Journal of Enterprise Information Management

A multi-analytical approach to understand and predict the mobile commerce adoption

Rajan Yadav Sujeet Kumar Sharma Ali Tarhini

Received 22 April 2015
Revised 20 June 2015
15 July 2015
Accepted 10 September 2015

A multi-analytical approach to understand and predict the mobile commerce adoption

Rajan Yadav
Department of Management, Delhi Technological University, Delhi, India
Sujeet Kumar Sharma
Department of Operations Management and Business Statistics, Sultan Qaboos University, Muscat, Oman, and
Ali Tarhini
Department of Information Systems, Brunel University, London, UK

Abstract

Purpose – The advent of mobile telephony devices with strong internet capabilities has laid the foundation for mobile commerce (m-commerce) services. The purpose of this paper is to empirically examine predictors of m-commerce adoption using a modification of the widely used technology acceptance model and the unified theory of acceptance and use of technology model.

Design/methodology/approach – The data were collected from 213 respondents by means of an online survey. The data were analyzed through multi analytic approach by employing structural equation modeling (SEM) and neural network modeling.

Findings – The SEM results showed that variety of services, social influence, perceived usefulness, cost and perceived trust have significant influence on consumer's intention to adopt m-commerce. The only exception was perceived ease of use which observed statistically insignificant influence on adoption of m-commerce. Furthermore, the results obtained from SEM were employed as input to the neural network model and results showed that perceived usefulness, perceived trust and variety of services as most important predictors in adoption of m-commerce.

Practical implications – The findings of this study give an insight of key determinants that are important to develop suitable strategic framework to enhance the use of m-commerce adoption. In addition, it also provides an opportunity to academicians and researchers to use the framework of this study for further research.

Originality/value – The study is among a very few studies which analyzed m-commerce adoption by applying a linear and non-linear approach. The study offers a multi-analytical model to understand and predict m-commerce adoption in the developing nation like India.

Keywords Neural network, India, Perceived trust, India, M-commerce, Variety of services
Paper type Research paper

1. Introduction

The developing countries have witnessed an unprecedented and remarkable growth in the telecommunication technology infrastructure development during past one decade. The growth is phenomenal in terms of improving access to wireless communication which has colossal impact on the lives of billions of people worldwide. The access has not only transformed the ease and speed of communication but also provided possibilities to marketers to redefine the art of connecting with potential customers. A strong mobile telecom service network is also positively found to be linked with the economic growth of a country. A World Bank study conducted among 120 countries observed that for every 10 percent increase in mobile subscriber base, there is a corresponding increase of approximate 0.8 percent in the GDP (Qiang, 2009).

Journal of Enterprise Information Management
Vol. 29 No. 2, 2016
pp. 222-237

1741-0398
DOI 10.1108/JEIM-04-2015-0034

Thus, policy makers, marketers and mobile operators are looking for all the possible avenues to integrate benefits of mobile communication in their business architecture. Over the years, a mobile phone has become a lifestyle device especially among youngsters. Such a transformation is reflected in terms of growing mobile density. Mobile phones are simply no longer treated as a device for chatting and sending SMSs only. It has evolved into a device which facilitates the process of finding location of a store, selling and purchasing of products and services, payment for utility bills, performing banking transactions and connecting to social networks (Kleijnen *et al.*, 2003; Khalifa and Ning Shen, 2008; Hsu and Wang, 2011; Hanafizadeh *et al.*, 2014).

Such a close interaction between the mobile phones and human beings has provided profound opportunities to business firms in terms of mobile commerce (m-commerce). Realizing immense potential to deliver personalized services through m-commerce platforms, investment in terms of m-commerce infrastructure, technology and services are in top of the agenda among business firms worldwide. M-commerce is an extension of the e-commerce eco-system in which business activities are performed in a wireless environment through mobile devices (Zhang *et al.*, 2012). However, it offers plenty of advantage over e-commerce to users in terms of its ability of personalization, ubiquitous and anytime access and instantaneity of use (Chong *et al.*, 2012; Thakur and Srivastava, 2013; Chong, 2013). The seamless access to high-speed data technology like 3G, growing popularity of smartphone devices and tablets, declining internet access cost and easy access to mobile apps have given a new Philip and made m-commerce a new business phenomenon worldwide. The vast potential and opportunities of m-commerce market can be seen in terms of growing penetration of mobile phones especially the smartphones. According to projections, the total number of mobile phones globally is likely to cross 5.13 billion by 2017 which is around a little less than 70 percent of the world population; around half of it would be using smart mobile devices by the end of same period (Srivastava, 2014). This shows a strong appetite and potential for mobile-based applications and services worldwide. When we look at the adoption pattern of various information technology/information system (IT/IS) during last couple of decades, mobile telephony, perhaps, has been adopted faster than any other technology in the world. Surprisingly, the number of mobile phone subscribers has over taken the number of internet connections among some of the countries in the world (Chong, 2013). The smartphones are now emerging as the primary means of connecting to the internet and accessing internet enabled services.

In spite of several unique benefits offered by mobile technology, it is primarily used for purposes namely listening to music, web browsing, social networking and other form of content sharing. The number of mobile phone subscribers, conducting business transactions for goods and services are abysmally low (Wei *et al.*, 2009). Moreover, patterns of m-commerce adoption among different countries vary significantly. The geographically smaller eastern countries like Singapore, Japan, Korea and Taiwan display a higher degree of m-commerce adoption at par or even faster than several developed countries of west (Zhang *et al.*, 2012). The basic reason is superior mobile telecommunication infrastructure and high degree of mobile technology adoption in these countries. Though the developing countries have tremendous potential in m-commerce domain, still the actual usage is quite low (Chong, 2013). To boost m-commerce in these countries, it is imperative to understand the factors that prevent mobile phone users to adopt this technology for conducting various m-commerce activities. An understanding of such factors would help policy makers and practitioners to develop a strategic framework to utilize the inherent benefits of m-commerce. There are many published

research studies which focus on technology and network aspects of m-commerce (Lee *et al.*, 2007; Ngai and Gunasekaran, 2007; Chong, 2013). Very few research studies have focussed on behavioral dimensions in analyzing adoption of m-commerce. Hence, this aspect of m-commerce calls for an extension of existing approaches which are mainly relevant to understand adoption of a traditional IT/IS-based services. Thus, this research study offers a unified approach to understand m-commerce adoption from consumer behavior perspective by extending the scope of existing theories. The study is based on the proposition that scope of m-commerce is not merely limited to financial transactions-based exchange.

The aims of this study are threefold. First, it intends to explore factors that motivate/inhibit consumers to adopt m-commerce. Second, the study integrates appropriate constructs from three important works of technology acceptance model (TAM), theory of planned behavior (TPB) and innovation diffusion theory (IDT), widely used in forecasting the adoption intent of innovative technologies. Third, the paper intends to integrate empirical modeling methods for prediction purposes using explanatory and predictive modeling methods (Shmueli and Koppius, 2010). A large majority of empirical studies (Zhou *et al.*, 2010; Akturan and Tezcan, 2012; Hanafizadeh *et al.*, 2014) in m-commerce adoption employ explanatory methods such as structural equation modeling (SEM) and multiple linear regression. In this study, SEM is employed to test proposed research hypotheses and results obtained from SEM were employed as an input variables to the neural network model to predict m-commerce adoption in India. In this way, this study proposes to develop and test a hybrid model with better predictive ability to understand m-commerce adoption.

2. Literature review and hypotheses development

The term m-commerce is a relatively a new phenomenon. It is under the stage of development in comparison to other IT/IS like internet banking, online shopping, e-tax return filing, e-governance initiatives, e-learning platforms and 3G networks. The extant body of literature available in field of IT/IS adoption widely used empirical work of theory of reasoned action (TRA) (Fishbein and Ajzen, 1975), TAM (Davis, 1989), TPB (Ajzen, 1991) and IDT (Roger, 1995). These studies have been widely used to understand adoption process of various IT/IS for number of years (Safeena *et al.*, 2013; Sharma, 2015; Tarhini *et al.*, 2014a, b). However, the individual robustness and predictive ability of these models vary according to the nature of IT/IS selected for analysis, research area, demographic and socio-economic profile of the respondents. The basic motivation of this study is to propose a synthesized model which improves parsimony, explanatory power, and predictive ability and to overcome the basic limitations of the existing models. It is therefore, imperative to understand the adoption intention of m-commerce in an integrated framework in the back drop of an extension of established IT/IS adoption theories and specific dimensions required in view of inherent characteristics of mobile technology.

2.1 Perceived ease of use

The construct has been adapted from the original TAM which has been used widely to explain the adoption intention of numerous IT/IS applications. It is defined as "the degree to which a person believes that using a particular system would be free from efforts" (Davis, 1989). The variable has been studied to examine the adoption intention of m-commerce eco-system like mobile internet, mobile instant messaging,

mobile banking and e-commerce in addition to a large number of other IT/IS adoption studies (Kim *et al.*, 2007; Hsu *et al.*, 2009; Sharma *et al.*, 2013, 2014; Abbasi *et al.*, 2015; Tarhini *et al.*, 2015a, b). A wide variety of mobile applications are now being introduced by marketers to offer a seamless service experience to its customers. The download, installations and applications of these services are difficult and challenging for a large number of mobile phone subscribers. The issues related to internet connectivity, small display screen and physical design of the handset, nature of keypad further escalates this problem. The variable basically reflects the intrinsic features of a particular IT/IS and also affects its long-term usage pattern (Guriting and Ndubisi, 2006; Ramayah and Lo, 2007; Hanafizadeh *et al.*, 2014). Another issue in designing the interface between a mobile-based application and its users is the tradeoff between features and the functionalities of mobile system (Chong *et al.*, 2010). The customer perception gets affected by the degree of complexity in using mobile device for m-commerce (Riquelme and Rios, 2010). It is posited that higher the complexity, lower would be the intention to adopt m-commerce. Therefore, the following hypothesis is proposed:

H1. Perceived ease of use has a positive and significant relationship to adopt m-commerce.

2.2 Perceived usefulness

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989). It is another important variable with recurrent evidence in literature to explain the adoption intention of a variety of IT/IS (Zhang *et al.*, 2012; Chong, 2013; Sharma *et al.*, 2013, 2015). The mobile phone users can accomplish their task in a wireless connection in comparison to alternative formats like e-commerce. It acts as an external reward and motivates users to engage with such IS more frequently (Venkatesh *et al.*, 2003). The users will adopt m-commerce more rapidly if the marketers are able to offer superior benefits over alternative technology platforms like e-commerce. Therefore, the study posits that higher perceived usefulness leads to higher degree of adoption intentions. The following hypothesis is proposed:

H2. Perceived usefulness has a positive and significant relationship in adoption of m-commerce.

2.3 Perceived cost

Over the years, the TAM has been extended with integration of additional variable like cost. It was observed that cost benefit pattern plays an important role in influencing the PEOU and PU in adoption of an IT/IS (Szajna, 1995). Cost is considered as another important variable which affects the adoption intention of various IT/IS (Wei *et al.*, 2009). The migration of customers from fixed line to mobile technologies implies certain additional expenses (Wu and Wang, 2005). This cost may consist of initial handset cost, network access cost, subscription fee and service charge (Gitau and Nzuki, 2014). The cost acts as major constraints in countries where average revenue per user of mobile users is quite low. The cost is defined as the extent to which a user perceives that using m-commerce is costly (Zhang *et al.*, 2012). A rational customer analyzes both monetary and non-monetary cost incurred in availing a service and evaluates its value accordingly. The non-monetary cost may be in terms of time cost, effort cost, fatigue cost and opportunity cost. The aggregate benefits of all these non-monetary costs are also required to be integrated along with

the monetary cost by m-commerce companies to attract customers from alternative models. The key question is the overall value that m-commerce companies deliver in exchange of cost incurred by customers. Therefore, it is proposed that:

H3. Perceived cost has a negative relationship in adoption of m-commerce.

2.4 Perceived trust

Mobile-based transactions are conducted in a virtual environment without face-to-face interaction between buyers and service providers. Sharing personal information with a third party in such an exchange process creates uncertainty and risk among users (Lu *et al.*, 2003). The uncertainty and risk is perceived to be more in monetary transactions like mobile banking, payment of utility bills through mobile devices and buying goods and services through mobile phones (Chong, 2013). The alternative business models like e-commerce have slowly and gradually formed some degree of trust among the users. But, being a new phenomenon and lack of a clear regulatory framework, such a trust and confidence is lacking among m-commerce subscribers (Wei *et al.*, 2009). The trust in this study is defined as a person's feeling or belief that the processes, systems and environment in which he/she transacts has appropriate safeguards and measures (Vance *et al.*, 2008). The institution-based trust has been incorporated as a construct in many researcher studies and found to play an important role in adoption of m-commerce (Featherman and Pavlou, 2003; Lee and Wu, 2011). The study proposes that:

H4. Trust has a significant and positive relationship in adoption of m-commerce.

2.5 Social influence

Consumer decision-making process toward the purchase or use of any product or service is influenced by many factors. Over the years, socialization through offline and online agents has emerged as one of the important variable in influencing the adoption of various IT/IS. Social influence is defined as the degree to which an individual user's perception is affected by the belief of most others who are important to him/her toward the use of an innovation (Fishbein and Ajzen, 1975). The variable has been studied in the form of subjective norm in TRA and image in IDT and found to have significant influence in adoption of past technology like SMS usage (Karahana and Limayem, 2000), internet banking (Riquelme and Rios, 2010; Sharma and Govindaluri, 2014), mobile internet (Lu *et al.*, 2005), 3G (Chong *et al.*, 2010), social networking (Chang and Zhu, 2011). Further, the success of a website significantly depends on the number of users who are visiting that website. This is known as network effect (Aggarwal and Philip, 2012). It has been observed that the network effect substantially depends upon how users are using mobile applications. The study proposes that family, reference groups, friends and peers have significant influence on m-commerce adoption decision. Since the m-commerce is at its nascent stage, the marketers-driven communication on mass media like television might also have profound influence in shaping the individual behavior toward the use of m-commerce. In recent years, information shared through online sources like discussion forums, electronic bulletin boards, blogs, news-group, product-service review sites including social networking platforms found to have more interactive, trustworthy and credible impact on consumer adoption decisions especially among youngsters (Liao and Cheung, 2006). It is proposed that:

H5. Social influence has a positive and significant relationship in adoption of m-commerce.

2.6 Variety of services

The literature on role of variety of services in adoption of m-commerce is reflected inadequately. Though, variety of services offered by an IT/IS act as a catalyst in the adoption process. The e-commerce has a relative advantage over m-commerce in terms of services offered. Therefore, m-commerce companies are required to add more variety in terms of services offered. Needless to say a variety of mobile-based applications introduced by marketers to facilitate the delivery of service in different domains are slowly and gradually changing the competitive landscape in favor of m-commerce. The variety of services offered by mobile technology is divided into two broad categories. The entertainment-oriented services like accessing social networks, listening to music, chatting and playing games have been deeply adopted by mobile users. The problem lies in terms of adopting value added services like mobile banking, purchase and sale of products and services and mobile phone-based promotion (Chong *et al.*, 2012). The m-commerce companies and software firms are required to identify and write service-specific customized mobile applications to attract more users. It is imperative to understand how variety of services influences the adoption intention of m-commerce. It is proposed that:

H6. Variety of services has positive and significant relationship in adoption of m-commerce.

2.7 Conceptual model

The model is based on the assumption that every IT/IS is unique and every theory cannot address the problem of rapid changes being observed in IT/IS platforms. The study proposes a conceptual model in which behavioral intention to use m-commerce is treated as a dependent variable and tests how six independent variables namely perceived ease of use, perceived usefulness, perceived trust, perceived cost, social influence and variety of services influences dependent variable (Figure 1).

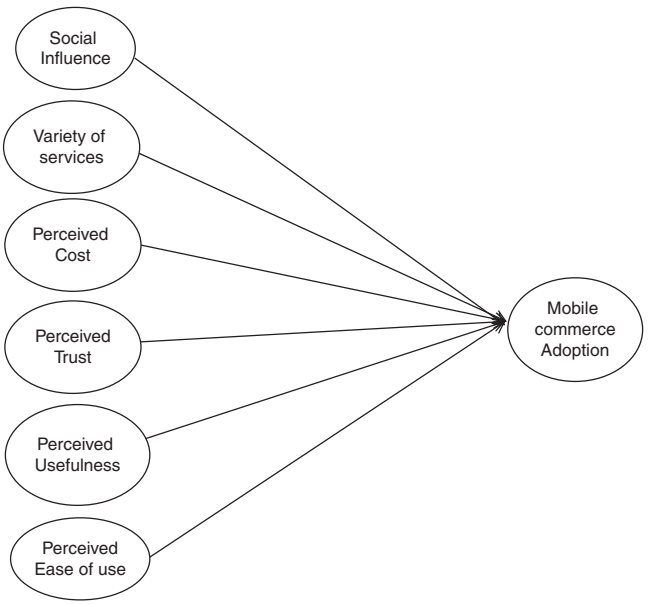

Figure 1.
Research model

3. Research methodology

3.1 Participants

The survey is based on the primary data collected from the postgraduate students of Delhi Technological University (India) and Delhi University (India). The young students constitute the largest segment for use of modern technology (Davis, 1989; Hanafizadeh *et al.*, 2014). It has been observed that young consumers are innovators and risk takers. They typically adopt innovative technologies, which eventually filter through the older segments and age groups (Lewis *et al.*, 2010). They also play an active role in influencing the purchase decision-making process for various goods and services in the family. The penetration of smartphones is also found to be high among such young consumers. Thus, the sample of the study was considered as a good representative of the population under consideration.

3.2 Survey instrument

A close ended structured questionnaire was designed. The questionnaire was divided into two parts. The first part obtained information on m-commerce adoption in the form of statement formulated to understand user's perception. The second part obtained information on key demographic variables relevant to study. The questionnaire was pre-tested with 15 respondents, three faculty members with interest area of technology management and one start up entrepreneur from the area of digital marketing. The instrument was modified and redesigned according to the feedback obtained in the pilot study.

3.3 Variables and measurement

The proposed model is based on the relationship between six independent and one dependent variable. The scales were adopted from the studies discussed in the literature review and hypotheses development as their internal reliability and convergent validity have been tested successfully in previous research studies. Collectively, 20 items were used to measure predictors and three items were used to measure the adoption intention of m-commerce. Besides, demographic variables, a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) were used to measure the variable.

3.4 Data collection and sampling

The study used single cross-sectional descriptive research design. The data collection process was conducted through offline and online mode. The offline mode was used during pilot study phase. Using such technique gives an exposure of true feeling of the respondents and ensures immediate response. An online survey link was mailed to the respondents in the final phase of data collection through various online groups formed by students in both the universities. The methods was found to be convenient, provided wider scope of data coverage and addressed the problems of incomplete survey form and duplicate entry as it did not accept the incomplete and duplicate forms submitted from the same IP address. Only those respondents who had some prior experience of m-commerce, qualified to participate in the survey. The sample size for this study was 213. Data were collected in the months of January-February 2015. Consistent to previous other studies to understand the behavioral intention on IT/IS adoption; the current study also used non-random sampling technique for the purpose of data collection (Featherman and Pavlou, 2003; Wu and Wang, 2005; Lewis *et al.*, 2010) (Table I).

Variables	Frequency	%
Gender		
Male	154	72
Female	59	28
Age		
Less than 30 years	144	68
Between 30 and 40 years	57	27
More than 40 years	12	5
Education		
Diploma	54	25
Bachelor degree	130	61
Masters or higher degree	29	14
Family income (INR)		
Less than 75,000	70	33
Between 75,000 and 150,000	64	30
More than 150,000	79	37

Table I. Demographic details

3.5 SEM-neural network modeling

In this paper, two staged SEM and neural network modeling was used. The SEM is a commonly used statistical modeling to test linear relationship proposed in the hypotheses. Sometimes, relationship between decision variables may not be linear. To address this important issue, neural network modeling was employed. Neural network modeling helps in understanding linear as well as non-linear relations among associated decision variables. This is one of the commonly cited advantages of the neural network modeling. However, there are some disadvantages of using neural network modeling also; one of the commonly discussed concerns is of its "black box" approach. It is difficult to use neural network models to test hypotheses and understand causal relationships (Chong, 2013). In this research, an attempt is made to take advantages of these two advanced statistical tools. In the first stage, SEM is employed to test proposed research hypotheses whereas in the second stage statistical significant independent variables are used as input to the neural network model for the prediction of m-commerce adoption.

3.6 Measurement model results

In SEM, a two-stage approach was employed. In first stage, the measurement model (CFA) was employed to assess the fitness of observed variables in measuring constructs whereas in the second stage, relationship among constructs was tested. The reliability and validity of observed variables was measured using composite reliability (CR) and average variance extracted (AVE). The CR of all constructs were greater than 0.70 and accepted as per the recommendations made in Hair *et al.* (2010). Since all values of CR were more than AVE and all values of AVE were more than 0.50 (Hair *et al.*, 2010), the convergent validity was confirmed. Furthermore, all values of the MSV were less than corresponding values of AVE and all values of AVS were less than AVE (see Table II), this confirmed the validity of constructs. The overall fitness of CFA model was also tested. The results of CFA model were as follows: χ^2 test statistic/df = 2.14; NFI = 0.95; GFI = 0.93; AGFI = 0.90 CFI = 0.96 and RMSEA = 0.041, which shows the fitness of the proposed model.

Constructs	CR	AVE	MSV	ASV	PT	PU	VoS	Cost	SI	PEOU	Adopt
PT	0.863	0.680	0.464	0.189	0.825						
PU	0.850	0.655	0.329	0.183	0.388	0.809					
VoS	0.847	0.582	0.464	0.236	0.681	0.517	0.763				
Cost	0.835	0.633	0.042	0.018	0.169	−0.061	0.035	0.796			
SI	0.828	0.616	0.314	0.109	0.322	0.292	0.327	−0.204	0.785		
PEOU	0.823	0.609	0.261	0.124	0.369	0.511	0.431	−0.062	0.071	0.780	
Adopt	0.807	0.583	0.392	0.245	0.504	0.574	0.626	−0.171	0.560	0.392	0.763

Table II.
Reliability and validity of constructs

Notes: CR, Composite reliability; AVE, average variance extracted; MSV, maximum shared squared variance; ASV, average shared squared variance

3.7 Structural model results

The results of structural model for testing of proposed hypotheses are shown in Table III. Since *p*-values in all hypotheses are less than 0.05 other than *H1* (*p*-value > 0.05). Hence, all the proposed hypotheses were accepted except *H1* at 5 percent level of significance. Variety of services is the most influencing construct in the decision of m-commerce adoption, followed by social influence, perceived usefulness, cost and perceived trust.

3.8 Neural network results

The neural network model was developed using SPSS 21.0 software. The training of neural network model was performed using the multilayer perceptron training algorithm. Cross-validation was used to avoid over fitting of the model. In neural network literature, no algorithm is capable of determining the exact number of hidden nodes in a neural network model. The accuracy of the network model is measured by the root mean square error (RMSE). Activation function in hidden layer was a hyperbolic tangent. Wang and Elhag (2007) suggested examining neural network model by varying the number of hidden nodes from one to ten. In this study, ten-fold cross-validations were used whereby 74 percent of the data points were used to train network model and 26 percent data points were used to test the model. Six covariates namely variety of services, perceived ease of use, perceived usefulness, cost, perceived trust and social influence were included in input layer of the network model. The dependent variable m-commerce adoption is included in the output layer of the network model (Figure 2).

The RMSE (Table IV) of training model was 0.44 and of testing model was 0.36.

The sensitivity analysis of input variables in neural network was performed and results obtained are shown in Table V.

Hypotheses	Variables	Estimates	SE	*t*-Values	*p*-Values	Remarks
H1	Perceived ease of use	0.091	0.066	1.373	0.170	Not-supported
H2	Perceived usefulness	0.185	0.048	3.825	***	Supported
H3	Cost	−0.126	0.056	−2.228	0.026	Supported
H4	Perceived trust	0.123	0.050	2.435	0.015	Supported
H5	Social influence	0.241	0.049	4.924	***	Supported
H6	Variety of services	0.287	0.061	4.706	***	Supported

Table III.
Structural results

Note: *H3* and *H4* are significant at 5 percent level of significance and *H2*, *H5* and *H6* are significant at 1 percent level of significance

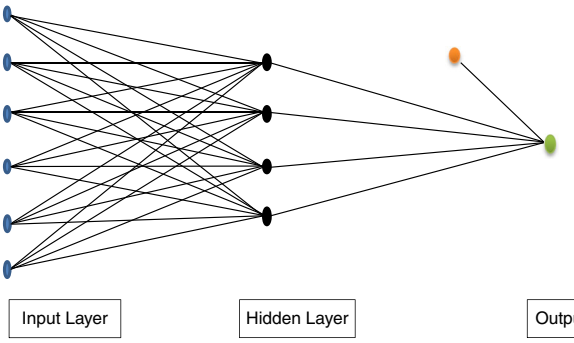

Figure 2. Neural network model

Network	Testing	Training
ANN1	0.44	0.28
ANN2	0.39	0.39
ANN3	0.38	0.37
ANN4	0.48	0.42
ANN5	0.51	0.49
ANN6	0.32	0.33
ANN7	0.55	0.31
ANN8	0.58	0.27
ANN9	0.36	0.36
ANN10	0.41	0.41
Average	0.44	0.36

Table IV. RMSE for neural networks

	Independent variable importance	
Constructs	Importance	Normalized importance (%)
Perceived trust	0.202	92.1
Variety of services	0.185	84.1
Perceived usefulness	0.220	100.0
Social influence	0.186	84.7
Cost	0.108	49.4
Perceived ease of use	0.099	45.3

Table V. Sensitivity analysis

4. Discussion

This study captures causal relationship among the factors that predict the intention to adopt m-commerce by using a linear and non-linear approach. As literature suggested, the application of such an approach improves the predictive ability of the proposed model. The SEM result found that variety of services, social influence, perceived usefulness, cost and perceived trust play a significant role in adoption of m-commerce. It is observed that perceived ease of use had no significant relationship with consumer intention to adopt m-commerce which contradicted previous studies (Hsu *et al.*, 2009; Lee *et al.*, 2011). Key reason for this contradiction is due to the rapid change in the nature of technology under examination. The smartphones have become so popular especially among the youngsters who generally spend their time in social networking,

gaming, chatting, etc. (Chong, 2013). In this study, youngsters were found more frequent and easy in adoption of new technologies than other age group respondents (Wei *et al.*, 2009). Therefore, perceived ease of use in using m-commerce showed insignificant influence on m-commerce adoption.

According to the results, variety of services emerged as one of the strongest determinants which affects adoption of m-commerce. It is important to see that consumers like to use smartphones for m-commerce services. The inclination to use mobile applications is increasing as it is compatible with life styles of many consumers (Chong, 2013). Social influence emerged as second important determinant showing positive influence on adoption of m-commerce. This showed consistency with the previous findings and highlighted how important is the influence of family, peer groups and celebrity in adoption of m-commerce (Wei *et al.*, 2009; Sharma and Govindaluri, 2014). It is observed that youngsters get easily inclined to social influence and setting new m-commerce trends. The growing strength of virtual social community provides ability to its members to share their experiences with a service at very low cost. The decision makers may use celebrity endorsement and opinion leaders through offline/online communication to influence the adoption of m-commerce.

In line with studies conducted to understand the adoption intention of various IT/IS, perceived usefulness emerged another important variable to predict m-commerce adoption (Lewis *et al.*, 2010; Sharma and Govindaluri, 2014; Hanafizadeh *et al.*, 2014). The m-commerce offers considerable advantages to the customers. Unlike e-commerce, it offers ubiquity, immediacy and support the retrieval of data anywhere and anytime immediately. The perceived usefulness also gets affected by the combined effect of perceived trust and cost of the particular technology. However, the superior benefits and inherent characteristics associated with perceived usefulness made it more influential variable than perceived trust and perceived cost. Hence, decision makers may focus to design m-commerce platforms which meet customers' needs and improve his/her productivity and performance. The study found a significant negative influence of perceived cost in adoption of m-commerce and validates the findings of prior research (Luran and Lin, 2005; Khalifa and Ning Shen, 2008). The high cost of smartphones, high-speed internet and subscription cost act as a major deterrent and negatively influence the adoption of m-commerce. Hence, there is an inverse relationship between the cost of m-commerce devices/services and adoption of m-commerce. Wei *et al.* (2009) found that consumers' intention to use m-commerce is derived from an affordable cost of mobile devices. Decision makers are, therefore, suggested to make efforts to reduce the cost and also develop creative campaigns to attract and educate smartphone users to avail the true benefits of m-commerce. The study validates the prior research which observed a positively significant relationship between perceived trust and intention to adopt m-commerce (Luran and Lin, 2005; Hanafizadeh *et al.*, 2014). In comparison to other IT/IS, m-commerce is a relatively new business model and still at the stage of infancy in several developing countries. The degree of trust in m-commerce transactions is required to be addressed from three different levels: trust in smartphones, telecom service providers and marketers. Any uncertainty and risk in aforementioned levels may prevent the adoption of m-commerce. In order to increase adoption of m-commerce, decision makers are suggested to invest in new technologies and processes to enhance customer security and privacy issues to set a new benchmark.

To understand the non-linear relationship to predict m-commerce adoption, the study employed neural network approach. This approach was found a better predictive

ability over other techniques to explain the causal relationship between the adoption factors and m-commerce adoption (Shmueli and Koppius, 2010; Chong, 2013). The neural network results showed perceived usefulness as one of the most important predictors in adoption of m-commerce followed by perceived trust, variety of services, social influence and perceived cost. Interestingly, perceived cost contradicts the findings of SEM results and found no strong influence on adoption of m-commerce in neural network model. The perceived ease of use was observed as a weak a predictor of m-commerce adoption which validates the findings of SEM. Thus, perceived ease of use and perceived cost are relatively not so important variables in m-commerce adoption using neural network model.

5. Research implications

Among some theoretical implications of this paper are as followed. This study modified previous researches in the domain of m-commerce conducted in the developed and developing countries. This study provides a multi-analytical approach to predict the m-commerce adoption in one of the biggest m-commerce market in the world. The service providers and marketers may use the derived results of this study to formulate appropriate strategies to improve the adoption of m-commerce in future. This study extended the TAM by adding variety of services, perceived cost, social influence and perceived trust as additional variables. Such an integrated approach retains the simplicity of TAM and improves the parsimony of the proposed model through additional variables. By incorporating constructs like subjective norm (social influence), behavioral control (perceived cost) and trust-based constructs (perceived trust), the study used a comprehensive approach and presents a considerable improvement in predictive ability of the proposed model. Further, this study employed SEM and neural network modeling to understand and predict important variables which influence the adoption of m-commerce. The use of such a multi-analytical approach develops a sense of confidence and reinforces the validity of the results obtained from individual approaches.

The practical implications of this study may assist service providers to implement the suggested strategies from this study to enhance the number of m-commerce users. The findings of this study validated the importance of perceived usefulness, variety of services, social influence and perceived trust as strong predictors of m-commerce. The service providers may focus to make m-commerce applications highly useful, enjoyable and something which offers next level of variety of services. Trust building measures may be incorporated to develop customer confidence toward m-commerce. Besides, social influence may be creatively used through word of mouth, above and below the line media and Web 2.0 highlighting privacy guarantees, company policy and regulatory support mechanism to increase the number of users through socialization process. Further the findings of this study provide strong empirical base to all those marketers and vendors who are looking to tap the vast potential of m-commerce in near future. Based on the results of this study, they can formulate the appropriate strategies to attract, educate and retain the customer toward the use of m-commerce.

6. Limitations and future work

This study has mainly three limitations. First, the sample size is not large enough to generalize results to the whole country since India is a geographically dispersed country and more than 50 percentage of the population resides in the rural India.

Therefore, further studies may have to be conducted for generalizing results for the entire country. Another limitation of this study is that the survey was conducted in the capital city of India. Hence, inclusion of rural locations while conducting the survey may provide additional insights. Finally, this study focussed merely on adoption of m-commerce and can be expanded further to understand continued usage trends of m-commerce.

7. Conclusion

To sum up, the purpose of this research was to extend the theoretical framework of TAM and unified theory of acceptance and use of technology model to provide new insight into m-commerce adoption research in a developing country like India. Variables such as perceived cost, perceived trust, social influence and variety of services were added in the proposed model. The proposed model used two staged analytical approach of SEM to test the hypothetical relationships among variables and neural networks to predict determinants of m-commerce adoption. Such a multi-analytic approach provides a comprehensive and rigorous base for future research underpinning the adoption of m-commerce. The findings provide useful insight to m-commerce companies, telecommunication service providers and others to develop appropriate business strategies to improve the adoption intention of m-commerce.

References

Abbasi, M.S., Tarhini, A., Elyas, T. and Shah, F. (2015), "Impact of individualism and collectivism over the individual's technology acceptance behaviour: a multi-group analysis between Pakistan and Turkey", *Journal of Enterprise Information Management*, Vol. 28 No. 6, pp. 747-768.

Aggarwal, C.C. and Philip, S.Y. (2012), "On the network effect in Web 2.0 applications", *Electronic Commerce Research and Applications*, Vol. 11 No. 2, pp. 142-151.

Ajzen, I. (1991), "The theory of planned behaviour", *Organizational Behaviour and Human Decision Processes*, Vol. 50 No. 2, pp. 179-211.

Akturan, U. and Tezcan, N. (2012), "Mobile banking adoption of the youth market: perceptions and intentions", *Marketing Intelligence & Planning*, Vol. 30 No. 4, pp. 444-459.

Chang, Y.P. and Zhu, D.H. (2011), "Understanding social networking sites adoption in China: a comparison of pre-adoption and post-adoption", *Computers in Human Behavior*, Vol. 27 No. 5, pp. 1840-1848.

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*, Vol. 40 No. 4, pp. 1240-1247.

Chong, A.Y.L., Chan, F.T.S. and Ooi, K.B. (2012), "Predicting consumer decisions to adopt mobile commerce: cross country empirical examination between China and Malaysia", *Decision Support System*, Vol. 53 No. 1, pp. 34-43.

Chong, A.Y.L., Darmawan, N., Ooi, K.B. and Lin, B. (2010), "Adoption of 3G services among Malaysian consumers: an empirical analysis", *International Journal of Mobile Communications*, Vol. 8 No. 2, pp. 129-149.

Davis, F.D. (1989), "Perceived usefulness, perceived ease of use, and user acceptance of information technologies", *MIS Quarterly*, Vol. 13 No. 2, pp. 319-340.

Featherman, M.S. and Pavlou, P.A. (2003), "Predicting e-services adoption: a perceived risk facets perspective", *Journal of Human-Computer Studies*, Vol. 59 No. 4, pp. 451-474.

Fishbein, M. and Ajzen, I. (1975), *Beliefs, Attitudes, Intention, and Behavior: An Introduction of Theory and Research*, Addison-Wesley, Reading, MA.

Gitau, L. and Nzuki, D. (2014), "Analysis of determinants of m-commerce adoption by online consumers", *International Journal of Business, Humanities and Technology*, Vol. 4 No. 3, pp. 84-94.

Guriting, P. and Ndubisi, N. (2006), "Borneo online banking: evaluating customer perceptions and behavioural intention", *Management Research News*, Vol. 29 Nos 1-2, pp. 6-15.

Hair, F.J., Black, W., Babin, B. and Anderson, R. (2010), *Multivariate Data Analysis: A Global Perspective*, Pearson Education Inc., Upper Saddle River, NJ.

Hanafizadeh, A., Behboudi, M., Koshksaray, A.A. and Tabar, M.J.S. (2014), "Mobile-banking adoption by Iranian bank clients", *Telematics and Informatics*, Vol. 31 No. 1, pp. 62-78.

Hsu, C.I., Shih, M.L., Huang, B.W., Lin, B.Y. and Lin, C.N. (2009), "Predicting tourism loyalty using an integrated Bayesian network mechanism", *Expert Systems with Applications*, Vol. 36 No. 9, pp. 11760-11763.

Hsu, C.L. and Wang, C.F. (2011), "Investigating customer adoption behaviors in mobile financial services", *International Journal of Mobile Communications*, Vol. 9 No. 5, pp. 477-494.

Karahana, E. and Limayem, M. (2000), "E-mail and v-mail usage: generalizing across technologies", *Journal of Organizational Computing and Electronic Commerce*, Vol. 10 No. 1, pp. 49-66.

Khalifa, M. and Ning Shen, K. (2008), "Explaining the adoption of transactional B2C mobile commerce", *Journal of Enterprise Information Management*, Vol. 21 No. 2, pp. 110-124.

Kim, H.W., Chan, H.C. and Gupta, S. (2007), "Value based adoption of mobile internet: an empirical investigation", *Decision Support System*, Vol. 43 No. 1, pp. 111-126.

Kleijnen, M., Wetzels, M. and Ruyter, K. (2003), "Consumer acceptance of wireless finance", *Journal of Financial Services Marketing*, Vol. 8 No. 3, pp. 206-217.

Lee, C.C., Cheng, H.K. and Cheng, H.H. (2007), "An empirical study of mobile commerce in insurance industry: task-technology fit and individual differences", *Decision Support Systems*, Vol. 43 No. 1, pp. 95-110.

Lee, F.H. and Wu, W.Y. (2011), "Moderating effects of technology acceptance perspectives on e-service quality formation: evidence from airline websites in Taiwan", *Expert Systems with Applications*, Vol. 38 No. 6, pp. 7766-7773.

Lee, Y.K., Park, J.H., Chung, N. and Blakeney, A. (2011), "A unified perspective on the factors influencing usage intention towards mobile financial services", *Journal of Business Research*, Vol. 65 No. 11, pp. 1590-1599.

Lewis, K.N., Palmer, A. and Moll, A. (2010), "Predicting young consumer's take up of mobile banking services", *International Journal of Bank Marketing*, Vol. 28 No. 5, pp. 410-432.

Liao, Z. and Cheung, M.T. (2006), "Internet based e-shopping and consumer attitude: an empirical study", *Information and Management*, Vol. 38 No. 5, pp. 299-306.

Lu, J., Yao, J.E. and Yu, C.S. (2005), "Personal innovativeness, social influences and adoption of wireless internet services via mobile technology", *The Journal of Strategic Information Systems*, Vol. 14 No. 3, pp. 245-268.

Lu, J., Yu, C., Liu, C. and Yao, J. (2003), "Technology acceptance model for wireless internet", *Internet Research: Electronic Networking Applications and Policy*, Vol. 13 No. 3, pp. 206-222.

Luran, P. and Lin, H.H. (2005), "Towards an understanding of the behavioral intention to use mobile banking", *Computer in Human Behavior*, Vol. 21 No. 6, pp. 873-891.

Ngai, E.W.T. and Gunasekaran, A. (2007), "A review for mobile commerce research and applications", *Decision Support Systems*, Vol. 43 No. 1, pp. 3-15.

Qiang, C.Z.W. (2009), "Mobile telephony: a transformational tool for growth and development", *Private Sector & Development, Proparco's Magazine*, No. 4, November.

Ramayah, T. and Lo, M.C. (2007), "Impact of shared beliefs on 'perceived usefulness' and 'ease of use' in the implementation of an enterprise resource planning system", *Journal of Management Research News*, Vol. 30 No. 6, pp. 420-431.

Riquelme, H.E. and Rios, R.E. (2010), "The moderating effect of gender in the adoption of mobile banking", *International Journal of Bank Marketing*, Vol. 28 No. 5, pp. 328-341.

Roger, E.M. (1995), *Diffusion of Innovations*, The Free Press, New York, NY.

Safeena, R., Date, H., Hundewale, H. and Kammani, A. (2013), "Combination of TAM and TPB in internet banking adoption", *International Journal of Computer Theory and Engineering*, Vol. 5 No. 1, pp. 146-150.

Sharma, S.K. (2015), "Adoption of e-government services: the role of service quality dimensions and demographic variables", *Transforming Government: People, Process and Policy*, Vol. 9 No. 2, pp. 207-222.

Sharma, S.K. and Govindaluri, S.M. (2014), "Internet banking adoption in India: structural equation modeling approach", *Journal of Indian Business Research*, Vol. 6 No. 2, pp. 155-169.

Sharma, S.K., Al-Shihi, H. and Govindaluri, S.M. (2013), "Exploring quality of e-government services in Oman", *Education, Business and Society: Contemporary Middle Eastern Issues*, Vol. 6 No. 2, pp. 87-100.

Sharma, S.K., Chandel, J.K. and Govindaluri, S.M. (2014), "Students' acceptance and satisfaction of learning through course websites", *Education, Business and Society: Contemporary Middle Eastern Issues*, Vol. 7 Nos 2-3, pp. 152-166.

Sharma, S.K., Govindaluri, S.M. and Al-Balushi, S.M. (2015), "Predicting determinants of internet banking adoption: a two-staged regression-neural network approach", *Management Research Review* Vol. 38 No. 11, pp. 750-766.

Shmueli, G. and Koppius, O.R. (2010), "Predictive analytics in information systems research", *MIS Quarterly*, Vol. 35 No. 3, pp. 553-572.

Srivastava, A. (2014), "2 billion smart phone users by 2015: 83% of internet usage from mobiles", available at: http://dazeinfo.com/2014/01/23/smartphone-users-growth-mobile-internet-2014-2017/ (accessed January 9, 2015).

Szajna, B. (1995), "Empirical evaluation of the revised technology acceptance model", *Management Science*, Vol. 42 No. 1, pp. 85-92.

Tarhini, A., Hone, K. and Liu, X. (2014a), "The effects of individual differences on e-learning users' behaviour in developing countries: a structural equation model", *Computers in Human Behavior*, Vol. 41 No. 1, pp. 153-163.

Tarhini, A., Hone, K. and Liu, X. (2014b), "A cross-cultural examination of the impact of social, organizational and individual factors on educational technology acceptance between British and Lebanese university students", *British Journal of Educational Technology*, Vol. 46 No. 4, pp. 739-755.

Tarhini, A., Teo, T. and Tarhini, T. (2015a), "A cross-cultural validity of the e-learning acceptance measure (ElAM) in Lebanon and England: a confirmatory factor analysis", *Education and Information Technologies*. doi: 10.1007/s10639-015-9381-9.

Tarhini, A., Scott, M., Sharma, S.K. and Abbasi, M.S. (2015b), "Differences in intention to use educational RSS feeds between Lebanese and British students: a multi-group analysis based on the technology acceptance model", *Electronic Journal of e-Learning*, Vol. 13 No. 1, pp. 14-29.

Thakur, R. and Srivastav, M. (2013), "Customer usage intention of mobile commerce in India: an empirical investigation", *Journal of Indian Business Research*, Vol. 5 No. 1, pp. 52-72.

Vance, A., Cosaque, C.E.D. and Straub, B. (2008), "Examining trust in information technology artifacts: the effects of system quality and culture", *Journal of Management Information System*, Vol. 24 No. 4, pp. 73-100.

Venkatesh, V., Morris, M.G., Davis, G.B. and Davis, F.D. (2003), "User acceptance of information technology: toward a unified view", *MIS Quarterly*, Vol. 27 No. 3, pp. 425-478.

Wang, Y.M. and Elhag, T. (2007), "A comparison of neural network, evidential reasoning and multiple regression analysis in modelling bridge risks", *Expert Systems with Applications*, Vol. 32 No. 2, pp. 336-348.

Wei, T.T., Marthandan, G., Loong, A.Y., Boon, C.K. and Arumugam, O.S. (2009), "What drives Malaysian m-commerce adoption? An empirical analysis", *Industrial Management and Data System*, Vol. 109 No. 3, pp. 370-388.

Wu, J.H. and Wang, S.C. (2005), "What drives mobile commerce? An empirical evaluation of the revised technology acceptance model", *Information & Management*, Vol. 42 No. 5, pp. 719-729.

Zhang, L., Zhu, J. and Liu, Q. (2012), "A meta-analysis of mobile commerce adoption and the moderating effect of culture", *Computers in Human Behaviour*, Vol. 28 No. 5, pp. 1902-1911.

Zhou, T., Lu, Y. and Wang, B. (2010), "Integrating TTF and UTAUT to explain mobile banking user adoption", *Computers in Human Behavior*, Vol. 26 No. 4, pp. 760-767.

Further reading

Thakur, R. and Srivastav, M. (2014), "Adoption readiness, personal innovativeness, perceived risk and usage intention across customer groups for mobile payment services in India", *Internet Research*, Vol. 24 No. 3, pp. 369-392.

About the authors

Dr Rajan Yadav is an Associate Professor in Marketing and Supply Chain Management. He graduated from the Delhi University and earned his Master's Degree in Business Management from the MD University. He was awarded PhD in Organized Retail from the Meerut University and also qualified National Eligibility Test (NET) conducted by UGC. His research interest includes behavioral dimensions of technology diffusion, online social networks, retail management and student community-related social marketing issues. He has more than 11 years of post-graduate teaching experience with some of the leading management institutions in Delhi NCR.

Dr Sujeet Kumar Sharma is an Assistant Professor in the Department of Operations Management and Business Statistics in the Sultan Qaboos University, Oman. Dr Sharma earned his PhD in Statistics. His teaching and research interests include the areas of structural equation modeling, multivariate data analysis, data mining, technology acceptance model and e-government. His research has been published in journals including the *Measurement, Management Research Review*, *Journal of Enterprise Information Management*, *Journal of Modeling in Management*, *Journal of Indian Business Research*, *Transforming Government: People, Process and Policy*, *European Journal of Sports Sciences*, *Education, Business and Society*, etc. He has authored a book on *Computer-Based Numerical and Statistical Techniques*. Dr Sujeet Kumar Sharma is the corresponding author and can be contacted at: drsujeet@squ.edu.om

Dr Ali Tarhini is a Researcher in the Department of Information Systems at the Brunel University, UK, where he received his PhD. Dr Ali also has MS in Advanced Web Application Programming the from University of Essex in 2008, UK. His research interests include knowledge sharing, cross-cultural studies, user adoption and acceptance of technology, quantitative methods, structural equation modeling. His research has been published in journals including the *Computers in Human Behavior*, *Information Technology & People*, *Journal of Educational Computing Research*, *British Journal of Educational Technology*, *Interactive Learning Environments*.

This article has been cited by:

1. Jun-Jie Hew. 2017. Hall of fame for mobile commerce and its applications: A bibliometric evaluation of a decade and a half (2000–2015). *Telematics and Informatics* **34**:1, 43-66. [CrossRef]
2. ObeidatBader Yousef Bader Yousef Obeidat Dr Bader Yousef Obeidat is an Assistant Professor of Information Systems and Information Technology at the University of Jordan. His research interests include but are not limited to electronic commerce, internet banking, information systems, electronic markets and auctions. Dr Obeidat has published more than 30 papers in information systems and business. Al-SuradiMai Maher Mai Maher Al-Suradi Miss Mai Maher Al-Suradi holds a master's degree in management information systems from the University of Jordan. Her research interests include but are not limited to knowledge sharing, technology adoption and IT-business strategic alignment. Masa'dehRa'ed Ra'ed Masa'deh Dr Ra'ed Mas'deh is an Associate Professor of Management Information Systems at the University of Jordan. His work focuses on IT-business strategic alignment, strategic use of technology in the public sectors, knowledge management capabilities, sustainable innovation and IT-based competitive advantage, quantitative methods and structural equation modeling. TarhiniAli Ali Tarhini Dr Ali Tarhini is an Assistant Professor at the College of Economics and Political Science, Information Systems Department, Sultan Qaboos University. He holds a PhD in Information Systems from Brunel University London, UK, and MSc in E-commerce from University of Essex, UK. His research interests include knowledge management, social media, ICT in information systems (technology adoption and diffusion), cross-cultural issues in IS (at individual and national culture, cross-cultural studies). Ali has published more than 45 articles in leading academic journals including Computers in Human Behavior, Information Technology & People, Information Systems Management, Journal of Enterprise Information Management, Journal of Management Development, Management Research Review, British Journal of Educational Technology, Interactive Learning Environments. Department of Business Management, The University of Jordan, Amman, Jordan MIS Department, The University of Jordan, Amman, Jordan Department of Computer Science, Brunel University London, Uxbridge, UK . 2016. The impact of knowledge management on innovation. *Management Research Review* **39**:10, 1214-1238. [Abstract] [Full Text] [PDF]
3. BolatElvira Elvira Bolat ebolat@bournemouth.ac.uk Dr Elvira Bolat is a Lecturer in Marketing at the Business School, Bournemouth University. She is a member of the Academy of Marketing and British Academy of Management. She is also a Deputy Chair for the Academy of Marketing Business to Business Special Interest Group (B2B SIG). KooliKaouther Kaouther Kooli kkooli@bournemouth.ac.uk Dr Kaouther Kooli is a Lecturer in Marketing at Bournemouth University. She is a member of the Academy of Marketing and Chair of its Business to Business Special Interest Group (B2B SIG). Dr Kaouther is a Fellow of the Higher Education Academy. She has published in a number of academic journals including the Journal of Business and Industrial Marketing. Her research interests include B2B marketing and also E-Marketing. WrightLen Tiu Len Tiu Wright L.T.Wright@hud.ac.uk Professor Len Tiu Wright is a Professor of Marketing and heads the research group in Marketing, Branding and Innovation (GAMBI: www.hud.ac.uk/gambi) at the University of Huddersfield, UK. She was formerly Research Professor and Professor of Marketing at De Montfort University, Leicester and Visiting Professor at the University of Keele. Her full-time appointments include those at the universities of Keele, Birmingham and Loughborough. She has given guest lectures at universities and professional bodies in the UK and overseas, as well as keynote addresses at conferences. Additionally, she has consultancy and industrial experience and has researched in the Far East, Europe and North America. Her writings have

appeared in books, in American and European academic journals and at major conferences where some have gained best paper awards. She has organised workshops and conferences at universities and at IBM in Warwick, UK. She is on the editorial boards of a number of marketing journals, carried out reviews of papers and special issues for leading marketing journals and is Founding Editor of Qualitative Market Research, an Emerald journal. She is currently Editor-in-Chief of CogentOA Business & Management series. Department of Marketing, Bournemouth University, Bournemouth, UK Department of Logistics, Operations, Hospitality and Marketing, The Business School, University of Huddersfield, Huddersfield, UK . 2016. Businesses and mobile social media capability. *Journal of Business & Industrial Marketing* **31**:8, 971-981. [Abstract] [Full Text] [PDF]

4. MadanKhushbu Khushbu Madan YadavRajan Rajan Yadav Delhi School of Management, Delhi Technological University, Delhi, India . 2016. Behavioural intention to adopt mobile wallet: a developing country perspective. *Journal of Indian Business Research* **8**:3, 227-244. [Abstract] [Full Text] [PDF]