TECHNOLOGY ACCEPTANCE MODEL REVISITED FOR MOBILE BASED AGRICULTURAL EXTENSION SERVICES IN INDIA

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Abstract
Technology acceptance was theorized in 1986 and has been in use since then. This research applies the same model in the study of mobile based agricultural extension services and tests its validity. The model stands out even after thirty years. The conceptual framework underlying the study was based on the Theory of Planned Behavior. Structural Equation Modeling was used to confirm a proposed mobile based agricultural extension services acceptance model based on Technology Acceptance Model (TAM). Perceived usefulness, perceived ease of use determines the attitude and behavioural intention for mobile based agricultural extension services in India. This paper examines the benefits of mobile based AES for farmers.
Keywords: Perceived usefulness; perceived ease of use; attitude; behavioural intention; mobile based AES

1. INTRODUCTION

Many farmers hesitate to use mobile based agricultural extension services for a variety of reasons. This reluctance results in inconvenience associated with writing letters and spending time to visit a centre for consultation with experts to get agricultural information. On the other hand, by using mobile based agricultural extension services, farmers can conduct fast and convenient transaction activities and obtain their agriculture information without the limitation of office hours and a need to visit a centre. Factors encouraging increased use of mobile based agricultural extension services are the greater convenience and reduced cost of services. Individuals benefit from 24 hours/7days access to their accounts and customer services from home or anywhere with their mobiles.

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2. AGRICULTURAL EXTENSION SERVICES (AES)

Agriculture has been recently recognized as crucial to development and poverty alleviation (World bank, 2007). Agriculture can serve as an important engine for economic growth in developing countries. In China, AES is enacted by agents who are funded by the government (Hu, Yang, Kelly, & Huang, 2009). AES is implemented through personnel in Ethiopia (Belay & Abebaw, 2004). Land management is with private players in an advisory role in England (Klerkx & Proctor, 2013). AES is implemented by local government through messengers in Ecuador (Buck & Alwang, 2011). Rapid spread of mobile phone coverage in developing countries provides a unique opportunity to facilitate technological adoption via information and communication technology (ICT)-based extension programs. Changes in AES are measured by its adoption. In Egypt, AES was successful when it transformed from being government driven to farmer participatory activity (Fleischer, Waibel, & Walter-Echols, 2002). In Iran, it was found that Farmers with individualistic attitude towards poverty were more likely to adopt AES as compared to farmers with fatalistic attitude towards poverty (Hayati & Karami, 2005). Adoption of AES lead to a dip in yield initially but increased in the long run for grape farmers in Argentina (Maffioli, Ubfal, Bar´e, & Cerd´an-Infantes, 2011). A farmer's willingness to pay for AES increases with higher interaction with such services in the past was confirmed in Nigeria (Ozor, Garforth, & Madukwe, 2013). Cost of AES is a barrier to small scale farmers in European Union and affected their productive and environmental performance (Labarthe & Laurent, 2013). For production of dates in Pakistan, small-scale farmers who used the agricultural extension services produced a better yield compared to that of the medium- and large-scale farmers (Baloch & Thapa, 2016).

Agricultural production function implies that farmers need information on a variety of topics, at a variety of stages, before adopting a new technology. In order to make prudential and accurate decisions, farmers need speedy access to advises on agricultural problems which could be timely, reliable and consistent. Hence, they have to resort on the subject matter specialists like agronomist, entomologist, plant pathologist, soil scientist, horticulturist and farm scientists.

Farmers can obtain information from a number of sources, including, among others, their own trial and error and from members of their social network. Yet while traditional economic theory assumes that information is costless, information is rarely symmetric or costless in developing countries. This is partly due to the high cost of obtaining information via traditional means, such as travel, radio, or newspaper.

Agricultural extension systems were conceived of and developed in response to information asymmetries for poor farmers, particularly those with limited access to other sources of information (landlines, newspapers, and radios). While infrastructure investments still remain low in many developing countries,

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one of the most dramatic changes over the past decade has been an increase in mobile phone coverage and adoption. Mobile phones can significantly reduce the costs of obtaining agricultural information. A recent nationally representative survey shows that just 5.7% of farmers report receiving information about modern agricultural technologies from public extension agents in India (Glendenning, Babu, & Asenso-Okyere, 2010).

Mobile phone operators have developed a variety of mobile services and applications in developing countries. The most prominent of these is mobile money transfers (known as m-money), a system whereby money can be transferred to different users via a mobile phone. Mobile based agricultural extension service is a relatively new application and is in stages of infancy. Companies which had been providing AES through their agents or centres are now providing it through mobile applications. It is being adopted by the farmers; however, the absence of human intervention is felt.

For diffusion, mobile based AES follows technology acceptance model. It is described in the ensuing section.

3. LITERATURE REVIEW

The Technology Acceptance Model (TAM), introduced by (Davis, 1986), is an adaptation of the Theory of Reasoned Action (TRA) specifically modified for modeling user acceptance of information technology (Davis, 1986); (Davis, 1989). TAM posits that IT use is determined by the behavioral intention to use IT. The behavioral intention is affected by an individual's attitude toward using IT and perceived usefulness. An individual's attitudes are a joint function of perceived usefulness and perceived ease of use. Finally, perceived usefulness is determined by perceived ease of use as well as external variables, while perceived ease of use is influenced only by external variables. Throughout the body of TAM research, perceived usefulness and ease of use were found to be strong determinants and predictors of behavioral intention with behavioral intention being linked to IT use. TAM is an information system theory that focuses on technology adoption and use at an individual level. This theory states that a user's intention to adopt a new technology is largely driven by the user's perception of the technology's usefulness and its expected ease of use (Venkatesh & Davis, 2000). The basic technology acceptance model has confirmed by several meta-analysis studies (King & He, 2006).

The Theory of planned behavior (TPB) is an extension of the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), which is widely used in social psychology and marketing studies to explain the determinants of intended behaviors (Ajzen & Fishbein, 1980). Both the TRA and TPB suggest that behavior is directly influenced by behavioral intention. TPB also postulates that behavioral intention is

influenced by attitude toward the behavior and subjective norm. Attitude toward the behavior refers to the degree to which people have a positive or negative feeling toward the behavior.

With the rise of smartphones and handheld computers, a new platform for software and services was created (e.g.mobile internet (Chu & Pan, 2008), mobile video (See-To, Papagiannidis, & Cho, 2012) or mobile television (Shin, 2006)). However no study has been conducted for mobile based AES. This paper establishes the relationship between perceived usefulness, perceived ease of use, attitude and behavioural intention in context of mobile based AES.

Perceived Usefulness

According to Davis (1986), perceived usefulness can be defined as the degree to which an individual believes subjectively that using a particular IT would enhance his or her job performance. Perceived usefulness suggests a user believes that using a particular service will be beneficial. The degree to which a person believes that using the particular technology would improve his/her quality of life (Venkatesh, Morris, Davis, & Davis, 2003).

H1 Perceived usefulness (PU) of using AES positively influences attitude (AT)

H2 Perceived usefulness (PU) of using AES positively influences behavioral intention (Int)

Perceived Ease of Use

Perceived ease of use is defined as the degree to which a person believes that using a particular system will be free from effort (Davis, 1989). In a mobile advertisement context it was defined ease of use as mobile phone users' expectations of the effort required to use mobile advertising messages (Zhang & Mao, 2008). Numerous researches have provided support that PEOU had a significant effect on usage intention; it is an important forecaster of technology adoption.

H3 Perceived ease of use (PEOU) of using AES positively influences attitude (AT)

H4 Perceived ease of use (PEOU) of using AES positively influences behavioral intention (Int)

H5 Perceived ease of use (PEOU) of using AES positively influences perceived usefulness (PU)

Attitude

According to (Schiffman & Kanuk, 1997), attitude is a learned predisposition to behave in a consistently favorable or unfavorable way with respect to a given object. Attitude is an important determinant of an individual's predisposition to respond and has a positive relationship to behaviors of interest (Allport,

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1935). In the context of TAM, Davis (1986) defined attitude as an individual's degree of evaluative affect toward the usage behavior. Attitude is defined as an individual's positive or negative feelings (evaluative affect) about performing a behavior (Fishbein & Ajzen, 1975). It is the psychological tendency depending on a degree of favour or disfavor (Eagley & Chaiken, 1993). Attitudes are formed through previous purchasing behavior, direct experience with the product, word of-mouth information acquired from others, exposure to mass media advertising, the Internet, and so on. However, attitudes are not permanent; they do change.

H6: Attitude (AT) towards mobile based AES positively influences behavioral intention (Int).

Behavioural Intention to use

According to Davis (1986), behavioral intention reflects the strength of the prospective user's intention to make or to support the usage decision in their mind. Behavioral intention is jointly determined by attitudes and perceived usefulness.

4. DATA ANALYSIS

A sample of 327 farmers using such mobile based AES were considered for survey to test the hypothesis. Data was collected using a five points Likert scale with measures asking whether respondents strongly agreed, agreed, undecided, disagreed, or strongly disagreed vis-à-vis each item.

TABLE 1 - DESCRIPTIVE STATISTICS

		Mean	SD	Reliability α	AVE
PU	4	3.778	0.118	0.831	0.5346
PEOU	3	3.882	0.045	0.681	0.5170
Attitude	3	3.865	0.145	0.812	0.5677

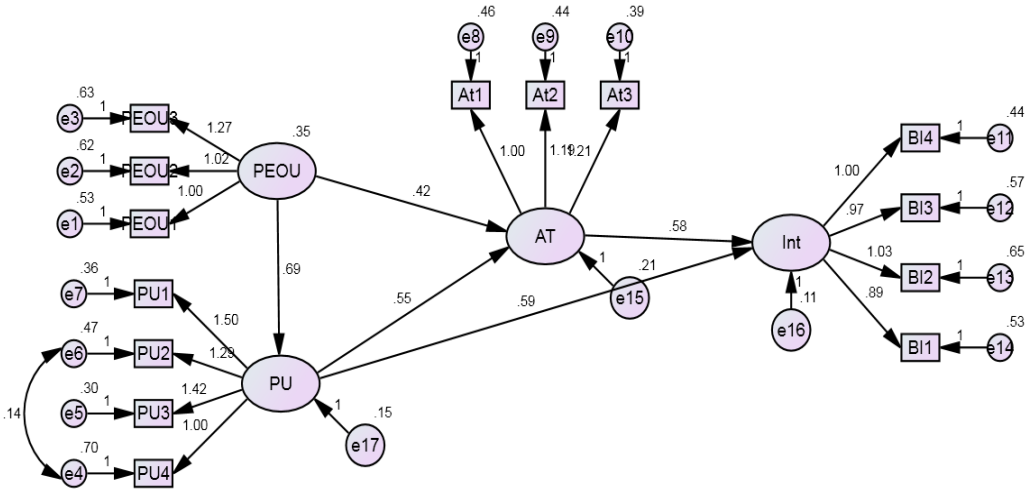

FIGURE 1 - SEM MODEL

This was followed by reliability analysis and discriminant validity of the scale. The reliability of constructs is greater than 0.7 (Nunnally, 1967) and the discriminant validity is higher than 0.5 (Fornell & Bookstein, 1982). This confirms the validity of the survey instrument.

The causal effects theorised in our model are assessed using structural equation modeling. The structural model is as in Figure 1.

5. FIT STATISTICS

The CFI is 0.963, AGFI is 0.908, RMSEA is 0.056, chi square is 144.720, P close is 0.258. The model is a good fit of the theory. The regression weights are as mentioned in the table.

FIGURE 2 - REGRESSION WEIGHTS: (GROUP NUMBER 1 - DEFAULT MODEL)

			Estimate	S.E.	C.R.	P
PU	<---	PEOU	.686	.100	6.885	***
AT	<---	PEOU	.425	.129	3.298	***
AT	<---	PU	.549	.133	4.129	***
Int	<---	AT	.583	.090	6.452	***
Int	<---	PU	.588	.114	5.166	***

6. DISCUSSIONS

The technology acceptance model is robust even today. Perceived usefulness impacts attitude with a β coefficient of 0.549 and a critical ratio of 4.129. It was found perceived usefulness (PU) had a significantly positive influence on attitude towards using smartphones (Ma, Chan, & Chen, 2016).

PEOU influences attitude with a path coefficient of 0.425 and a critical ratio of 3.298. However, it was not found to be significant in the case of mobile advertisement (Izquierdo-Yusta, Olarte-Pascual, & Reinares-Lara, 2015). Similar to this study, both PU and PEOU influenced attitude towards mobile emergency applications (Watzdorf, Ippisch, Tobias, & Thiesse, 2010).

PU influences behavioural intention with a path coefficient of 0.588 and critical ratio of 5.166. This is reconfirmation of studies on adoption of mobile TV (Jung, Perez-Mira, & Wiley-Patton, 2009) and smartphones (Ma, Chan, & Chen, 2016). Similarly, PU had a strong and significant relationship with BI in a study of mobile phones to seek health information (Lin, et al., 2011) and use of personally controlled electronic health record in Australia (Andrews, Gajanayake, & Sahama, 2014). This relationship was found to be significant for m-learning adoption in Jordan (Althunibat, 2015). Both PU and PEOU influenced

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behavioural intention to use mobile health care application in Ethiopia (Shanko, Negash, & Bandyopadhyay, 2016) and a green initiative bike in Taiwan (Chen & Lu, 2016).

Perceived ease of use (PEOU) had a significantly positive effect on perceived usefulness (PU) with a β coefficient of 0.686 and a critical ratio of 6.885. This is confirmed by the study on Chinese smartphone adoption (Ma, Chan, & Chen, 2016).

Attitude influences intention with a β coefficient of 0.583 and a critical ratio of 4.129. The results show, similar to other research, that attitude has a positive influence on people's intention. This was also observed during adoption of IB services by Yemini bank users (Zolait, 2010) and retail e-commerce purchase in Chile (Andrews & Bianchi, 2013). In case of mobile advertisement using mobile internet attitude influenced intention in Spain (Izquierdo-Yusta, Olarte-Pascual, & Reinares-Lara, 2015). It also influenced the intention to use personally controlled electronic health in Australia (Andrews, Gajanayake, & Sahama, 2014).

In this study, PEOU did not influence intention significantly. This study confirms the central role of attitude in determining the intention to use AES.

7. MANAGERIAL IMPLICATIONS

Managers engaging in innovation, technology foresight and corporate development activities in the field of mobile business applications should take the results of the present study into account. One of the key challenges for designers of business applications and providers is to enable the growing segment of the farmers to use their applications. The farmers have to be convinced of the additional benefit and efficiency (perceived usefulness) in a mobile based agricultural services application. Reduction of transaction costs, security and conspicuity can be some useful benefits of using a mobile based AES.

When launching new mobile application for the farmers, the AES operators should consider prior developments of mobile applications and users' familiarity with agriculture related technologies. Conversion of their intention to actual behaviour will hinge on farmer's technical concerns and design factors. The findings of this research are especially relevant for managers of innovation in the field of new mobile business applications and providers of value added services.

8. FUTURE RESEARCH

First, future studies could examine the intensity of intended use of mobile based agricultural extension services among intended users. Second, since mobile based agricultural extension services were

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relatively new when the data for this study were collected, this study examined the intended use of mobile based agricultural extension services. Future studies could expand this study to actual usage of mobile based agricultural extension services over time. Third, future studies could examine factors related to the mobile infrastructure which affect on the use of mobile based agricultural extension services.

Fourth, it is recommended for future research to conduct longitudinal studies to more accurately reflect mobile based agricultural extension services usage. Such longitudinal studies should also include follow-up questions to investigate reasons as to why users might not convert their intentions into actual behaviour. This would reveal valuable insights to offer explanations behind the intention usage gap, for which there is currently an acute lack of in the TAM literature.

Fifth, a design study can be done to find which applications and their features seem to be of use to the farmer. Moreover, what else can be added and what should be removed or improved so as to increase the perceived usefulness of the mobile based agricultural extension services.

9. CONCLUSION

This research confirms that the technology acceptance model is robust even for mobile based agricultural extension services. Agricultural extension services can be successful if perceived usefulness is established. This research proves that behavioural intention is routed through attitude even for AES. Mobile based AES would be the road to development for a country.

REFERENCES

Ajzen, I., & Fishbein, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall.

Allport, G. W. (1935). Attitudes. InC. Murchinson. In Clark, Handbook of social psychology. Worchester, MA: University Press.

Althunibat, A. (2015). Determining the factors influencing students' intention to use m-learning in Jordan higher education. Computers in Human Behavior, 52, 65-71.

Andrews, L., & Bianchi, C. (2013). Consumer internet purchasing behavior in Chile. Journal of Business Research, 66, 1791-1799.

Andrews, L., Gajanayake, R., & Sahama, T. (2014). The Australian general public's perceptions of having a personally controlled electronic health record. i n t e r n a t i o n a l j o u r n a l o f m e d i c a l i n f o r m a t i c s, 83, 889-900.

Baloch, M. A., & Thapa, G. B. (2016). The effect of agricultural extension services: Date farmers' case in Balochistan, Pakistan. Journal of the Saudi Society of Agricultural Sciences.

Belay, K., & Abebaw, D. (2004). Challenges Facing Agricultural Extension Agents: A Case Study from South-western Ethiopia. African Development Bank, 139-168.

Management Research and Practice
Volume 8 Issue 4 / 2016
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2067- 2462

Buck, S., & Alwang, J. (2011). Agricultural extension, trust, and learning: results from economic experiments in Ecuador. Agricultural Economics, 42, 685-699.

Chen, S.-Y., & Lu, C.-C. (2016). Exploring the Relationships of Green Perceived Value, the Diffusion of Innovations, and the Technology Acceptance Model of Green Transportation. Transportation Jouranl, 55(1), 51-77.

Chu, C. P., & Pan, J. G. (2008). The forecasting of the mobile Internet in Taiwan by diffusion model. Technological Forecasting & Social Change, 75, 1054-1067.

Davis, F. D. (1986). A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results. Unpublished Doctoral Dissertation. Sloan School of Management, Massachusetts Institute of Technology.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 319-339.

Eagley, A. H., & Chaiken, S. (1993). The Psychology of Attitudes. Fort Worth, TX.: Harcourt Brace Jovanovich.

Fishbein, M., & Ajzen, I. (1975). Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Reading, MA: Addison-Wesley.

Fleischer, G., Waibel, H., & Walter-Echols, G. (2002). TRANSFORMING TOP-DOWN AGRICULTURAL EXTENSIONTO A PARTICIPATORY SYSTEM: A STUDY OF COSTS AND PROSPECTIVE BENEFITS IN EGYPT. public administration and development, 22, 309-322.

Fornell, C., & Bookstein, F. L. (1982). Two structural equations models: LISREL and PLS applied to consumer exit-voice theory. Journal of Marketing Research, 19(4), 440-452.

Glendenning, C., Babu, S., & Asenso-Okyere, K. (2010). Review of Agricultural Extension in India: Are Farmer' Information Needs Being Met? IFPRI Discussion Paper 01048. 2.1.

Hayati, D., & Karami, E. (2005). Typology of causes of poverty: The perception of Iranian farmers. Journal of Economic Psychology, 26, 884-901.

Hu, R., Yang, Z., Kelly, P., & Huang, J. (2009). Agricultural extension system reform and agent time allocation in China. China Economic Review, 20, 303-315.

Izquierdo-Yusta, A., Olarte-Pascual, C., & Reinares-Lara, E. (2015). Attitudes toward mobile advertising among users versus non-users of the mobile Internet. Telematics and Informatics, 32, 355-366.

Jung, Y., Perez-Mira, B., & Wiley-Patton, S. (2009). Consumer adoption of mobile TV: Examining psychological flow and media content. Computers in Human Behavior, 25, 123-129.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. Inf. Management, 43, 740-755.

Klerkx, L., & Proctor, A. (2013). Beyond fragmentation and disconnect: Networks for knowledge exchange in the English land management advisory system. Land Use Policy, 30, 13-24.

Labarthe, P., & Laurent, C. (2013). Privatization of agricultural extension services in the EU: Towards a lack of adequate knowledge for small-scale farms? Food Policy, 38, 240-252.

Lin, S., Xue, L., Yen, C. C., Chang, L., Chan, H. C., Tai, B. C., . . . Choolani, M. (2011). A study on Singaporean women's acceptance of using mobile phones to seek health information. Internat ional journal of medical informatics, 80, e189-e202.

ISSN
2067- 2462

Ma, Q., Chan, A. H., & Chen, K. (2016). Personal and other factors affecting acceptance of smartphone technology by older Chinese adults. Applied Ergonomics, 54, 62-71.

Maffioli, A., Ubfal, D., Bar´e, G. V., & Cerd´an-Infantes, P. (2011). Extension services, product quality and yields: the case of grapes in Argentina. Agricultural Economics, 42, 727-734.

Nunnally, J. C. (1967). Psychometric Theory. New York: McGraw Hill.

Ozor, N., Garforth, C. J., & Madukwe, M. C. (2013). FARMERS' WILLINGNESS TO PAY FOR AGRICULTURAL EXTENSION SERVICE:EVIDENCE FROM NIGERIA. Journal of International Development, 25, 382-392.

Schiffman, L. G., & Kanuk, L. L. (1997). Consumer Behavior. New Jersey: Prentice Hall.

See-To, E. W., Papagiannidis, S., & Cho, V. (2012). User experience on mobile video appreciation: how to engross users and to enhance their enjoyment in watching mobile video clips. Technological Forecasting & Social Change, 79, 1484-1494.

Shanko, G., Negash, S., & Bandyopadhyay, T. (2016). Mobile healthcare services adoption. Int. J. Networking and Virtual Organisations, 16(2), 143-155.

Shin, D. H. (2006). Socio-technical challenges in the development of digital multimedia broadcasting: a survey of Korean mobile television development. Technological Forecasting & Social Change, 73, 1144-1160.

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. Management Science, 46(2), 186-204.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: towards a unified view. MIS Quaterly Management Information System, 27(3), 425-478.

Watzdorf, S., Ippisch, T., Tobias, A., & Thiesse, F. (2010). The Influence of Provider Trust on the Acceptance of Mobile Applications An Empirical Analysis of Two Mobile Emergency Applications. Computer Society, 329-336.

World bank. (2007). World Development Report 2008: Agriculture for Development. Washington DC: World Bank.

Zhang, J., & Mao, E. (2008). The influence of user expertise and phone complexity on performance, ease of use and learnability of different mobile phones. Behavioural Information Technology, 21(5), 303-312.

Zolait, A. H. (2010). An examination of the factors infl uencing Yemeni Bank users behavioural intention to use Internet banking services. Journal of Financial Services Marketing, 15(1), 76-94.

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