A Hybrid SEM-Neural Network Model for Predicting Determinants of Mobile Payment Services

Sujeet Kumar Sharma
MIS Area, Indian Institute of Management Tiruchirappalli, India,
Email: Sujeetks1@gmail.com

Himanshu Sharma
Department of Information Technology, Nizwa College of Technology, Oman
Email: devhim@gmail.com

Yogesh K. Dwivedi
Emerging Markets Research Centre (EMaRC), School of Management, Swansea University, UK
Email: ykdwivedi@gmail.com

Abstract:

This study develops a new research model to understand and predict the key determinants influencing the adoption of mobile payment services in a Middle Eastern country, Oman. The research model was tested using a hybrid structural equation modeling (SEM) and neural network (NN) modeling. The findings suggest valuable insights to the mobile payment service providers in the development of appropriate and effective strategy to raise the number of new consumers in Oman.

Keywords

Mobile-payment, technology acceptance, behavioral intention, neural network, Oman

Introduction

Digital payment using mobile device has been recognized as one of the innovative technological changes in recent years. These devices provide consumers with an improved functionality, which makes the overall payment activity hassle-free (Veríssimo, 2016; Dwivedi, Shareef, Simintiras, Lal & Weerakkody 2016; Liébana-Cabanillas, Marinkovic, de Luna, & Kalinic, 2017a). A payment (remittance of money from a buyer to a seller for a commodity or service) is considered as the fundamental component for the development of goods' and services' providers as well as the economy of a nation. Payments can be achieved in various ways such as cash, cheque, demand drafts, debits/credit cards, or internet banking (Slade, Williams, & Dwivedi, 2013). The mobile commerce (m-commerce) transactions require fast and secure payments. Both buyers and sellers seek reliability in digital money transactions and therefore it is the responsibility of the e-payment service providers to offer the secured and trustworthy environment to its consumers (Slade et al., 2013). New generation mobile devices (e.g., Smartphone), equipped with distinctive and extraordinary features, have been widely accepted by consumers as an innovative method for digital payments (Slade et al., 2013; Yadav, Sharma, & Tarhini, 2016). Mobile payment or m-payment (MP) is referred to the transfer of money (in digital form) from one party (e.g., consumer) to another party (e.g., seller or merchant) using a mobile device (Chandra, Srivastava, & Theng, 2010). Mobile payment can be grouped in three major forms – a) in-person mobile payment or contactless payment. This type of m-payments works on near field communication (NFC) technology in which transaction is done by establishing a connection between mobile device and point of sale (POS) through radio waves, b) payments through mobile app or

website (remote MP), and c) person-to-person payment using the dedicated mobile (Liébana-Cabanillas et al., 2017a).

According to the statistics published by Statista (2015), the total number of mobile phone users across the world is projected to surpass five billion users by 2019. On the other hand, Smartphone users worldwide are expected to reach almost 2.5 billion in 2019. Mobile technologies are presenting the large number of service innovations to the users. M-payment, as one of the major mobile innovations, became popular among the users across the world (Laukkanen, 2016). According to Timetric research, the projected value of MP transactions in the Asia Pacific (APAC) region will touch approximately $301 trillion by 2020. The current trend of MP in APAC and Eastern Europe, Middle East, and Africa (EMEA) regions delineates the enormous possibilities in the adoption of MP in other regions of the globe. In regard to the Middle East, the number of mobile (Smartphone) connections has been doubled in past few years and reached 263 million till the second quarter of 2016 resulting Kuwait, Israel, and Oman reaching mobile adoption rates over 70 percent (GSMA, 2016). In regard to Oman, as per the report (yStats.com, 2016) the total mobile phone subscriptions were recorded as 150 percent (6,975,757) of total Omani residents (4,642,521). The aforementioned statistical data clearly showed that consumers in the Middle Eastern countries are rapidly adopting the mobile technologies, and Oman is no behind in this race. The aim of our research is to identify and understand whether the residents in Oman use and adopt mobile technologies for making digital payments and what factors influence their intention to do so.

Mobile services in Oman

In Oman, the number of Internet and mobile device subscriptions were increased substantially during the past few years (Sharma, 2017). In order to harness and augment the mobile technology usage trends, the government of Oman had clutched some important maneuvers including advancing a national e-payment gateway (ePG) – a secured real-time payment gateway (Omanuna), constructing a public Internet access center, introducing the digital Oman national strategy, and instituting information technology authority (ITA) in order to provide the superior eservices to the consumers (Riffai, Grant, & Edgar, 2012). In Oman, ePG provides free e-service support to both public and private sectors (Omanuna). This payment gateway pays an important role in facilitating the effective and secured electronic payment processing using all major international credit/debit cards including MasterCard and Visa. Currently, ePG allows consumers to make online payments for their traffic and municipality fines, internet, telephone, and mobile bills, electricity bills, insurance premium, online donations, and for many other occasions (Omanuna). These initiatives were the clear signs of the progress in m-services in Oman. The effective implementation of m-services in Oman is relying on the degree of its realization, use, and adoption by its residents. As the mobile devices have become an integral part of consumers in Oman, many are still not aware of the mobile payment services use and its potential benefits.

The past studies conducted in Oman examined the use of m-services in different areas such as consumers using m-services for making regular calls and exchanging short messages, for navigating vehicles via global positioning system (Belwal & Belwal, 2009), for mbanking (Riffai et al., 2012; Sharma, 2017) for paying parking fee via short message

service (SMS), for drivers enquiring traffic offences, and for students fetching final grades from Ministry of Education (Naqvi, 2012). After analyzing existing literature, it can be observed that use of m-services (especially in context of digital payments) in Oman is still immature and needs to be studied further to explore its potential adoption among the consumers in Oman. To our knowledge, no study (particularly in Oman) has yet examined the use and adoption of m-services in the context of digital payments. Thus, in this study, we attempt to bridge the extant research gaps by developing a research model that yields the cognizance of m-payment adoption by Omani residents.

The objectives of our study are in three fold. First, fill the gap in the literature by modifying the technology acceptance model (TAM) to explore and understand consumers' intention to use mobile devices for the digital payments. Second, integrate determinants studied and obtained from our literature review, and propose a new research model to predict the most significant factors that affect the consumers' intention. The originality of our research model can be validated by its multi-layered structure that incorporates determinants namely customization, mobility, awareness of benefits, and the self-efficacy, perceived usefulness, perceived ease of use, perceived trust and perceived security. Third, our study employed hybrid structural equation modeling (SEM) and neural network modeling method. The SEM is employed to test the proposed research model, whereas neural network model is used to rank the importance of the key predictors that influence user' decision to adopt mobile-based payment. Finally, this research is conducted in Oman, a Middle Eastern country. To the best of our knowledge, no similar model has been employed to examine and predict consumers' intention towards mobile payment acceptance.

Literature review

The adoption of mobile payments or m-payment services are seen not only as the innovative payment system for hassle-free transactions but also as the buttress for the economic growth worldwide (AlAlwan, Dwivedi, & Rana, 2017; Liébana-Cabanillas et al., 2017a; Dennehy & Sammon, 2015; Shareef et al. 2018; 2017; Slade et al., 2013; Carton, Hedman, Damsgaard, Tan, & McCarthy, 2012; Veríssimo, 2016). Existing research suggested well-known technology acceptance models analyse and predict the most significant factors impacting consumers' perceptions of using mobile services. These models include diffusion of innovation (DOI) theory (Rogers, 1983), "addressed the significance of diffusion of a new idea or technology among the members of a social system over the time." (Sharma, Joshi, & Sharma, 2016, p. 343), technology acceptance model- TAM by Davis (1989) that introduced two new determinants- perceived usefulness (PU) and perceived ease of use (PEOU) to determine technology recognition and its usage, and unified theory of acceptance and use of technology (UTAUT) model by Venkatesh, Ramesh, and Massey (2003) that suggested four key constructs to examine user's intention and system use. These models have been widely applied and extended by several researchers (Kapoor, Dwivedi & Williams, 2015; Liébana-Cabanillas et al., 2017a, Liébana-Cabanillas, Marinković, & Kalinić, 2017b; Sharma, 2017; Dwivedi et al. 2017 A; Dwivedi et al., 2017 B; Rana et al., 2017; Rana et al., 2016; Slade, Williams, Dwivedi, & Piercy, 2015a; Slade, Dwivedi, Piercy, & Williams, 2015b; Chen & Tseng, 2012; Venkatesh & Davis, 2000) and determine the most significant factors influencing the user's intention.

Researchers, for example, Liébana-Cabanillas et al. (2017a) investigated consumers' behavior towards m-commerce acceptance by extending the traditional TAM with new determinants such as perceived compatibility, subjective norms, individual mobility, and personal innovativeness as indirect independent variables along with perceived security, perceived ease of use, and perceived usefulness as mediating factors influencing intention. In light of this, we attempt to extend the traditional TAM and propose a new research model to identify the most significant predictors of user's intention behind mobile services adoption in Oman, a Middle Eastern country. Unlike the original TAM, the proposed model integrates four external independent factors – self-efficacy (SE), mobility (MOB), awareness of benefits (AW), and customization (CUST). Perceived usefulness (PU), perceived ease of use (PEOU), perceived trust (PT), and perceived security (PS) are employed as mediating factors to examine the impact on resulting factor (dependent) – intention to use (INT). Figure 1 illustrates our proposed research model.

Alalwan, Dwivedi, & Williams (2016b) examined customers' intention and adoption of telebanking services offered by the banks in Jordan (one of the rapidly growing Middle Easter countries). Interestingly, the results (Alalwan et al, 2016b) indicated that only 21% of the total surveyed consumers used telebanking services frequently for payment purposes, for example utility bills, and only about 3% used telebanking several times in a month for repaying their loan installments. Existing literature showed that researchers (Slade et al., 2015a) examined the impact of PEOU and PU on acceptance of proximity mobile payments and found that PEOU and PU had a significant impact on intention to adopt m-payment. Liébana-Cabanillas et al. (2017b), in

their recent study, analyzed the responses of 224 respondents in the Republic of Serbia to understand their behavioral intention to use m-commerce. In their study, researchers considered various independent factors such as perceived usefulness, perceived ease of use, trust, mobility, customization, and customer involvement. The results of their study showed customization and customer involvement as the most influencing predictors. In a study, Chong, Chan, and Ooi (2012) investigated the adoption of m-commerce in Malaysian and Chinese consumers by extending the TAM and DOI with independent antecedents such as social influence, trust, cost, a variety of services, and trialability. The results of their study suggested a variety of services, trust, and social influence as the strongest determinants for the Malaysian consumers, whereas social influence, trust, and cost as the most significant for Chinese consumers.

In an empirical research of mobile payment acceptance on restaurant industry, researchers (Cobanoglu, Yang, Shatskikh, & Agarwal, 2015) found "compatibility with lifestyle" as the strongest factors that influence consumers' intention to adopt m-payment in restaurants followed by other significant predictors- usefulness, subjective norm, security, and previous experience with mobile payment. Another research on mobile service acceptance, conducted by Zarmpou, Saprikis, Markos, and Vlachopoulou (2012), tested the influence of functionality, trust, innovativeness, and relationship drivers with mediating factors – PEOU and PU on behavioral intention of the consumers. According to Zarmpou et al. (2012), the results revealed that trust and PEOU had no direct impact on consumers' intention, whereas both innovativeness and PU were found as the strongest factors.

Research model

As we know that users' intention is a key determinant that stimulates the adoption of a new technology by users (Sharma, 2017), the proposed research model of current study incorporates three layers with intermediary layer of two antecedents (perceived ease of use and perceived usefulness) taken from the well-known TAM model along with two other variables (perceived trust and perceived security). The trust factor in context of m-commerce can be defined as "the extent to which an individual believes that using m-commerce is secure and has no privacy threats" (Wei, Marthandan, Chong, Ooi, & Arumugam, 2009). Lin and Wang (2006) clearly established that trust is composed of several aspects such as service provider's credibility and honesty (integrity), consideration of customer's expectations of service provider (benevolence), service provider's capacity to perform as per the needs of the consumer (competence), and service provider's consistent behavior (predictability). Thus, in this study, it is assumed that the absence of trust would impact consumer's intention towards the adoption of m-payment. Besides trust, the presence of security of m-payment is another cardinal issue. As we know that m-payment involves processing of confidential information of the user, m-payment service is expected to be safe and secure. Therefore, security of the transaction is one of the key factors that may directly influence users' intention to adopt m-payments (Ooi & Tan, 2016; Liébana-Cabanillas et al., 2017a).

The outer layer of our proposed research model integrates the control factors, self-efficacy, mobility, awareness of benefits, and customization, to test their effect on PEOU and PU. Self-efficacy refers to the extent of user's belief in his/her ability to accomplish the desired work (Ozturk, Bilgihan, Nusair, & Okumus, 2016). In the context of m-payment, it can be implied that mobile-friendly consumers should regard m-payment

simple and easy to use. Thus, in this research, self-efficacy is considered as an important factor to investigate users' intention (Al-Somali, Gholami, & Clegg, 2009). The mobility as the most considerable feature of mobile technology allows users to access mobile-based services and mobile commerce anytime and anywhere (Mallat, 2007; Büyüközkan, 2009; Kim, Mirusmonov, & Lee, 2010). In regard to m-payment, it is assumed that mobility of m-payment service allows consumers to use it anytime and anywhere, which may further influence on consumers' intention (Marinkovic & Kalinic, 2017). Another important factor used in the out layer is awareness of benefits (AW). Lack of awareness of service's or product's advantages has been found as a reason for users' disinclination towards the use of that service (e.g., m-payment) and treated impractical or non-functional (Sathye, 1999). Hence, in our proposed research model AW is considered as an important factor. Users with more awareness about the advantages and disadvantages of a new innovation are more likely to perceive its usefulness (Nui Polatoglu & Ekin, 2001). Based on past studies, (Venkatesh et al., 2003; Wang & Li, 2012; Ooi and Tan, 2016; Marinkovic and Kalinic, 2017) it can be implied that customization of features provided by m-payment environment could enhance the usefulness of the service which can lead to service acceptance. It is also important to understand that the customization factor does not directly influence the trust and the loyalty of m-payment application and its vendor. Yeh and Li (2009), their investigation determined that customization directly and positively impacts consumer satisfaction and trust toward service providers. Thus, customization is considered as an important determinant in our research model. On the basis of extensive literature review, we proposed the following research model (Figure 1) to understand the key determinants influencing m-payment acceptance in a developing

country. Also, as per our literature review, no past study has considered and tested the direct impact of other factors, included in the outer layer of our research model, on perceived trust and perceived security.

<Figure 1 about here>

Hypotheses development

Self-efficacy

Bandura (1986, p. 391) coined the term "self-efficacy" and defined it as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances." In other words, self-efficacy affects the task performance of a person based on the amount of effort and time one spent to perform that task (Bandura, 1997). Perceived self-efficacy has been considered as one of the important factors to examine its impact on perceived ease of use (Reid & Levy, 2008; Al-Somali et al., 2009; Scott & Walczak, 2009; Shaw, 2014; Ozturk et al., 2016). In a study, Alalwan, Dwivedi, and Simintiras (2016a) investigated the impact of SE on telebanking adoption in Jordan. The results of their study, interestingly, found that SE had a significant relationship with consumers' adoption of online banking channels. In a prior research (Shaw 2014) it was clearly shown that SE had a great impact on mobile wallet adoption. The analytical results of the study also proved that consumers with high SE believed that they received greater benefits. Scott and Walczak (2009) employed SE factor to determine the user acceptance of the internet/multimedia tool and found that computer SE had a positive and strong affect on PEOU of the multimedia tool. On the contrary, Reid and Levy (2008) unexpectedly, determined SE as a weak and irrelevant variable to effect PEOU. In light of this, Shin (2009) and Ozturk et al. (2016) found that SE had

insignificant impact on intention and PEOU respectively. Regardless of studies with unexpected results of SE, our study still focuses on examining the impact of SE on PEOU in the context of mobile payment adoption. Therefore, we hypothesize that:

H1: Consumers' self-efficacy is positively and significantly influences perceived ease of use of mobile services.

Mobility

This ubiquity nature of mobile services motivated researchers to consider mobility as one of the key factors to examine its influence on mobile service adoption (Mallat, 2007; Kim et al., 2010; Zarmpou et al., 2012). The key benefit of anytime and anywhere access of mobile services is that these services are not dependent on user's physical location, type of transaction, and availability of ATM machines (Mallat 2007; Slade et al., 2013; Sharma, 2017). In a study, Schierz, Schilke, and Wirtz (2010) identified mobility as the strong factor towards the adoption of mobile payment services. Ramos-de-Luna, Montoro-Ríos, and Liébana-Cabanillas (2016) found mobility as the most important determinant that influences ease of use. Similarly, in a recent study, (Liébana-Cabanillas et al., 2017a) considered mobility as a predictor to examine its influence on perceived ease of use. The results of their study suggested that individual mobility had a significant factor impacting PEOU. In another study by Marinkovic and Kalinic (2017) mobility was acknowledged as the most important driver of customer satisfaction in terms of m-commerce adoption. On the contrary, Kim et al. (2010) tested the influence of mobility on perceived ease of use and found that mobility has no impact on the adoption of m-payment services. In light of the above literature, the current study adopts mobility as one

of the important factors to examine its impact on the adoption of m-payment services. Therefore, the following hypothesis is proposed:

H2: M-payment services' mobility is positively and significantly influences perceived ease of use of m-payment services.

Awareness of benefits

The consumers' perception of adoption and rejection of any new technology, service, or product commences when "the consumer becomes aware of the product" (Rogers & Shoemaker, 1971). Therefore, it is essential for the service providers to make their prospective consumers aware about the services, product, its benefits, and how these services are better than the services offered by the competitors (Sathye, 1999). According to the study conducted by Sathye (1999), the adoption of net-banking is influenced by building and spreading awareness among Australian consumers. In a study, it was found that lack of awareness was one of the critical determinants responsible for the low adoption of online banking in Australia. Researchers (Nui Polatoglu & Ekin, 2001) in their research mentioned that amount of consumer's knowledge and proficiency in new technology or services is relative to the usefulness of the product. As per Marinkovic and Kalinic (2017), in order to keep the potential customers, service providers must educate and aware the consumers about the "usefulness, convenience, safety, and advantages of m-commerce." On this light, Al-Somali et al. (2009) studied the reasons for consumers' unwillingness to adopt internet banking services provided by the banks in Saudi Arabia. They found awareness of services and their benefits had a positive and significant influence on a perceived usefulness of the bank's eservices. Scholars (Kim et al., 2010; Shaw 2014) while supporting the inputs of past studies identified knowledge had a

positive and significant impact on perceived ease of use and perceived usefulness of the new product respectively. Balachandran and Tan (2015) examined the association between the amount of information and intention to NFC m-payments and found it positive and significant. To our knowledge, no study has rejected the fact that awareness factor has a negative or insignificant relationship with the perceived usefulness (PU) that instigate the adoption of a new product. Thus, the following hypothesis is proposed:

H3: Consumers' awareness of benefits of m-payment services is positively and significantly influences perceived usefulness of m-payment services.

Customization

Customization can be defined as the "degree of offering or recommending tailored content and the transactional environment to the individual customer" (Choi, Seol, Lee, Cho, & Park, 2008, p. 321). In regard to m-payment services, customization and personalization of the services, according to the transactional environment of the customer, are considered as the effective factors to satisfy consumers' expectations (Wang & Li, 2012) as well as to meet their heterogeneous needs (Marinkovic and Kalinic, 2017). For example, m-payment applications allow customers to customize the application by saving multiple bank accounts to complete the transactions using the preferred bank account. In addition, customers can tailor "services and offers" section of the app according to their preferences. Altogether, these customization features make m-payment platforms more customer friendly. Thus, in this study, we defined customization as the facility provided by m-payment applications that give users the friendly environment to tailor the application according to their preferences without hampering the security, safety, and quality of the application. On the light of this, researchers (Kim

et al., 2010; Slade et al., 2013; Cobanoglu et al., 2015; Ozturk et al., 2016) considered product's compatibility as consumer's needs, lifestyle, habits, values, and past experiences to predict the customer's readiness to adopt mobile services. Venkatesh et al. (2003) in their study stated that the impact of service customization can improve the design of mobile interface in order to advance the usability of mobile-based services as well as the level of customer satisfaction. Yeh and Li (2009) found customization had a significant and positive influence on the quality characteristic of m-commerce website. (Wang & Li, 2012) identified that personalization of m-services motivated consumers to become loyal to the service provider. Ooi and Tan (2016) examined the influence of mobile perceived compatibility (MPC) on the usefulness of m-payment system and found a positive and significant association. In an empirical study, Liébana-Cabanillas et al. (2017b) considered customization as one of the important factors to determine the impact on behavioral intention. The results of their study suggested that customization had a significant and positive influence on users' intention to adopt m-commerce. In contrast to above studies, Marinkovic and Kalinic (2017) determined customization had no significant impact on perceived usefulness. In this study, while considering the results of past studies, we believe that customization is one of the critical factors influencing the usefulness of m-payment services. Thus, we develop the following hypothesis:

H4: M-payment services' customization is positively and significantly influences perceived usefulness of m-payment services.

Perceived ease of use on perceived usefulness

Davis (1993, p. 477) defined perceived ease of use as the "degree to which an individual believes that using a particular system would be free of physical and mental effort."

PEOU has been recognized as one of the dominant and extensively used factors to determine the adoption of m-payments (Dahlberg, Guo, & Ondrus, 2015; Liébana-Cabanillas et al. 2017a). In regard to m-payment acceptance, PEOU has been considered for its reliability and importance as the stronger predictor of TAM. According to Teo, Lim, & Lai (1999), users are more likely to adopt information system useful that is perceived to be easy to use and work with. Kim et al. (2010); Leong, Hew, Tan, & Ooi (2013); Li, Liu, & Heikkilä (2014) in context of m-payment adoption, investigated the effect of perceived ease of use on perceived usefulness and found that perceived ease of use is positively influence perceived usefulness. However, there are some contradictory results found by Tan, Ooi, Chong, and Hew (2014) for NFC mobile credit cards acceptance. The researcher found that there is no impact of Perceived ease of use on Perceived usefulness. Thus, we develop the following hypothesis to test whether the consumers' perceived ease of use of m-payment services has positive impact on their perceived usefulness of m-payment.

H5: Consumer's perceived ease of use of m-payment services is significantly and positively influences his/her perceived usefulness of m-payment services.

Perceived trust

Consumer's intention towards the acceptance of services can be influenced by one of the significant adoption factors known as "trust" (Zhou, 2013; Chandra et al. 2010; Mallat, 2007). Trust can be defined as "positive expectation of consumer towards service provider" (Shankar and Datta, 2018, p. 6). In context of electronic payments or payments through mobile applications (m-payments), perceived trust plays an important role. For instance, consumer's belief and confidence that m-payment service provider has adequate

information privacy controls on electronic transactions can influence customer's intention to use m-payments (Mallat, 2007; Kim et al., 2010; Daştan & Gürler, 2016; Ooi & Tan 2016; Shankar and Datta, 2018). Previous studies established the association between trust and consumer's intention to use m-payments. According to Shin (2009), perceived trust is quite a critical factor in terms of mobile wallets because the financial loss can hamper the adoption of m-wallets. In a study, Shin (2009) investigated buyers' attitude towards mobile wallet. In his research, it was highlighted that users' intention towards mobile wallet was significantly influenced by the perceived trust. On the other hand, Chong (2013) found perceived trust as the strongest determinant in influencing consumers' decision to adopt mobile commerce. Daştan & Gürler (2016), found that absence of trust can negatively impact both the acceptance of mobile payment service (MPS) and intention to use MPS. Results of their study revealed that perceived trust has a positive influence on the adoption of MPS. On the light of this, Shankar and Datta (2018) analyzed factors influencing the m-payment adoption intention mobile payment. The findings clearly indicated that perceived trust has a significant effect on acceptance of mobile payments. In contrast to above studies (Alkhunaizan & Love 2012; Zarmpou et al., 2012) reported opposite or no impact of trust on consumers' intention to adopt m-commerce. Since the results identified in aforementioned studies addressed the significance of trust variable to understand the consumers' intention, we hypothesize that:

H6: Consumers' perceived trust in m-payment service is significantly and positively influences consumers' intention towards the adoption of m-payment services.

Perceived ease of use on intention to use

The association between PEOU and intention has been validated by past studies (Shareef et al. 2016; Dahlberg et al., 2015; Li et al., 2014; Kim et al., 2010). The results suggested that perceived ease of use has been the most significant determinant that influences users' intention towards mobile technology adoption. In light of in support of earlier findings (Teo, Tan, Ooi, Hew, & Yew, 2015a; Teo, Tan, Ooi, & Lin, 2015b; Dutot, 2015; Sharma, 2017; Liébana-Cabanillas et al., 2017a) tested the impact of PEOU on intention to adopt m-payment acceptance and highlighted the strong relationship between PEOU and intention towards the acceptance of NFC based mobile technology. In addition to the aforementioned studies, Zarmpou et al. (2012), Ooi and Tan, (2016) (for mobile services), Chong (2013), Yadav et al. (2016), Liébana-Cabanillas et al. (2017b) (for m-commerce), and Liébana-Cabanillas et al. (2017a) (for m-payment) found PEOU as negatively related factor to intention. Considering the aforementioned studies and their results the current study intends to test the relationship between perceived usefulness and intention, thus we propose the following hypothesis:

H7: Consumer's perceived ease of use of m-payment is significantly and positively influences his/her intention towards the adoption of m-payment services.

Perceived usefulness

Perceived usefulness factor was introduced by Davis (1989) as an important predictor of systems' acceptance and diffusion. Davis (1989, p. 320) defined PU as "the degree to which a person believes that using a particular system would enhance his or her job performance". In regard to mobile payment services technology acceptance, perceived usefulness has been employed as a key predictor. For example, Liébana-Cabanillas et al. (2017a) in their recent study found PU as a significant determinant that influence users'

intention to adopt m-payment services, while Liébana-Cabanillas et al. (2017b) reported that usefulness had a significant impact on user's intention to use m-commerce. Cobanoglu et al. (2015) examined the consumers' intention to mobile payments and found perceived usefulness as one of the important determinants. Shaw (2014) studied acceptance of mobile wallet by consumers in North America. His research found PU as a significant factor influencing consumers' intention to use a mobile wallet for the payments. Past studies, conducted by Shareef et al. 2016; Kim et al. (2010), Lee, Park, Chung, & Blakeney (2012), Chong et al. (2013), Ooi and Tan (2016), and Sharma (2017) determined PU as an important predictor influencing user's belief towards the acceptance of m-services. However, researchers such as Li et al. (2014), and Dutot (2015) in their investigations reported that PU has no significant influence on users' intention to adopt mobile payments. In this paper, therefore, while considering both supporting and contradicting studies, we hypothesize that:

H8: Perceived usefulness is significantly and positively influences consumers' intention towards the adoption of mobile payment services.

Perceived security

Security in context of electronic services refers to secured and safe transaction (Pearson, Tadisina, & Griffin, 2012). According to Shin (2009), perceived security is referred to as "the degree to which a customer believes that using a particular mobile payment procedure will be secure" (p. 1346). Researchers Ooi and Tan (2016) stated PS as a safety feature to protect confidential data of a user on mobile transactions. Thus, the current research considered the role of PS factor on consumers' intention to use mobile payment services. In a recent study, Liébana-Cabanillas et al. (2017a) considered

perceived security factor to analyze its impact on users' intention to adopt m-payment. The results of their study suggested that PS has a statistically significant effect on intention. According to Cheong, Ling, and Teh (2014), mobile perceived security has a significant association with intention to use. Other researchers Shin (2009) and Oliveira, Thomas, Baptista, and Campos (2016) in their studies mentioned that perceived security had a positive influence on intention to accept mobile-based services (e.g., mobile wallets or m-payments). While perceived security has been considered an important factor, unexpectedly a few studies found PS a non-significant predictor (Tan et al., 2014; Morosan & DeFranco, 2016). In spite of the above negative results of perceived security factor, this study considered PS factor in the proposed research model. Thus, we hypothesize:

H9: Perceived security is significantly and positively influences consumers' intention towards the adoption of mobile payment services.

Research methodology

This research study attempts to employ two staged research methodology (see figure 2). The flowchart presented in figure 2 is self-explanatory. In the first stage, structural equation modeling (SEM) tests the hypothesized paths in the proposed research model. The SEM has capabilities to examine linear relationships only among decision variables and in some cases, it may oversimplify the complexities involved in the decision making process. This weakness of SEM is addressed by the strength of neural network modeling i.e. capability to detect linear as well as a non-linear relationship. Thereby, in the second stage, a neural network (NN) modeling was employed to rank the key antecedents and validates the SEM results.

<Figure 2 about here>

Sample and methods

The indicators, used in this paper, to measure mobile users' response have been analysed and validated in previous studies (Ahmad & Khalid, 2017; Zhou, 2013; Davis, 1989; Sharma, 2017; Al-Somali et al., 2009). The survey questionnaire was developed and reviewed by information system experts to ensure its readability and ease of understanding of survey items from mobile users' perspective. The pilot study was conducted with the help of three information system experts from banks, four university professors who are teaching courses related to information systems and information technology management, and five senior information systems research scholars. The results obtained from pilot study revealed that the survey questionnaire was easy to understand and needed approximately 10 minutes' time to respond to all the questions. Upon completion of the pilot study, minor suggestions helped in revising the survey questionnaire to determine and classify key antecedents influencing consumers' opinion to adopt mobile payment services in Oman. A questionnaire survey strategy was found appropriate to test all proposed research hypotheses empirically (Saunders, Lewis, & Thornhill, 2007). All indicators in the survey questionnaire were measured using a five-point Likert scale (Dwivedi et al. 2013; Sharma & Sharma, 2019) with range representing 1 = "strongly disagree" to 5 = "strongly agree" except demographic variables. The items in survey questionnaire were in English language only. In the beginning of the survey questionnaire, a mandatory question was asked, for example, "Are you using mobile

payment services?" If the response was positive, only users were allowed to complete the survey.

A convenient sampling method was adopted for data collection because the actual population size is not known for this research study (San Martin & Herrero, 2012). Furthermore, San Martin and Herrero (2012) recommended employing a quota-sampling procedure to match target population meeting criteria of gender and age. Data were collected by sending emails to students, faculty members, staff, and their friends & relatives in the capital city "Muscat" in September and October 2017. On completion of data collection stage, a 242-survey questionnaire was received. In the data collection stage, non-response bias is a common concern. The recommendations suggested by Armstrong & Overton (1977) were adopted to address non-response bias. The responses received within first three weeks were treated as early responses and remaining as late responses. We decided to cutoff three weeks on the basis of the pattern of the responses from the respondents. The results of two groups revealed that there was no statistical difference observed (p value > 0.05). After filtering stage, a 30-survey questionnaire was found incomplete. Hence, this research study investigated 212 usable survey questionnaires resulting from 57% male and 43% female respondents. Table 1 shows the summary of demographic variables pertaining to the analyzed sample.

<Table 1 about here>

Data analysis and results

Measurement assessment

Hair, Black, Babin, and Anderson (2010) recommended a set of guidelines to analyze all measures for testing reliability and validity. Data analysis was performed using popularly

known statistical software SPSS 23.0 and AMOS 18. The confirmatory factor analysis (CFA) was performed to assess uni-dimensionality of all measures. The results of CFA were found as follows: Chi-Square/df= 2.06; normed fit index (NFI) = 0.92; comparative goodness of fit index (CFI) = 0.95; Tucker Lewis fit index (TLI) = 0.94; incremental fit index (IFI) = 0.95, and root mean square of error of approximation (RMSEA) = 0.05. The aforementioned series of fit indices confirm the fitness of the proposed research model. In addition, the reliability analysis of all measures was performed using Cronbach alpha. Hair et al. (2010) further recommended guidelines if Cronbach alpha is greater than 0.70 then internal consistencies of factors are reasonably good. In this research study, the Cronbach alpha for all factors was higher than 0.78 (Perceived ease of use = 0.81; Perceived usefulness = 0.89; Customization = 0.85; Self-efficacy = 0.90; Perceived trust = 0.91; Perceived security = 0.92; Mobility = 0.84; Awareness of benefits = 0.80; Intention to use = 0.95). The confirmatory factor loadings were higher than 0.69, and all values were statistically significant at 1% level of significance.

Next, composite reliability (CR) and average variance extracted (AVE) were computed to assess the internal consistency of all factors measured using multiple indicators. As per recommendations made by Hair et al. (2010), composite reliability is considered better reliability measure of variance shared by each indicator and average variance extracted perform better to measure internal consistency. The general recommendation by researchers (Hair et al., 2010; Sharma, Gaur, Saddikuti, & Rastogi, 2017) for AVE and CR in empirical studies is greater than 0.50 and 0.70 respectively for a satisfactory level of construct reliability. Furthermore, Hair et al. (2010) defined the discriminant validity of a construct as “the extent to which a construct truly differs from

neighboring constructs." The values of average shared squared variance (ASV) and maximum shared squared variance (MSV) can be seen in table 2 and observed that AVE > MSV and AVE > ASV, which confirms the satisfactory level of discriminant validity of factors. Convergent validity of each factor was achieved, as CR values are greater than AVE values for all factors.

<Table 2 about here>

Testing of hypotheses

The examination of structural model was conducted, as results of measurement model were found satisfactory. The fit indices of structural model were as follows: Chi-Square/df= 2.18; normed fit index (NFI) = 0.91; comparative goodness of fit index (CFI) = 0.93; Tucker Lewis fit index (TLI) = 0.92; incremental fit index (IFI) = 0.91, and root mean square of error of approximation (RMSEA) = 0.06. The testing of hypotheses was conducted as per the statistical significance of beta values for hypothesized paths. The summary of hypotheses testing results are given in Table 3.

In the primary phase of analysis, we tested the influence of the self-efficacy and mobility on perceived ease of use. Both factors have positive impact on perceived ease of use. Hence, H1 and H2 are supported. It is found that the influence of self-efficacy predictor ($\beta = .160$, $p < 0.05$) has stronger affect (consistent to Scott & Walczak, (2009), and Alalwan et al. (2016a) as compared to the impact of the mobility factor ($\beta = .221$, $p < 0.05$). Liébana-Cabanillas et al. (2017a), Marinkovic & Kalinic (2017), and Lu et al. (2017) also found mobility as an important driver of the adoption of mobile commerce. In another phase of analysis, we tested the impact of awareness of benefits and customization on perceived usefulness. Results of our test showed that both two factors

have positive and strong influence on perceived usefulness while awareness of benefits (β = .325, p < 0.05) is found with more intense impact than customization (β = .298, p < 0.05) factor on perceive usefulness. Thus, both the hypotheses H3 and H4 are supported. The results of this study are found parallel to the results of Al-Somali et al. (2009), Balachandran and Tan (2015), Ooi and Tan (2016), Liébana-Cabanillas et al. (2017b). It can be stated, as per the results obtained, that consumers believe that awareness of benefits stimulates their perception towards perceived usefulness of mobile payment services rather personalization nature of m-payment services. In addition, perceived ease of use significantly influenced perceived usefulness (β = .111, p < 0.05), hence H5 is supported.

In next phase of analysis, we examined the influence of perceived trust, perceived ease of use, perceived usefulness, and perceived security on the intention to use m-payment services. Results showed that all three independent predictors except the perceived ease of use have significant influence on consumer's intention. Thus, hypotheses H6, H8, and H9 are all supported whereas, H7 not supported. It is worth noting that among all the significant variables, the perceived usefulness distinctly impacts (β = .670, p < 0.05) consumers' intention to adopt m-payments. However, perceived ease of use has no significant impact on users' intention. The results of this study are consistent with the findings of Liébana-Cabanillas et al. (2017a). The current study clearly indicates that usefulness, trust, and security in terms of m-payments play a major role in the adoption of mobile-based services.

<Table 3 about here>

Neural network analysis

The recent development in information and communication technologies has made an artificial neural network (ANN) available for solving complex business problems. The ANN architecture is similar to the layout of the human brain, which is capable in acquiring knowledge using learning processes (Chiang, Zhang, & Zhou, 2006). Haykin (2001, p. 2) defined ANN as "a massively parallel distributed processor made up of simple processing units, which have a neural propensity for storing experimental knowledge and making it available for use." The acquired knowledge from learning processes is stored in synaptic weights (Liebana Cabanillas et al., 2017a). Researchers Chiang et al. (2006), Chong (2013), Leong et al. (2013), Sharma, Govindaluri, & Al Balushi (2015), Chong, Liu, Luo, & Keng-Boon (2015), Sharma (2017), Sharma et al. (2017), Liebana Cabanillas et al. (2017a) have considered the most commonly employed neural network model – feed-forward back-propagation multilayer perceptron (MLP) in business research to understand and predict dependent variable using independent variables. Researchers (Priyadarshinee et al., 2017; Chiang et al., 2006; Chong, 2013) have argued that the performance of the neural network models has been proved better than traditional statistical models including logistic regression, linear regression, and discriminant analysis.

The neural network modeling has been employed in solving a number of business research problems such as NFC-enabled mobile credit card acceptance (Leong et al., 2013), mobile commerce adoption (Chong, 2013), RFID adoption in healthcare (Chong et al., 2015), mobile commerce acceptance (Yadav et al., 2016; Liebana-Cabanillas et al., 2017b), m-payment adoption (Liebana-Cabanillas et al., 2017a), cloud computing adoption (Priyadarshinee et al., 2017), and many other business domains.

The neural network model comprises mainly three layers known as input layer, one or more hidden layers, and one output layers. The number of hidden layers depends on the nature of the complexity of the problem. In this study, one hidden layer is sufficient to handle complexity involved because it can represent any continuous function. In the aforementioned studies, one hidden layer was used to develop neural network models. Liébana-Cabanillas et al. (2017b) argued that two hidden layers are even enough to model discontinuous functions. Each layer in the NN model is made of neurons, which are directly connected with the neurons in the next layer of the NN model (Liebana-Cabanillas et al., 2017a). The number of neurons in the input layer depends on the number of independent variables, whereas there is only single neuron in the output layer, that is, a number of dependent variables. The layers in neural network model are associated with activation function. In this study, the activation function used is hyperbolic tangent. The main reason behind choosing hyperbolic tangent over sigmoid was the nature of hyperbolic tangent centering around "0" rather than "0.5" as chosen in sigmoid function, as a result learning in the next layer becomes easy. In addition, Mostafa (2009) argued that the advantage of hyperbolic tangent function lies in the fact that it suppresses data points together at the low and high ends of original data. The neural network model is a supervised learning and is capable of exploring linear and non-linear relationships among decision variables because it is a data-driven model.

Neural network modeling in mobile payment acceptance

A number of information systems adoption studies have employed advanced statistical models such as multiple linear regression and/or structural equation modeling (Kim et al., 2010; Zarmpou et al., 2012; Chong, 2013; Balachandran & Tan 2015; Dutot, 2015;

Szopiński, 2016; Liébana-Cabanillas et al., 2017b) to test empirical models. Such traditional analytical models used to examine linear relationships, generalize the intricacy and significance of acceptance decisions. Thus, the neural network approach is recommended (Liébana-Cabanillas et al., 2017b) for understanding the complexity of the non-linear relationship. Both Shmueli and Koppius (2011, and Chong (2013) argued that a large number of mobile commerce acceptance studies, instead of predictive models, used causal-explanatory statistical models where inferential statistical method was employed to test the research hypotheses which were based on popularly known explanatory models such as TAM and UTAUT (Shmueli & Koppius, 2011; Chong, 2013). It has been observed that most of the empirical studies, based on TAM and UTAUT, relied on the apriori assumptions that the decision process involved in the mobile technology acceptance are compensatory (Chiang et al., 2006; Chong et al., 2015). In particular, these explanatory models assume that enhancing perceived security could compensate a shortfall in mobile payment acceptance by perceived trust.

Validations of neural networks

Neural network model in this research was developed using the popular statistical package IBM SPSS 23.0. In this study, a feed-forward back-propagation neural network model was used to train and test the research model. In order to avoid the possibility of overfitting of the model, cross-validation procedure was used. Researchers (Sexton, Johnson, & Hignite, 2002; Chong, 2013) argued that no algorithm is available to compute the exact number of hidden nodes in the neural network model. Chong (2013) recommended the use of NN model with 10 hidden nodes as it was complex enough to map data points to produce results with minimum error. The root mean square error

(RMSE) is a common procedure to assess the accuracy of the neural network model. In this research, only statistically significant factors from the results of structural equation model are used in the neural network model. The proposed research model, shown in figure 1, can be presented by three sub-models (Figure 3) suitable for neural network analysis.

<Figure 3 about here>

Model A has two neurons in the input layer and each neuron is represented by factors namely self-efficacy, and mobility, whereas perceived ease of use was represented by one neuron in the output layer. Model B has three neurons in the input layer, which are represented by perceived ease of use, customization, awareness of benefits, and one neuron represented perceived usefulness in the output layer. Next, model C incorporates four neurons in the input layer represented by perceived trust, perceived security, perceived ease of use, and perceived usefulness, whereas intention to adopt mobile payment services was represented by one neuron in the output layer. There was one hidden layer allotted to each model by SPSS software automatically. In these three neural network models, eighty percent data points were considered to train model, whereas remaining twenty percent data points were selected to test the obtained results (Chong, 2013; Chong et al., 2015; Sharma, 2017; Sharma et al., 2017; Liebana Cabanillas et al., 2017a; Priyadarshinee et al., 2017).

<Table 4 about here>

The accuracy of the results obtained from neural network models was determined by the root mean square error (RMSE), which is defined as the difference between actual and predicted values of dependent variable, that is, intention to use mobile payment services.

The summary of RMSE values for all three neural network models is given in Table 4. The RMSE values obtained from all three neural network models for training and testing data points are very small. Hence, the results obtained are quite accurate (Chong et al., 2015; Sharma et al., 2017; Liebana-Cabanillas et al., 2017a).

Sensitivity analysis

The purpose of computing sensitivity analysis was to understand the importance of factors and was computed by averaging the relative importance of the independent variables obtained from neural network models (Chong, 2013). The relative importance of factors determines the normalized importance, which can be expressed as the ratio of relative importance to its highest relative importance and is also normally expressed in percentage (Tan et al., 2014; Chong et al., 2015; Yadav et al., 2016; Sharma et al., 2017; Liebana-Cabanillas et al., 2017a). Table 5 summarizes the average relative importance and normalized relative importance obtained from all three neural network models.

<Table 5 about here>

In model A, self-efficacy is the key predictor of perceived ease of use followed by mobility. Next, in model B, awareness of benefits is the most important predictor of perceived usefulness followed by perceived ease of use and customization, whereas in model C the key predictor of intention to adopt mobile payment services was perceived usefulness followed by perceived trust, perceived security and perceived ease of use. The importance of perceived ease of use in the decision to adopt mobile payment services was minimum.

Interestingly, self-efficacy contradicts the results obtained from SEM as it was found most influential in the SEM results whereas mobility is the most influential in

neural network model results in predicting perceived ease of use towards mobile payment services. In case of the predictors of perceived usefulness, there is a change in the results obtained from SEM and NN model results. Awareness of benefits is the most influential predictor by SEM results followed by customization and perceived ease of use, whereas awareness of benefits is also the most influential predictor by neural network model followed by perceived ease of use and customization in predicting perceived usefulness. The difference between results obtained by structural equation model and neural network model can be justified by the nonlinear and non-compensatory nature of neural network model and much higher order prediction capability of the later model. The results obtained by SEM are validated by the results obtained from neural network model in case of predicting behavioral intention by perceived usefulness, perceived trust, perceived security and perceived ease of use.

Discussion

On the basis of the summary of the results presented in the aforementioned sub-sections, it can be inferred that the research model proposed in this study was able to show predictive power in terms of the coefficient of determination (R^2) at a satisfactory level as: *intention to use (69 %), perceived usefulness (46%),* and *perceived ease of use (31%).* It is also worth mentioning that R^2 increased to 69% from 65% on the inclusion of trust factor in the research model. The values of reliability indices, validity indices and other all fit indices were within the established range as recommended in Hair et al. (2010). In addition to SEM results, this study used neural network results to rank the constructs of *intention to use, perceived usefulness*, and *perceived ease of use.* Moreover, neural network modeling provided evidence to validate SEM results.

In this study, we tested the impact of the self-efficacy and mobility on the perceived ease of use and found that both factors have a positive impact on perceived ease of use. These findings imply that residents in Oman believe that mobility and expertise in the use of mobile payments influence perceived ease of use in operations of mobile payments. These results are consistent with previous studies (Scott & Walczak, 2009; Alalwan et al., 2016a; Marinkovic & Kalinic, 2017). In addition, while testing the impact of awareness of benefits, ease of use and customization on perceived usefulness, we found a positive and strong influence of these factors on perceived usefulness. However, the effect of awareness of benefits was identified stronger than that of other two factors on perceived usefulness. These findings imply that awareness of benefits, ease of use and customization determine the usefulness of mobile payment services in Oman. These results are found parallel to the results in previous information systems studies (Al-Somali et al., 2009; Balachandran & Tan 2015; Liébana-Cabanillas et al., 2017b).

We further tested the impact of perceived trust, perceived ease of use, perceived usefulness, and perceived security on the intention to use m-payment services. The results revealed that perceived trust, perceived usefulness, and perceived security have a significant influence on consumer's decision to accept mobile payments services. It is worth reporting that among all the significant variables, the perceived usefulness distinctly impacts consumers' intention to adopt m-payments. These findings imply that usefulness, trust, and security in terms of m-payments play a major role in the adoption of mobile-based services. These results are found consistent with the previous information systems studies (Ooi & Tan 2016; Szopiński, 2016; Sharma 2017; Ling & Teh 2014;

Oliveira et al., 2016). On the other hand, it is interesting to note that perceived ease of use has no significant impact on users' intention. The possible reason for this contradictory finding may be the regular usage of high end mobile phones among Omani residents. This finding is found consistent with the findings of Liébana-Cabanillas et al. (2017a).

Theoretical implications

This study has two key theoretical research contributions. First, this study has contributed substantially to the literature of technology adoption in the context of developing countries, in particular, Oman, a Middle Eastern country. There are a few research models explaining the usage of mobile payment services in the literature. The research model discussed in this study is quite comprehensive in nature, which includes variables namely customization, mobility, awareness of benefits, self-efficacy, perceived usefulness, perceived ease of use, perceived trust and perceived security to determine intent to use mobile payment services. Finally, this research study has employed an innovative research methodology, which is based on the integration of structural equation modeling and neural network modeling. The structural equation modeling supported the test done for understanding the impact of independent factors on the dependent variable. On the other hand, neural network model helped in verifying results obtained from the aforementioned model and in ranking independent factors.

Managerial implications

The findings of this research study can be of great importance to decision makers of mobile companies and banks to increase their customer base in Oman, a Middle Eastern country. As the consumers in the Middle Eastern countries are profoundly using mobile devices for multiple purposes such as calling, playing games, watching videos, the usage

of mobile devices for digital payments is a relatively new trend. Therefore, it is essential for mobile service providers and the government agencies to create the awareness about the benefits of mobile payments or contactless payments among the citizens of Oman, a Middle Eastern country.

Perceived usefulness and perceived trust are two important predictors of intention to use mobile payment services in Oman, one of the prominent Middle Eastern countries. In case of perceived usefulness, it is recommended to use social media platform such as Facebook, YouTube, Twitter, and others to spread awareness by showing short videos of mobile payment benefits as most of the mobile users spend reasonably good time on such platforms. It is also suggested to social media advertisements to highlight the key advantages of using mobile payment services as an opportunity to enhance social status of mobile users. Furthermore, social media advertisements, in order to attract mobile users, can highlight the points of multiple key benefits such as quick shopping, faster ticket and hotel booking, faster children fee payment, lesser risks and many more usefulness tags of mobile payment services. As a result, the benefited mobile users will share their experience with peers and family members. This will further help in developing a perception of the usefulness of mobile payment services among the potential users. In addition, the key strategies pertaining to promotions towards mobile payment services should focus on convenience instead of just perceived usefulness of the services (Lee et al., 2012). Therefore, decision makers in banking institutions and mobile application developers should prioritize the importance of usefulness in addition to perceived security concerns in the mobile payment services environment. A sense of

insecure mobile payment environment may become hurdle in the acceptance and utilization of mobile payment services.

In regard to perceived trust, mobile manufacturers, mobile service providers, and bankers should emphasize on developing trust about mobile payment services among the mobile users. In Oman, trust factor plays a cardinal role in the acceptance and use of any innovative technology, particularly in case of mobile payment technology where the personal and sensitive information is supposed to be disclosed and shared by the consumers. Hence, mobile devices and security features should be of international standards promoting the total security of user credential. In addition, it is important to spread awareness about the level of security measures adopted in the mobile payment services to end users with the help of social networking websites such as Facebook, Twitter, and others. In addition to social networks, forums, local newspapers and other digital platforms should be utilized to motivate and influence the users' perception towards the acceptance of mobile payment services in Oman.

Limitations and future studies

There are a number of limitations of this current study. First, this research was conducted in Oman, a Middle Eastern country and the sample was chosen from urban part of the country. Therefore, future research should be conducted by taking a large sample from both rural and urban part of the country. Secondly, this study was conducted in the boundary of one country. Hence, it is advised to use the proposed model in this research to conduct a cross-country and cross-cultural examination and to predict preferences of different countries. Thirdly, since customization features do not allow user to manipulate

security and privacy aspects of the m-payment app, it would be interesting to see the impact of customization on trust factor in the future research studies. Finally, it would be interesting to see the comparison of results of the proposed model in this research from different gender and different age groups in the future research studies.

Conclusion

To sum up, the objective of this research study was to explore key constructs influencing the decision of users' intention towards mobile payment services in a Middle Eastern country namely Oman. This study proposed and tested a new research model to understand and predict mobile payment services acceptance. It was observed that the modified Technology Acceptance Model by incorporating constructs namely customization, mobility, awareness of benefits, and the self-efficacy in addition to, perceived trust and perceived security were able to predict users' intention. This study adopted two staged research methodology to test and validate the proposed research model. The structural equation modeling was employed to test the research model and neural network models were used to validate as well as rank the key constructs influence the mobile payment services acceptance. The results obtained imply that usefulness is not enough to motivate users to adopt mobile payment services. It is important for decision-makers to provide significant importance to other constructs such as trust, security, awareness, customization as well so that old customers can be retained and potential consumers can be attracted. The theoretical and managerial implications provide useful directions to senior professionals in the banking sector and researchers in academic

institutions to work on effective strategies to receive better business performance of the mobile payment services.

References

Ahmad, S. Z., & Khalid, K. (2017). The adoption of M-government services from the user's perspectives: Empirical evidence from the United Arab Emirates. *International Journal of Information Management,* 37(5), 367-379.

AlAlwan, A., Dwivedi, Y.K., & Rana, N.P. (2017). Factors Influencing Adoption of Mobile Banking by Jordanian Bank Customers: Extending UTAUT2 with Trust. *International Journal of Information Management*, 37(3), 99-110.

Alalwan, A. A., Dwivedi, Y. K., Rana, N. P., & Simintiras, A. C. (2016a). Jordanian consumers' adoption of telebanking: Influence of perceived usefulness, trust and self-efficacy. *International Journal of Bank Marketing,* 34(5), 690-709.

Alalwan, A. A., Dwivedi, Y. K., & Williams, M. D. (2016b). Customers' intention and adoption of telebanking in Jordan. *Information Systems Management,* 33(2),154–178.

Alkhunaizan, A., & Love, S. (2012). What drives mobile commerce? An empirical evaluation of the revised UTAUT model. *International Journal of Management and Marketing Academy,* 2(1), 82–99.

Al-Somali, S. A., Gholami, R., & Clegg, B. (2009). An investigation into the acceptance of online banking in Saudi Arabia. *Technovation,* 29(2), 130-141.

Armstrong, J. S., & Overton, T. S. (1977). Estimating nonresponse bias in mail surveys. *Journal of marketing research*, 14(3), 396-402.

Balachandran, D., & Tan, G. W. H. (2015). Regression modelling of predicting NFC mobile payment adoption in Malaysia. *International Journal of Modelling in Operations Management*, 5(2), 100-116.

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. *Englewood Cliffs, NJ*, US: Prentice-Hall, Inc.

Bandura, A. (1997). Self-efficacy: The exercise of control. Macmillan.

Belwal, R., & Belwal, S. (2009, June). Mobile phone usage behavior of university students in Oman. In *New Trends in Information and Service Science, 2009. NISS'09. International Conference on* (pp. 954-962). IEEE.

Büyüközkan, G. (2009). Determining the mobile commerce user requirements using an analytic approach. *Computer Standards & Interfaces*, 31(1), 144-152.

Carton, F., Hedman, J., Damsgaard, J., Tan, K-T., & McCarthy, J. (2012). Framework for mobile payments integration. *The Electronic Journal of Information Systems Evaluation,* 15(1), 14-25.

Chandra, S., Srivastava, S. C., & Theng, Y. L. (2010). Evaluating the role of trust in consumer adoption of mobile payment systems: An empirical analysis. *Communications of the Association for Information Systems,* 27(29), 561–588.

Chen H. R., & Tseng H. F. (2012). Factors that influence acceptance of web-based e-learning systems for the in-service education of junior high school teachers in Taiwan. *Evaluation and Program Planning,* 35(3), 398-406.

Cheong, S. N., Ling, H. C., & Teh, P. L. (2014). Secure encrypted steganography graphical password scheme for near field communication smartphone access control system. *Expert Systems with Applications*, 41(7), 3561-3568.

Chiang, W. Y. K., Zhang, D., & Zhou, L. (2006). Predicting and explaining patronage behavior toward web and traditional stores using neural networks: a comparative analysis with logistic regression. *Decision Support Systems*, 41(2), 514-531.

Choi, J., Seol, H., Lee, S., Cho, H., & Park, Y. (2008). Customer satisfaction factors of mobile commerce in Korea. *Internet Research*, 18(3), 313-335.

Chong, A. Y. L., Chan, F. T., & Ooi, K. B. (2012). Predicting consumer decisions to adopt mobile commerce: Cross country empirical examination between China and Malaysia. *Decision Support Systems*, 53(1), 34-43.

Chong, A. Y. L., Liu, M. J., Luo, J., & Keng-Boon, O. (2015). Predicting RFID adoption in healthcare supply chain from the perspectives of users. *International Journal of Production Economics*, 159, 66-75.

Chong, A. Y. L. (2013). A two-staged SEM-neural network approach for understanding and predicting the determinants of m-commerce adoption. *Expert Systems with Applications*, 40(4), 1240-1247.

Cobanoglu, C., Yang, W., Shatskikh, A., & Agarwal, A. (2015). Are consumers ready for mobile payment? An examination of consumer acceptance of mobile payment technology in restaurant industry. *Hospitality Review*, 31(4), 6.

Dahlberg, T., Guo, J., & Ondrus, J. (2015). A critical review of mobile payment research. *Electronic Commerce Research and Applications*, 14(5), 265-284.

Daştan, İ., & Gürler, C. (2016). Factors affecting the adoption of mobile payment systems: An empirical analysis. EMAJ: *Emerging Markets Journal*, 6(1), 17-24.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 319-340.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user perceptions and behavioral impacts. *International Journal of Man-Machine Studies*, 38(3), 475–487.

Dennehy, D., & Sammon, D. (2015). Trends in mobile payments research: A literature review. *Journal of Innovation Management*, 3(1), 49.

Dutot, V. (2015). Factors influencing near field communication (NFC) adoption: An extended TAM approach. *The Journal of High Technology Management Research*, 26 (1), 45–57.

Dwivedi YK, Shareef MA, Simintiras AC, Lal B & Weerakkody V (2016). A generalised adoption model for services: A cross-country comparison of mobile health (mhealth). *Government Information Quarterly*, 33(1), 174-187.

Dwivedi YK, Rana NP, Jeyaraj A, Clement M & Williams MD (2017 A). Re-examining the Unified Theory of Acceptance and Use of Technology (UTAUT): Towards a Revised Theoretical Model. *Information Systems Frontiers*.
DoI: https://link.springer.com/article/10.1007/s10796-017-9774-y

Dwivedi YK, Rana NP, Janssen M, Lal B, Williams MD & Clement RM (2017 B). An Empirical Validation of a Unified Model of Electronic Government Adoption (UMEGA). *Government Information Quarterly*, 34(2), 211-230.

Dwivedi YK, Kapoor KK, Williams MD & Williams J (2013). RFID systems in libraries: An empirical examination of factors affecting system use and user satisfaction. *International Journal of Information Management*, 33(2), 367-377

GSMA (2016). "THE MOBILE ECONOMY MIDDLE EAST AND NORTH AFRICA-2016." Retrieved from https://www.gsmaintelligence.com/research/?file=9246bbe14813f73dd85b97a90738c860&download

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). Multivariate data analysis: A global perspective (Vol. 7): Pearson Upper Saddle River.

Haykin, S. S. (2001). Neural networks: a comprehensive foundation. Tsinghua University Press.

Kapoor KK, Dwivedi YK & Williams MD (2015). Examining the role of three sets of innovation attributes for determining adoption of the interbank mobile payment service. *Information Systems Frontiers*, 17(5), 1039-1056.

Kim, C., Mirusmonov, M., & Lee, I. (2010). An empirical examination of factors influencing the intention to use mobile payment. *Computers in Human Behavior*, 26(3), 310-322.

Laukkanen, T. (2016). Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking. *Journal of Business Research*, 69(7), 2432-2439.

Lee, Y. -K., Park, J. -H., Chung, N., & Blakeney, A. (2012). A unified perspective on the factors influencing usage intention toward mobile financial services. *Journal of Business Research*, 65(11), 1590–1599.

Leong, L. Y., Hew, T. S., Tan, G. W. H., & Ooi, K. B. (2013). Predicting the determinants of the NFC-enabled mobile credit card acceptance: A neural networks approach. *Expert Systems with Applications*, 40(14), 5604-5620.

Li, H., Liu, Y., & Heikkilä, J. (2014). Understanding the Factors Driving NFC-Enabled Mobile Payment Adoption: an Empirical Investigation. *In PACIS* (p. 231).

Liébana-Cabanillas, F., Marinkovic, V., de Luna, I. R., & Kalinic, Z. (2017a). Predicting the determinants of mobile payment acceptance: A hybrid SEM-neural network approach. *Technological Forecasting and Social Change*. (In press)

Liébana-Cabanillas, F., Marinković, V., & Kalinić, Z. (2017b). A SEM-neural network approach for predicting antecedents of m-commerce acceptance. *International Journal of Information Management*, 37(2), 14-24.

Lin, H. H., & Wang, Y. S. (2006). An examination of the determinants of customer loyalty in mobile commerce contexts. *Information & Management*, 43, 271–282.

Mallat, N. (2007). Exploring consumer adoption of mobile payments – A qualitative study. *Journal of Strategic Information Systems*, 16, 413–432.

Marinkovic, V., & Kalinic, Z. (2017). Antecedents of customer satisfaction in mobile commerce: Exploring the moderating effect of customization. *Online Information Review*, 41(2), 138-154.

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

Mostafa, M.M. (2009). Modeling the efficiency of top Arab banks: a DEA-neural network approach. *Expert Systems with Applications*, 36, 309-20.

Naqvi, S. J. (2012). M-services Adoption in Oman Using Technology Acceptance Modeling Approach. *Communications of the IBIMA*, 2012, 1.

Nui Polatoglu, V., & Ekin, S. (2001). An empirical investigation of the Turkish consumers' acceptance of Internet banking services. *International Journal of Bank Marketing*, 19(4), 156-165.

Oliveira, T., Thomas, M., Baptista, G., Campos, F. (2016). Mobile payment: understanding the determinants of customer adoption and intention to recommend the technology. *Computers in Human Behavior*, 61, 404–414.

Omanuna -The Official Oman eGovernment Services Portal. Retrieved from http://www.oman.om/wps/portal/index/gov/centralinitiative/epaymentgateway

Ooi, K. B., & Tan, G. W. H. (2016). Mobile technology acceptance model: An investigation using mobile users to explore smartphone credit card. *Expert Systems with Applications*, 59, 33-46.

Ozturk, A. B., Bilgihan, A., Nusair, K., & Okumus, F. (2016). What keeps the mobile hotel booking users loyal? Investigating the roles of self-efficacy, compatibility, perceived ease of use, and perceived convenience. *International Journal of Information Management*, 36(6), 1350-1359.

Pearson, A., Tadisina, S., & Griffin, C. (2012). The role of e-service quality and information quality in creating perceived value: antecedents to web site loyalty. *Information Systems Management*, 29(3), 201–215.

Priyadarshinee, P., Raut, R. D., Jha, M. K., & Gardas, B. B. (2017). Understanding and predicting the determinants of cloud computing adoption: A two staged hybrid SEM-Neural networks approach. *Computers in Human Behavior, 76*, 341-362.

Rana NP, Dwivedi YK, Williams MD & Weerakkody V (2016). Adoption of online public grievance redressal system in India: Toward developing a unified view. *Computers in Human Behavior*, 59, 265-282.

Rana NP, Dwivedi YK, Lal B, Williams MD & Clement M (2017). Citizens' adoption of an electronic government system: towards a unified view. *Information Systems Frontiers*, 19(3), 549-568.

Ramos-de-Luna, I., Montoro-Ríos, F., & Liébana-Cabanillas, F. (2016). Determinants of the intention to use NFC technology as a payment system: an acceptance model approach. *Information Systems and e-Business Management*, 14(2), 293-314.

Reid, M., & Levy, Y. (2008). Integrating trust and computer self-efficacy with TAM: An empirical assessment of customers' acceptance of banking information systems (BIS) in Jamaica. *Journal of Internet Banking and Commerce*, 12(3), 1-17.

Riffai, M. M. M. A., Grant, K., & Edgar, D. (2012). Big TAM in Oman: Exploring the promise of on-line banking, its adoption by customers and the challenges of banking in Oman. *International Journal of Information Management*, 32(3), 239-250.

Rogers, E. M. (1983). Diffusion of innovations. New York: Free Press.

Rogers, E.M. and Shoemaker, F. (1971). Communications in Innovation. Free Press, New York, NY.

San Martín, H., & Herrero, Á. (2012). Influence of the user's psychological factors on the online purchase intention in rural tourism: Integrating innovativeness to the UTAUT framework. *Tourism Management*, 33(2), 341-350.

Sathye, M. (1999). Adoption of Internet banking by Australian consumers: an empirical investigation. *International Journal of Bank Marketing*, 17(7), 324-334.

Saunders, M., Lewis, P., & Thornhill, A. (2007). Research methods for business students. (4th rev. ed.). England: Prentice Hall.

Schierz, P. G., Schilke, O., & Wirtz, B. W. (2010). Understanding consumer acceptance of mobile payment services: An empirical analysis. *Electronic Commerce Research and Applications*, 9(3), 209-216.

Scott, J. E., & Walczak, S. (2009). Cognitive engagement with a multimedia ERP training tool: Assessing computer self-efficacy and technology acceptance. *Information & Management*, 46(4), 221-232.

Sexton, R. S., Johnson, R. A., & Hignite, M. A. (2002). Predicting Internet/e-commerce use. *Internet Research*, 12(5), 402-410.

Shankar, A., & Datta, B. (2018). Factors Affecting Mobile Payment Adoption Intention: An Indian Perspective. *Global Business Review*, 19(3_suppl), S72-S89.

Shareef, M. A., Dwivedi, Y. K., Laumer, S., & Archer, N. (2016). Citizens' adoption behavior of mobile government (mGov): a cross-cultural study. *Information Systems Management*, 33(3), 268-283.

Shareef MA, Dwivedi YK, Kumar V & Kumar U (2017). Content design of advertisement for consumer exposure: Mobile marketing through short messaging service. *International Journal of Information Management*, 37(4), 257–268

Shareef, MA, Baabdullah, A, Dutta, S, Kumar, V, and Dwivedi, YK (2018). Consumer Adoption of Mobile Banking Services: An Empirical Examination of Factors According to Adoption Stages. *Journal of Retailing and Consumer Services*, 43 (July), 54–67.

Sharma, S. K. (2017). Integrating cognitive antecedents into TAM to explain mobile banking behavioral intention: A SEM-neural network modeling. *Information Systems Frontiers*, 1-13.

Sharma, S. K., & Sharma, M. (2019). Examining the role of trust and quality dimensions in the actual usage of mobile banking services: An empirical investigation. *International Journal of Information Management*, 44, 65-75.

Sharma, S. K., Gaur, A., Saddikuti, V., & Rastogi, A. (2017). Structural equation model (SEM)-neural network (NN) model for predicting quality determinants of e-learning management systems. *Behaviour & Information Technology*, 36(10), 1053-1066.

Sharma, S. K., Joshi, A., & Sharma, H. (2016). A multi-analytical approach to predict the Facebook usage in higher education. *Computers in Human Behavior*, 55, 340-353.

Sharma, S. K., Govindaluri, S. M., & Al Balushi, S. M. (2015). Predicting determinants of Internet banking adoption: A two-staged regression-neural network approach. *Management Research Review*, 38(7), 750-766.

Shaw, N. (2014). The mediating influence of trust in the adoption of the mobile wallet. *Journal of Retailing and Consumer Services*, 21(4), 449-459.

Shin, D. H. (2009). Towards an understanding of the consumer acceptance of mobile wallet. *Computers in Human Behavior*, 25(6), 1343-1354.

Shmueli, G., & Koppius, O. R. (2011). Predictive analytics in information systems research. *MIS Quarterly*, 35(3), 553-572.

Slade, E. L., Williams, M. D., & Dwivedi, Y. K. (2013). Mobile payment adoption: Classification and review of the extant literature. *The Marketing Review*, 13(2), 167-190.

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

Slade, E. L., Dwivedi, Y. K., Piercy, N. C., & Williams, M. D. (2015b). Modeling consumers' adoption intentions of remote mobile payments in the United Kingdom: extending UTAUT with innovativeness, risk, and trust. *Psychology & Marketing*, 32(8), 860-873.

Statista.com. (2015). Mobile phone users worldwide 2013-2019. Retrieved from https://www.statista.com/statistics/274774/forecast-of-mobile-phone-users-worldwide/

Szopiński, T. S. (2016). Factors affecting the adoption of online banking in Poland. *Journal of Business Research*, 69(11), 4763-4768.

Tan, G. W. H., Ooi, K. B. , Chong, S. C. , & Hew, T. S. (2014). NFC mobile credit card: The next frontier of mobile payment? *Telematics and Informatics*, 31 (2), 292–307.

Teo, T. S., Lim, V. K., & Lai, R. Y. (1999). Intrinsic and extrinsic motivation in Internet usage. *Omega*, 27(1), 25-37.

Teo, A. C., Tan, G. W. H., Ooi, K. B., Hew, T. S., & Yew, K. T. (2015a). The effects of convenience and speed in m-payment. *Industrial Management & Data Systems*, 115(2), 311-331.

Teo, A. C., Tan, G. W. H. , Ooi, K. B. , & Lin, B. (2015b). Why consumers adopt mobile payment? A partial least squares structural equation modelling (PLS-SEM) approach. *International Journal of Mobile Communications*, 13 (5), 478–497.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46(2), 186e204.

Venkatesh, V., Ramesh, V. and Massey, A.P. (2003), "Understanding usability in mobile commerce." *Communications of the ACM*, 46(12), 53-56.

Veríssimo, J. M. C. (2016). Enablers and restrictors of mobile banking app use: A fuzzy set qualitative comparative analysis (fsQCA). *Journal of Business Research*, 69(11), 5456-5460.

Wang, W-T. and Li, H-M. (2012). Factors influencing mobile services adoption: a brand-equity perspective. *Internet Research*, 22(2), 142-179.

Wei, T. T., Marthandan, G., Chong, A. Y.-L., Ooi, K.-B., & Arumugam, S. (2009). What drives Malaysian m-commerce? An empirical analysis. *Industrial Management & Data Systems*, 109(3), 370-388.

Yadav, R., Sharma, S.K., Tarhini, A. (2016). A multi-analytical approach to understand and predict the mobile commerce adoption. *Journal of Enterprise and Information Management*. 29 (2), 222–237.

Yeh, Y.S. and Li, Y-M. (2009). Building trust in m-commerce: contributions from quality and satisfaction. *Online Information Review*, 33(6), 1066-1086.

Yousafzai, S.Y., Pallister, J.G., Foxall, G.R. (2003). A proposed model of e-trust for electronic banking. *Technovation*, 23 (11), 847–860.

yStats.com (2016). Global Mobile Payment Methods: Full Year 2016. Retrieved from: https://www.ystats.com/wp-content/uploads/2017/03/20170101_Product-Brochure-Order-Form_Middle-East-and-Africa-Online-Payment-Methods_Full-Year-2016.pdf

Zarmpou, T., Saprikis, V., Markos, A., & Vlachopoulou, M. (2012). Modeling users' acceptance of mobile services. *Electronic Commerce Research*, 12(2), 225-248.
Zhou, T. (2013). An empirical examination of continuance intention of mobile payment services. *Decision Support Systems*, 54(2), 1085-1091.

Appendix

Table 1. Sample structure

Demographic variable	**Categories**	**Number of respondents**	**Percentage**
Gender	Male	121	57
	Female	91	43
Age group	18-30	68	32
	31-42	95	45
	43+	49	23
Education level	Diploma	51	24
	Bachelor	95	45
	Masters or higher	66	31

Table 2. Reliability and validity

	CR	**AVE**	**MSV**	**ASV**	**INT**	**SE**	**MOB**	**AW**	**CUST**	**PS**	**PEOU**	**PU**	**PT**
INT	0.903	0.756	0.477	0.242	0.869								
SE	0.926	0.806	0.493	0.089	0.092	0.898							
MOB	0.954	0.873	0.493	0.083	0.040	0.702	0.934						
AW	0.851	0.589	0.493	0.238	0.691	0.154	0.019	0.768					
CUST	0.876	0.640	0.475	0.248	0.625	0.104	0.032	0.675	0.800				
PS	0.858	0.668	0.347	0.167	0.497	0.164	0.178	0.489	0.581	0.817			
PEOU	0.956	0.880	0.145	0.038	0.066	0.381	0.337	0.090	0.029	0.091	0.938		
PU	0.889	0.668	0.493	0.253	0.681	0.042	0.081	0.702	0.689	0.589	0.054	0.817	
PT	0.913	0.777	0.345	0.154	0.587	0.025	0.137	0.451	0.561	0.314	0.137	0.481	0.882

Table 3. Hypotheses testing results

Research Hypotheses		Estimate	S.E.	P-value	Result
H1	Self-Efficacy → Perceived Ease of Use	.160	.063	0.011	Supported
H2	Mobility → Perceived Ease of Use	.221	.062	***	Supported
H3	Awareness of Benefits → Perceived Usefulness	.325	.053	***	Supported
H4	Customization → Perceived Usefulness	.298	.047	***	Supported
H5	Perceived ease of use → Perceived usefulness	.111	.037	0.003	Supported
H6	Perceived Trust → Intention to use	.284	.052	***	Supported
H7	Perceived Ease of Use → Intention to use	.024	.051	.640	Not Supported
H8	Perceived Usefulness → Intention to use	.670	.106	***	Supported
H9	Perceived Security → Intention to use	.206	.071	0.003	Supported

Table 4: Neural network validation results

Network	Model A Inputs:		Model B Inputs:		Model C: Inputs	
	Training	Testing	Training	Testing	Training	Testing
ANN1	0.124	0.132	0.072	0.067	0.125	0.118
ANN2	0.145	0.136	0.069	0.059	0.142	0.132
ANN3	0.107	0.121	0.102	0.096	0.151	0.137
ANN4	0.135	0.138	0.089	0.102	0.162	0.141
ANN5	0.122	0.132	0.106	0.102	0.133	0.122
ANN6	0.157	0.146	0.087	0.075	0.154	0.145
ANN7	0.139	0.164	0.096	0.078	0.149	0.136
ANN8	0.108	0.101	0.104	0.089	0.129	0.124
ANN9	0.124	0.129	0.088	0.072	0.117	0.105
ANN10	0.101	0.108	0.109	0.099	0.146	0.131
Average	0.126	0.131	0.092	0.084	0.141	0.129
S.D.	0.018	0.018	0.014	0.016	0.014	0.012

Table 5. Importance of constructs

Network	Model A	Model B	Model C

	MB	SE	PEOU	CUST	AW	PU	PEOU	PT	PS
ANN1	0.386	0.589	0.393	0.171	0.447	0.347	0.067	0.281	0.278
ANN2	0.398	0.592	0.423	0.168	0.454	0.378	0.056	0.289	0.285
ANN3	0.413	0.605	0.384	0.109	0.486	0.336	0.082	0.322	0.236
ANN4	0.419	0.626	0.385	0.121	0.472	0.379	0.106	0.346	0.256
ANN5	0.364	0.631	0.404	0.128	0.482	0.401	0.051	0.269	0.248
ANN6	0.372	0.571	0.416	0.113	0.458	0.358	0.045	0.272	0.261
ANN7	0.428	0.584	0.397	0.121	0.459	0.365	0.078	0.297	0.294
ANN8	0.381	0.598	0.388	0.152	0.453	0.368	0.069	0.303	0.241
ANN9	0.356	0.636	0.379	0.161	0.487	0.357	0.087	0.338	0.234
ANN10	0.423	0.607	0.391	0.138	0.462	0.371	0.112	0.294	0.257
Avg. Importance	0.394	0.604	0.396	0.138	0.466	0.366	.075	0.301	0.259
Normalized Importance	65.5	100	85	29.6	100	100	20.4	82.2	70.8

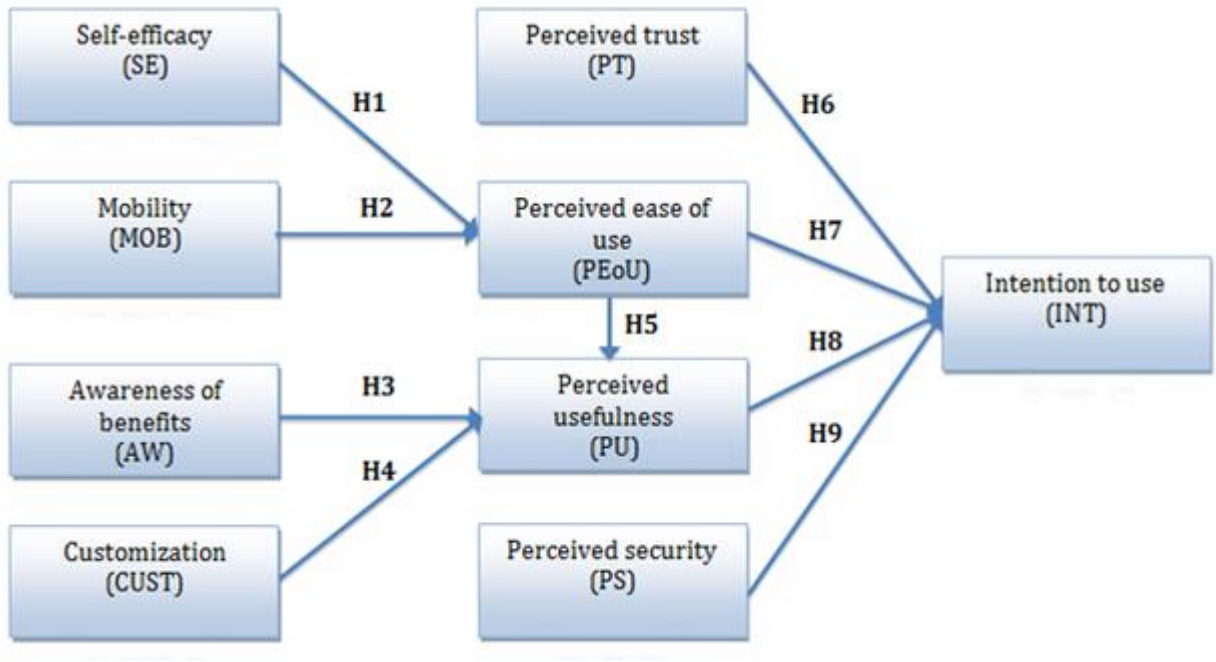

Figure 1. Proposed research model of the intention to use mobile services by Omani consumers.

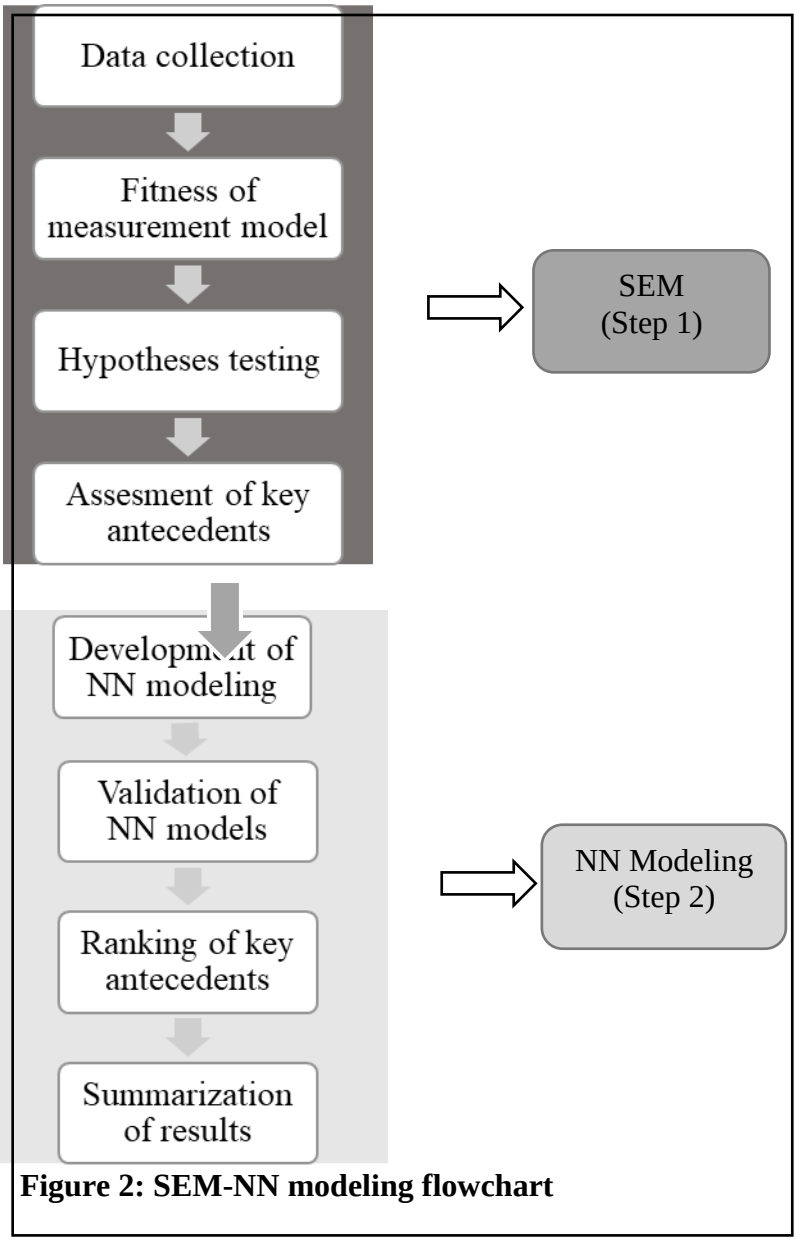

Figure 2: SEM-NN modeling flowchart

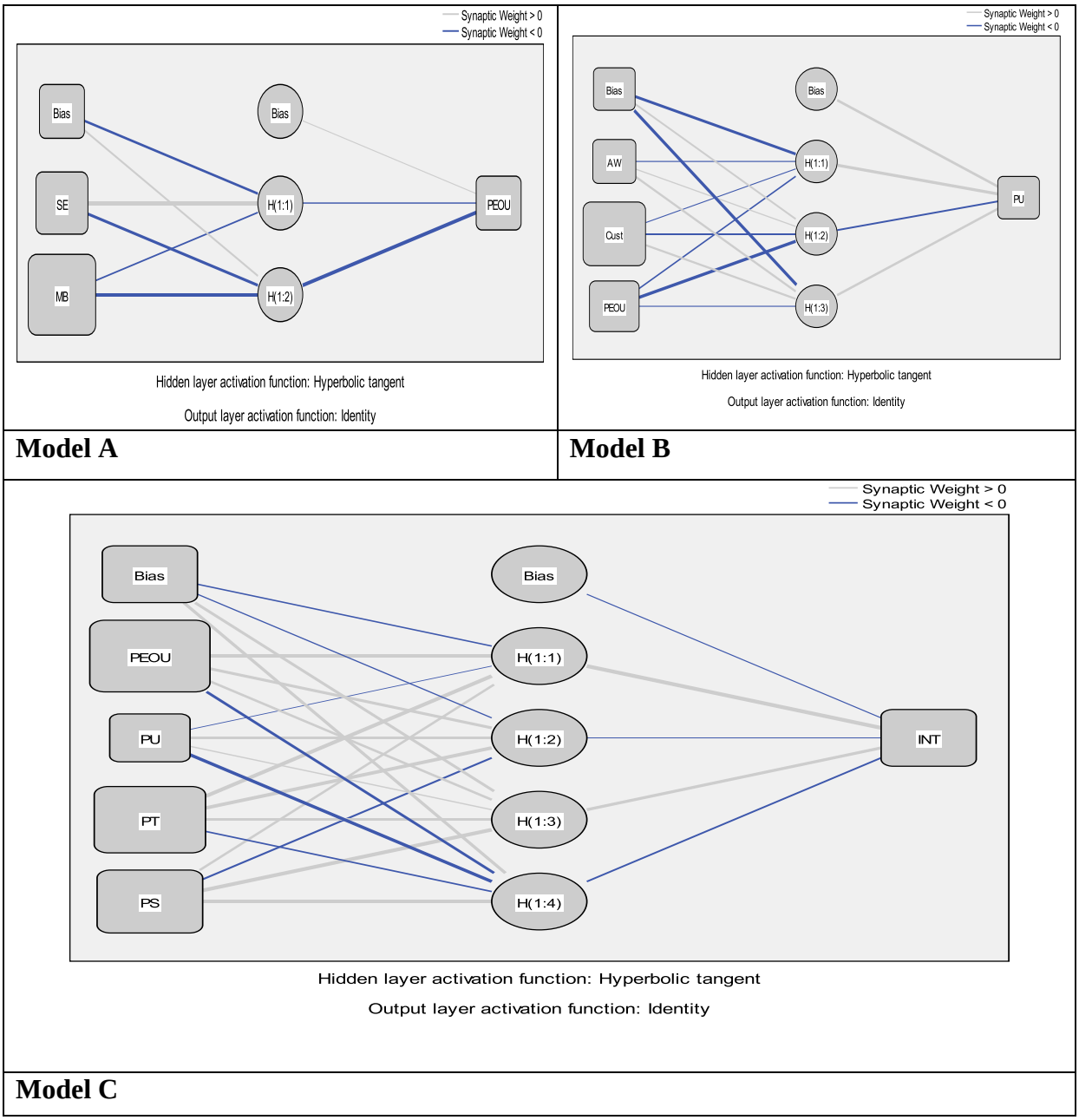

Figure 3: Neural Network Models

Authors' bio

Sujeet K. Sharma is an Associate Professor in the 'Management Information Systems Area' at Indian Institute of Management (IIM) Tiruchirappalli, India. Prior to joining IIM, he worked with Sultan Qaboos University, Oman. His research articles have appeared in well-known refereed international journals including *International Journal of Information Management, Government Information Quarterly, Computers in Human Behavior, Measurement, Information Systems Frontiers, Education and Information Technology, Behavior and Information Technology,* and *Interactive Learning Environments, among others.* He is serving as the Editor-in Chief of the journal "International Journal of Business and Data Analytics" published by Inderscience, Switzerland.

Himanshu Sharma is a Lecturer in Information Technology Department at Nizwa College of Technology, Ministry of Manpower, Oman. His current research interests are in information and communication technologies, e-learning technologies and user acceptance behaviour. His recent research papers focused on users' intention to adopt social media technologies in the context of developing countries. His research has been published in Computers in Human Behavior, Journal of International Education in Business and in Review of Business and Technology Research journals.

Yogesh K. Dwivedi is a Professor of Digital Marketing and Innovation, Dean of Academic Leadership (REF Environment), and Director of the Emerging Markets Research Centre (EMaRC) in the School of Management at Swansea University, Wales, UK. His research interests are at the interface of Information Systems (IS) and Marketing, focusing on issues related to consumer adoption and diffusion of emerging ICT-based applications, electronic/digital government, and digital marketing particularly in the context of emerging markets. He has published more than 250 articles in a range of leading academic journals and conferences. More information about Professor Dwivedi can be found at: http://www.swansea.ac.uk/staff/som/academic-staff/y.k.dwivedi/