DO CONSTRUCTS OF TECHNOLOGY ACCEPTANCE MODEL PREDICT THE ICT APPROPRIATION BY PHYSICIANS AND NURSES IN HEALTHCARE PUBLIC CENTRES IN AGADIR, SOUTH OF MOROCCO?

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Abstract: This communication explores the constructs of Technology Acceptance Model (TAM) and examines if they do predict the Information and communication technology (ICT) appropriation by physicians and nurses working in healthcare public centers in Agadir City, South of Morocco. The study revealed that Attitude, Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) influence positively the intention of ICT appropriation. Also Perceived Usefulness is still to be a major determinant of the intention of ICT appropriation by these practitioners.

1 INTRODUCTION

Information and communication technology (ICT) leads to some significant changes of information management. It allows high-quality and efficient care delivery (Wu et al., 2009) and contributes to organizational expenses reduction (Scott, 2007). Thus, the hospital, as a healthcare organization, is more and more concerned by ICT appropriation by practitioners, especially physicians and nurses. It is defined as the process by which people consider technologies in their practices (DeSanctis and Poole, 1994) and it is also seen, as the ultimate goal of the usage process (Proulx, 2001).

This communication shows the progress of an ongoing research project in Morocco. It concerns ten health pubic centers located in Agadir city, south of Morocco. It attempts to answer the question: Do constructs of Technology Acceptance Model (TAM) predict the ICT appropriation by healthcare practitioners in health public centres in Morocco? It examines Attitude, Perceived Usefulness and Perceived Ease of Use variables that might affect the intention of the appropriation of ICT by physicians and nurses working for these centres.

The first paragraph will review the literature on the adoption theories, will present the Technology Acceptance Model and its extension, and will examine the research work on the prediction of ICT appropriation in healthcare context. The second one will introduce the hypothesis and will propose a research model, the third will show the methodology retained. Before concluding and recommending managerial implications, the outcomes will be presented and discussed in the fourth paragraph.

2 LITERATURE REVUE

According to Sally and Indrit (2007), "*Many competing theoretical models co-exist in the innovation acceptance and adoption literatur*e..., *most of these models attempt build theories to explain how and why innovations or technologies are adopted and predict the level of acceptance and adoption"*.

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Research in Information Systems studies how and why individuals adopt ICT (Venkatech et al., 2003). One of the streams that it developed referred to adoption theories to study the acceptance and predict the use of ICT (Kukafka et al., 2003). The following sub-paragraphs review briefly adoption theories and models considered as a basis to build up a framework for predicting ICT appropriation. Prior presenting researches in the healthcare context, they introduce Innovation Diffusion Theory (IDT), Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), and Theory of Interpersonal Behavior (TIB); and describes Technology Acceptance Model (TAM) and its extension.

2.1 Adoption Theories

2.1.1 Innovation Diffusion Theory

Rogers (1983) has developed a theory called the Innovation Diffusion Theory (IDT) in order to study and understand the diffusion of a given innovation within a social group. Compeau and Higgins (1991) noted that this theory can be also applied to individual reactions vis-à-vis the decision of adoption of an innovation, especially computing technology. In 1995, Rogers considered that five factors affect the innovation adoption: 1) Relative advantage 2) Compatibility 3) Complexity 4) Trialability and 5) Observability. Chau and Tam (1997) stated that it provides a solid basis to develop a conceptual ICT appropriation models, but it does not explain clearly, neither adoption behaviors nor individual reluctance.

2.1.2 Theory of Reasoned Action

In 1975, Fishbien and Ajzen defined relationships between beliefs, attitudes, social norms, intentions and behavior in what they called Theory of Reasoned Action (TRA). It stated that an individual's actual behavior is determined by the person's intention to perform the behavior, and this intention is influenced jointly by the individual's attitude and subjective norms. Attitude is determined by relevant beliefs about the results of performing the behavior and the evaluation of the desirability of those results.

2.1.3 Theory of Planned Behavior

According to the Theory of Planned Behavior (TPB) (Ajzen, 1991) which is an extension of TRA, the behavior is determined by the intention; this one is predicted by three factors: attitude towards the behavior, subjective norms, and perceived behavioral control. It introduced a third construct of intention called Perceived Behavior Control (PBC). This theory attempted to overcome the problem of volitional control found in TRA and postulates that attitude, subjective norms, and PBC are direct determinants of intentions that have a positive impact on appropriation behavior.

2.1.4 Theory of Interpersonal Behavior

The Theory of Interpersonal Behavior (TIB) is founded by Triandis on 1980. It is based on the psychological model to understand ICT appropriation by individuals and integrated the majority of the variables presented in the above mentioned theories. The TIB postulated that a behavior has three determinants: Intention, Habits and Facilitating Conditions. The intention itself involves four determinants: Social factors, Perceived consequences (cognitive dimension of the practice), Personal affection (emotional dimension) and Convictions.

2.2 Technology Acceptance Model and its Extension

2.2.1 Technology Acceptance Model

The literature in Information Systems area showed that a large number of models were drawn from the TRA. For instance contrary to IDT that focused on innovation itself, TRA examines perceptions of the ICT appropriation by individuals (Moore and Benbasat, 1991). One of these models, moreover, simplest, easiest and more used by the researchers in this area is the Technology Acceptance Model (TAM) (Figure 1 in Appendix). Since it was developed by Davis in 1989, it represents the most powerful models to establish the variables which influence the acceptance of ICT. This model is proved to be the more successful in the prediction and the explanation of the appropriation of this technology (Adams and al, 1992; Igbaria, 1993; Chang, 1998). The TAM suggests that the real use of a technology can be determined by behavioural intention. This later is influenced by individual attitude. Behavioural intention is modelled as a function of the attitude and usefulness and determines the actual use. Attitude is defined as the positive or negative feelings towards ICT. Within this model, Davis (1989) defines the two constructs that are of primary relevance to computer acceptance

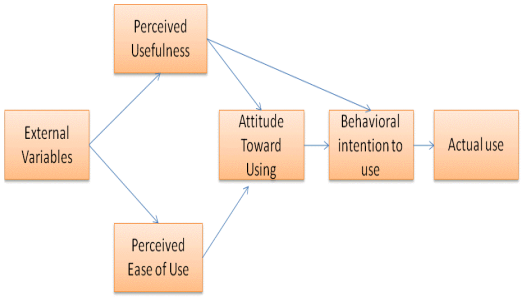

Figure 1: Technology Acceptance Model (Davis et al., 1989).

behaviors: (1) Perceived Usefulness (PU) means degree to which a person believes that using a particular system would enhance his/her job performance; (2) Perceived Ease of Use (PEOU) designs degree to which a person believes that using a particular system would be free of effort. These two basic constructs undergo the effect of external factors (individual, organisational or technical) that influence positively or negatively intention of ICT appropriation by individual. Thus, there is a need for the extension of the original technology acceptance model.

2.2.2 Extended Technology Acceptance Model

Many changes to the original TAM model have been made allowing new models. The most well-known ones are presented in the following.

In 1995 Taylor and Todd developed a model called "the Augmented TAM" which is an extension of the original TAM. They aimed to understand the behavior of experienced and inexperienced users. The results revealed that their model can be used to predict ICT appropriation for inexperienced users, and the perceived usefulness was the strongest predictor of intention of the ICT appropriation for the inexperienced users. Whereas, perceived behavioral control was the predictor of experienced users' intention. They also found a strong link between behavioral intention and behavior for experienced users.

The objective of Igbaria, Parasuraman, and Baroudi's study (1996) was to examine the influence of three motivators 1) perceived usefulness, 2) perceived enjoyment/fun, and 3) social pressure on ICT appropriation by individual. Their results showed the importance of perceived usefulness, perceived enjoyment, and social pressure in mediating the relationships of antecedent variables and perceived complexity on microcomputer appropriation. They explained the relationships between perceived usefulness, perceived enjoyment, social pressure, and microcomputer usage, and revealed that perceived complexity is an important variable in linking skills, organizational support, and organizational usage with perceived usefulness, perceived enjoyment, and social pressure.

Agarwal and Prasad (1998) developed a modified TAM model that focused on the perceptions of technology usefulness and ease of use. It is based on the idea that personal innovativeness positively moderates the relationship between the perceptions of relative advantage, ease of use, compatibility and the intention of ICT appropriation. Moreover, Agarwal and Karahanna (1998) have added other causal links between compatibility, perceived usefulness and ease use. Their results support the indirect effect of compatibility on the individual attitude through the perceived usefulness an ease of Use. They showed that compatibility is an important factor in the contemporary technological environment.

Compeau, Higgins, and Huff (1999) developed a conceptual model to study the influences of self-efficacy, performance and personal outcome expectations, affect, and anxiety on ICT appropriation. Their results reveal that the relationship between personal outcome expectations and affect was not supported. Furthermore, they confirmed a negative relationship between personal outcome expectations and use, and found that self-efficacy explains a total of 18% of the variance in an individual ICT appropriation.

In 2000 Venkatesh and Davis extended the original TAM to TAM2 by introducing social and cognitive constructs. Their objective was to explain PU and appropriation intention in terms of social influence processes (Subjective Norm, Voluntariness, and Image) and cognitive instrumental processes (Job Relevance, Output Quality, Result Demonstrability and PEOU). Their results showed that the TAM2 explained up to 60% of the variance in perceived usefulness as a determinant of individual appropriation intention.

In 2003, Venkatesh et al. Synthesized acceptance models to propose the Unified Theory of Acceptance and Use of Technology (UTAUT). It is formulated with four constructs of intentions and usage: performance expectancy, effort expectancy, social influence, and facilitating conditions, moderated by: gender, age, experience, and voluntariness of use. UTAUT identifies three constructs as determinants of intention of appropriation: performance expected from use, expected efforts and social influence. It

accounts for 70% of variance in appropriation intention, and enables a much more sophisticated analysis of appropriation behaviors.

2.3 Prediction of ICT Application in Healthcare Context

TAM is widely used by researchers to predict the appropriation of ICT by individuals, particularly in the healthcare context. This subparagraph presents a summary of the literature review in this context.

Hu et al. (1999) applied the original TAM model to study the appropriation of telemedicine- an ICT application- by physicians. The outcomes showed that perceived usefulness and attitude have a large influence on the intention of physicians to appropriate telemedicine. Thus, they concluded the limited utility of this model to predict and explain ICT appropriation by individuals in healthcare context. Subsequently, in addition to the original model, Chau and Hu (2001, 2002) used an integrated model derived from TAM and TPB to evaluate decisions of ICT appropriation based on the technology's compatibility. Their results revealed that PU and Attitude influence positively telemedicine appropriation by physicians, whereas PEOU, subjective norms and perceived behavioral control have no effect on this appropriation. They concluded that TAM model seemed to be the most appropriate model to predict and explain ICT appropriation by physicians.

To study factors influencing ICT appropriation by physicians, Croteau and Vieru (2002) proposed a conceptual model combining the original TAM and the Innovation diffusion theory. They used a sample of 390 physicians to test it. A group of 250 were working for a large urban institution, and another group of 140 for rural institutions. The outcomes showed that perceived effort and PEOU have a significant effect on the intention of ICT appropriation by physicians for both groups; PU is found to be the most significant factor of this intention.

Referring to TAM2, Chismar and Wiley-Patton (2003) considered cognitive instrumental and social influence to find out the variable contributing to the appropriation intention of Internet-based applications by pediatricians in Hawaii. Their outcomes revealed that the primary factors of ICT appropriation by pediatricians relate to their usefulness and job relevance. Still, ease of use and social influence do have no influence on this intention. They conclude that TAM2 model explained at least 40 % of physicians' intention to appropriate internet-based applications.

To explain the intention of patient to use e-health solutions, Wilson and Lankton (2004), tested three theoretical models of ICT acceptance (TAM, motivational model and integrated model) among patients who had recently registered for access to provider-delivered e-health. An online questionnaire was administered to 1750 to measure perceptual constructs from these models (intrinsic motivation, perceived ease of use, perceived usefulness/extrinsic motivation, and behavioral intention to use e-health). Only 163 were completed representing 9% of the total population. Results confirmed that the three tested models performed well in predicting patients' intention to appropriate to e-health.

Banderker and Van Belle (2006) conducted a qualitative study in two public hospitals in Western Cape, South Africa, to study the influencing factors of the mobile appropriation by physicians. They concluded that Work importance, Utility, Fit task-work, Demonstrability, Self-efficacy and Characteristics of the technology influence positively the intention of physicians to appropriate ICTs. Moreover, physicians having technical skills intend more to appropriate technologies.

Schaper and Pervan (2007) examined the ICT appropriation by the Australian therapists. To develop their conceptual model, they referred to literature review on adoption of technologies by health care actors, to Unified Theory of Acceptance Use of Technology, and to generic structure of acceptance proposed Chau and Hu in 2002. Results of their analysis confirmed that the influence of compatibility, attitude, and self-efficacy on the intention of therapists to appropriation ICT is larger than the one of perceived effort, and social influence. They also noted the importance of motivation, individual engagement and the variables moderating (age, experience, and skill) to explain this intention.

In 2007 Wu et al., aimed to present a conceptual framework for assessing the medical professional behavioral intention to adopt Mobile Healthcare Systems which defining the healthcare information processing systems, including all relevant medical professional participants and the use of new technology to deliver healthcare services and exchange healthcare information via mobile devices anytime and everywhere. Technology acceptance model (TAM) and the innovation diffusion theory (IDT) serve as the theoretical basis to develop their research model. Conformation factor analysis was performed to test the reliability and validity of the

measurement model, and the structural equation modeling technique was used to evaluate the causal model. Their results indicated that compatibility, perceived usefulness and perceived ease of use significantly affected healthcare professional appropriation intention. Furthermore, Mobile Healthcare Systems (MHS) self-efficacy had strong indirect impact on healthcare professional appropriation intention through the mediators of perceived usefulness and perceived ease of use. However, the hypotheses for technical support and training effects on the perceived usefulness and perceived ease of use were not supported.

Wu et al., (2008), tried to understand factors that might influence healthcare professional's appropriation to an adverse event reporting system. Their conceptual model integrated, besides to TAM constructs, trust and management support as determinants of intention appropriation. The outcomes indicated that perceived usefulness, perceived ease of use, subjective norm, and trust had a significant effect on a professional's intention to appropriate an adverse event reporting system.

Recently, Aggelidis and Chatzoglou (2009) attempted to test the applicability and effectiveness of technology acceptance models in health care area in Greece, and examined factors affecting the intention of public health institutions' personnel to appropriate ICTs. They have extended the original TAM by include the following exogenous constructs: anxiety, self-efficacy, facilitating condition, training and social influence. Their results indicated that perceived usefulness, ease of use, social influence, attitude, facilitating conditions and self-efficacy significantly affect hospital personnel behavioral intention. Training has a strong indirect impact on behavioral intention through the mediators of facilitating condition and ease of use.

3 HYPOTHESES AND RESEARCH MODEL

Research work reviewed in the previous paragraph and by a prior exploratory study conducted by the author (Bennani et al., 2008) inspired the hypothetical research model suggested in this communication (Figure 2). Compared to the traditional TAM model, the interrelationships between PU, PEOU constructs and the Attitude variable have been modified to stress the importance of the later in the proposed model in order to explain the intention of ICT appropriation by physicians and nurses.

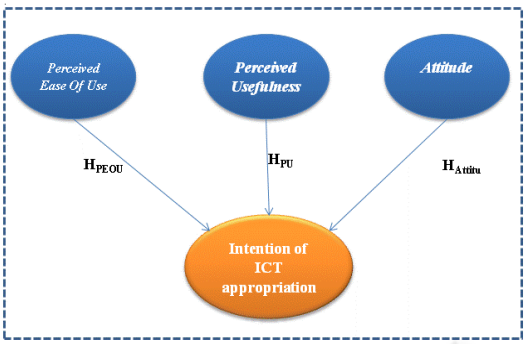

Figure 2: Hypothetical research model.

Roger's innovation diffusion theory provided a context in which ICT appropriation could be explored, but it didn't explain this appropriation totally. However, it offered a basis for the development of this model.

Theories of reasoned action, planned behavior and interpersonal behavior examined individual behavior, and concluded that ***ICT appropriation,*** as behavior**,** can be depicted by ***Intention*** variable. This later is defined like an intermediate between attitude and the behavior (Fishbein and Ajzen,1975). It shows desire, wish, and determination or will to emit a behavior. Dodds, Monroe and Grewall (1991), specified that intention of ICT appropriation represents the probability that a potential user will intend to use technology. Referring to Technology Acceptance Model, Intention is influenced by individual Attitude, Perceived Usefulness (PU) and Perceived Ease Of Use. Three hypotheses are tested in this communication.

Attitude

The first hypothesis is:

H_{Attitu} : *The attitude influences positively the intention of the appropriation of ICT by physician and nurses working in health public centers*

According to Triandis (1980) ***Attitude*** indicates "*the affect*", it is defined as the feeling of pleasure, gaiety and dissatisfaction that associates individual to a given behavior. For Ajzen (1975), attitude is "*a predisposition to answer an object in a favorable or unfavorable way*". It expresses the positive or negative feelings about performing the ICT appropriation (Ajzen and Fishbein, 1980, Davis, 1989). Several studies noted the positive influence of attitude on intention (Davis et al. 1989; Jackson et al. 1997; Karahana et al. 1999). In healthcare context, Chau and Hu (2001, 2002) concluded that Attitude influences positively the intention to appropriate telemedicine, moreover, Schaper and Pervan (2007) confirmed the positive impact of

Attitude on ICT appropriation by therapists. Recently, Aggelidis and Chatzoglou (2009) indicated that Attitude affect positively hospital personnel ICT appropriation intention.

Perceived Usefulness (PU)

The second hypothesis is:

H_{PU}: *The Perceived usefulness influences positively the intention for the appropriation of ICT by physician and nurses working in health public centers*

Perceived usefulness (PU) is one of the prior belief constructs developed by TAM. It is defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance*" (Davis et al., 1989). It represents a theoretical substitute of "the relative advantage" developed in the IDT. According to Roger (1995), relative advantage means the degree to which using the innovation is perceived as being better than using its precursor. PU is proved to be an important determinant of ICT appropriation intention (Taylor and Todd , 1995 ; Igbaria et al., 1996 Venkatesh and Davis, 2000; Gefen et al., 2003, Venkatesh et al, 2003). Within the healthcare area, perceived usefulness is a major determinant of physicians' intention to appropriate ICTs. This result is supported by Hu et al., 1999; Chau and Hu 2001, 2002; Croteau and Vieru, 2002; Chismar and Wiley-Patton, 2002; Schaper and Pervan, 2007; Wu et al., 2007; Aggelidis and Chatzoglou, 2009.

Perceived Ease Of Use (PEOU)

The third hypothesis is:

H_{PEOU}: *The Perceived ease of use influences positively the intention for the appropriation of ICT by physician and nurses working in health public centers*

Perceived ease of use (PEOU) refers to "*the degree to which a person believes that using a particular system would be free of effort*" (Davis et al., 1989). It indicates degree to which user finds that the use of a technology is relatively deprived of effort. Technologies perceived as being easier to use and less complicated are more likely to be appropriated by potential users. Compared to perceived usefulness, perceived ease of use is considered the second important determinant of a user's ICT appropriation (Davis, 1989; Taylor and Todd, 1995; Igbaria et al., 1996; Agarwal and Prasad, 1998; Venkatesh and Davis, 2000; Venkatesh et al., 2003). In healthcare context, whereas some researchers found, that, PEOU does not have a significant direct effect on users' appropriation intention (Chau and Hu 2001, 2002; Croteau and Vieru, 2002; Chismar and Wiley-Patton, 2002; Schaper and Pervan, 2007; Wu et al., 2007; Aggelidis and Chatzoglou, 2009), Others confirmed that it influences positively the ICT appropriation (Croteau and Vieru, 2002; Wu et al. 2007; Wu et al., 2008; Aggelidis and Chatzoglou, 2009).

4 RESEARCH METHOD

Physicians and nurses working for the health public centers located in the city of Agadir represent the target population for this study. They correspond to a total of 145 individuals, divided into 37 physicians and 108 nurses. The data collection process took place from the beginning of June 2008 and lasted six months, till December, 2008. A set of questionnaires were handed on to major or physician chief of each one of the ten centers, who dealt with their distribution to the various actors of the process of patient care. One week later, a first revival is ensured to get the feed-back from respondents, and to provide explanation whenever it is needed. The total completed questionnaires were retained for being studied. Data processing was performed using SPSS software package. The response rate achieved was quite high (76.55%), with 111 replies. As shown in Table 1, the breakdown of these replies consisted of 30 physicians and 81 nurses. 64.9% are females and only 35.1% corresponded to males. Almost the half of the respondents (45.9%) are older than 40, 42.3% are aged between 25 and 40, whereas, only 11.7% who are less than 25.

Table 1: breakdown and frequency of the replies.

		Frequency	Frequency (percentage)
Activity	Physicians	30	27%
	Nurses	81	73 %
Gender	Male	39	35.1%
	Female	72	64.9%
Age	Less than 25 years	13	11.7%
	Between 25 and 40 years	47	42.3%
	More than 40 years	51	45.9%

5 RESULTS AND DISCUSSION

A confirmatory analysis is used to check the content reliability of the hypothetical model constructs. For this issue, the Cronbach's coefficient (α) was

Table 2: Reliability of variables.

Variable	Cronbach's alpha (α)	Interpretation
Attitude	α=0.818	A very good coherence between items of "Attitude"
Perceived Usefulness	α=0,904	A very good coherence between items of "Perceived Usefulness"
Perceived Ease of Use	α=0,845	A very good coherence between items of "Perceived Ease of Use"
Intention	α=0.813	A very good coherence between items of "Intention"

calculated. As exposed in Table 2 in the Appendix, a very good coherence is shown between items of Attitude (α=0.818), Perceived Usefulness (α=904), Perceived Ease of Use (α=0,845) and Intention (α=0.813). The four constructs are retained as their reliability coefficient being higher than the recommended threshold (0.7). Furthermore a correlation between intention, as a dependent variable, and Attitude, Perceived Usefulness and Ease Of Use as independent constructs is calculated to test the three initial hypotheses: H_{Attitu}, H_{PU} and H_{PEOU}. Results reveal that Attitude PU and PEOU showed a significant positive correlation with the Intention of ICT appropriation construct (Table 3 in Appendix). Moreover linear regression results show that only two constructs of these three independents variables (PU and PEOU) determine ICT appropriation (Table 4).

Table 3: Correlation between the three independent variables and the Intention of ICT appropriation construct.

	Attitude	PU	PEOU
Pearson Correlation	0.373	0.570	0.410
P-Value	0.000	0.000	0.000

The findings are consistent with Chau and Hu 2001, 2002; Croteau and Vieru, 2002; Chismar and Wiley-Patton, 2003; Schaper and Pervan, 2007; Wu et al., 2007; Aggelidis and Chatzoglou, 2009. Contrary to some authors (Chau and Hu 2001, 2002; Croteau and Vieru, 2002; Chismar and Wiley-Patton, 2002; Schaper and Pervan, 2007; Wu et al., 2007; Aggelidis and Chatzoglou, 2009), results of this communication reveal that PEOU influence positively the intention of ICT appropriation by physician and nurses.

Table 4: Regression results.

Model R, R^2,		Coefficients		t	Sig.
		B	Std. Error		
R= 0.617	(Constant)	-,012	,083	-,143	,887
	Perceived Usefulness	,492	,087	5,655	,000
R^2= 0.380	Perceived Ease of Use	,226	,087	2,591	,011

6 CONCLUSIONS AND MANAGERIAL IMPLICATION

Using constructs of the TAM model, this communication attempts to explain ICT appropriation by physicians and nurses working in healthcare public centers in Agadir, south of Morocco. It concludes that the PU, PEOU and Attitude, considered together, explain these appropriation in healthcare context, but still insufficient and it needs to be extended and completed by other external variables such as culture and scientific level of the physicians and nurses working in health public centres in Morocco. Also, the outcomes confirm that Perceived Usefulness is still to be a major determinant of ICT appropriation by healthcare actors, especially by physicians and nurses. Finally, the authors suggest that the proposed model could help healthcare managers, and Chief Information Officers to identify success factors of ICT appropriation in healthcare organizations in order to consider them and develop more appropriate information system solutions for these organizations.

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