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Review

Agricultural Extension Theories and Practice in Sub-Saharan Africa: A Critical Review

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Abstract

The paper critically examines the agricultural extension theories and practice in sub-Saharan Africa, and gives a typology of extension theories and technology acceptance model. Over the years, a number of models have been used to enhance the effectiveness of extension services and service delivery. However, the function of theory in research is to identify the starting point of the research problem and to establish the vision to which the problem is directed. Extension science evolved from rural sociology and overtime extension has become more and more associated with social psychology and communication. Consequently, extension theory helps us to comprehensively understand the contextual factors of the innovation process and provides valuable insights into the factors that influence adoption and decision-making amongst smallholder farmers. The paper reviewed and analyzed the most accepted theories/models being used historically and currently for studying technology adoption decisions amongst smallholder farmers. These theories/models include: Cognitive Dissonance Theory, Diffusion of Innovation Theory, Task Technology Fit Model, Expectation Disconfirmation Theory or Expectation Confirmation Theory, Theory of Planned Behaviour, Social Cognitive Theory, Technology Acceptance Model, Model of PC Utilization, Decomposed Theory of Planned Behaviour, The Unified Theory of Acceptance and Use of Technology.

Keywords: Adoption, diffusion, extension, models, practice, technology, theory.

INTRODUCTION

Agricultural extension services have long been recognized as the most important and critical channel to reach smallholder farmers worldwide (Hassan et al. 2011). Extension services have a significant catalytic role in present-day and future world development especially in terms of food security and prosperity (Shinn et al. 2009). In addition, extension services are an indispensable mainstay for agricultural development across the globe. Agricultural extension directly influences seven of the United Nations' Sustainable Development Goals (UN 2015). As a result, the fundamental role of agricultural extension cannot be overrated. Furthermore, Cunguara and Moder (2011) and Chowdhury et al. (2014) asserted that agricultural extension services play a significant role in, and are often credited with, improving food security, reducing poverty, and improving livelihoods. This assertion was sustained in the work of Ngugi et al. (2014) which maintained that participatory extension services are the most effective mechanism and package which assist smallholder farmers by exposing them to various educational techniques that equip farmers by making it possible for them to improve their farming enterprises; cultivation methods; rapidly increase productivity and increase income levels; improve livelihoods; and promote social and economic standards (Anderson and Feder 2004; Baig and Aldosari, 2013). The consensus view seems to be that agricultural extension has a momentous role in

encouraging the adoption of improved technologies and innovations; addressing rural poverty; increasing agricultural (mainly food) production and providing critical access to knowledge. This should lead to enhanced productivity, quality of life, and livelihoods (Anderson and Feder, 2007; Davis et al., 2010; Aker, 2011).

Currently, there is evidence from developing countries corroborating the notion that understanding extension services goes beyond the aforementioned roles to also include the subjects of training and learning, technology transfer, and helping farmers in forming groups (Davis et al., 2010; Chowdhury et al., 2014). Agricultural extension services in its broader working sphere now create initiatives dealing with marketing issues, in partnership with a wide range of service providers and other relevant organizations that address farming issues and rural development (Birner et al., 2009; Baig and Aldosari, 2013).

Extension services have been publicly funded and implemented in Nigeria since the pre-independence era of the 1960s through the Ministry of Agriculture. In this traditional system of extension, the national government was situated in the department of the regional government, and later adopted by the State Ministry of Agriculture (Okwu and Ejembi, 2001). There are changing trends and challenges facing the provision of coherent and quality delivery of extension to farmers that is aimed at ensuring sustainable agricultural development in Nigeria; these are often connected to social, economic, and environmental performance (Chowdhury et al., 2014). Key challenges include: extremely low extension agent to-farmers ratios; a lack of essential skills for efficient functioning; a lack of a definite plan of work; too few qualified and trained extension staff; under-resourced transport and logistics; poor, weak, and deteriorated infrastructure; extension organization and management problems; unclear extension mandates; lack of job descriptions for staff; poor remuneration of the personnel; and a high rate of absenteeism among staff (Naswem et al., 2008; Anandajayasekeram et al., 2008; Baig and Aldosari, 2013).

Consequently, in a reaction to the worrisome performance in the agricultural sector, the Government has embarked on several agricultural interventions and reforms, with policies and programs explicitly designed at reinvigorating the sector to its enviable position in the Nigerian economy between 1959 and 2000. It is important to note that various extension approaches exist and are increasingly being shown to play an essential role in the agricultural sector. These extension approaches are related to the extension theories. These are explored in the following section.

Theoretical and Conceptual Framework

Several theoretical models relating to technology adoption and communication are presented and critiqued. These theories are then applied to various extension approaches.

Technology Adoption Theories

Technology can be described as an enabler or a vehicle for the dissemination of information, knowledge, and skills to smallholders to increase agricultural productivity (Rogers, 2003). In the same vein, technology adoption could be viewed as a process of decision-making by farmers that require cognition, i.e., it necessitates the use of an individual's abilities to perceive, comprehend and interact with their environment in an intelligent way (Botha and Atkins, 2005; Samaradiwakara and Gunawardena, 2014). In order to understand the process of technology adoption, several theories have been put forward.

Abdellah (2015) defined theory as "an explanation of a phenomenon or abstract generalization that systematically describes the relationship among given phenomena, for purposes of explaining, predicting and controlling such phenomena". Moreover, the function of theory in research is to identify the starting point of the research problem and to establish the vision to which the problem is directed. According to Roling (1988) extension science evolved from rural sociology and overtime extension has become more and more associated with social psychology and communication. Consequently, extension theory helps us to comprehensively understand the contextual factors of the innovation process and provides valuable insights into the factors that influence adoption and decision-making amongst smallholder farmers. Traditionally, it was believed that all farmers would eventually see the benefits of the new technologies and for this reason, adopt those (Irungu et al., 2015). However, more recently, theories suggest that adoption is more complex. Samaradiwakara and Gunawardena (2014) reviewed and analyzed the most accepted theories/models being used historically and currently for studying technology adoption decisions amongst smallholder farmers. These theories/models include:

- Cognitive Dissonance Theory (Festinger 1957)
- Diffusion of Innovation Theory (Rogers 1962)
- Task Technology Fit Model (Strong et al. 1973)
- Expectation Disconfirmation Theory or Expectation Confirmation Theory (Oliver 1980)
- Theory of Planned Behaviour (Ajzen 1985)
- Social Cognitive Theory (Bandura 1986)
- Technology Acceptance Model (Davis 1989)
- Model of PC Utilization (Thompson et al. 1991)
- Decomposed Theory of Planned Behaviour (Taylor and Todd 1995)
- The Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2003).

For this research study, only five theories are

discussed here (highlighted in bold above) to give a general overview.

The foremost rationale for chosen these five theories as the focus of the study was mainly because they could embrace elements from anywhere and are more relevant and important to this research study and also provides the underlying principles for conducting the study to investigate the research questions. It also provides the background that supports the investigation and offers justification for the study.

Diffusion of Innovation Theory

According to Rogers (1962) and Rogers (2003), diffusion is the process by which an innovation or new idea spreads through certain communicated channels over time among smallholder farmers or members of a social system. The diffusion of new ideas alters the structure and function of a social system, ensuing the consequences that lead to social change (Rogers, 2003; Rogers, 2004). Roger's "Diffusion of Innovation Theory" has played a central role in extension theory and practice (Roling, 1988). Diffusion of Innovation Theory deals with innovation-development stages (Haider and Kreps, 2004; Sundstrom, 2016). The diffusion research provided feedback to agricultural researchers about the fate of their recommendations. The theory also provides a basis for creating a coherent body of generalizations, without which, the huge body of completed research might be "a mile wide and an inch deep" (Rogers, 1995).

According to Rogers (1995) diffusion is not a single, all-inclusive theory. Rather, it is several theoretical perspectives that relate to the general concept of diffusion; it is a meta-theory (Yates, 2001). Researchers identified four factors that influence the adoption of an innovation (Rogers, 1995; Yates, 2001; Botha and Atkins, 2005; Nutley et al., 2012), including:

- **The innovation itself**: Understanding the nature of innovation and its ultimate goal to the well-being of smallholder farmers and rural communities could help to predict the likelihood of adoption of such innovation. Besides, the rate at which innovation is adopted by smallholder farmers broadly depends on the innovation itself, its traits, the personal characteristics of the rural farmers, and the local environment in which the technology/innovation transfer process takes place (Palis et al., 2010). However, without an excellent understanding of how innovation and the potential users (smallholder farmers) interact in their local setting before and during an innovation process, any attempt by extension workers to transfer an innovation may not succeed. This is a top-down approach of innovation diffusion theory and the target users may not adopt the innovation (Rogers, 2003). Consequently, the effective participation of the rural farmers in the development process of innovation cannot be overemphasized. Similarly, the fundamental goal of agricultural technology/innovation diffusion among the rural community is to improve the welfare of the households, and this is done by validating and promoting the use of agricultural innovation that could enhance crop productivity and farmer's income (Palis et al., 2010).
- **The communication channels**: Utilized to spread information about the innovation**:** The use of accurate and appropriate channels of communication helps in facilitating and influence the rate of adoption of innovation among rural communities. Therefore, in the opinion of Olajide and Oresanya (2017), the right communication channels have the inherent potential to disseminating timely and up-to-date information to smallholder farmers. The literature revealed that there are various communication channels employed by researchers and extension workers ranging from mass media, traditional media, print media, on-farm researcher-led demonstrations, farmer-to-farmers information sharing system, community leaders, community broadcasting, modern ICT, interpersonal and small group communication (Ajani and Agwu, 2012; Nyambo and Ligate, 2013; Ilahiane, 2013; Mwombe et al., 2014; Kiptot and Franzel, 2015; Mingxiang et al., 2016). However, Mwombe et al. (2014) argued that the use of modern ICT, particularly mobile technology text messaging was found to be very effective and influence the rapid spread of agricultural innovation and subsequent adoption among smallholder banana farmers in Kenya. On the other hand, Kiptot and Franzel (2015) opined that farmer-to-farmer extension is playing a complementary role to formal extension services in facilitating the spread of agricultural technologies and improving farmers' capacities.
- **Time:** Diffusion is a process by which innovation is communicated through channels over time among members of a social system (Rogers, 2003). The time taken to propagate the information of innovation may influence the adoption of such innovation among smallholder farmers. Furthermore, the more complex an innovation is, the more likely the farmers have to change their attitude and belief to receive timely information before adopting the innovation. On the contrary, the easier an innovation is for farmers to experiment, the more likely the innovation will be adopted (Palis et al., 2010; Saravanan, 2013). Smallholder farmers may be classified into categories based upon the time of adoption of innovation as an innovator, early adopters, early and late majority, and late adopter or laggards (Rogers, 1995).
- **The nature of the society:** To whom it is introduced or the social system: The local setting of the smallholders to which the innovation is communicated may influence significantly the adoption of innovation. The success of innovation diffusion is subjected to a wide range of factors; the nature of the society, social norms, beliefs, attitude, and knowledge of the target users (Palis et al.,

2010). Therefore the nature of the society of the farmers may influence their decision to adopt an innovation.

However, Agarwal (2000) argues that “the potential users make decisions to adopt or reject an innovation based on beliefs that they form about the innovation or technology”. On the other hand, Lee et al. (2011) identified five characteristics of innovations theory: relative advantage, compatibility, complexity, trialability, and observability. In the same light, Rogers (1995) illustrates that there are four main theories that concord with the diffusion of innovations. These include the innovation-decision process theory, the individual innovativeness theory, the rate of adoption theory, and the theory of perceived attributes. However, Rogers failed to reveal how knowledge has been acquired. The significant limitation of the theory is that it does not consider the possibility that people will reject an innovation even if they fully comprehend the idea behind the new technology (Waterman, 2004). Similarly, inadequate consideration is given to the innovation characteristics and how these change over time (Botha and Atkins, 2005).

Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is one unique case of multi-equation theory that attempts to describe people's cognition. The theory was first postulated by Ajzen (1985); the theory explains why a person behaves in a certain way, takes into consideration available information, and considers the resultant effect of their actions (Figure 1). In addition, the theory proposes that "a person's intention to perform (or not to perform) a behavior is the most important immediate determinant of that action. Basically, the theory predicts a person's intention"(ibid. 2005). Furthermore, it recognizes and integrates other determinants of behavior in the conceptual model to account for attitudes, social influence, and perceptions over control. The motivating factors are attitude towards the behavior, subjective norm, and perceived behavioral control. Altogether, the impact the behavior of an individual, which depends on the situation under consideration (ibid. 2005). The theory also provides a standard framework to explain the relationship between decision variables. Three key concepts determine the intention of an individual, these include their attitude towards the particular behavior, their subjective norms, and their perceived behavioral control (Ajzen, 2005, De Cannière et al., 2009). The Theory of Planned Behaviour has strength in describing and predicting the technology adoption behavior of farmers, yet it clearly disregards the eccentricity behavior as well as the complexities of interconnection between farmers, workers, families, and third parties (Ukohalet al., 2011 – see later).

Social Cognitive Theory

The Social Cognitive Theory was postulated by Bandura (1986) and the theory suggests that environmental conditions, demographic characteristics (in the form of cognitive and affective factors, etc), and behavior are determined communally. Furthermore, studies have shown that variables such as gender, age, and experience play an important role in the explanation of technology acceptance and adoption amongst rural communities (Venkatesh and Davis, 2000; Colley and Comber, 2003; Samaradiwakara and Gunawardena, 2014). An individual’s cognitive competencies influence the behavior of technology acceptance and adoption and a productive interplay with the technology (Compeau and Higgins, 1995; Long, 2005). The Social Cognitive Theory gives importance to the concept of self-efficacy; where self-efficacy is defined as the perception of one's capability to utilize technology to achieve a distinct task (Compeau and Higgins, 1995).

Social Cognitive Theory has been criticized for its inadequate to account for age-related development differences, inadequate specificity of cognitive process, failure to clearly explain differences between behavioral competency and performance, and implications that social conformity is a developmental achievement (Carillo, 2015). The theory was also criticized for giving too much focus on the situation and very little explanation around a person's inner traits and does explain a substantive amount of variance in health behavior (Bandura, 2001). Critics also emphasized that the theory focuses on one or two constructs such as self-efficacy while ignoring the others, and is not a fully systematized, unified theory and is also slackly organized (Nabavi, 2012; Carillo, 2015).

The Unified Theory of Acceptance and Use of Technology

Based on eight other theories and models, another important theoretical model called the Unified Theory of Acceptance and Use of Technology (UTAUT) was proposed by Venkatesh et al. (2003). This has four central determinants of intentions to use the information on technology; these are (1) performance expectancy, (2) effort expectancy, (3) social influence, and (4) facilitating conditions. All of these are influential and have been theorized in formulating the UTAUT with the core aim of determining user acceptance and usage behavior on technology (Figure 2). These four constructs are defined as follows:

- **Performance expectancy:** The degree to which the user expects that acceptance and usage of the system will help him attain higher yields in agricultural produce (Venkatesh et al., 2003). Interestingly, this new construction has five source constructs from the other

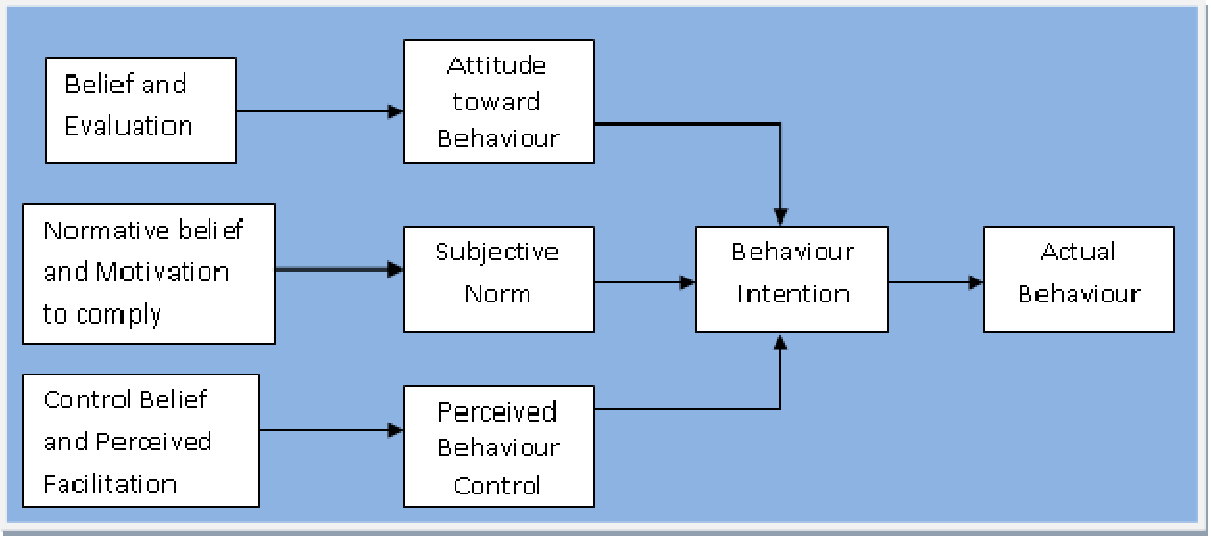

Figure 1. Theory of Planned Behaviour (Ajzen, 2005).

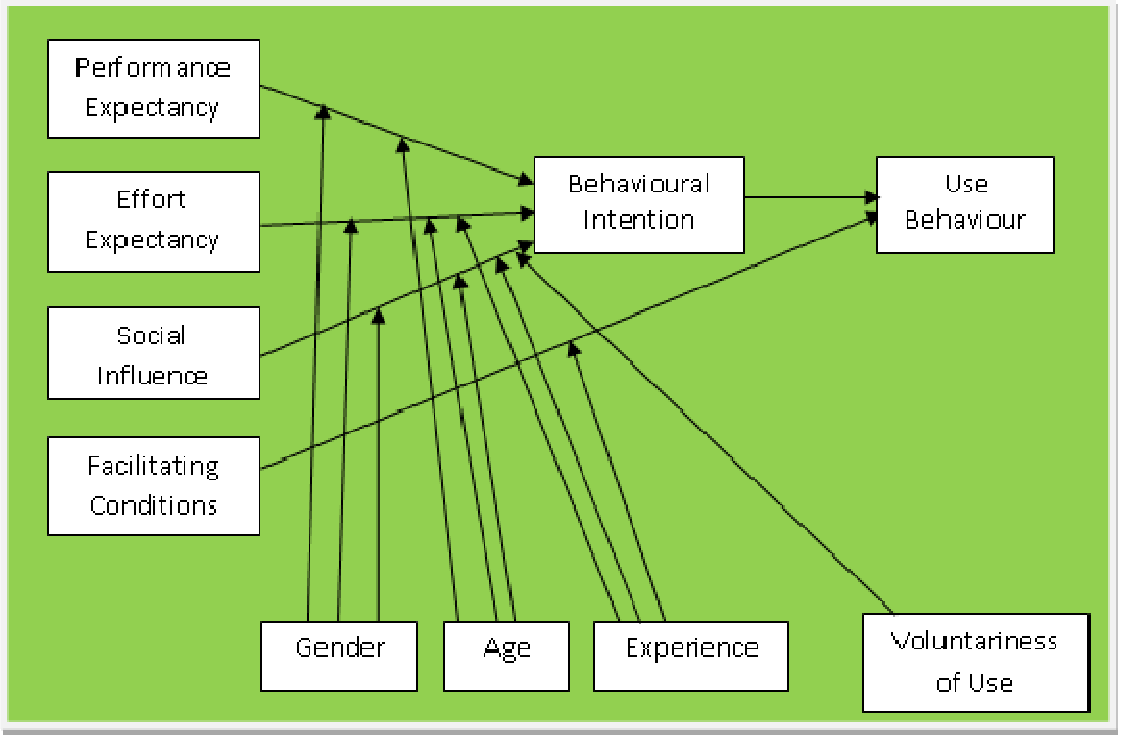

Figure 2. The Unified Theory of Acceptance and Use of Technology model (Venkatesh et al., 2003).

theories (Technology Accepted Model and Social Cognitive Theory) and models: perceived usefulness, extrinsic motivation (theory/model), relative advantage (theory/model), and outcome expectations (theory/model) (Venkatesh et al., 2003; Long, 2010).

- **Effort expectancy:** The degree of ease connected with the acceptance and usage of the system.
- **Social influence:** The extent to which an individual perceives that important others believe that he or she should use the new system (Venkatesh et al., 2003).
- **Facilitating conditions:** The age and experience of an individual influence the usage of a system. Basically, the moderators of this model are gender, age, voluntariness, and experience (Samaradiwakara and Gunawardena, 2014).

The UTAUT also provides a refined view of how the

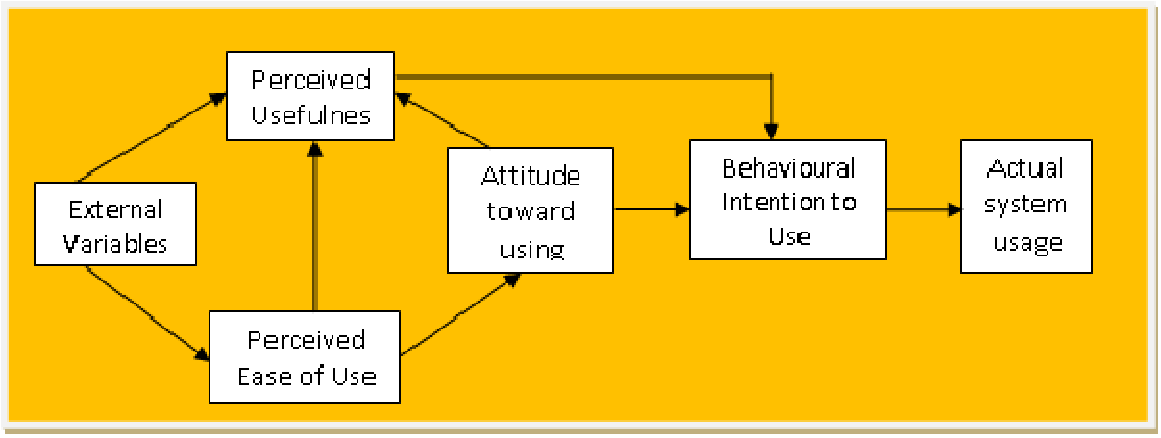

Figure 3. Technology Acceptance Model.
Source: Davis (1989)

determinants of intention and behavior change over time, however, most of the relationships in the model are moderated (Venkatesh et al., 2003; Kriponant, 2007).

Technology Acceptance Model

The Technology Acceptance Model (TAM) was proposed by Davis (1989) as the first model to identify psychological factors affecting technology acceptance amongst farmers and it was developed from the Theory of Reasoned Action postulated by Fishbein and Ajzen (1980). The model is an information system theory in which the users (smallholder farmers) come to adopt and put into practice a technology. The TAM argues that when smallholder farmers are presented with new technology, a number of motivating factors influence their decisions about how and when they will implement and use the technology, primarily:

- **Perceived Usefulness (PU):** Refers to the degree to which a person believes that using a particular system would result in enhanced job performance and output efficiency (Lederer et al. 1998).
- **Perceived Ease of Use:** The degree to which a person feels that the technology will need little or no effort determines Perceived Ease of Use (PEU).

Both perceived use and perceived ease of use influence the farmers' attitude towards new technology, which affects the intention to adopt the technology (Venkatesh and Davis 2000, Liu and Ma 2006). The Technology Acceptance Model also suggests that users could choose to adopt a specific improved technology based on individual cost-benefits thoughtfulness (Compeau et al. 1999). This signifies that individuals are more likely to adopt or accept technology if there is added value to a process (Figure 3).

The underlying correlation between two key constructs and users' attitudes, intention, and actual technology usage behavior, were specified using the theoretical underpinning of the previous version of the Theory of Reasoned Action (Davis, 1989). Besides, perceived usefulness is likewise seen as being impacted by perceived ease of use (Davis 1989, Venkatesh and Morris 2000). The TAM has been widely studied by many researchers for various technology adoption situations and has perhaps become the most influential theory; It has also been upgraded to the TAM2 and TAM3 (Venkatesh and Davis, 2000; Venkatesh and Morris, 2000; Plouffe et al., 2001; Mathieson et al., 2001). According to Venkatesh and Davis (2000), the main contribution of TAM2 was that it incorporates additional theoretical constructs spanning social influence processes (such as subjective norms, voluntariness, and image) and cognitive instrumental processes (such as job relevance, output quality, result demonstrability and perceived ease of use). The TAM3 has also been proposed in the context of e-commerce (Wixom and Todd, 2005; Venkatesh and Bala, 2008). Basically, TAM3 focuses on the determinants that influence Perceived Usefulness and Perceived Ease of Use of an innovation/new technology.

According to Trakulmaykee et al. (2015), the model can be analyzed as follow:

- **TAM 1:** Is the original model which has two factors (Perceived Usefulness and Perceived Ease of Use) to influence users' intention to use new innovation.
- **TAM 2:** Have three factors (Perceived Usefulness, Perceived Ease of Use, and Perceived Control P). As mentioned previously, the model has three generic perceptions which are two original perceptions from TAM and PCP.
- **TAM 3:** Have five factors (Perceived Usefulness, Perceived Ease of Use, PCP, PCP, and PAQ), two factors are original factors in TAM and the other three factors are extended factors.

The Technology Acceptance Model

The adoption theories/models discussed above individually have both user acceptance with some overlapping constructs (Dillion and Morris, 1996). This section presents a critique of the main model used for this research study - TAM. The Technology Acceptance Model was developed by Davis in 1989, the theory attaches high importance to understanding the different sets of new technology acceptance and adoption determinants. However, the theory has been widely criticized despite its frequent use amongst researchers, for its questionable heuristic value (approach to problem-solving, learning, or discovery that employs a practical method not guaranteed to be optimal or perfect, but sufficient for the immediate goals), limited explanatory value and lack of any practical value (Chutter, 2009). Also, TAM is considered to be limited in providing significant information about the users' acceptance of a particular technology and its inability to consider other factors such as time or lack of funds that could hinder an individual from utilizing information and adopting an innovation (Mathieson et al., 2001; Koufaris, 2002).

Benbasat and Barkin (2007) opined that "TAM has diverted its attention away from significant research issues and has created an illusion of progress in knowledge accumulation". The author stated further that the independent effort by many researchers to expand TAM to adapt it has led to a state of theoretical chaos and mystification. In the same vein, Lunceford et al. (2009) argue that the framework of perceived usefulness and ease to use neglect other important issues, such as cost and structural requirements that force users into adopting the new technology. Another limitation noted by Chuttur (2009) was that many researchers are uncertain about the application and theoretical precision of the model; as a result, it is persuasive to conclude that research on the Technology Acceptance Model (TAM) may have attained a saturation stage.

CONCLUSION

This suggests future research may focus on developing new models that that would take advantage of the strong points of TAM. Bogozzi (2007) acknowledged specific noticeable limitations of the TAM and emphasized that the model is inadequate in explaining technology adoption by ignoring the societal influence that dictates technology adoption. He stated further that aside from the individual perspective that influences the adoption of technology, other factors such as user's community, exposure, environment, and economic status of the target population can collectively influence the adoption and use of technology. However, Benbasat and Barkin (2007) criticized the TAM for inadequate to accommodate and adapt to the regularly changing Information Technology environment which has led to hypothetical disarray and chaos. Generally, the TAM has been criticized and the limitations identified by many scholars initiated the development of the Unified Theory of Acceptance and Use of Information Technology (UTAUT).

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