). As a result, perceived security is included in the technological context for better explaining m-commerce adoption in Vietnamese SMEs. Consequently, three perceived technological characteristics were proposed including perceived benefits, perceived compatibility, and perceived security.

Perceived Benefits

Perceived benefits are the anticipated advantage from adopting technologies (Duan et al., 2012). They are reflected from the degree to which the technology is expected to bring better performance and the extent to which business activities are covered when a technology is adopted (Jeon, Han & Lee, 2006).

Perceived benefits are critical for the adoption of technologies in organizations (Ifinedo, 2011; Picoto, Belanger & Palma-dos-Reis, 2013; Otieno & Kahonge, 2014). The adoption of technologies in SMEs such as m-commerce can help them reengineer their business processes for better performance (Lal, 2005). Wang & Ahmed (2009) confirm that SMEs can better compete in the market as the entry barrier to the market is lowered with the adoption of technologies. Ghobakhloo & Tang (2013) indicate that technologies are more likely to be adopted in SMEs if their benefits are perceived outweighed risks. This means that the higher the perceived benefits, the greater the intention to adopt the technology. This leads to the following hypothesis:

H1: Perceived benefits are positively associated with the adoption of m-commerce.

Perceived Compatibility

Compatibility is the degree to which a technology is consistent with existing values, needs and experiences of the organization (Rogers, 2010). It is measured by the fit of the technology with customers and suppliers, the fit with the organizational structure, and the perceived suitability of the business to adopt the technology (Salah, 2013). Perceived compatibility can speed up or slow down the adoption in organizations. It is critical for technology adoption in SMEs (Hung, Yang, Yang & Chuang, 2011; Alfahl et al., 2017). Hung et al. (2011) indicate that technologies are more likely to be adopted when they are compatible with the work practices, values, and beliefs of organizations. Alam, Ali & Jani (2011) confirm that a higher level of perceived compatibility is associated with an improved intention to adopt technologies in organizations. This leads to the following hypothesis:

H2: Perceived compatibility is positively associated with the adoption of m-commerce.

Perceived Security

Perceived security is the awareness of organizations about the security of m-commerce. It can be measured by transaction security, facility security, and antivirus capability (Xu, Liu & Lu, 2010). Perceived security is critical for the adoption of technologies in organizations (Zhu, Kraemer & Xu, 2006; Wu & Chuang, 2010). Tan et al. (2009) show that security is the main concern for the adoption of technologies in small businesses in developing countries. Alam, Khatibi, Ahmad & Ismail (2008) confirm that security is the most important barrier to the use of e-commerce in Malaysian SMEs. Alam et al. (2011) indicate that the fear of losing trade secrets leads to the reluctance of SMEs to adopt e-commerce. A survey of the Vietnam Chamber of Commerce and Industry reveals that security is the main barrier to the adoption of internet commerce in Vietnam (VCCI, 2016). As m-commerce is conducted using mobile devices, the perceived security certainly affects the intention to adopt m-commerce in SMEs. This leads to the following hypothesis:

H3: Perceived security is positively associated with the adoption of m-commerce.

Organizational Context

The organizational context is related to the characteristics of organizations. It represents the organizational factors that affect the adoption of technologies (Duan et al., 2012). A literature review shows that organizational readiness and top management support are the most important determinants for such adoption (Chau & Deng, 2018a). Furthermore, the cost of adoption is a concern, especially for SMEs in developing countries (Chau & Deng, 2018b). Consequently, three perceived organizational characteristics are proposed: perceived organizational readiness, perceived adoption cost, and perceived top management support.

Perceived Organizational Readiness

Perceived organizational readiness is about the availability of technological, financial, and human resources for adopting technologies. Technological readiness is related to the accessibility of organizations to IT resources that encourage the adoption of technologies. Financial readiness is linked to the financial resources available to pay for the installation, enhancements and ongoing expenses on the adoption of technologies (Pham, Pham & Nguyen, 2011). Human resources readiness is concerned about the availability of IT expertise and staffs for the adoption of technologies (Kurnia, Karnali & Rahim, 2015). Perceived organizational readiness is critical for technology adoption, especially in SMEs (Alam et al., 2011). The high perception of organizational readiness leads to improved technology adoption in organizations (Mahroeian, 2012). This leads to the following hypothesis:

H4: Perceived organizational readiness is positively associated with the adoption of m-commerce.

Perceived Adoption Cost

Perceived adoption cost is related to the estimated expense of adoption. It includes the cost of technologies, maintenance, and training. The cost of adoption is critical for SMEs, especially SMEs in developing countries (Tan et al., 2009; Chau & Deng, 2018b). Ghobakhloo, Aranda & Amado (2011) indicate that SMEs are operating under severe resource constraints, particularly financial constraints. This compels SMEs to be cautious about their investment in technology adoption. In Vietnam, the slow adoption of technologies in SMEs is attributed to many challenges. In addition to the lack of awareness of the benefits, there is a business perception that technology adoption is costly. Perceived adoption cost is directly associated with technology adoption in many IS studies (Mallat & Tuunainen, 2008; Tan et al., 2009; Amegbe, Hanu & Nuwasiima, 2017). The higher the perceived adoption cost, the slower the pace of adoption (Alam et al., 2011). This leads to the following hypothesis:

H5: Perceived adoption cost is negatively associated with the adoption of m-commerce.

Perceived Top Management Support

Top management support is about the involvement, enthusiasm, motivation, and encouragement provided by management toward the adoption of technologies (Ramdani, Kawalek & Lorenzo, 2009). It is critical for technology adoption in SMEs as the decision-making process is mostly centralized in a few managers (Alfahl et al., 2017). Such persons can provide a vision, support and commitment to creating a positive environment for technology adoption (Al-Alawi & Al-Ali, 2015). This shows that management support is crucial for the adoption of technologies in SMEs. Top management support is positively related to the adoption of technologies in organizations (Al-Alawi & Al-Ali, 2015; Lu et al., 2015; Ibrahim, Hassan & Gusau, 2018). This leads to the following hypothesis:

H6: Perceived top management support is positively associated with the adoption of m-commerce.

Environmental Context

The environmental context is related to the surrounding of organizations with respect to competitors, customers, suppliers, and government (Baker, 2012). It includes the size and structure of the industry, the competitors, the macroeconomic context, and the regulatory environment (Tornatzky & Fleischer, 1990). A review of organizational m-commerce adoption has identified the three most important environmental factors: perceived competitive pressures, perceived customer pressures, and perceived government support (Chau & Deng, 2018b). These perceived environmental factors are therefore proposed in the conceptual framework.

Perceived Competitive Pressures

Perceived competitive pressures are about the degree that organizations are affected by competitors (Porter, 1985). There are five competitive forces for collectively determining the profitability of the industry: power of buyers, power of suppliers, threat of new entrants, threat of substitute products, and rivalry among existing competitors (Porter & Millar, 1985). Perceived competitive pressures significantly affect the adoption of technologies in SMEs (Al-Zoubi, 2013; Awa, Ukoha & Emecheta, 2016). SMEs would feel the pressure to adopt specific technologies for being competitive when their competitors have adopted such technologies (Ahmad, Bakar, Faziharudean & Zaki, 2015). As a result, the greater the perceived competitive pressures, the more likely the adoption of technologies (Duan et al., 2012). This leads to the following hypothesis:

H7: Perceived competitive pressures are positively associated with the adoption of m-commerce.

Perceived Customer Pressures

Perceived customer pressures come from the customers on the need for adopting specific technologies in organizations. SMEs tend to innovate when they come under pressures from customers (Chatzoglou & Chatzoudes, 2016). When the dominant customers have adopted specific technologies, organizations may adopt these technologies to show their fitness as business partners (Al-Bakri & Katsioloudes, 2015). Perceived customer pressures are critical for the adoption of technologies in organizations (Huy, Rowe, Truex & Huynh, 2012; Mohammad Kasem Alrousan & Jones, 2016; Jiang, Phang, Tan & Chi, 2019). Ahmad et al. (2015) confirm that SMEs in developing countries adopt e-commerce because of customer pressures. As a result, the greater the perceived customer pressures, the more likely the adoption of specific technologies in SMEs (Duan et al., 2012). This leads to the following hypothesis:

H8: Perceived customer pressures are positively associated with the adoption of m-commerce.

Perceived Government Support

Government support is about the availability of specific policies and initiatives for promoting the adoption of technologies in organizations. It is reflected in three aspects including legislation and policies, funding and ICT infrastructure (Saprikis & Vlachopoulou, 2012). Perceived government support is critical for the adoption of technologies in SMEs (Alrawabdeh, 2014; Chatzoglou & Chatzoudes, 2016; Ali, Miao & Tran, 2018). Kurnia et al. (2015) indicate that government support serves as a facilitator in assisting SMEs in adopting technologies. Mohammad Kasem Alrousan & Jones (2016) show that government incentives lower the barrier of technology adoption. Chatzoglou & Chatzoudes (2016) reveal that government policies encourage businesses including SMEs to adopt technologies. This leads to the following hypothesis:

H9: Perceived government support is positively associated with the adoption of m-commerce.

RESEARCH METHODOLOGY

This study aims to identify the critical determinants for m-commerce adoption in Vietnamese SMEs. To achieve this objective, a research question is formulated as follows: *what are the critical determinants for m-commerce adoption in Vietnamese SMEs?* To answer this question, a conceptual model is developed that is to be tested and validated using SEM. To facilitate the testing and validating process, data are collected using a survey of managers of Vietnamese SMEs. A survey is adopted in this study as it is the most suitable approach for collecting a large amount of perceptual data from the population (Zhang, Li and Deng, 2017). It provides an effective method for obtaining information

from a targeted sample, therefore increasing the validity and generalizability of the research findings (Williams, Dwivedi, Lal & Schwarz, 2009).

Before the distribution of the questionnaire, a pre-test process is conducted for improving the clarity, wording, and validity of questions. Three professors and five doctoral students in business information systems are invited to analyse the content and wording of the question. Modifications are based on their suggestions to increase the questionnaire validity and reliability. Because the survey is conducted in Vietnam where the official language is Vietnamese, the questionnaire is translated into Vietnamese using a parallel translation technique to ensure an accurately-worded translation (Usunier, 1998). A pilot test with thirty-two Vietnamese SMEs' managers is then conducted. Based on the feedback, the final questionnaire is used. The research is approved by the university research ethics committee. No monetary incentive is provided to the participant.

This study uses multiple items to measure each variable, with variables previously verified by experts serving as a reference for the questionnaire design. In addition to the basic data of the business, the questionnaire consists of questions for evaluating the critical determinants for m-commerce adoption in Vietnamese SMEs. A five-point Likert-type scale is adopted in which the value "1" represents "strongly disagree", and the value "5" represents "strongly agree". Table 1 presents the items used in the questionnaire and their sources.

The self-administered survey was conducted in Vietnam between April and October 2018 via online and paper-based surveys. The target population is Vietnamese SMEs. The sampling frame is obtained from the Vietnam Association of SMEs (VINASME) website using the probability sampling method. The sample unit is the managers of selected SMEs. For an online survey, an e-mail package, which includes a Vietnamese version of the invitation letter and the Qualtrics link to the online Vietnamese version of the questionnaire, is sent by the VINASME to the managers of selected SMEs. Two follow-up reminds are sent to those managers that have not responded after the first two weeks and the first four weeks. For a paper-based survey, a mail package, which includes a printed version of the questionnaire and the invitation letter along with a postage-paid return envelope, is delivered to the managers of selected SMEs. A total of 556 responses are received including 184 responses from the online survey and 372 responses from the paper-based survey. Data cleaning and examination processes are conducted for addressing missing values, outliers, and normality. These processes lead to the deletion of forty-three cases, including those with unanswered questions, missing data on dependent variables, and outliers. Finally, 513 usable responses, including 159 responses of the online survey and 354 responses of the paper-based survey, are retained for the statistical analysis.

The respondents are the general manager and department manager of the selected SMEs. Table 2 presents the characteristics of these SMEs. The diverse industries, duration of business, and sizes of SMEs indicate that the survey data are representative of the population.

The data are examined for potential response bias between the online survey and the paper-based survey (Bryman & Bell, 2015). This study conducts a survey on the three dimensions of the critical determinants for m-commerce adoption in SMEs. As a result, the bias test is estimated based on the mean of each dimension. A two-sample *t*-test is conducted for comparing the result of the respondent from both types of survey. Table 3 presents the independent *t*-test result for the respondents of both surveys. The results indicate no significant difference between online and paper-based responses at a 95% confidence interval for the chosen variables.

RESULTS AND DISCUSSION

A two-stage approach is followed in data analysis including measurement model analysis and structural model analysis (Hair, Black, Babin, Anderson & Tatham, 2010). Stage one targets the perceived characteristics in the technological, organizational, and environmental dimensions for performing confirmatory factor analysis (CFA) of the measurement model. Stage two focuses on structural model analysis to verify the rationality of the research hypotheses.

Table 1. A summary of the item in the theoretical framework

Constructs	Items and References	
Perceived Benefits	PBEN1	Operating cost saving (Zhu, Dong, Xu & Kraemer, 2006; Ifinedo, 2011)
	PBEN2	Simplification of the operating procedures (Zhu, Dong, et al., 2006; Alam et al., 2011)
	PBEN3	Increase in market share (Scupola, 2009)
	PBEN4	Growth of revenue (Ifinedo, 2011; Martin, Catalan & Jeronimo, 2012)
	PBEN5	Creation of marketing channels (Scupola, 2009; Ghobakhloo & Tang, 2013)
	PBEN6	Improvement of the company's image (Zhu, Dong, et al., 2006; Alam et al., 2011)
	PBEN7	Improvement in competitiveness (Teo, Lin & Lai, 2009; Alam et al., 2011)
	PBEN8	Enhancement of customer services (Scupola, 2009; Ifinedo, 2011)
Perceived Compatibility	PCPA1	Alignment with ICT infrastructure (Zhu, Dong, et al., 2006; Lin & Lin, 2008)
	PCPA2	Integration with current business processes (Ghobakhloo et al., 2011)
	PCPA3	Adaptability of existing distribution channels (Picoto, Belanger & Palma-dos-Reis, 2014a)
	PCPA4	Consistency with the organizational culture (Ghobakhloo et al., 2011; Picoto et al., 2014a)
	PCPA5	Suitability with customers' ways of business (Alam et al., 2011; Ghobakhloo et al., 2011)
	PCPA6	Experience in adopting an innovation (Picoto et al., 2014a)
Perceived Security	PSEC1	Awareness of the security of m-commerce (Alam et al., 2011)
	PSEC2	Availability of industrial security standards (Alam et al., 2011)
	PSEC3	Availability of laws and regulations (Alam et al., 2011)
Perceived Organizational Readiness	PREA1	Financial readiness (Alam et al., 2011; Huy et al., 2012)
	PREA2	Technological readiness (Alam et al., 2011; Huy et al., 2012)
	PREA3	Human resource readiness (Alam et al., 2011; Huy et al., 2012)
Perceived Adoption Cost	PCST1	Infrastructure cost requirements (Al-Qirim, 2006; Ghobakhloo et al., 2011)
	PCST2	Training cost requirements (Al-Qirim, 2006; Ghobakhloo et al., 2011)
	PCST3	Maintenance cost requirements (Al-Qirim, 2006; Ghobakhloo et al., 2011)
Perceived Top Management Support	PTMS1	Awareness of benefits (Lin & Wu, 2004; Seyal & Rahim, 2006)
	PTMS2	Allocation of necessary resources (Premkumar, 2003; Seyal & Rahim, 2006)
	PTMS3	Championship of management (Ifinedo, 2011; Li & Wang, 2018)
Perceived Competitive Pressures	PCPE1	Similar products/services of competitors (Thong & Yap, 1995; Ghobakhloo et al., 2011)
	PCPE2	Similar products/services of new entrants (Thong & Yap, 1995; Ghobakhloo et al., 2011)
	PCPE3	Substitute products/services (Thong & Yap, 1995; Ghobakhloo et al., 2011)
Perceived Customer Pressures	PCUS1	Requirement for adopting m-commerce (Teo et al., 2009; Mohammad Kasim Alrousan, 2015)
	PCUS2	Expectation for adopting m-commerce (Teo et al., 2009; Mohammad Kasim Alrousan, 2015)
	PCUS3	Maintain relationships with customers (Teo et al., 2009; Mohammad Kasim Alrousan, 2015)
Perceived Government Support	PGOV1	Legal considerations for m-commerce (Huy et al., 2012; Al-Alawi & Al-Ali, 2015)
	PGOV2	Financial support (Jeon et al., 2006; Huy et al., 2012)
	PGOV3	Training and education programs (Mohammad Kasim Alrousan, 2015)
Adoption	ADPT1	Have an intention for adoption (Davis, 1989; Riemenschneider, Harrison & Mykytyn, 2003)
	ADPT2	Have a certain plan for adoption (Davis, 1989; Riemenschneider et al., 2003)
	ADPT3	Have a strong commitment to adoption (Davis, 1989; Riemenschneider et al., 2003)

Table 2. The sample characteristics of the surveyed SMEs

Category	Description	Frequency	Percent	Category	Description	Frequency	Percent
Location	North Vietnam	119	23.2%	Duration	< 5 years	186	36.2%
	Central & Highland	268	52.2%		5 - 10 years	167	32.6%
	South Vietnam	126	24.6%		11 - 15 years	69	13.5%
Industry	Services	143	27.9%		> 15 years	91	17.7%
	Trading	141	27.5%	Size	< 10	193	37.6%
	Construction	72	14.0%		10 - 50	201	39.2%
	Manufacturing	54	10.5%		51 - 100	57	11.1%
	Transportation	36	7.0%		101 - 200	30	5.9%
	Others	67	13.1%		201 - 300	32	6.2%

Table 3. Independent sample t-test for survey types bias

Dimensions	t	df	p	Mean			Std. Error Difference
				Online (n=159)	Paper (n=354)	Difference	
Mean of Technological Dimension	1.523	511	.128	3.9391	3.8628	.0763	.0501
Mean of Organizational Dimension	.243	511	.808	3.9508	3.9386	.0122	.0502
Mean of Environmental Dimension	-.618	511	.537	3.8657	3.8994	-.0337	.0545

CFA tests the measurement model by providing evidences on the validity of individual measures based on the model's overall fitness and the construct validity (Hair et al., 2010). To assess the overall fitness of the model, various goodness-of-fit measures are used including absolute fit indices, incremental fit indices, and parsimony fit indices. The absolute fit indices include the normed chi-square ($\chi 2/df$), the root-mean-square error of approximation (RMSEA), the root mean square residual (RMR) and the standardized root mean square residual (SRMR). The incremental fit indices include the incremental fit index (IFI), the Tucker-Lewis index (TLI) and the comparative fit index (CFI). The parsimony fit indices include the parsimony normed fit index (PNFI), the parsimony comparative fit index (PCFI) and the p-value of close fit (PClose). The maximum likelihood estimation technique is used for estimating the parameters in the model. Data are analysed using SPSS and AMOS version 25.

Measurement Model Analysis

The measurement model is evaluated for dimensionality, reliability, convergent validity, and discriminant validity. An assessment for the dimensionality of the instrument is carried out through exploratory factor analysis (EFA) to uncover the underlying factor for the measured variables of the instrument. Before running EFA, an examination of the pre-requirement is conducted. First, the sample size of 513 achieves the case-to-variable ratio of 13.5:1. This satisfies the minimum requirement of the case-to-variable ratio at 5:1. Second, an examination of the item-total correlations are between 0.3 and 0.8. Third, the Kaiser-Meyer-Olkin (KMO) test and the Bartlett's test of sphericity (BTOS) are used to examine the factorability of the data. The data are factorable if the KMO is between 0.5 and 1, and the BTOS is significant with the value below 0.05. The result of these tests indicates that all the KMO values range from 0.730 to 0.873 with significant BTOS values below 0.05. These support for the suitability of running EFA.

This study works with three distinct theoretical dimensions of organizational m-commerce adoption and one dependent variable. As a result, four separate EFA models are estimated using the maximum likelihood extraction method and the Promax rotation method. The number of extracted factors is determined based on Kaiser's criterion of retaining factors with an eigenvalue greater than 1.0. The minimum factor loading to allocate an item to a factor is set at 0.5. Single item factors and items with significant loadings on more than one factor are dropped (Hair et al., 2010). This procedure is repeated until a clear factor structure has emerged.

Table 4 presents the EFA results. This leads to the deletion of six items (PBEN1, PBEN2, PBEN3, PBEN4, PCPA5, and PCPA6) that do not meet one or more of the factor extraction criteria, resulting in the retention of thirty-two items loaded into ten factors: perceived benefits (F1: eigenvalue = 1.506), perceived compatibility (F2: eigenvalue = 5.097), perceived security (F3: eigenvalue = 1.145), perceived organizational readiness (F4: eigenvalue = 1.038), perceived adoption cost (F5: eigenvalue = 1.426), perceived top management support (F6: eigenvalue = 4.523), perceived competitive pressures (F7: eigenvalue = 1.100), perceived customer pressures (F8: eigenvalue = 1.795), perceived government support (F9: eigenvalue = 4.487) and m-commerce adoption (F10: eigenvalue = 2.568). These results support the dimensionality and represent an initial specification of the measurement model.

Reliability test examines the degree to which items are free from random errors, therefore yielding consistent results (Deng, Karunasena & Xu, 2018). Cronbach's alpha (α) is the most widely used measure for assessing the reliability of the measurement instrument (Hair et al., 2010). Ten variables from the EFA model are examined for reliability by calculating their alpha coefficients. Table 5 presents the results. It indicates that the average of α coefficients ranges from 0.832 for perceived benefits to 0.915 for m-commerce adoption, confirming that all the variables are satisfactory for the reliability of a multi-item scale.

Convergent validity assesses the extent to which the items constituting the variable converge or share a high proportion of variance in common (Hooper, Coughlan & Mullen, 2008; Hair et al., 2010). It is assessed by the significance of the factor loadings of all items, variable reliability, and average variance extracted (AVE) (Fornell & Larcker, 1981; Hair et al., 2010). Specifically, standardized factor loading (SFL) for each observed item should be at least 0.6 to be considered as significant. Variable reliability greater than 0.7 is acceptable. The AVE of 0.5 or higher is adequate for convergent validity (Hair et al., 2010).

Table 5 presents the CFA results for convergent validity assessments. The SFLs of the variables is between 0.655 and 0.949. The CR values of all the constructs range from 0.833 to 0.919. The AVE values for all the retained variables range from 0.557 to 0.790. These results confirm that the measurement items of each variable possess convergent validity.

Discriminant validity measures the extent to which different variables diverge from one another (Hooper et al., 2008; Hair et al., 2010). To get satisfactory discriminant validity, the square roots of AVE for each variable should be greater than the correlation coefficient between that variable and other variables (Hair et al., 2010). This means that the items share more common variance with their respective variables than with other Variables.

Table 6 lists the correlation coefficients between the variables, with the square root of the AVE on the diagonal. The results indicate that all the correlation coefficients fail to exceed 0.9, and the square roots of diagonal AVE are all greater than the correlation coefficients between a variable and other variables. These confirm that acceptable discriminant validity between the variables is achieved.

The overall fitness of the measurement model describes how well the model fits the data. Table 7 presents the goodness of fit indices for the measurement model. The normed chi-square of 2.477 is less than 3. The absolute fit index (RMSEA, RMR, and SRMR) values are at 0.054, 0.024 and 0.041 respectively. The incremental fit index (IFI, TLI and CFI) values are 0.943, 0.932

Table 4. Results of factor analysis

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10
PBEN7	.830									
PBEN8	.781									
PBEN6	.674									
PBEN5	.674									
PCPA2		.932								
PCPA1		.799								
PCPA3		.691								
PCPA4		.537								
PSEC2			.940							
PSEC3			.812							
PSEC1			.611							
PREA2				.930						
PREA1				.722						
PREA3				.709						
PCST2					.835					
PCST3					.802					
PCST1					.767					
PTMS3						.837				
PTMS1						.836				
PTMS2						.807				
PCPE2							.942			
PCPE3							.881			
PCPE1							.730			
PCUS2								.919		
PCUS1								.912		
PCUS3								.766		
PGOV3									.964	
PGOV2									.759	
PGOV1									.711	
ADPT1										.964
ADPT2										.848
ADPT3										.845

and 0.943 respectively. These values are greater than the threshold value of 0.9. The parsimony fit index (PNFI and PCFI) values are 0.767 and 0.797 respectively that are above 0.5. The PClose value is 0.068 that is above 0.05. The combination of these values confirms that the measurement model fits the data well.

Table 5. Measurement model: Loadings, reliability, and average variance extracted

Variables	Indicators	Mean	Std. Deviation	SFLs	α	CR	AVE
Perceived Benefits **(PBEN)**	PBEN5	4.144	0.714	0.719	0.832	0.833	0.557
	PBEN6	4.084	0.715	0.673			
	PBEN7	4.060	0.711	0.799			
	PBEN8	4.136	0.662	0.786			
Perceived Compatibility **(PCPA)**	PCPA1	3.788	0.737	0.775	0.842	0.848	0.584
	PCPA2	3.735	0.753	0.833			
	PCPA3	3.803	0.757	0.783			
	PCPA4	3.716	0.798	0.655			
Perceived Security **(PSEC)**	PSEC1	3.916	0.760	0.764	0.853	0.857	0.667
	PSEC2	3.814	0.762	0.859			
	PSEC3	3.774	0.755	0.825			
Perceived Organizational Readiness **(PREA)**	PREA1	3.898	0.751	0.794	0.843	0.846	0.647
	PREA2	3.920	0.736	0.858			
	PREA3	3.893	0.703	0.758			
Perceived Adoption Cost **(PCST)**	PCST1	3.899	0.799	0.787	0.849	0.849	0.653
	PCST2	3.758	0.850	0.794			
	PCST3	3.819	0.798	0.842			
Perceived Top Management Support **(PTMS)**	PTMS1	4.138	0.660	0.851	0.870	0.870	0.691
	PTMS2	4.025	0.697	0.840			
	PTMS3	4.131	0.647	0.801			
Perceived Competitive Pressures **(PCPE)**	PCPE1	3.940	0.797	0.785	0.862	0.866	0.683
	PCPE2	3.830	0.859	0.877			
	PCPE3	3.812	0.836	0.815			
Perceived Customer Pressures **(PCUS)**	PCUS1	3.961	0.826	0.877	0.898	0.900	0.751
	PCUS2	3.961	0.812	0.903			
	PCUS3	4.043	0.759	0.818			
Perceived Government Support **(PGOV)**	PGOV1	3.852	0.764	0.813	0.902	0.904	0.759
	PGOV2	3.780	0.829	0.891			
	PGOV3	3.823	0.789	0.906			
Adoption **(ADPT)**	ADPT1	3.743	0.788	0.860	0.915	0.919	0.790
	ADPT2	3.635	0.832	0.949			
	ADPT3	3.511	0.862	0.855			

Structural Model Analysis

SEM is applied for verifying the rationality of the research hypotheses. Figure 2 presents the analytical result of the structural model. The path coefficients along with their significant levels confirm the statistical significance of the five determinants of m-commerce adoption in Vietnamese SMEs. Particularly, the results indicate that perceived benefits (path coefficient = 0.373, $p < 0.01$), perceived

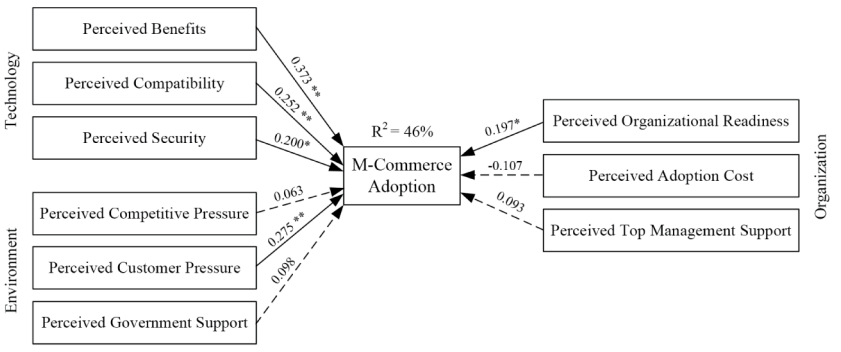
Table 6. Correlation among variables

Variables	Mean	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) PBEN	4.106	**0.746**									
(2) PCPA	3.765	0.561	**0.764**								
(3) PSEC	3.834	0.488	0.626	**0.817**							
(4) PREA	3.904	0.536	0.597	0.603	**0.804**						
(5) PCST	3.825	0.460	0.545	0.627	0.636	**0.808**					
(6) PTMS	4.098	0.509	0.513	0.578	0.541	0.481	**0.831**				
(7) PCPE	3.861	0.572	0.590	0.609	0.613	0.545	0.560	**0.826**			
(8) PCUS	3.988	0.447	0.515	0.544	0.542	0.416	0.592	0.594	**0.867**		
(9) PGOV	3.818	0.228	0.383	0.562	0.447	0.482	0.432	0.370	0.372	**0.871**	
(10) ADPT	3.630	0.534	0.517	0.471	0.346	0.296	0.459	0.477	0.538	0.194	**0.889**

Table 7. Model fit indices for the measurement model and the structural model

Dimensions	Indices	Recommended Values	References	Measurement Model
Absolute fit indices	χ^2/df	< 5 (≤ 3 preferred)	Hair et al. (2010); Tabachnick & Fidell (2013)	2.477
	RMSEA	≤ 0.05 – 1.0	Hair et al. (2010)	0.054
	RMR	≤ 0.09	Hair et al. (2010); Byrne (2016)	0.024
	SRMR			0.041
Incremental fit indices	IFI	≥ 0.9	Hooper et al. (2008)	0.943
	TLI			0.932
	CFI			0.943
Parsimony fit indices	PNFI	≥ 0.5	Hooper et al. (2008); Hair et al. (2010)	0.767
	PCFI			0.797
	PClose	≥ 0.05	Hair et al. (2010)	0.068

Figure 2. Structural model analysis results



*Notes: ** = p < 0.01 and * = p < 0.05*

compatibility (path coefficient = 0.252, $p < 0.01$), perceived security (path coefficient = 0.200, $p < 0.05$), perceived organizational readiness (path coefficient = 0.197, $p < 0.05$), and perceived customer pressures (path coefficient = 0.275, $p < 0.01$) are critical for the adoption of m-commerce in Vietnamese SMEs. These results support the hypotheses H1, H2, H3, H4, and H8. The results also indicate that there is insufficient evidence to support hypotheses H5, H6, H7, and H9. This means that perceived adoption cost (path coefficient = -0.107, $p > 0.05$), perceived top management support (path coefficient = 0.093, $p > 0.05$), perceived competitive pressures (path coefficient = 0.063, $p > 0.05$), and perceived government support (path coefficient = 0.098, $p > 0.05$) are insignificantly related to the adoption of m-commerce. All the independent variables explain 46% ($R^2 = 0.46$) of the variance in the dependent variable. This indicates that the proposed conceptual model possesses adequate predictive power for explaining the adoption of m-commerce in sampled SMEs. Table 8 summarises these hypothesis testing results.

Discussion

This study aims to better understand m-commerce adoption in SMEs by examining the critical determinants from the perceptive of SMEs' managers. The study provides solid support for the proposed framework that is developed from perceived technological characteristics, perceived organizational characteristics, and perceived environmental characteristics. The analytical results confirm that perceived technological characteristics, perceived organizational characteristics, and perceived environmental characteristics significantly affect the adoption of m-commerce in Vietnamese SMEs. Each of these perceived characteristics is discussed in the following.

Perceived Technological Characteristics

The study shows that perceived benefits, perceived compatibility, and perceived security positively influence the adoption of m-commerce. These findings indicate that better perception of the benefits and the compatibility of m-commerce and the high confidence about m-commerce security improve the adoption of m-commerce in SMEs. Consistent with the findings of previous m-commerce adoption studies in both large enterprises and SMEs, perceived benefits of m-commerce are found to be significant for the adoption of m-commerce (Mallat & Tuunainen, 2008; Picoto, Belanger & Palma-dos-Reis, 2014b; Grandhi & Wibowo, 2016; Johnson, Kiser, Washington & Torres, 2018). This means that SMEs perceiving m-commerce to be more useful are more likely to adopt m-commerce. Furthermore, the analytical results are also consistent with the notion that m-commerce is a complex technological innovation whose successful adoption is closely related to the perception of technological

Table 8. Hypothesis testing results

Hypothesis	Path Coefficient	Remarks
H1: Perceived Benefits → M-commerce Adoption	0.373**	Supported
H2: Perceived Compatibility → M-commerce Adoption	0.252**	Supported
H3: Perceived Security → M-commerce Adoption	0.200*	Supported
H4: Perceived Organizational Readiness → M-commerce Adoption	0.197*	Supported
H5: Perceived Adoption Cost → M-commerce Adoption	-0.107	Not supported
H6: Perceived Top Management Support → M-commerce Adoption	0.093	Not supported
H7: Perceived Competitive Pressure → M-commerce Adoption	0.063	Not supported
H8: Perceived Customer Pressure → M-commerce Adoption	0.275**	Supported
H9: Perceived Government Support → M-commerce Adoption	0.098	Not supported

Notes: ** = $p < 0.01$ and * = $p < 0.05$

compatibility (Mallat & Tuunainen, 2008; Alfahl et al., 2017) and the confidence of security (Mashagba, Mashagba & Nassar, 2013; Lu et al., 2015; Njenga et al., 2016; Johnson et al., 2018).

Perceived Organizational Characteristics

The study shows that perceived organizational readiness positively influences the adoption of m-commerce. This finding indicates that the perception of a high level of organizational readiness increases the intention to adopt m-commerce in SMEs. SMEs tend to lack resources for m-commerce adoption. Such lack of resources becomes the barrier to the adoption of m-commerce in SMEs. As a result, increasing the readiness would enhance the intention of SMEs to adopt m-commerce. The importance of having the required financial, technological, and human resources for m-commerce adoption in organizations has been confirmed in previous adoption studies (Doolin & Ali, 2008; Otieno & Kahonge, 2014).

The study shows that perceived adoption cost is insignificant to the adoption of m-commerce in SMEs. This finding contradicts to the findings of previous studies that show perceived adoption cost is significant for m-commerce adoption in organizations in general and in SMEs in particular (Al-Qirim, 2006; Hossain & Khandanker, 2011; Rana et al., 2019). This finding, however, is in line with the studies of Al-Qirim (2007) and Rahayu & Day (2015) which confirm that the cost of adoption is insignificant for the adoption of technologies in SMEs. There are several possible explanations for this finding. The rapid development of mobile technologies, for example, leads to a significant decrease in the acquisition cost of such technologies. As a result, these technologies are not expensive for SMEs anymore. Another plausible reason is that the benefits of m-commerce adoption outweigh the investment required to adopt it as perceived. As a result, SMEs would optimize their limited resources for adopting m-commerce to serve their strategic objectives.

The study shows the insignificance of perceived top management support for the adoption of m-commerce in Vietnamese SMEs. This suggests that the support from top management in Vietnamese SMEs does not have a significant influence on the adoption of m-commerce. This is in contrast to the findings of previous m-commerce adoption studies that confirm the role of top management support and its positive relationship with the adoption of m-commerce (Doolin & Ali, 2008; Otieno & Kahonge, 2014; Alfahl et al., 2017; Li & Wang, 2018). However, this finding is consistent with the studies of Seyal, Awais, Shamail & Abbas (2004) and Salwani, Marthandan, Norzaidi & Chong (2009) that show perceived top management support is not significant for the adoption of e-commerce in SMEs in Pakistan and Malaysia respectively. This can be explained by the fact that top management of these SMEs has faced other external factors that have contributed to such an adoption indirectly (Seyal et al., 2004). Furthermore, it seems to indicate that m-commerce adoption is not a priority to top managers of SMEs, but rather meeting the needs of their key business partners (Salwani et al., 2009).

Perceived Environmental Characteristics

The study shows that perceived customer pressures positively influence the adoption of m-commerce. This finding indicates that Vietnamese SMEs' decisions on m-commerce adoption are driven by customer pressures. The adoption of technologies is not only the result of a rational assessment of the business implication of technologies, but also a response to satisfy external pressures, especially the pressures from customers. Customer pressures are the driver for SMEs to adopt m-commerce to meet the requirements and expectation of customers, to maintain the relationship with customers, and to show their fitness as business partners. Such pressures have been found as a critical determinant of m-commerce adoption in New Zealand (Doolin & Ali, 2008), Jordan (Alrawabdeh, 2014) and China (Li & Wang, 2018).

The study shows that perceived competitive pressures are insignificant to the adoption of m-commerce in SMEs. This finding contradicts with the findings of prior m-commerce adoption studies (Picoto et al., 2014a, 2014b; Lu et al., 2015; Martin & Jimenez, 2015). Such a finding, however,

is in line with the study of Swilley (2007) that finds perceived competitor pressures are insignificant for the adoption of m-commerce in organizations in the US.

The study reveals the insignificance of perceived government support for the adoption of m-commerce in Vietnamese SMEs. This finding is inconsistent with the findings of previous m-commerce adoption studies that confirm the importance of government support and its positive relationship with the adoption of m-commerce (Alfahl et al., 2017). The support from government in terms of policy initiatives has been highlighted for accelerating the growth of women-owned micro-enterprises through adopting mobile value-added services (Sathye, Prasad, Sharma, Sharma & Sathye, 2017). However, this finding is consistent with the study of Alrawabdeh (2014) that finds perceived government support in the form of the regulatory environment for m-commerce is insignificant for the adoption of m-commerce.

CONCLUSION

Given the importance of m-commerce adoption in enhancing the competitiveness of SMEs and the "much-slower-than expected" adoption of m-commerce in Vietnamese SMEs, there is a necessity to have better understanding of the critical determinants of such adoption. This study presents an attempt to examine a perception-based model for m-commerce adoption in Vietnamese SMEs that is theoretically grounded on the TOE framework. The model is empirically tested and validated using the data collected from 513 SMEs in Vietnam. The study confirms the significance of five determinants: perceived benefits, perceived compatibility, perceived security, perceived organizational readiness and perceived customer pressures.

This study has several theoretical contributions. It is one of the few studies focusing on understanding m-commerce adoption in SMEs in developing countries. This study conceptualizes a perception-based model for m-commerce adoption in SMEs that concentrates on the perceived characteristics from the perspective of organizations. Such an approach for identifying the critical determinants for m-commerce adoption in SMEs adds value to existing literature. It confirms the appropriateness of the TOE framework for investigating the adoption of technologies in organizations. The study shows that the adoption of m-commerce in SMEs is not primarily based on the perceived characteristics of mobile technologies themselves but also depends on the perception of other determinants related to the organization and its external environment.

With respect to the practical implication, this study attempts to help practitioners recognize that adopting m-commerce as technological innovations is more of an adaptive solution than a technical challenge. The findings of this study can enhance practitioners' understanding of the critical determinants for the adoption of m-commerce. Specifically, SMEs seeking to adopt m-commerce must realize the potential benefits and the compatibility of m-commerce for their business. It is important for SMEs to perceive the security not as an obstacle for the adoption of m-commerce. SMEs that intend to adopt m-commerce need to prepare themselves regarding financial readiness, technological readiness, and human resource readiness. Furthermore, increasing external pressures from customers tend to stimulate the adoption of m-commerce since its adoption can help organizations meet the demand of their customers.

This study has several limitations. First, this study examines m-commerce adoption through a cross-sectional survey which does not permit the interpretation of the causal inference between the variables. As a result, a longitudinal study would be appropriate to see how the perception change over time for facilitating the understanding of m-commerce adoption and the diffusion of m-commerce. Second, this study only focuses on the adoption of m-commerce in Vietnamese SMEs. This affects the applicability of the findings across developing countries. Consequently, similar research in other developing countries would provide data for comparison. Third, due to the collection of single responses from the manager of each surveyed SMEs, lack of further respondents from the same SME exists as it does not allow the evaluation of the perception of the entire group. This makes the

results susceptible to the method bias. Finally, the target population for data collection is the SMEs in Vietnam that includes both the adopters and non-adopters. As a result, the differences in their perception of the critical determinants for m-commerce adoption could create a bias for the empirical results. This suggests for a comparative study on the critical determinants for m-commerce adoption in SMEs between adopters and non-adopters in future in developing appropriate suggestions for SMEs and policy-makers in the formulation of specific strategies and policies to facilitate the adoption of m-commerce in SMEs.

REFERENCES

Ahmad, S. Z., Bakar, A. R. A., Faziharudean, T. M., & Zaki, K. A. M. (2015). An empirical study of factors affecting e-commerce adoption among small and medium-sized enterprises in a developing country: Evidence from Malaysia. *Information Technology for Development*, *21*(4), 555–572. doi:10.1080/02681102.2014.899961

Al-Alawi, A. I., & Al-Ali, F. M. (2015). Factors affecting e-commerce adoption in SMEs in the GCC: An empirical study of Kuwait. *Research Journal of Information Technology*, *7*(1), 1–21. doi:10.3923/rjit.2015.1.21

Al-Bakri, A. A., & Katsioloudes, M. I. (2015). The factors affecting e-commerce adoption by Jordanian SMEs. *Management Research Review*, *38*(7), 726–749. doi:10.1108/MRR-12-2013-0291

Al-Qirim, N. A. Y. (2006) Mobile commerce technologies penetration in small to medium-sized enterprises in New Zealand. *Proceedings of the International Conference on Innovations in Information Technology*.

Al-Qirim, N. A. Y. (2007). The adoption of eCommerce communications and applications technologies in small businesses in New Zealand. *Electronic Commerce Research and Applications*, *6*(4), 462–473. doi:10.1016/j.elerap.2007.02.012

Al-Zoubi, M. I. (2013). Predicting EBusiness Adoption through Integrating the Constructs of the Rogers's Diffusion of Innovation Theory Combined with Technology-Organization-Environment Model. *International Journal of Advanced Computer Research*, *3*(4), 63–73.

Alam, S. S., Ali, M. Y., & Jani, M. F. M. (2011). An empirical study of factors affecting electronic commerce adoption among SMEs in Malaysia. *Journal of Business Economics and Management*, *12*(2), 375–399. doi:10.3846/16111699.2011.576749

Alam, S. S., Khatibi, A., Ahmad, M. I. S., & Ismail, H. B. (2008). Factors affecting e-commerce adoption in the electronic manufacturing companies in Malaysia. *International Journal of Commerce and Management*, *17*(1/2), 125–139. doi:10.1108/10569210710776503

Alfahl, H., Houghton, L., & Sanzogni, L. (2017). Mobile Commerce Adoption in Saudi Organizations: A Qualitative Study. *International Journal of Enterprise Information Systems*, *13*(4), 31–57. doi:10.4018/IJEIS.2017100103

Ali, A. B., Miao, J. J., & Tran, Q. D. (2018). Study on E-Commerce Adoption in SMEs Under the Institutional Perspective: The Case of Saudi Arabia. *International Journal of E-Adoption*, *10*(1), 53–72. doi:10.4018/IJEA.2018010104

Alrawabdeh, W. (2014). Environmental Factors Affecting Mobile Commerce Adoption-An Exploratory Study on the Telecommunication Firms in Jordan. *International Journal of Business and Social Science*, *5*(8), 151–164. doi:10.30845/ijbss

Alrousan, M. K. (2015). *E-commerce adoption by travel agencies in Jordan* (Doctoral thesis). Cardiff Metropolitan University, UK.

Alrousan, M. K., & Jones, E. (2016). A conceptual model of factors affecting e-commerce adoption by SME owner/managers in Jordan. *International Journal of Business Information Systems*, *21*(3), 269–308. doi:10.1504/IJBIS.2016.074762

Amegbe, H., Hanu, C., & Nuwasiima, A. (2017). Small-scale individual entrepreneurs and the usage of mobile money and mobile commerce in facilitating business growth in Ghana. *Management Science Letters*, *7*(8), 373–384. doi:10.5267/j.msl.2017.5.004

Awa, H. O., Ukoha, O., & Emecheta, B. C. (2016). Using TOE theoretical framework to study the adoption of ERP solution. *Cogent Business & Management*, *3*(1), 1–23. doi:10.1080/23311975.2016.1196571

Baker, J. (2012). The technology–organization–environment framework. In *Information Systems Theory* (pp. 231–245). Springer.

Bryman, A., & Bell, E. (2015). *Business research methods*. Oxford University Press.

Byrne, B. M. (2016). *Structural equation modeling with AMOS: Basic concepts, applications, and programming*. Routledge.

Chatzoglou, P., & Chatzoudes, D. (2016). Factors affecting e-business adoption in SMEs: An empirical research. *Journal of Enterprise Information Management*, *29*(3), 327–358. doi:10.1108/JEIM-03-2014-0033

Chau, N. T., & Deng, H. (2018a). Critical Determinants for Mobile Commerce Adoption in Vietnamese SMEs: A Conceptual Framework. *Procedia Computer Science*, *138*, 433–440. doi:10.1016/j.procs.2018.10.061

Chau, N. T., & Deng, H. (2018b) Critical Determinants for Mobile Commerce Adoption in Vietnamese SMEs: A Preliminary Study. *Proceedings of the 29th Australasian Conference on Information Systems*.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, *13*(3), 319–340. doi:10.2307/249008

Deng, H., Karunasena, K., & Xu, W. (2018). Evaluating the performance of e-government in developing countries: A public value perspective. *Internet Research*, *28*(1), 169–190. doi:10.1108/IntR-10-2016-0296

Doolin, B., & Ali, E. A. H. (2008). Adoption of mobile technology in the supply chain: An exploratory cross-case analysis. *International Journal of E-Business Research*, *4*(4), 1–15. doi:10.4018/jebr.2008100101

Downs, G. W., & Mohr, L. B. (1976). Conceptual Issues in the Study of Innovation. *Administrative Science Quarterly*, *21*(4), 700–714. doi:10.2307/2391725

Duan, X., Deng, H., & Corbitt, B. (2012). Evaluating the critical determinants for adopting e-market in Australian small and medium-sized enterprises. *Management Research Review*, *35*(3), 289–308. doi:10.1108/01409171211210172

Duan, X., Deng, H., & Luo, F. (2019). An integrated approach for identifying the efficiency-oriented drivers of electronic markets in electronic business. *Journal of Enterprise Information Management*, *32*(1), 60–74. doi:10.1108/JEIM-05-2018-0090

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *JMR, Journal of Marketing Research*, *18*(1), 39–50. doi:10.1177/002224378101800104

Ghobakhloo, M., Aranda, D. A., & Amado, J. B. (2011). Adoption of e-commerce applications in SMEs. *Industrial Management & Data Systems*, *111*(8), 1238–1269. doi:10.1108/02635571111170785

Ghobakhloo, M., & Tang, S. H. (2013). The role of owner/manager in adoption of electronic commerce in small businesses: The case of developing countries. *Journal of Small Business and Enterprise Development*, *20*(4), 754–787. doi:10.1108/JSBED-12-2011-0037

Grandhi, S., & Wibowo, S. (2016). Mobile Commerce Adoption in North American Organizations: An Empirical Study of Organizational Factors. *Communications of the IBIMA*, *2016*, 1–17. doi:10.5171/2016.682007

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2010). *Multivariate data analysis* (7th ed.). Pearson Prentice Hall.

Hong, I. B. (2019). Understanding and Predicting Behavioral Intention to Adopt Mobile Banking: The Korean Experience. *Journal of Global Information Management*, *27*(3), 182–202. doi:10.4018/JGIM.2019070110

Hooper, D., Coughlan, J., & Mullen, M. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, *16*(1), 53–60.

Hossain, M. S., & Khandanker, M. R. A. (2011) Implementation challenges of mobile commerce in developing countries - Bangladesh perspective. *Proceedings of the 14th International Conference on Computer and Information Technology*.

Hung, Y. C., Yang, Y. L., Yang, H. E., & Chuang, Y. H. (2011). Factors affecting the adoption of e-commerce for the tourism industry in Taiwan. *Asia Pacific Journal of Tourism Research*, *16*(1), 105–119. doi:10.1080/10941665.2011.539394

Huy, L. V., Rowe, F., Truex, D., & Huynh, M. Q. (2012). An empirical study of determinants of e-commerce adoption in SMEs in Vietnam: An economy in transition. *Journal of Global Information Management*, *20*(3), 23–54. doi:10.4018/jgim.2012070102

Ibrahim, A. M., Hassan, M. S., & Gusau, A. L. (2018). Factors Influencing Acceptance and Use of ICT Innovations by Agribusinesses. *Journal of Global Information Management*, *26*(4), 113–134. doi:10.4018/JGIM.2018100107

Ifinedo, P. (2011). Internet/e-business technologies acceptance in Canada's SMEs: An exploratory investigation. *Internet Research*, *21*(3), 255–281. doi:10.1108/10662241111139309

Imre, O. (2016). Adopting Information Systems in a Small Company: A Longitudinal Study. *Journal of Applied Economics & Business Research*, *6*(4), 269–283.

Jain, M., Le, A. N. H., Lin, J. Y. C., & Cheng, J. M. S. (2011). Exploring the factors favoring m-commerce adoption among Indian MSMEs: A TOE perspective. *Tunghai Management Review*, *13*(1), 147–188.

Jeon, B. N., Han, K. S., & Lee, M. J. (2006). Determining factors for the adoption of e-business: The case of SMEs in Korea. *Applied Economics*, *38*(16), 1905–1916. doi:10.1080/00036840500427262

Jiang, Q., Phang, C. W., Tan, C.-H., & Chi, J. (2019). Retaining Clients in B2B E-Marketplaces: What Do SMEs Demand? *Journal of Global Information Management*, *27*(3), 19–37. doi:10.4018/JGIM.2019070102

Johnson, V. L., Kiser, A., Washington, R., & Torres, R. (2018). Limitations to the rapid adoption of M-payment services: Understanding the impact of privacy risk on M-Payment services. *Computers in Human Behavior*, *79*, 111–122. doi:10.1016/j.chb.2017.10.035

Kuan, K. K. Y., & Chau, P. Y. K. (2001). A perception-based model for EDI adoption in small businesses using a technology–organization–environment framework. *Information & Management*, *38*(8), 507–521. doi:10.1016/S0378-7206(01)00073-8

Kurnia, S., Karnali, R. J., & Rahim, M. M. (2015). A qualitative study of business-to-business electronic commerce adoption within the Indonesian grocery industry: A multi-theory perspective. *Information & Management*, *52*(4), 518–536. doi:10.1016/j.im.2015.03.003

Lal, K. (2005). Determinants of the adoption of e-business technologies. *Telematics and Informatics*, *22*(3), 181–199. doi:10.1016/j.tele.2004.07.001

Li, L., & Wang, X. (2018). M-Commerce Adoption in SMEs of China: The Effect of Institutional Pressures and the Mediating Role of Top Management. *Journal of Electronic Commerce in Organizations*, *16*(2), 48–63. doi:10.4018/JECO.2018040103

Lin, F. H., & Wu, J. H. (2004). An empirical study of end-user computing acceptance factors in small and medium enterprises in Taiwan: Analyzed by structural equation modeling. *Journal of Computer Information Systems*, *44*(3), 98–108. doi:10.1080/08874417.2004.11647587

Lin, H. F., & Lin, S. M. (2008). Determinants of e-business diffusion: A test of the technology diffusion perspective. *Technovation*, *28*(3), 135–145. doi:10.1016/j.technovation.2007.10.003

Lu, M. T., Hu, S. K., Huang, L. H., & Tzeng, G. H. (2015). Evaluating the implementation of business-to-business m-commerce by SMEs based on a new hybrid MADM model. *Management Decision*, *53*(2), 290–317. doi:10.1108/MD-01-2014-0012

Mahroeian, H. (2012). A study on the effect of different factors on e-Commerce adoption among SMEs of Malaysia. *Management Science Letters*, *2*(7), 2679–2688. doi:10.5267/j.msl.2012.08.021

Mallat, N., & Tuunainen, V. K. (2008). Exploring merchant adoption of mobile payment systems: An empirical study. *e-Service Journal*, *6*(2), 24–57. doi:10.2979/esj.2008.6.2.24

Martin, S. S., Catalan, B. L., & Jeronimo, M. A. R. (2012). Factors determining firms' perceived performance of mobile commerce. *Industrial Management & Data Systems*, *112*(6), 946–963. doi:10.1108/02635571211238536

Martin, S. S., & Jimenez, N. (2015). A Typology of Firms Regarding M-Commerce Adoption. *International Journal of Information System Modeling and Design*, *6*(4), 42–56. doi:10.4018/IJISMD.2015100103

Mashagba, F. F. A., Mashagba, E. F. A., & Nassar, M. O. (2013). Exploring Technological Factors Affecting the Adoption of M-Commerce in Jordan. *Australian Journal of Basic and Applied Sciences*, *7*(6), 395–400.

Moore, G. C., & Benbasat, I. (1991). Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, *2*(3), 192–222. doi:10.1287/isre.2.3.192

Nafea, I., & Younas, M. (2014) Improving the performance and reliability of mobile commerce in developing countries. *Proceedings of the 11th International Conference on Mobile Web and Information Systems*.

Njenga, A. K., Litondo, K., & Omwansa, T. (2016). A Theoretical Review of Mobile Commerce Success Determinants. *Journal of Information Engineering and Applications*, *6*(5), 13–23. doi:10.7176/JIEA

Otieno, E. O., & Kahonge, A. M. (2014). Adoption of Mobile Payments in Kenyan Businesses: A Case Study of Small and Medium Enterprises in Kenya. *International Journal of Computers and Applications*, *107*(7), 5–12.

Pham, L., Pham, L. N., & Nguyen, D. T. (2011). Determinants of e-commerce adoption in Vietnamese small and medium sized enterprises. *International Journal of Entrepreneurship*, *15*, 45–72.

Picoto, W. N., Belanger, F., & Palma-dos-Reis, A. (2013). M-business organizational benefits and value: A qualitative study. *Journal of Organizational Computing and Electronic Commerce*, *23*(4), 287–324. doi:10.1080/10919392.2013.837789

Picoto, W. N., Belanger, F., & Palma-dos-Reis, A. (2014a). An organizational perspective on m-business: Usage factors and value determination. *European Journal of Information Systems*, *23*(5), 571–592. doi:10.1057/ejis.2014.15

Picoto, W. N., Belanger, F., & Palma-dos-Reis, A. (2014b). A technology–organisation–environment (TOE)-based m-business value instrument. *International Journal of Mobile Communications*, *12*(1), 78–101. doi:10.1504/IJMC.2014.059240

Porter, M. E. (1985). *Competitive Strategy: Creating and Sustaining Competitive Advantage*. Free Press.

Porter, M. E., & Millar, V. E. (1985). How information gives you competitive advantage. *Harvard Business Review*, *63*(4), 149–174.

Premkumar, G. P. (2003). A meta-analysis of research on information technology implementation in small business. *Journal of Organizational Computing and Electronic Commerce*, *13*(2), 91–121.

Rahayu, R., & Day, J. (2015). Determinant factors of e-commerce adoption by SMEs in developing country: Evidence from Indonesia. *Procedia: Social and Behavioral Sciences*, *195*, 142–150. doi:10.1016/j.sbspro.2015.06.423

Rahman, M. M. (2013). Barriers to M-commerce adoption in developing countries – A qualitative study among the stakeholders of Bangladesh. *The International Technology Management Review*, *3*(2), 80–91. doi:10.2991/itmr.2013.3.2.2

Ramdani, B., Kawalek, P., & Lorenzo, O. (2009). Predicting SMEs' adoption of enterprise systems. *Journal of Enterprise Information Management*, *22*(1), 10–24. doi:10.1108/17410390910922796

Rana, N. P., Barnard, D. J., Baabdullah, A. M., Rees, D., & Roderick, S. (2019). Exploring barriers of m-commerce adoption in SMEs in the UK: Developing a framework using ISM. *International Journal of Information Management*, *44*, 141–153. doi:10.1016/j.ijinfomgt.2018.10.009

Riemenschneider, C. K., Harrison, D. A., & Mykytyn, P. P. (2003). Understanding IT adoption decisions in small business: Integrating current theories. *Information & Management*, *40*(4), 269–285. doi:10.1016/S0378-7206(02)00010-1

Rogers, E. M. (2010). *Diffusion of Innovations*. Simon and Schuster.

Salah, K. (2013). *E-commerce and small and medium enterprises in least developed countries: The case of Tanzania* (PhD thesis). University of Cape Town.

Salwani, I. M., Marthandan, G., Norzaidi, M. D., & Chong, S. C. (2009). E-commerce usage and business performance in the Malaysian tourism sector: Empirical analysis. *Information Management & Computer Security*, *17*(2), 166–185. doi:10.1108/09685220910964027

Saprikis, V., & Vlachopoulou, M. (2012). Determinants of suppliers' level of use of B2B e-marketplaces. *Industrial Management & Data Systems*, *112*(4), 619–643. doi:10.1108/02635571211225512

Sathye, M., Prasad, B., Sharma, D., Sharma, P., & Sathye, S. (2017). Mobile Value Added Services in Fiji: Institutional Drivers, Industry Challenges, and Adoption by Women Micro Entrepreneurs. *Journal of Global Information Management*, *25*(2), 1–14. doi:10.4018/JGIM.2017040101

Scupola, A. (2009). SMEs' e-commerce adoption: Perspectives from Denmark and Australia. *Journal of Enterprise Information Management*, *22*(1), 152–166. doi:10.1108/17410390910932803

Seyal, A. H., Awais, M. M., Shamail, S., & Abbas, A. (2004). Determinants of electronic commerce in Pakistan: Preliminary evidence from small and medium enterprises. *Electronic Markets*, *14*(4), 372–387. doi:10.1080/10196780412331311801

Seyal, A. H., & Rahim, M. M. (2006). A Preliminary investigation of electronic data interchange adoption in Bruneian small business organizations. *The Electronic Journal on Information Systems in Developing Countries*, *24*(4), 1–21. doi:10.1002/j.1681-4835.2006.tb00159.x

Sila, I. (2013). Factors affecting the adoption of B2B e-commerce technologies. *Electronic Commerce Research*, *13*(2), 199–236. doi:10.1007/s10660-013-9110-7

Stoica, M., Miller, D. W., & Stotlar, D. (2005). New technology adoption, business strategy and government involvement: The case of mobile commerce. *Journal of Nonprofit & Public Sector Marketing*, *13*(1-2), 213–232. doi:10.1300/J054v13n01_12

Sutanonpaiboon, J., & Pearson, A. M. (2006). E-commerce adoption: Perceptions of managers/owners of small and medium-sized enterprises in Thailand. *Journal of Internet Commerce*, *5*(3), 53–82.

Swilley, E. (2007). *An empirical examination of the intent of firms to adopt mobile commerce as a marketing strategy* (Master thesis). The Florida State University.

Tabachnick, B. G., & Fidell, L. S. (2013). *Using multivariate statistics*. Allyn and Bacon.

Tan, K. S., Chong, S. C., Lin, B., & Eze, U. C. (2009). Internet-based ICT adoption: Evidence from Malaysian SMEs. *Industrial Management & Data Systems*, *109*(2), 224–244. doi:10.1108/02635570910930118

Tan, K. S., & Eze, U. C. (2008). An empirical study of Internet-based ICT adoption among Malaysian SMEs. *Communications of the IBIMA*, *1*(1), 1–12.

Tan, T. C. F. (2010) A perception-based model for technological innovation in small and medium enterprises. *Proceedings of the 18th European Conference on Information Systems*.

Teo, T. S., Lin, S., & Lai, K.-h. (2009). Adopters and non-adopters of e-procurement in Singapore: An empirical study. *Omega*, *37*(5), 972–987.

Thong, J. Y. L., & Yap, C. S. (1995). CEO characteristics, organizational characteristics and information technology adoption in small businesses. *Omega*, *23*(4), 429–442. doi:10.1016/0305-0483(95)00017-I

Tornatzky, L. G., & Fleischer, M. (1990). *The Processes of Technological Innovation*. Lexington Books.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, *29*(1), 28–45. doi:10.1109/TEM.1982.6447463

Usunier, J. C. (1998). *International and cross-cultural management research*. Sage.

Varshney, U., Malloy, A., Ahluwalia, P., & Jain, R. (2004). Wireless in the enterprise: Requirements, solutions and research directions. *International Journal of Mobile Communications*, *2*(4), 354–367. doi:10.1504/IJMC.2004.005856

VCCI. (2016). *Digital technologies: Opportunities for Vietnamese SMEs*. Retrieved from http://www.nhandan.com.vn/hangthang/van-hoa/item/29999102-co-hoi-cho-cac-doanh-nghiep-nho-va-vua-viet-nam.html

VECITA. (2017). *Only 20% of small and medium-sized enterprises have been ready for electronic commerce*. Retrieved from https://tintuc.inet.vn/chi-20-doanh-nghiep-vua-va-nho-tiep-can-thuong-mai-dien-tu.html

Wang, Y., & Ahmed, P. K. (2009). The moderating effect of the business strategic orientation on eCommerce adoption: Evidence from UK family run SMEs. *The Journal of Strategic Information Systems*, *18*(1), 16–30. doi:10.1016/j.jsis.2008.11.001

Williams, M. D., Dwivedi, Y. K., Lal, B., & Schwarz, A. (2009). Contemporary trends and issues in IT adoption and diffusion research. *Journal of Information Technology*, *24*(1), 1–10. doi:10.1057/jit.2008.30

Wu, L., & Chuang, C. H. (2010). Examining the diffusion of electronic supply chain management with external antecedents and firm performance: A multi-stage analysis. *Decision Support Systems*, *50*(1), 103–115. doi:10.1016/j.dss.2010.07.006

Xu, H., Liu, D. l., & Lu, Z. J. (2010) A Research Model for Measuring the Level of E-commerce in SMEs. *Proceedings of the International Conference on in Machine Vision and Human - Machine Interface*.

Zhang, X., Li, Z., & Deng, H. (2017). Information Security Behaviours of Smartphone Users in China: An Empirical Analysis. *The Electronic Library*, *35*(6), 1177–1190. doi:10.1108/EL-09-2016-0183

Zhu, K., Dong, S., Xu, S. X., & Kraemer, K. L. (2006). Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies. *European Journal of Information Systems*, *15*(6), 601–616. doi:10.1057/palgrave.ejis.3000650

Zhu, K., Kraemer, K. L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. *Management Science*, *52*(10), 1557–1576. doi:10.1287/mnsc.1050.0487

Ngoc Tuan Chau is a faculty member at the Faculty of Statistics and Informatics, University of Economics – The University of Danang, Vietnam. He holds the first bachelor degree in Mathematics & Informatics, the second bachelor degree in Business Administration, and master degree in Database Professional. He is currently a PhD student in Business Information Systems at RMIT University, Melbourne, Australia. His research interests are in the areas of business information systems, business innovation, and business analytics.

Hepu Deng is a professor in information systems at the School of Business Information Technology and Logistics, RMIT University, Melbourne, Australia. His research interests are in the areas of decision analysis, intelligent systems, digital business, knowledge management, e-government, e-learning, and their applications in business. The multidisciplinary nature of his research and the emphasis on both theoretical and applied research are exemplified by numerous refereed publications in top refereed international journals and at major refereed international conferences including Journal of Operational Research Society, European Journal of Operational Research, Computers and Operations Research, International Journal of Approximate Reasoning, IEEE Transactions on Systems, man, and Cybernetics, Government Information Quarterly, Expert Systems with Applications, Computers and Mathematics with Applications, International Journal of E-Government Research, Journal of Systems and Information Technology, and Management Research Review.

Richard Tay is a Vice Chancellor's Senior Research Fellow and has over 25 years of experience in research, and translating research into policy and practice, particularly in transportation and logistics, health and safety, and customer demand and choices.