

Why Do Users Accept Innovative Technologies?

A Critical Review of Models and Theories of Technology Acceptance in The Information System Literature

Abeer Alkhwaldi^{1,2,*}, Dr. Mumtaz Kamala^{1,**}

¹School of Electrical Engineering and Computer Science, Faculty of Engineering & Informatics
University of Bradford, United Kingdom

²Department of Management Information Systems, School of Business
Mutah University, Jordan

*A.F.A.HamidAlkhwaldi@bradford.ac.uk, ** M.A.Kamala@bradford.ac.uk

Abstract— Earlier literature illustrates that the selection of the appropriate theoretical model has always prescribed as a crucial task for the research community in the information systems (IS) field. According to the authors' knowledge, there are few articles aims to review IT acceptance theories and models at the individuals' level. Thus, this paper aims to bridge this gap by presenting a critical review of ten of the most influential models/theories that have been employed in predicting and explaining the human acceptance behavior of different technologies at the individuals' level. This paper also provides a summary of their evolution, pointed out the main constructs, strengths, related fields, and criticisms based on a selected published literature appeared in IS research.

This review offers a holistic view for future scholars to select appropriate constructs/models owing to their strengths and criticisms as well explanatory or predictive power. This paper concluded that the well-established and comprehensive theoretical model should consider the parsimony in the term of simplifying the model with the least constructs and the highest predictive power, also the ability to integrate the relevant context's factors (e.g., UTAUT2).

Keywords— *Technology acceptance behavior; Acceptance Models; Acceptance Theories; Information Systems; UTAUT2*

I. INTRODUCTION

Understanding the acceptance and rejection of information technology by individuals is deemed as one of the widely-researched issues in the area of Information systems(IS), Information technology(IT) and social science[1, 2]. Since the 1970s, researchers carried out several studies with the aim of understanding, predicting and explaining the influencing factors of IT acceptance at the individuals and organizations level, as user's willingness to accept and adopt new technology is vital to determine

the success or failure of any IS initiative[3, 4]. User's acceptance is defined as "*the initial decision made by the individual to interact with the technology*"[5].

In order to understand the determinants of users' acceptance decision and behavior, several competing models and theories have been developed in different fields, namely information systems, psychology, and sociology. The most prominent theoretical models are: Theory of Reasoned Action (TRA), Social Cognitive Theory(SCT), Technology Acceptance Models (TAM), Theory of Planned Behaviour (TPB), Model of PC Utilization (MPCU), Diffusion of Innovation (DOI), the Motivational Model (MM),the model combined between TAM and TPB(C-TAM-TPB),the Unified Theory of Acceptance and Use of Technology (UTAUT) which integrates variables across the eight mentioned model/theory, and lastly the most recent theory ,UTAUT2 the extended version of UTAUT(Figure 1).

However, selecting the best constructs is not a straightforward decision. The researchers have the ability to "pick and choose" and apply the most proper model/theory while ignoring the contributions of others[6, 7]. Bagozzi (1992) argued that the model with perfect parsimoniousness and fewer constructs is superior[8]. In contrast, understanding the investigated phenomena in details is more valuable than parsimony as stated by Venkatesh et al. (2003). Whilst Taylor and Todd (1995b) clarified that the balance between both perspectives should be considered in the models' evaluation [9].

Therefore, it becomes crucial to have an evident review of these models concerning their theoretical bases. In consequent, researchers and practitioners will effectively understand individuals' acceptance behavior and so can get a rational and updated knowledge of the research in this field to ascertain the suitable theoretical model for their ongoing studies. Further, there will be no comprehensive and systematic research without understanding the origin, development as well the limitations of these theoretical models. While most of these models and

theories widely-used in the literature, to the best of the authors' knowledge, there are no many reviews of the IT acceptance models at the individual level. To address this issue, this article will present a comprehensive and critical review of the most influential theoretical models in the IS field, exploring their theoretical basis, developments, key constructs, in addition, studying their limitations. Accordingly, this paper will recommend the most robust and powerful theoretical model and thus the more appropriate for future research.

This paper is structured as follows: the next section (section2) will provide a critical review of existing individual acceptance models. The following section (section3) presents the conclusion of the research.

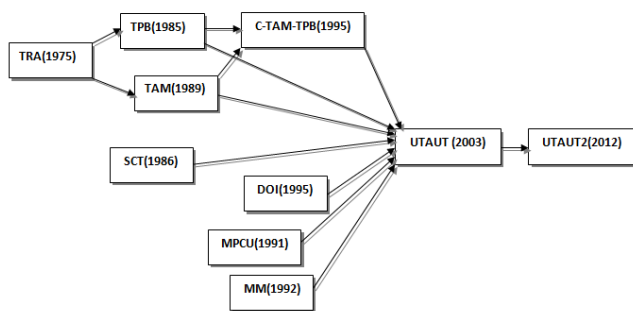


Figure 1: Development of Unified Theory of Acceptance and Use of Technology Model

II. INDIVIDUAL ACCEPTANCE OF NEW TECHNOLOGY: THEORIES AND MODELS

1. Theory of Reasoned Action(TRA) (Ajzen and Fishbein 1975)[10]

Acquired from the field of social psychology, the TRA considered as one of the most influential and primary theories of explaining human behavior [6, 11]. This theoretical model has been extensively used to predict and explain a wide range of intentions/behaviors [6, 10, 12]. In the technology acceptance literature, Davis et al. (1989) has applied TRA and found that explained variance is consistent with other contexts[13]. The theory postulates that behavioral intention(BI), which is an instant antecedent to the actual behavior, is a function of individuals' attitudes and subjective norms relating to the human behaviors in question, as depicted in Figure 2.

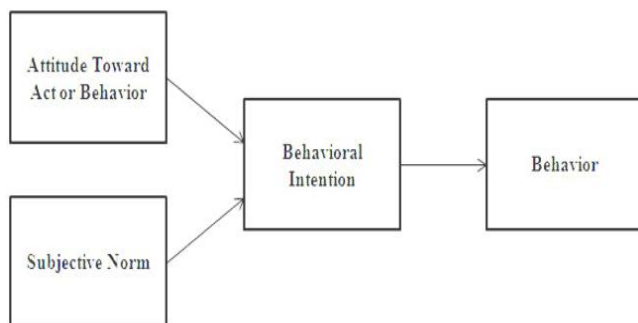


Figure 2: Theory of Reasoned Action[12]

1.1 Limitations of TRA:

TRA has been employed with respect to the behavior of IT usage by several researchers. However, it has been criticised since it is a general model as TRA was not designed for a particular behavior or information technology [13, 14]. Scholars go on to state that the assumption of human behavior is under volitional power is the primary limitation of this theory as it ignores the ability to direct the individual's behavior[15-17]. Furthermore, Ajzen (1985)noticed that correspondence is further criticism for TRA[18]. To illustrate this, Sheppard et al. (1988)stated that using this theory to predict and explain specific behaviors, intentions and attitudes required agreement on actions, contexts, targets time frames and specificity[19]. Also, TRA still limited with not considering other variables that influenced the individuals' intentions/ behaviors.

2. Theory of Planned Behaviour (TPB) (Ajzen 1991)[20]

The theory of planned behavior (TPB) was introduced as an extension of the theory of reasoned action (TRA) to overcome the original TRA model limitation in dealing with human behavior over which individual has inadequate volitional control[18, 20]. In fact, the difference between the TRA and the TPB is the inclusion of the Perceived Behavioural Control(PBC) as the third determinant of the behavioral intention. The (PBC) construct which improved the explanatory power of TPB model describes "the perceptions of internal and external constraints on behavior"[21]. According to[20], the behavior control refers to "people's perception of the ease or difficulty of performing the behavior of interest ." Two components constitute the Perceived Behavioural Control, namely "self-efficacy" and "facilitating conditions"[20, 22, 23]. As the theory stated, the PBC as the original contribution in the TPB can directly predict the behavioral achievement or indirectly through the behavioral intention(Figure 3).

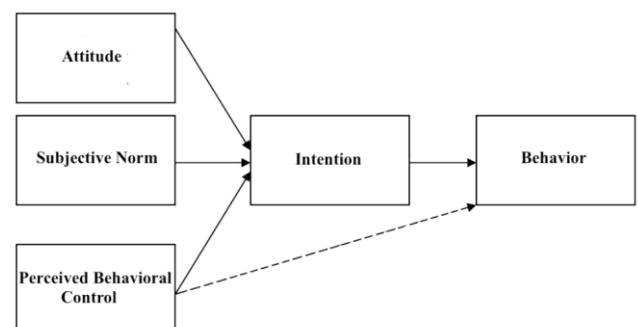


Figure 3: Theory of Planned Behaviour [18]

2.1 Limitations of TPB:

The TPB model has been successfully employed in order to understand the people acceptance and use of different IT[9, 24]. By contrast, this theory was derived from TRA thus has its criticisms. For instance, further

variables associated with predicting the intention and behavior were not considered (e.g., habit and self-identity) within TPB[25]. Assuming individuals experience the model similarly, demographic constructs were ignored. In addition, the planning mechanism of human behavior was not explained. Also, [9] criticised the proposition of single variable (PBC) as an acknowledgment to all non-controllable factors related to individual's behavior.

3. Social Cognitive Theory (SCT) (Bandura 1986b) [26]

The Social Cognitive Theory (SCT) is one of the most robust theories of human behavior [6, 26, 27]. According to the theory, human obtains and maintains a certain behavior as a result of a dynamic, triadic, and reciprocal interactions of environmental factors, personal factors, and behaviors[28] (Figure 4).

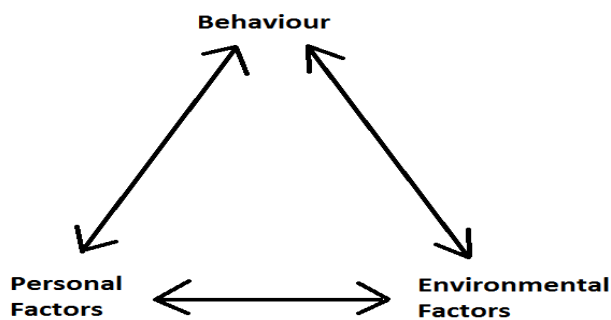


Figure 4: Social Cognitive Theory [28]

The SCT model has been investigated along with other constructs in the field of IT/IS to explain individual's acceptance of various information technologies. An extended version of SCT has been applied by Compeau and Higgins (1995b) in computer utilization context[29], while the author's other study also employed SCT to examine performance[30]. The theoretical model of Compeau and Higgins (1995b) investigated the computer usage, but the nature of the theory and the model allows the Compeau and Higgins's (1995b) model to be extended into the context of acceptance and usage of IT and IS generally[29]. The original theoretical model of the researchers utilized the usage behavior as a dependent variable. However, to keep the expectations of predicting individual users acceptance, Venkatesh(2003) and his colleagues studied the predictive validity of the SCT model from the perspective of behavioral intention(BI) to allow a fair comparison with other IT acceptance models and theories [6]. The core variables of the SCT model are self-efficacy, outcome expectation – personal, outcome expectation – performance, anxiety and affect[29] (Figure 5).

3.1 Limitations of SCT:

Social Cognitive Theory (SCT) has been implemented widely in different research fields including computer and internet utilization. As stated by Ratten (2013), the SCT has advantages compared to other IT acceptance/adoption theories as it

incorporated two levels of analysis: organizational and individual, which indicates including the technology innovations that not always under the individuals' control but also mandated by the organizations[31]. In spite of that, the high percentage (68%) of unexplained variance in usage behavior [29] encourages further studies to be conducted with the aim of examining other constructs and introduce theoretical models that might assist to explain users' behavior. In the same vein, Abbasi (2011) illustrated

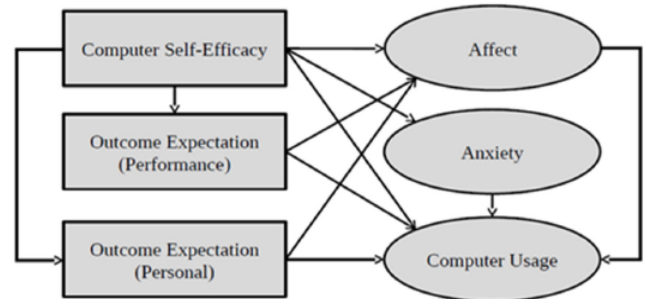


Figure 5: Social Cognitive Theory [29]

that, although the SCT offered ground-breaking constructs such as Self-Efficacy, the generalization of the theory itself is considered as a difficult task. Thus, the theory can be applied as an umbrella with the aim of extending its factors into a certain model and objective[32].

4. Technology Acceptance Model (TAM) (Davis et al. 1989) [13]

The TAM was developed by Davis et al.(1989) as an extension of TRA introducing a theoretical base for user's acceptance of IS[6].The aim of this model is to offer explanations of the factors determined computer's acceptance among wide-range of end-users' information technologies by maintaining both the parsimonious and theoretical justification[13, 33]. As being a reliable, robust and well-established theory, several researchers have used and extended the TAM model [3, 34, 35]. The TAM postulates that two specific beliefs, "perceived usefulness" and "perceived ease of use," as the main significance determinants for actual behavior of technology acceptance according to the individuals perspective[33, 36]. Davis (1989) emphasized, "A key purpose of TAM is to provide a basis for tracing the impact of external factors on internal beliefs, attitudes, and intentions," (Figure 6).

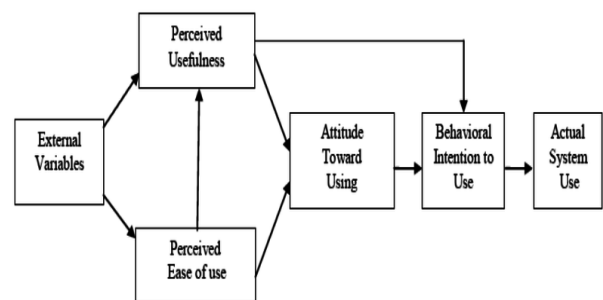


Figure 6: Technology Acceptance Model [13, 33]

4.1 Limitations of TAM:

With respect to the comparative study of Davis et al. (1989), it was found that TAM offered a superior explanation regarding the Behavioural Intention (BI) of the end-users than TRA did[13]. However, it is less general and ignores subjective norm factor in its theoretical structure. In spite of that, the comprehensiveness and suitability of this model have been questioned by the research community, considering Self-reported use as one of the most commonly reported criticisms[37, 38]. The second most cited criticism is the use of one IS with homogeneous respondents on the research project limiting the generalization of the findings[37, 38]. Furthermore, the low explanatory power(about 40%) and the inconsistency across the prior studies are main shortcomings of theory stated by [39]. Consequently, TAM has been enhanced by TAM2 [40], however, a number of researchers have acknowledged its limitations and concluded that it is required to extend and integrate it with other related models and variables. Also, shifting from TAM to UTAUT is revealed among research articles [41].

5. Model of Personal Computer Utilization (MPCU) (Thompson et al. 1991) [42]

Derived from Triandis' (1977,1979) theory of interpersonal behavior, Thompson et al. (1991) developed the Model of PC Utilisation (MPCU) [42].Triandis' research efforts resulted in a theoretical framework to describe how human behavior occurs, and what are the factors that stimulate the individuals' behavior [43].

As illustrated in Triandis' framework "Behaviour is determined by what people would like to do (attitudes), what they think they should do (social norms), what they have usually done (habits), and by the expected consequences of their behavior." Some other determinates of behavioral intention and/or actual behavior such as facilitating conditions, relevant arousal, and individual's perception of subjective culture's variables, also the relations in this framework are demonstrated in Figure 7.

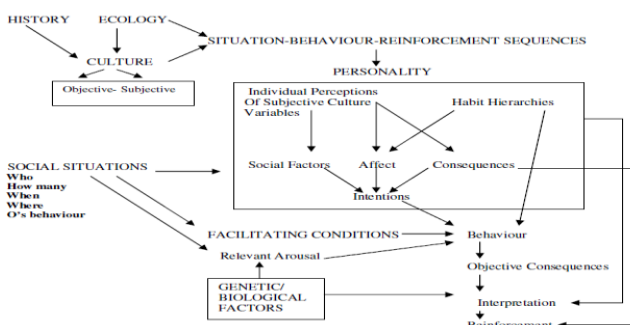


Figure 7: Triandis' framework[43]

Later in 1991, Thompson et al. refined and adapted the theoretical model of Triandis for ISs context with an aim to predict PCs utilization [6]. However, the nature of this theoretical model makes it appropriate in particular to predict individuals' acceptance and use of several information technologies. In the MPCU, it is indicated that the PCs utilisation behaviour could be

influenced by six core constructs ,namely individuals' feeling (affect) towards the use of PCs, social norms related to using PC for the work purpose, general habit regarding to computer usage, expected consequences to PC utilization by individuals, and the extent of facilitating conditions' availability at the workplace to assist using PCs[42],Figure 8. The authors investigated the usage behavior (actual) rather than intention (predictive), also habit variable was excluded owing to measurement issues.

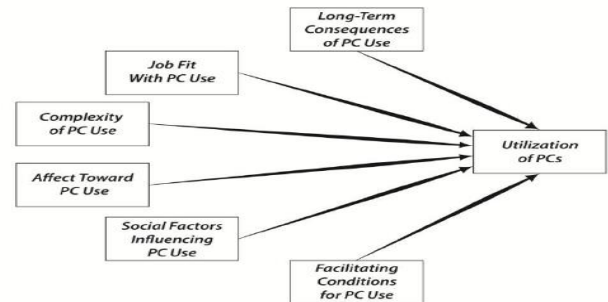


Figure 8: Model of Personal Computer Utilization [42]

5.1 Limitations of MPCU:

The MPCU model criticised by being successful theoretical base in the term of explaining and understanding the computer utilization behavior in a voluntary context. Moreover, the main shortcoming to implement this model is the low explanatory power(24%)[42].

6. The Motivational Model (MM) (Davis et al. 1992) [36]:

A significant body of theoretical models in psychology field has been based on the motivation research. For instance, the Self-Determination Theory (SDT) developed by Deci and Ryan proposed that self-determination process is the quality of human-functioning which encompass the choice experience, having the choice, and making a choice[44]. Deci et al. (1991) stated that when the human behaviour is self-determined, the regulatory process considered as a choice[45].

A considerable amount of literature has investigated the motivation theory and adapted it for particular contexts as an explanation for human behaviour. According to the Motivation Model (MM) literature, individuals' behaviour is based on intrinsic motivations or extrinsic motivations[45, 46]. SDT also addressed the ways that social context influences the motivated behaviour. Apart from the two types of motivation: intrinsic and extrinsic, it is argued by Deci and Ryan (1985) that a third variable (i.e., amotivation) need to be acknowledged to understand the individual's behaviours completely(Figure 9).

In the information technology realm, Davis et al. (1992) applied the MM drawing upon Deci's et al. extrinsic and intrinsic motivations and found them to be key determinants of human intentions toward the behaviour of IT usage[36]. Davis's et al. model has distinguished between the influence of extrinsic and

intrinsic motivations to use the PC at the workplace (Davis et al. 1992). Perceived usefulness(PU), subjective norms(SN), and perceived ease of use (PEOU) are examples of extrinsic motivations, while Computer enjoyment and playfulness are examples of intrinsic motivation [36, 40]. The study pointed out that a positive interaction noted between enjoyment and

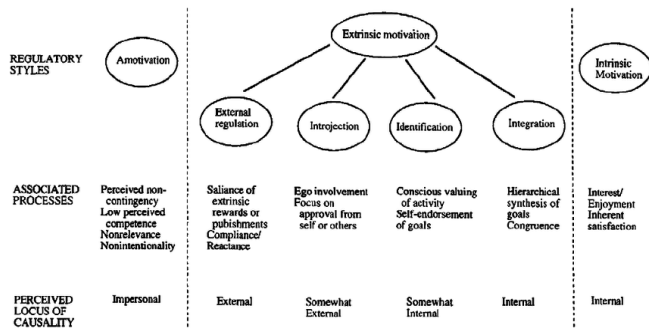


Figure 9: Self-Determination Theory " Taxonomy of Human Motivation" [46]

usefulness indicates that enjoyment strongly influences the intention when the IS is perceived as more useful. In other words, higher enjoy-ability of IS is improving the acceptance of the useful system [36].

6.1 Limitations of MM:

Although the Motivational Model (MM) has been found to be useful in understanding new technologies acceptance and use[36, 47], it explained just 28 percent [47] as well 62 percent[36] of the variance in behaviour intention. This suggested the need for further research to explore other factors could improve the explained variance in the BI.

7. Diffusion of Innovation(DOI)/Innovation Diffusion Theory(IDT) (Rogers 1995) [48]:

Based on sociology, Rogers' theory has been applied since the 60s with the aim of studying various innovations [49]. This DOI is one of the well-known models in the IS/IT literature to describe user's adoption of novel technology. Since the dominant concern of the theory is centered on how innovation diffused and adopted through society at the individual and organisational level, Rogers (1995) differentiated the diffusion from the adoption processes. The diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system," while the adoption referred to "a decision to make a full use of innovation as the best course of action available"[49].

The main factors included in the DOI/IDT theory to explain the hindrance and facilitation of the technologies diffusion and adoption are the process of innovation-decision, characteristics of innovation and characteristics of adopters. Five stages of the innovation-decision process illustrated by Rogers(1995) namely, knowledge, persuasion, decision, implementation, and confirmation(Figure 10). As suggested by Rogers (2003), individuals'

adoption patterns can be classified into five levels: (1)innovators; (2)early adopters; (3)early majority; (4)late majority; and (5)laggards.

The perceived characteristics of innovations have been prescribed as follows: relative advantage, compatibility, complexity, observability, and trial-ability[48]. For extending the work in the IT/IS context, Moore and Benbasat (1991)[50] adapted Roger's attributes with an improved set of variables related to

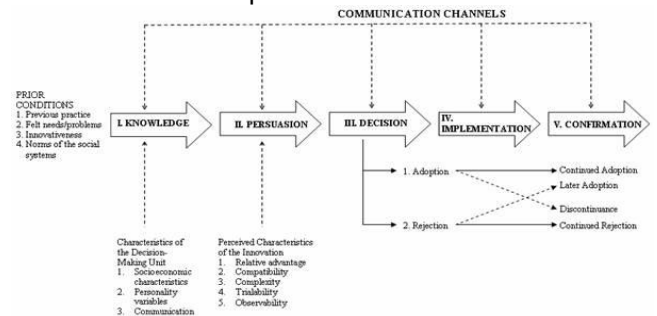


Figure 10: A Model of Five Steps of the Innovation-Decision Process[49]

technologies acceptance by individuals: voluntariness of use, visibility, result demonstrability, image, and ease of use.

7.1 Limitations of DOI/IDT:

The theory was employed by scholars with a focus on diffusion of IT to the societies. However, this classical theory has been criticised as reported by (Clarke 1999) [51] "its best as a descriptive tool, less strong in its explanatory power, and less useful still in predicting outcomes, and providing guidance as to how to accelerate the rate of adoption." Also, it has been limited with no indication on how the attitudes impact the adoption and rejection decision, or how features of innovations impact this process [52]. DOI/IDT presents a limited theory in respect to cultural context [51].Moreover, Academic studies may require considering the social contexts so that DOI theory may become more effective [53].

8. Combined TAM and TPB (C-TAM-TPB) (Taylor and Todd 1995a) [54]:

Using a complex approach , Taylor and Todd (1995a) combined the constructs of TPB and TAM theoretical models ,such as , attitudes towards behaviour (adapted from TRA/TPB), subjective norms (adapted from TRA/TPB), perceived behavioural control(PBC) (adapted from TPB), and perceived usefulness(PU) (adapted from TAM) in their study to improve the prediction of IT acceptance(Figure 11). In the hybrid model "C-TAM-TPB," the social influences and behavioural control are incorporated with TAM [55].

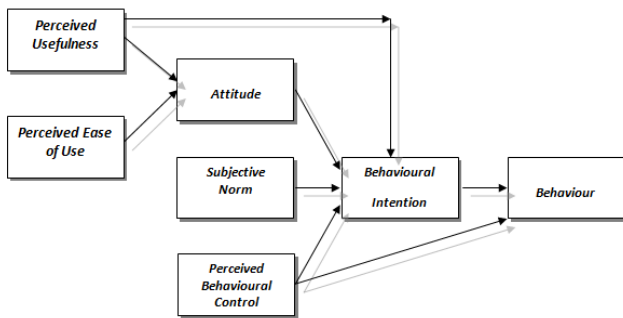


Figure 11: Combined-TAM-TPB[54]

Considering prior experience as a moderating variable, this study compared between inexperienced and experienced students of business school regarding using a computing resource centre. To conclude, the results indicated that C-TAM-TPB is an adequate model for predicting information technology usage at different levels of user's experience.

9. Unified Theory of Acceptance and Use of Technology(UTAUT) (Venkatesh et al. 2003) [6]:

On the basis of prominent theories and models in the literature on individuals acceptance of IT/IS, Venkatesh and his colleagues (2003) carried out an empirical research with the aim of comparison eight models/theories and accordingly developed the unified theory. The UTAUT model aimed to offer a further complete view of the technology acceptance process that any previous individual model has no ability to provide it alone. The model created by synthesising and integration of essential constructs of previously established IT acceptance models ,namely Theory of Reasoned Action (TRA)[10], Social Cognitive Theory (SCT) [28], Technology Acceptance Model (TAM) [13], Theory of Planned Behaviour (TPB) [20], Model of Personal Computer (PC) Utilisation (MPCU) [42], Motivational Model (MM)[36], Combined TAM-TPB [54]and the Innovation Diffusion Theory (IDT) [48].The unified model, in fact, is based on the similarities across the cited acceptance models in order to explain and predict the user behaviour. The unified theory includes four core determinants of IS/IT usage behaviour(Performance Expectancy(PE), Efforts Expectancy(EE), Social Influences(SI), and Facilitating Condition(FC)).Also, four moderating variables(gender, experience, age, and voluntariness of use), as shown in figure 12.

9.1 Limitations of UTAUT:

Similar to the earlier models/theories in the IT arena, UTAUT is not without criticisms. According to

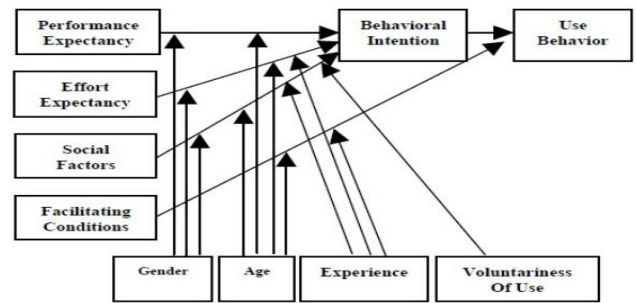


Figure 12: Unified Theory of Acceptance and Use of Technology [6]

Bagozzi (2007), the main limitation of this model is using a large number of independent variables [56]. In addition to the content validity limitation [6].However, the UTAUT has the ability to justify 70 percent of the variance in usage behavioral intention, considered as a substantial enhancement comparing to 40 percent in the original models. According to Venkatesh et al. (2003), It can be concluded that the unified theory contributed with a comprehensive model that synthesises what is known previously and presents a basis to guide the future research in the user's acceptance arena. Through including the consolidated explanatory power of the individual's acceptance models, UTAUT introduces a cumulative theoretical base while maintaining a parsimonious structure.

10. The Extending of the Unified Theory of Acceptance and Use of Technology (UTAUT2) (Venkatesh et al. 2012) [57] :

The UTAUT2 is a relatively new model in the Information Systems/Technology arena. Although, since its inception, the UTAUT model has been extensively applied to explain and predict the IT acceptance behaviour, Venkatesh et al. (2012) argued that "there is still the need for theorising of the salient factors that would apply to a consumer technology use context ."To bridge this gap, the authors extended a more inclusive version(UTAUT2) embedding the core concepts of the baseline model and incorporates three additional important constructs (i.e., hedonic motivations, habit, and price value), Table 1 shows the independent variables of UTAUT2 with its definitions, relevant theories, and constructs. While voluntariness moderator was omitted, thus tailoring the model into use and acceptance of IT in the consumer context, as illustrated in Figure 13.

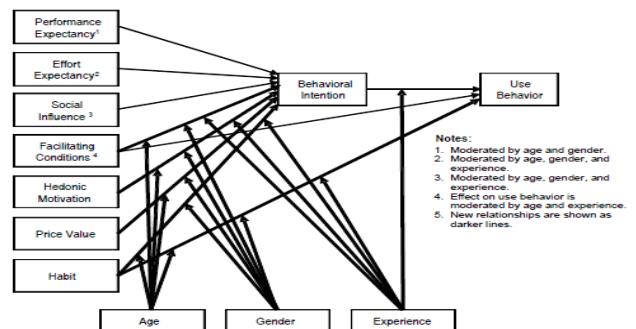


Figure 13: UTAUT2[57]

10.1 UTAUT2 and individuals' behaviour to accept innovative technology:

In spite of the fact that, the UTAUT2 is the latest theory in the IT acceptance literature, so it has not been widely used and tested in the field [58, 59], extending and applying this model will be considered as a significant contribution. Illustrating this, Venkatesh et al. (2012) asserted that UTAUT2 is superior compared to UTAUT in the term of variance explained related to technology use behaviour and intention from (52-56%) and (70-74%) respectively[57]. This high explanation power has been validated beyond the employee organisational contexts (UTAUT) by including consumer contextual dimensions, produced a substantial enhancement and parsimonious structure compared to the nine previously developed models. Furthermore, it is recommended to investigate the UTAUT2 in different countries, particularly less advanced technological nations as well different technologies to identify and incorporate other context relevant variables that may not be included in this model. Assisting for future research to increase the applicability of UTAUT2 in a wide range of IT use contexts [57, 58, 60].

In conclusion, with regard to IT/IS research community UTAUT2 will be considered to study the acceptance of different technologies and will be suited to different contexts through extension or integration of context-related factors. Consequently, will become the most significant theoretical framework in this arena.

III. CONCLUSION

This article critically reviewed ten of the most influential theoretical models used within the field of IS literature. In particular, this article highlighted the origins, developments, constructs, and limitations of these models. By doing so, it could be easier for future researchers to determine the common constructs and significant relationships amongst it. This will provide help in term of building a solid background of individuals' acceptance behaviour in IS literature with the aim to develop theoretical underpinnings for extended theoretical models in their future work. Additionally, at practitioners' level, the in-depth view can be obtained related to the reasons behind the promotion and hindrance the technology acceptance.

It is imperative to understand that these models have various assumptions about the determinants of users' behaviour. Also, these models have various predictive power with relevant strengths and criticisms.

This review revealed that the prevalent theoretical models were chosen either for parsimonious and justified theoretical structure (e.g. TAM) or their explanatory power (e.g. UTAUT). The alternative approach is the balance among both standpoints (e.g. UTAUT2).

The review evidently indicated that, although UTAUT2 is the most recent model in the research of technology acceptance and not widely applied in the field, using and extending this model will be a notable contribution. This is owing to its solid theoretical base (i.e., nine IT acceptance models) high predictive power (i.e., 74 % of the variance in usage behavioural intention) and robustness. In addition to its applicability for a various IT usage contexts (e.g., technologies and countries) through integrating the contexts' relevant factors. This argument asserted UTAUT2 future applicability and suitability to understand the measures of human acceptance or rejection behaviours towards new technologies. Such comprehensive and dynamic theoretical model which can consider cultural, social, technological and other pertinent behavioural predictors will help in understanding the phenomenon under research better than the traditional acceptance theoretical models do.

Table 1: *Main Constructs of UTAUT2*

Main Constructs	Definition	Similar Constructs	Relevant Theory
1. Effort Expectancy	<i>"The degree of ease associated with consumers' use of technology" [57]</i>	Ease of Use	DOI
		Complexity	MPCU
		Perceived Ease of Use	TAM
2. Performance Expectancy	<i>"the degree to which using a technology will provide benefits to consumers in performing certain activities"[57]</i>	Relative Advantage	DOI
		Extrinsic Motivation	MM
		Job Fit	MPCU
		Outcome Expectation	SCT
		Perceived Usefulness	TAM
3. Facilitating Conditions	<i>"consumers' perceptions of the resources and support available to perform a behaviour" [6, 57]</i>	Compatibility	DOI
		Facilitating Conditions	MPCU
		Perceived Behavioural Control	TPB
4.Social Influence	<i>"the extent to which consumers perceive that important others (e.g., family and friends) believe they should use a particular technology."[57]</i>	Image	DOI
		Social Factors	MPCU
		Subjective Norm	TRA
5.Price Value	<i>"consumers' cognitive trade-off between the perceived benefits of the applications and the monetary cost for using them" [57]</i>	Price Value	[61, 62]
6.Habit	<i>"the extent to which people tend to perform behaviours automatically because of learning"[57]</i>	Habit "Automaticity Repeated Behavioural Pattern "	[63, 64]
7.Hedonic Motivation	<i>"the fun or pleasure derived from using a technology, and it has been shown to play an important role in determining technology acceptance and use"[57]</i>	Intrinsic Motivation	MM

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