Journal of Human Development and Communication
Volume 5, 2016 [27-40]

Applying Diffusion of Innovation Theory and Unified Theory of Acceptance and Use of Technology (UTAUT) on Farmers' Use of Communication Technology

Ahmad Fahmi Mahamood[1], Rosli Mohammed[2], Mohd Khairie Ahmad[2], Ahmad Hifzurrahman Ridzuan[1], Mohamad Rezal Hamzah[1], Shuhairimi Abdullah[1], Hayrol Azril Shaffril[3]

[1]Universiti Malaysia Perlis
[2]Universiti Utara Malaysia
[3]Universiti Putra Malaysia

ABSTRACT

The study is focused on the use of communication technology in agricultural development. It is inevitable for the farmers to utilise the communication technology, which is a well known innovation, in order to get hold of various agricultural information that could help them to heighten the quality and quantity of agricultural products. Innovation is the implementation of ideas, products, practices, and services that adds the value to individuals (Rogers, 2003). The Malaysian farmers are merely way behind in terms of utilizing communication technology, which have prompted the researchers to look at this phenomenon in greater depth. The aim of this study is to help more farmers to use communication technology, henceforth naturally increases the number of knowledgeable and informative farmers. Based on Diffusion of Innovation Theory and Unified Theory of Acceptance and Use of Techology (UTAUT), this study observes the effectiveness of the combination of these two theories specifically on the use of communication technology among farmers. The construct of innovation characteristics includes relative advantages, compatibility, trialibility, complexity, and observability, whereas the construct of technology acceptance includes effort expectation, performance expectations, social influence, and facilitating situation. A total of 398 malaysian farmers were involved in this study as the respondents. The result shows that the use of communications technology such as interactive media and social media, can largely be utilised by the farmers, as the use and the acceptance of communication technology have increased. A linear regression test has shown the effect on the Diffusion of Innovation Theory and UTAUT is at 10.2 variance changes. Thus, the combined

use of these 2 theories suits effectively to be the foundation to investigate the use of the communication technology among farmers. This model can be improved or further modified for future research to identify other factors that could play a role in the use and acceptance of innovation, especially among farmers.

Keywords: Innovation; channel; agricultural development

1.0 INTRODUCTION

Agricultural development in general is one of the most important branches of effort made by the agricultural agencies to disseminate information to the farmers in order to help to improve their productivity and their well-being. Agricultural development can be defined as a system of informal education that provides advices through educational processes to help clients to increase the knowledge and the skills whenever they need, or whenever they have problems in the context of socio-economic (Bahaman, Jegak & Khadijah, 2009).

Agricultural development is indeed crucial in providing agricultural information such as in the areas of seed planting, fertilizer types and appropriateness, harvesting, selling price, advises, cultivation techniques, crop treatments, agricultural subsidies, weather reports, new market opportunities, new agricultural technologies, electronic markets (e-market), current issues and current affairs in the agricultural sector (Reta et al., 2011).

The rapid development of communication technology has led many individuals to change their approaches to get information to be more innovative, fast, and interactive, regardless of time and global reach. The agricultural development,particularly paddy plantation related activities, the farmers are mostly still practicing the use of the conventional media channels and the interpersonal communication (the development agency) in obtaining information on paddy planting activities, right from the ground-levelling process until the harvesting process. Such information is crucial to be channelled to the farmers in order to secure a good yield and good quality due to the known status of rice being the staple food of the country. Thus, innovation-embedded channels of communications technology are highly required to be used by the farmers in order to improve their plantation and their productivity (Reta et al., 2011).

2.0 PROBLEM STATEMENT

The research will look into the process of general acceptance of adopting innovations to the society that has the same of focus with Rogers (1995), which is based on the Diffusion of Innovation Theory. At the persuasion phase of deciding to adopt an innovation, there are five innovation characteristics, namely relative advantages, compatibility, complexity, trialbility and observability which are described as the most influential variables in the process to adopt an innovation.

However, there are some typical weaknesses in terms of communication channels that parallels the rapid development of communication technology nowadays, but the information channels on agricultural innovation is no longer confined to the mass media and development agencies (Marcista, 2012). The latest communication technology channels that are more bilateral in nature, combining public communication and interpersonal communication, fast, interactive, easily accessed at all time, are expected to be highly influential in persuading the farmers to embrace the innovation on agricultural information (Hudson, 2014).

Meanwhile, the Diffusion of Innovation Theory also has a disadvantage as it is not suitable to be used in all conditions and situations, that certain innovations are adoptable by certain individuals and communities only (Moore & Benbasat, 1996). Past studies on the adoption of innovations found many useful innovations shortcomings in this theory as there are other factors that also affect individuals in the process to adopt innovations such as age, educational background, computer literacy, social status and economic status (Montazemi et al., 2013). Is the adoption of information innovation in paddy plantation really being useful to the farmers in this country as suggested in the Diffusion of Innovation Theory? Use of mass media or better known as the conventional media is one-way in nature, uncreative and rigid. With the latest communication technology that is interactive, animated and dynamic, the conventional media's role in agricultural development activitiesis increasingly challenged for its effectiveness. Publishing materials on agricultural development through the latest communication technology can help to attract the target audience to change the channel of communication technology to become more efficient. Therefore, this study will also use the UTAUT to accommodate the shortcomings found in the Diffusion of Innovation Theory. This theory explains that the acceptance of the innovation or technology is dependent on the performance expectancy, effort expectancy, facilitating condition and social influences (*Venkatesh* et al., 2003). The four variables play an important role in determining the extent of the use of the latest communication technology

channel in agricultural development activities among the farmers. The impetus for this research is to find out the extent of information delivery of paddy plantation that can be channelled through the latest communication technology to ensure effective and efficient use of the channel. This focus is particularly important in persuading farmers to use the channel in finding agricultural information. According to Farah & Bahaman (2013), the selection of the right channel is an important factor in the process for the farmers to use the agricultural information. Previous studies that focused on the use of new media in agricultural extension also suggested that studies on the application and the impact of the growing use of the new media should be carried-out (Farah & Bahaman, 2013). Although there are many studies around the innovation adoption in agriculture, minimal number of research was carried specifically on the use of channel of communication technology, especially in the context of agricultural development in Malaysia (Anderson et al., 2010).

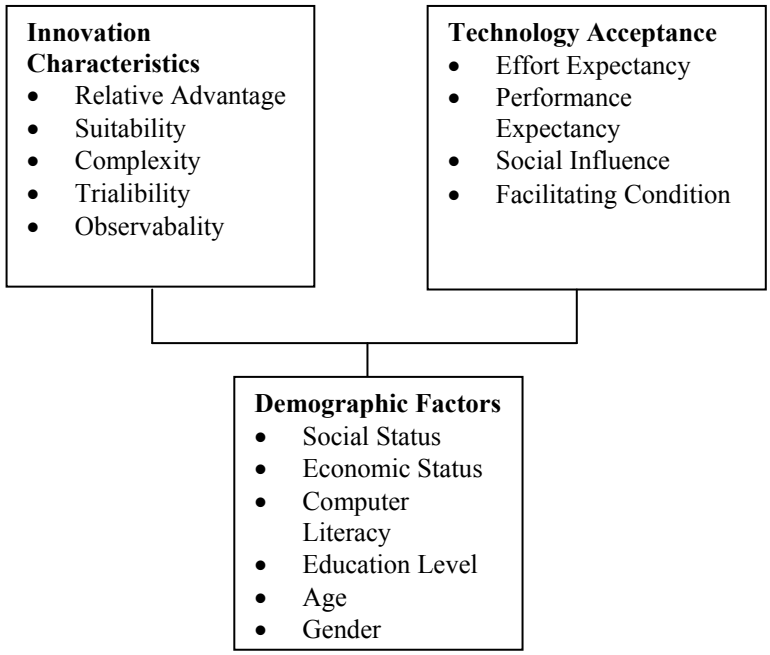
3.0 RESEARCH QUESTIONS

1. What are the selections of communication technology in the development of agricultural activities of the farmers?
2. How do the variables such as relative advantage, compatibility, trialibility, complexity, observability, performance expectations, business expectations, social influence and facilitating conditions, affect the use of communications technology in the development of agricultural activities of the farmers?
3. Is there any differences in terms of background demographics such as gender, social structure, economic status, age, level of education and computer literacy in the use of communication technology in the development of agricultural activities of the farmers?
4. Does the Diffusion of Innovation Theory and UTAUT influences the communication technology in the agricultural development activities of the farmers?

4.0 SIGNIFICANCE OF THE STUDY

This study is particularly important to identify the relationship between variables of relative advantages, compatibility, trialibility, complexity and observability as described in the Diffusion of Innovation Theory, and variables of performance expectancy, effort expectancy, social influences and facilitating condition as being set off in the UTAUT. This study identifies the contribution of the method or the use of communication technology channels that are efficient and effective in delivering agricultural development information.

Farmers have been regarded as a group of people that is not really tapping into the advance of the current scene of innovation especially in the area of communication technology. Therefore, the findings of this study are significant to the farmers as they will contribute to the acceptance and the adoption of communication technology. Furthermore, the findings could become the reference point for the agricultural agencies in order to promote better acceptance in the area. Efficient amount of supply, and decent delivery of agricultural information on paddy plantation,will increase the farmers' knowledge, skills, and productivity.



4.1 Hypothesis

Ha 1: There is a correlation between the innovation characteristics and technology acceptance.

Ha 2: There is a difference between demographic factors and technology acceptance.

Ha 3: There is an influence of innovation characteristic factors and technology acceptance.

5.0 METHODOLOGY

This study used quantitative approaches. The method of quantitative approach, a questionnaire was designed based on the adaptation of the suitable instruments that are appropriate for this research to find out the relevance of the variables such as the relative advantages, the trialibility, the compatibility, the complexity, the observability, the performance expectancy, the effort expectancy, the social influences and the facilitating condition, for the use of communication technology channels to acquire information for paddy plantation by the farmers. In addition, the demographic background such as the social status, the economic status, the age, the education background and the computer literacy are also considered as the factors that contribute to the use of the communication technology channels. There is a total number of 48730 MADA farmers, nonetheless based on stratified random sampling technique through below mentioned formula, 385 respondents were acknowledged.

$$no = \frac{(1.96)^2 (.5)(.5)}{(.5)^2} = 385$$

no = Sample size
z^2 = Significant level
p^2 = 0.5
q =1-p
e^2 = Accuracy

However, the researcher had opted for 400 respondents, and 400 questionnaires were distributed. Bigger number of respondents shall represent the population better (Creswell, 1998). Through stratified random sampling technique, the farmers were divided into 3 main stratas or scales which were based on 4 main MADA territories (Table 1).

Table 1: Sample

Territory 1		Territory 2	
Big Scale	25	Big Scale	16
Medium Scale	32	Medium Scale	25
Small Scale	43	Small Scale	59
TOTAL	100	TOTAL	100
Territory 3		Territory 4	
Big Scale	15	Big Scale	19
Medium Scale	23	Medium Scale	22
Small Scale	62	Small Scale	59
TOTAL	100	TOTAL	100
TOTAL NUMBER OF RESPONDENTS		**400**	

All 400 questionnaires were returned, but 2 of the questionnaires were not completed, therefore only 398 questionnaires were being analysed for the study.

5.1 Validity and Reliability

In order to determine the validity of the instrument, factor analysis was carried out on the questionnaire items to measure the independent variables (innovation characteristics) and the dependent variables (technology acceptance).

Below are the factor analysis of both the independent variables (innovation characteristics) and the dependent variables (technology acceptance) for every item in the questionnaire.

Table 2: Factor Analyses for Innovation Characteristics Items (Independent Variables)

Innovation Characteristics					
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
V16	0.738				
V15	0.688				
V17	0.611				
V19	0.540				
V18	0.530				
V20	0.499				
V22	0.450				
V21		0.596			
V23		0.582			
V25		0.523			
V24			0.732		
V29			0.732		
V26			0.611		
V27				0.654	
V28				0.651	
V30				0.489	
V31					0.723
V34					0.714
V33					0.712
V32					0.700
Eigen Value	5.168	1.778	1.541	1.568	1.192
% Variance	25.486	7.408	6.012	5.518	3.598
%Cumulative Variance	25.486	32.798	37.808	43.343	48.82
Note: *only factor loading >0.4considered*					

Table 2 has shown the factor analysis on all items in innovation characteristics based on all 5 factors. Kaiser Mayer-Olkin test has resulted in 0.723 which is more that 0.4. Furthermore, Barlett test has shown the total matric correlation to be significant. (x^2 = 658.7, df=174, p=0.000).

Based on the results, all 5 factors were retained in the construct of the innovation characteristics which explained the 48.82% from the total variant samples. Varimax rotation and Kaiser Normalisation had shown that most items (v16, v15, v17, v19, v18, v20, v22) has 0.4 factor loading, and being categorised in factor 1 (relative advantage). Items (v21, v23, v25) are in factor 2 (Compatibility). Items (v24, v29, v26) are being categorised in factor 3 (triability). On the other hand, item (v27, v28, v30) are in factor 4 (complexity), and lastly item (v31, v34, v33, v32) are in factor 5 (observability). Altogether, there are 20 items that are being inserted as part of the questionnaire to be used to measure the innovation characteristics.

Table 3: Factor Analyses for Technology Acceptance Items (Dependent Variables)

Technology Acceptance				
	Factor 1	Factor 2	Factor 3	Factor 4
V37	0.84			
V36	0.82			
V38	0.71			
V35	0.66			
V41		0.69		
V40		0.65		
V42		0.61		
V43		0.58		
V44		0.55		
V47			0.72	
V46			0.68	
V45			0.63	
V49				0.67
V48				0.65
V50				0.53
Eigen Value	5.788	1.711	1.651	1.292
% Variance	35.612	7.321	4.511	8.865
%Cumalative Variance	35.612	6.541	5.781	48.92
Note : *only factor loading >0.4 considered*				

Table 3 has shown the factor analysis on all items in the innovation characteristics based on all 4 factors. Kaiser Mayer-Olkin test has resulted in 0.813 which is more than 0.4. Furthermore, Barlett test has shown the total matric correlation to be significant. (x^2 = 712.57, df=102, p=0.000).

Based on the results, all 4 factors were retained in the construct of the technology acceptance which explained the 48.92% from the total variant samples. Varimax rotation and Kaiser Normalisation had shown that most items (v35, v36, v37, v38) has 0.4 factor loading and being categorised in factor 1(effort expectancy). Items (v40, v41, v42,v43,v44) are in factor 2 (performance expectancy). Items (v45, v46, v47) are being categorised in factor 3 (social influence). Lastly item item (v48, v49, v50) are in factor 4 (faciliting condition).

Altogether, there are 15 items that are being inserted as part of the questionnaire to be used in measuring the technology acceptance. However, there are 35 items in total that are being inserted as part of the questionnaire to be used in measure both variables.

Table 4: Alpha Croncbach analysis

	Variables	Alpha Croncbach (n=100)	Items
1.	Relative Advantage	0.72	7
2.	Compatibility	0.63	3
3.	Triability	0.68	3
4.	Complexity	0.72	3
5.	Observability	0.79	4
6.	Effort Expectancy	0.68	4
7.	Performance Expectancy	0.77	5
8.	Sosial Influence	0.77	3
9.	Faciliting Condition	0.71	3

The questionnaire is reliable as it had been tested through a pre-test that was carried out earlier on 100 respondents. The reliability was confirmed by the results portrayed in the table below. The value of Cronbach Alpha was recorded at 0.6 to 0.8 for every item which is being regarded as reliable. Then, the researchers distributed the questionares according to the sample which was predetermined in the MADA territories. The data collection took nearly five months to be completed from starting February 2015 until July 2015.

Statistical tests such as correlation,t-test, anova and regression tests were conducted on the data collected through questionaires using Statistical Package for Social Sciences (SPSS) Version 21.

6.0 FINDING AND ANALYSIS

The finding and the analysis part present two of the main descriptive analysis, and one of the main hyphotesis tested was on hyphotesis Ha3. Below are the results for the particular analysis which has been conducted by the researchers after the data collection was made.

Table 5: The Commonly Used Communication Channels to Get Information on Paddy Plantation Innovation

Channel	*f*	%	n
Interpersonal Media			
MADA Officer (Extension Agent)	235	59.0	398
Traditional Media			
Agricultural Programs on Television	215	54.0	398
Newspapers	211	53.0	398
Agricultural Programs on Radio	211	53.0	398
Magazines	203	51.0	398
Brochures	125	31.4	398
Notices	100	25.1	398
Interactive Media			
Short Messaging Service (SMS)	203	51.0	398
MADA's Whatapps Group	201	50.5	398
MADA's Website	177	44.4	398
MADA's Facebook	167	41.9	398
MADA's TV	167	41.9	398
Youtube	164	41.2	398
MADA's Blog	164	41.2	398
Agricultural Agencies Webpages	160	40.2	398
MADA's Twitter	49	12.3	398
E-Mail	40	10.0	398

In this study, the researchers reviewed the communication channels that are commonly used by respondents for the purpose of obtaining information on paddy agricultural innovations as shown in Table 5.. A total of 3 categories of media was classified in the context of this study, which are Interpersonal Media, Traditional Media, and Interactive Media. Generally, interpersonal media,

namely MADA officials received more attention than the traditional media and interactive media (235, 59%). However, traditional media are also seen to play a major role as a communication channel for farmers. Agricultural programs on television, (215, 54%) and newspapers (211, 53%) are perceived as the two popular traditional media among them. Agricultural program on radio is next (211, 53%), then magazines (203, 51%), then brochures (125, 31.4%) and lastly the notification letter (100, 25.1%).

Along with the development of communication technology during the agricultural community, interactive media such as WhatsApp groups (201, 50.5%), MADA's website (177, 44.4%), MADA's Facebook page (167, 41.9%), MADA TV (167, 41.9%), Youtube Website (164,41.2%) and MADA's blog page (164,41.2%) have also gained attention among the respondents. In addition, interactive media such as Twitter (49, 12.3%) and emails (40, 10%) are the two least favourite interactive media. Interpersonal media use is more compared to interactive media, is possibly due to the satisfaction of information obtained from interpersonal media which is more face-to-face, compared to information content in interactive media which naturally can be insufficient and not being updated. Furthermore, interpersonal media is widely used by the farmers because it was convenience to them to make extensinve discussion with the extension agent.A study also revealed that in developing countries, the role of development agencies are necessary especially to transmit knowledge and skills to farmers in rural areas (Gijsbers, 2009). However, the benefits of communications technology should also be utilized by farmers to cultivate them further. Farmers should also adapt to technological development around them as it is closely associated with farming life. Current agricultural development scene also shows that agriculture is moving towards modern and digital agriculture.

Ha3: The Influence of Diffusion of Innovation Theory and UTAUT on the Technology Acceptance.

Table 6: Linear regression Test of Innovation Characteristic on Technology Acceptance

Variables	Beta	Sig.
Relative Advantages	0.113	0.030
Compatibilty	0.053	0.331
Triability	0.012	0.827
Complexity	0.062	0.233
Obsevability	0.239	0.000

R^2= 0.102,F=8.912, P=0.05

For the purpose testing hypothesis Ha3, Table 3.6 shows the linear regression test result that shows the influence of the innovation characteristics which includes the relative advantages, compatibility, trialibility, complexity, observability of technology acceptance. The significant independent variable is the relative advantage ($\beta = 0.113$, $p = 0.30$) and the observability ($\beta = 0.239$, $p = 0.00$). However, there is no influence of the variables according to compatibility ($\beta = 0.53$, $p = 0.331$), trialibility ($\beta = 0.012$, $p = 0827$) and complexity ($\beta = 0.062$, $p = 0.233$). Generally, the model obtained is significant ($F = 8912$, $p = 0.00$) and accounted for 10.2 percent of the variance. It also showed that 89.8 percent are other factors that affect the model but not in the context of this study. This contradicts the findings of Ibrahim and Sadiq (2012) who found a significant difference in the relative advantage, compatibility, trialibility, complexity and observability of technology adoption. According to Ibrahim and Sadiq (2012), these five variables each plays a role in the use of mobile banking. Nevertheless, the findings are in line with Al-Ghatani (2003) which have found no significant effect for suitability, trialibility, and complexity is likely due to the background of demographic, locality, environment, culture and the influence of other individuals who encourage the use of technological communications among farmers. This finding was also supported by Martins, Steil and Todesco (2004) and Kuria (2014) which states that there are other factors that also contribute to the acceptance of the technology, in addition to the innovation characteristic factors where they are used in different observations.

8.0 CONCLUSION

The use and the adoption of communication technology among farmers is unquestionablely important in making them more knowledgeable and informative. Communication technology should be utilised by the farmers to increase their productivity, which happens to be in-line with the target set by the Ministry of Agriculture and the Agro-based Industries in rice farming sector. The use of communication technology such as the interactive media and the social media has to be applied at farmers level. In reality, the process of diffusing the innovation to farmers has shown to be a success although it takes a relatively long time. This provides a positive indication of the increasing use and adoption in communication technology. However, the development agency (interpersonal communication) and traditional media are still widely used as a channel for farmers to get variety of information on rice farming. Due to the rapid development in communication technology, the role of development agencies should also be improved in order to meet the challenges of the current

and future for disseminating innovation for the good of agricultural development. Meanwhile, the combination of the two theories is found to be the basis for understanding the phenomenon of the use and adoption of communication technology. The effect of the Diffusion of Innovation Theory and the Unified Theory of Acceptance and Use of Technology through linear regression test has resulted in 10.2 percent of the variance. The combination of these two theories can be added and further modified to take into account other factors to study more on the use and the acceptance of innovation for later study.

REFERENCES

Bahaman Abu Samah, Jegak Uli, & Khadijah Alavi. (2009). *Media dan Perkembangan Pertanian Ke Arah Memperkasakan Komuniti Luar Bandar.* Penerbit: Universiti Putra Malaysia.

Benoit A. Aubert, Andreas Schroeder, & Jonathan Grimaudo. (2015*). IT As Enabler of Sustainable Farming: An Empirical Analysis of Farmers' Adoption Decision of Precision Agriculture Technology*. Decision Support Systems Volume 54, Issue 1, December 2012, Pages 510–520.

Creswell. (1998). *Qualitative Inquiry and Research Design: Choosing Among Five Traditions.* Thousand Oaks, CA. Sage Publication

*Evelien Lambrecht, Bianka Kühne, & Xavier Gellynck (2015). Success Factors ofInnovation Networks: Lessons from Agriculture in Flanders***.** Proceedings in System Dynamics and Innovation in Food Networks 2015

Farah & Bahaman (2013). *Factors Impinging Farmers Use of Agriculture Technology*. Asian Social Science Journal. ISSN 1911-2017.

Gerrit William Gijsbers. (2009). *Agricultural Innovation in Asia*. PhD Series in Research Management: 156. ISBN 978-905892-191-8.

Heather E. Hudson. (2014)**.** *Information Technologies for Rural Development in Africa: New Paradigms from Radio to Broadband*. The Economics of Information, Communication, and Entertainment 2014, pp 117-128.

Jean-Marc Touzard. (2015). *Innovation systems and knowledge communities in the agriculture and agrifood sector: a literature review*. Journal of Innovation Economics & Management. Pg: 208 DOI : 10.3917/jie.017.0117.2015.

Jock Anderson, Gershon Feder, Regina Birner, & Klaus Deininger (2010). *Promises and Realities of Community-Based Agricultural Extension.* IFPRI Discussion Paper 00959. International Food Policy Research Institute

Montazemi, Ali Reza, Saremi, & Hamed Qahri. (2013). *Factors Affecting Internet Banking Pre-usage Expectation Formation.* System Sciences (HICSS), 2013 46th Hawaii International Conference. ISSN :1530-1605E-ISBN :978-0-7695-4892-0. Print ISBN: 978-1-4673-5933-7 Page: 4666 – 4675

Moore G. C., & Benbasat, I. (1996). "*Development of an instrument to measure the perceptions of adopting an information technology innovation"*. Information System Research, *2*(30), 192-221.

Rogers (1995). *Communication of innovations: A cross cultural approach.*The Free Press.A Division of Macmillan Publishing Co. Inc. New York.

Solomon, T. Reta, Calvin A. Lathan, Edward M. Goldberg, & Kevin, J. Balog (2011). S*trategic Effect of Information and Communication Technologies on Malawian Smallholder Farmers: A Phenomenological Study.* Capella University, South Africa.

Syenna Marcista. (2012). *Indonesia dan MasyarakatInformasi, ImplementasiTeknologi, Kesenjangan Digital dan Teori Difusi Inovasi.* http://syennamarcista.wordpress.com/2012/11/22/indonesia-dan masyarakat-informasi-implementasi-teknologi-kesenjangan-digital-dan-teori-difusi-inovasi

Viswanath *Venkatesh*, Michael G. *Morris*, Gordon B. *Davis*, & Fred D. *Davis.* (2003). *User Acceptance of Information Technology: Towards a Unified View", MIS Quarterly, 27*(3), pp. 425 – 478.