User Acceptance of Information Technology: A Critical Review of Technology Acceptance Models and the Decision to Invest in Information Security

Patrice Seuwou(✉), Ebad Banissi, and George Ubakanma

School of Engineering, Division of Computing and Informatics,
London South Bank University, London, UK
{seuwoup,banisse,george.ubakanma}@lsbu.ac.uk

Abstract. In today's fast changing world, technology is increasingly influencing and having a major impact on all aspect of our daily life. For decades, the user acceptance of technology has been a vital field of study. Despite numerous models being proposed to explain and predict the use of a system or to assist in decision making to invest in information security, the latest models and theories are still not been able to fully capture the complexity of the relationship between humans and technology. This paper provides a historical overview and a critical review of technology acceptance models (TAM) and theories. It also explores external variables influencing information security investment. It is concluded that although TAM and associated theories are well-established concepts in the information systems community, further research will be required to capture other important elements influencing public acceptance of technology which are not currently represented in existing models.

Keywords: Technology acceptance model · Unified theory of acceptance and use of technology · Theory of reasoned action · Information security · IT decision making

1 Introduction

In the field of Information Systems, it is known that information technology is underutilised in many organisations producing massive financial losses. Information technology acceptance and use is a subject that has attracted practitioners as well as researchers for several decades. Their interest is about exploring the models and theories that demonstrate potential in explaining and predicting behaviour across various fields. The aim of their studies is mainly to investigate how to promote usage and also examine the barriers obstructing usage and intention to use technology. It can be observed that a number of social and psychological factors influence the interaction between humans and technology. Therefore, due to the complexities involved in predicting human behaviour, several studies have generated a variety of models and theories to assist in explaining patterns of adoption and use of technologies.

H. Jahankhani et al. (Eds.): ICGS3 2017, CCIS 630, pp. 230–251, 2016.
DOI: 10.1007/978-3-319-51064-4_19

Each noticeable technology acceptance model or theory which has not been superseded by more recent research has different properties and benefits. It is therefore essential to study them intentionally, since it is expected that theoretical concepts from these theories will help to provide a sound basis for the theoretical framework for creating a research model that could properly demonstrate the acceptance of technology. This paper provides a critical review of the prominent technology acceptance works. This review identifies major technology acceptance models and theories in order to make explicit their major assumptions. Furthermore, we also discuss the external variables influencing decisions to invest in information security.

2 Concept Underling User Acceptance

In an attempt to explain system use, various academics initially developed tools for analysing and measuring computer user satisfaction. As highlighted by Bailey and Pearson in 1983 [1], it was logical to look for answers from psychologists who spent a great deal studying satisfaction. Presently, user acceptance can be defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support [1]. Thus, the concept is not being applied to situations in which users claim they will employ it without providing evidence of use, or to the use of a technology for purposes unintended by designers or procurers. Observably, there is a degree of fuzziness here since actual usage is always likely to deviate slightly from idealized, planned usage. The principle of user acceptance theory is that such deviations are not significant; that is, the process of user acceptance of any information technology for intended purposes can be predicted and modelled. Indeed, on several instances, users are not willing to use information systems which if used will produce remarkable performance gains. Thus, user acceptance has been regarded as the central factor in determining the failure or success of any information system project. Several technology acceptance models have been developed in the past and they all follow the very same concept. Figure 1 below illustrates the basic concept underlying user acceptance models and theories. They each have their own specific characteristics which will be reviewed and discussed in chronological order.

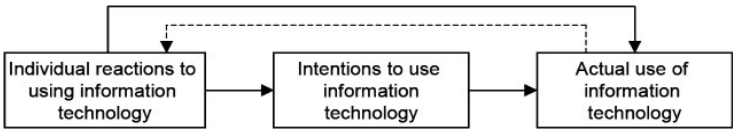

Fig. 1. Basic concept underlying user acceptance models [2]

3 Acceptance Models Historical Timeline

3.1 Theory of Reasoned Action

The theory of reasoned action (TRA) originates from learning theory and assumes that behaviour toward a specific object is approximated by an intention to perform that behaviour. The model was developed by Ajzen and Fishbein initially in 1975 and then in 1980 as an improvement over information integration theory [3–5]. It integrated various studies on attitudes from social psychology with the aim of developing an integrated conceptual framework to explain and predict an individual's behaviour towards adoption in a broad situational setting. The originators of this theory suggested that an individual's behavioural intention is the direct determinant of behaviour, their attitude and their subjective norm are facilitated through behavioural intention and their behavioural and normative beliefs are mediated through attitude and subjective norm. The TRA model can be seen as one of the earlier prediction models, but was not specifically aimed at the acceptance of technology, although it operated as a starting point for technology acceptance models [5]. TRA was adopted in several studies and is a strong predictor of actual behaviour in different locations, but it has been criticised since it does not take into consideration the individual's ability to control [6]. Figure 2 below shows the Theory of Reasoned Action model.

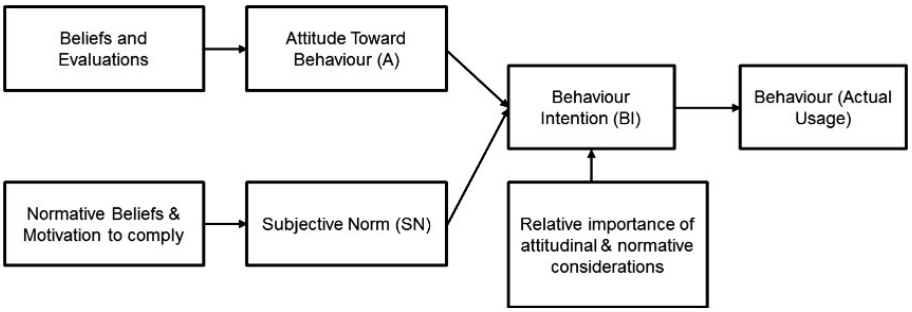

Fig. 2. Theory of Reasoned Action (TRA) [4]

3.2 Social Cognitive Theory

The social cognitive theory (SCT) was introduced by Albert Bandura in 1986. It states that learning occurs in a social context with a dynamic and reciprocal interaction of environmental factors, personal factors, and behaviours [7]. This theory is used in psychology, communication and education. It embraces portions of an individual's knowledge acquisition that can be directly related to observing others within the context of experiences, outside media influences, and social interactions. Furthermore, it posits that social environment in which behaviour is developed is considered when users acquire and maintain behaviour. It gives prominence to the concept of self-efficacy [8]. The theory speculates that people remember the sequence of events and use the information to guide following behaviours when they observe a model

performing behaviour and the consequences of that behaviour. The social cognitive theory suggests that personal factors, behaviours and environmental factors are determined reciprocally [9]. SCT is a theory with emphasis on social influence and on external and internal social reinforcement which are its unique features. However, some of its limitations include the fact that it assumes changes in the person will automatically be led by changes in the environment, which may not always be true. Furthermore, SCT massively concentrates on processes of learning therefore disregards hormonal and biological predispositions that may have an impact on behaviours, irrespective of past experience and expectations. Figure 3 below shows, the social cognitive theory.

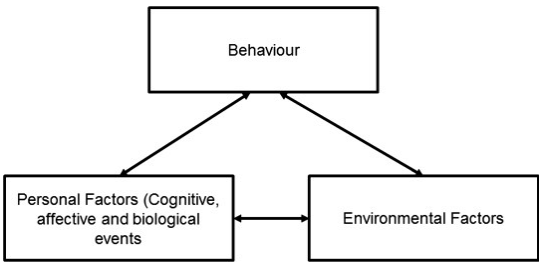

Fig. 3. Social Cognitive Theory (SCT) [7]

3.3 Technology Acceptance Model

Technology Acceptance Model (TAM) was developed by Davis in 1989. TAM was introduced to help in predicting technology usage behaviour. It was an adaptation of the TRA and specifically tailored for modelling user acceptance of information systems. Its goal was to provide an explanation of the constructs of computer acceptance which is generally also capable of explaining user behaviour across a broad range of end-user computing technologies and the population [5]. Figure 4 below shows Technology Acceptance Model.

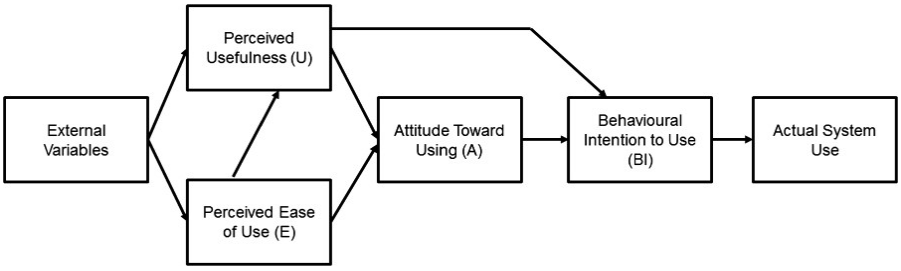

Fig. 4. Technology Acceptance Model (TAM) [5]

Two significant factors are perceived ease of use and perceived usefulness. Shroff stated system developers can have better control over users' beliefs about the system by manipulating these two determinants. Therefore enabling the ability to predict their behavioural intention and actual usage of the system [10]. TAM provided an explanation of the constructs of technology acceptance that made possible an explanation of user behaviour across an extensive scope of end-user information technologies and user populations [5]. As opposed to TRA, subjective norms are not included in TAM because of the weak psychometric results which are generated [5, 11]. The TAM system can be seen as a theoretical foundation for a number of different technology acceptance models, which are following different streams of technology acceptance research. One of these streams leads to models that are slightly modified or extended models of the TAM with a number of added determinants to come to a more accurate prediction within a specific setting. Other streams of research are aimed to be more unified and thereby making use of some of the TAM determinants. In a critical review of TAM, it was found that TAM is a useful theoretical model to understand and explain usage behaviour in IT implementation, [12] although many scholars have criticised this model for not including subjective norms.

3.4 Theory of Planned Behavior

The Theory of Planned Behaviour (TPB) is a theory that links behaviour and beliefs. This concept was introduced by Ajzen [13] to improve on some of the limitations of the theory of reasoned action (TRA) with the introduction of perceived behaviour. The theory examined the factors of subjective norms, attitude, perceived behavioural control, and intentions on actual behaviour. It was then concluded that TPB had a superior ability to predict behaviour that TRA [14, 15]. Figure 5 below shows the theory of planned behaviour.

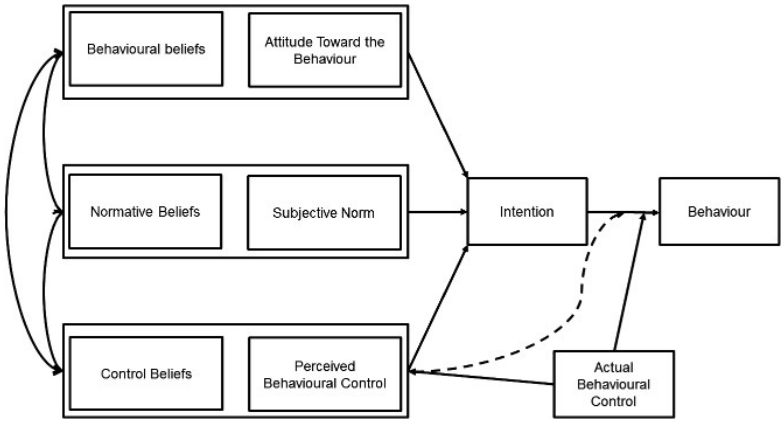

Fig. 5. Theory of Planned Behaviour (TPB) diagram [16]

Ajzen argued that some behaviour that is not under a person's volitional control might be problematic due to the differences in individuals' abilities and in external forces. It is noticeable people are expected to carry out their intentions when the opportunity arises once when given a sufficient degree of actual control over their behaviour that when given a sufficient degree of actual control over their behaviour, people are expected to carry out their intentions when the opportunity arises. Some examples of studies that can be conducted with TPB include whether to check oneself for disease and whether to wear a seat belt. Therefore, it has been concluded that TPB has a superior ability to predict behaviour than TRA [14, 15].

3.5 Model of PC Utilization (MPCU)

Thompson, Higgin and Howell in 1991 established MPCU to explain problems of PC utilization. According to them, "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 behaviour" [17]. This model resulted from Individual Behaviours model by Triandis in 1971 [18]. The Individual Behaviours model held that factors determining one's behaviours included attitudes, social norm, habits and expected results of the behaviours. Attitudes cover cognitive, affective and behavioural components. In MPCU factors affecting PC utilisation include perceived consequences, effect, social factors and facilitating conditions. Perception results cover complexity, job fitness and long-term consequences. Thompson et al. in 1991 conducted empirical studies of knowledge workers in the manufacturing industry [17]. The findings show only society, complexity, job fitness and long-term results have significant influence on PC utilization. Though MPCU relations were not proved to exist, scholars still had gained valuable studies based on the MPCU framework (Fig. 6).

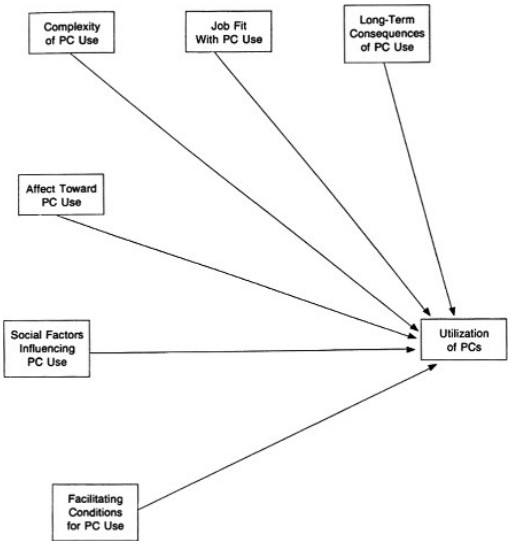

Fig. 6. The Model of PC utilization [17]

3.6 Motivation Model (MM)

Davis et al. in 1992 apply motivational theory to study information technology adoption and use [19]. The Motivation Model suggests that extrinsic and intrinsic motivations are the basis of individuals' behaviour. Extrinsic motivation can be defined as the perception that users want to perform an activity "because it is perceived to be instrumental in achieving valued outcomes that are distinct from the activity itself, such as improved job performance, pay, or promotions" [19]. The perceived ease of use, perceived usefulness and subjective norm are examples of extrinsic motivation. In this model, enjoyment and computer playfulness are determinants of intrinsic motivation [19, 20] and perceived ease of use, perceived usefulness, and subjective norm are constructs of extrinsic motivation. This model is based on the psychological sides of technology acceptance and has supported the general motivation theory as an explanation for behaviour.

3.7 Innovative Diffusion Theory (IDT)

Innovations Diffusion Theory (IDT) has been used since the 1950s to describe the innovation-decision process. It studies why, how, and at what rate new thoughts and technology spread through cultures. The theory has progressively evolved until the best well-known innovation-decision process was introduced by Rogers [21–24]. IDT applies not just in information technology exclusively, but also to other diffusion processes throughout society such as the acceptance of new technological products, dressing style, music style, food, principles, political candidates, or services. Disciplines such as education, sociology, communication, agriculture, marketing, and information technology amongst other have seen the application of research on the diffusion of innovation [23, 25, 26]. Theoretically, there is no explicit relation between the diffusion of innovation perspective and TAM, but both share important determinants. Some findings shows that the relative advantage construct in IDT is similar to the

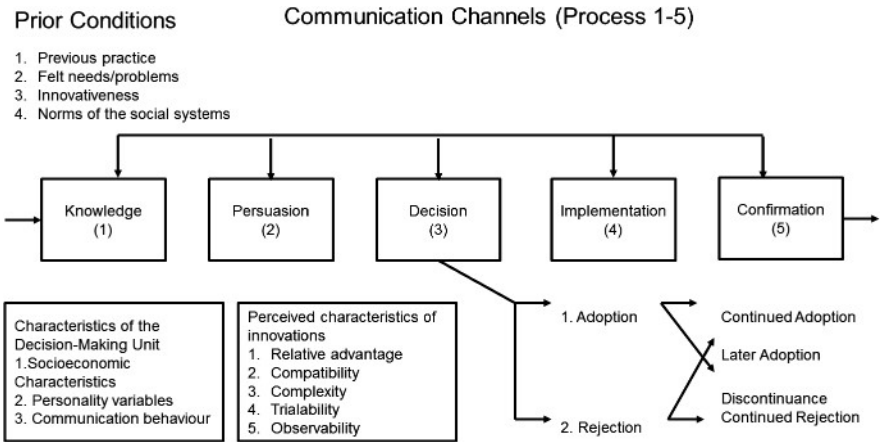

Fig. 7. A model of stages in the innovation-decision process [23]

notion of the PU in TAM, and the complexity construct in IDT captures the PEU in the technology acceptance model, although the sign is the opposite [27]. Figure 7 shows a model of stages in the Innovation-Decision Process.

3.8 Decomposed Theory of Planned Behavior (DTPB)

In 1995, Taylor and Todd introduced the Decomposed TPB (DTPB) also known as Combined TAM-TPB. DTPB was developed by linking the predictors of TPB with the determinant of perceived usefulness and ease of use from TAM [28, 29]. The theory explores the dimensions of subjective norm (i.e., social influence), attitude belief, and perceived behavioural control by decomposing them into specific belief dimensions [30]. DTPB proposes that behavioural intention is the main direct construct of behaviour. Attitude is decomposed to be influenced by perceived usefulness (relative advantage), perceived ease of use (complexity) and compatibility. The normative belief structure is affected by peer influence and superior influence. The control belief structure is affected by self-efficacy and facilitating conditions. Therefore, it seemed to have more capability in explaining usage behaviour although it is a less parsimonious theory when compared to TPB. Figure 8 below illustrates the decomposed theory of planned behaviour.

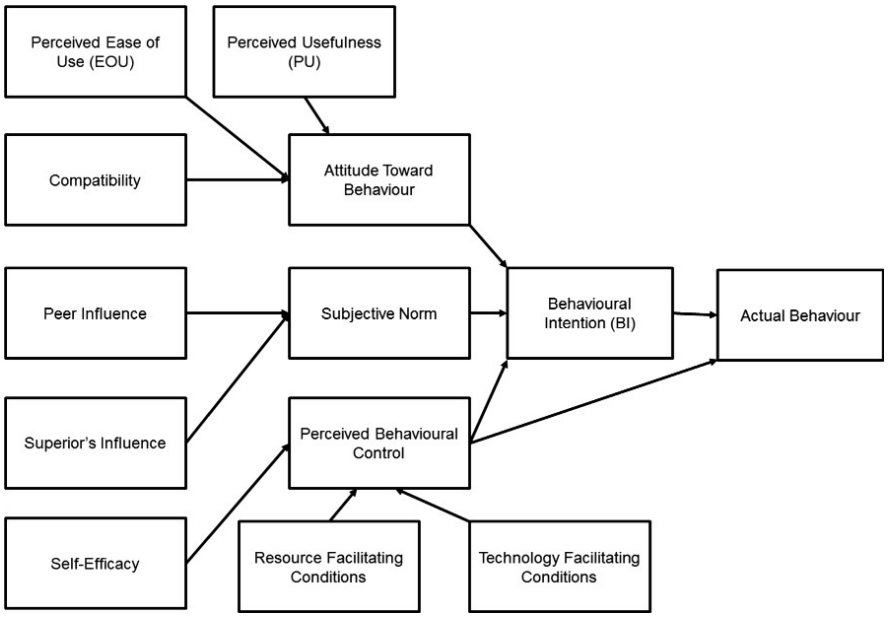

Fig. 8. Decomposed Theory of Planned Behaviour (DTPB) [30]

3.9 Technology Acceptance Model 2 (TAM2)

Venkatesh and Davis introduced TAM2 in 2000 as a theoretical extension of Technology Acceptance Model (TAM). This model included additional key constructs of TAM that explain perceived usefulness and usage intensions in terms of cognitive instrumental processes and social influence. Furthermore, it helped to understand how the effects of these constructs change with an increasing user experience of the target system over time. TAM2 keeps the concept of perceived ease of use from the original TAM as a direct construct influencing the perceived usefulness. All of these additional elements are believed to affect the acceptance of technology (Fig. 9).

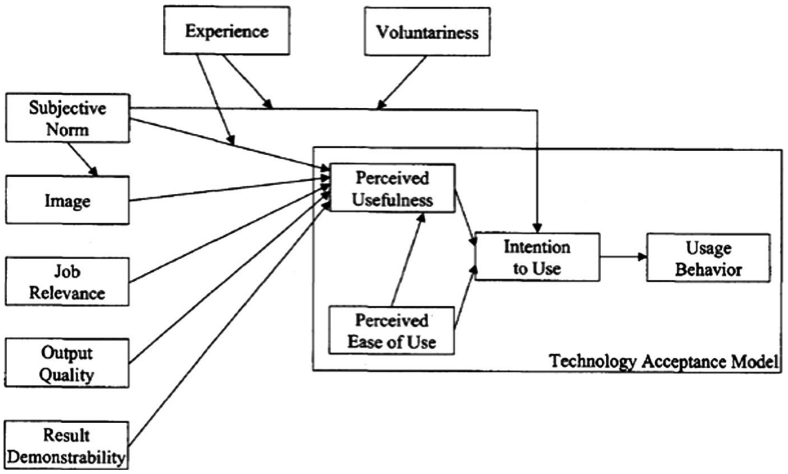

Fig. 9. TAM2 – Extension of TAM [31]

3.10 Unified Theory of Acceptance and Use of Technology (UTAUT)

In 2003, Venkatesh et al. introduced UTAUT which resulted from the integration of eight existing technology acceptance models and theories (TRA, TAM, MM, TPB, the combined TAM-TPB, the model of PC utilization, innovation diffusion theory and social cognitive theory). This theory has four main constructs of intention and usage, and up to four moderators of key relationships (performance expectancy, effort expectancy, social influence and facilitating conditions). Existing literature on technology acceptance has not given enough attention to age as a moderating factor although findings from the study of UTAUT indicate that age moderates all the main relationships in the theory. Additionally, gender is also a key moderating factor and has received some attention. These findings are consistent with other research conducted in social psychology and in sociology literature [32]. The UTAUT has been criticised because of the high number of independent variables used to predict intentions and behaviour towards the usage of technology. Nevertheless, it is considered to be more vigorous than other previous models used to evaluate and predict technology acceptance (Fig. 10).

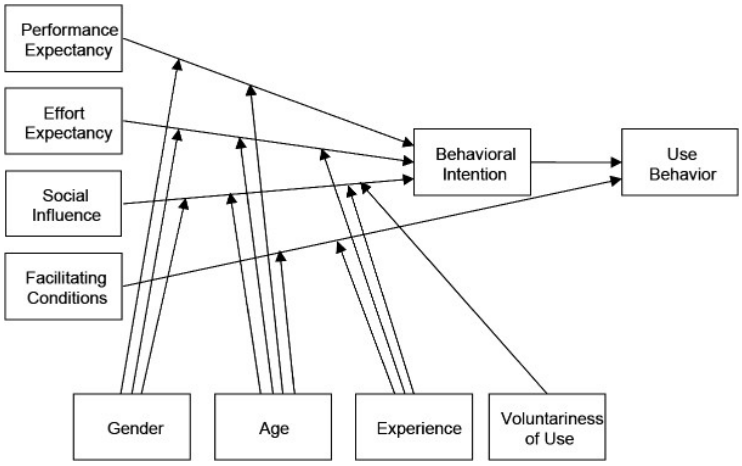

Fig. 10. Unified Theory of Acceptance and Use of Technology UTAUT [2]

3.11 Technology Acceptance Model 3 (TAM3)

In 2008 Venkatesh and Bala introduced TAM 3 [33]. The model was developed by combining TAM2 [31] and the model of the determinants of perceived ease of use [20]. TAM3, illustrated in Fig. 11 presents a complete nomological network of the constructs of individuals' IT adoption and use. The model suggests that perceived ease of use is influenced by computer playfulness, computer self-efficacy, computer anxiety, and perception of external control, perceived enjoyment and objective usability. The perceived usefulness is determined by job relevance, subjective norms, result demonstrability and image. Though, this model is criticised due to the high number of variables and the high number of relationship between variables.

3.12 Unified Theory of Acceptance and Use of Technology 2 (UTAUT2)

In 2012, Venkatesh et al. introduced UTAUT2 in order to extend the existing UTAUT model to other contexts [34]. This model is an updated version of the UTAUT which was initially introduced to explain employee technology acceptance and use [34], but because of its main focus on employees and organisations, its unified purpose is arguable. Since the numbers of technology devices and applications have an enormous value [35], the UTAUT model was extended with three additional determinants that are more customer oriented. The first of these determinants is the Hedonic Motivation, which can be seen as the extent to which a user experiences enjoyment from using a system. The second added determinant is Price Value, and is based on the idea that when consumers are responsible for costs, these costs can determine whether or not consumers will adopt the system [36, 37]. Finally, the Behavioural Intention, which in the UTAUT2 model is classified as 'Habit', is the last determinant and has shown in different research that habit has a direct impact on technology use. Similar to the original UTAUT model, age, gender and experience are taken into account, while the Voluntariness of Use has been removed and instead a line between Facilitating

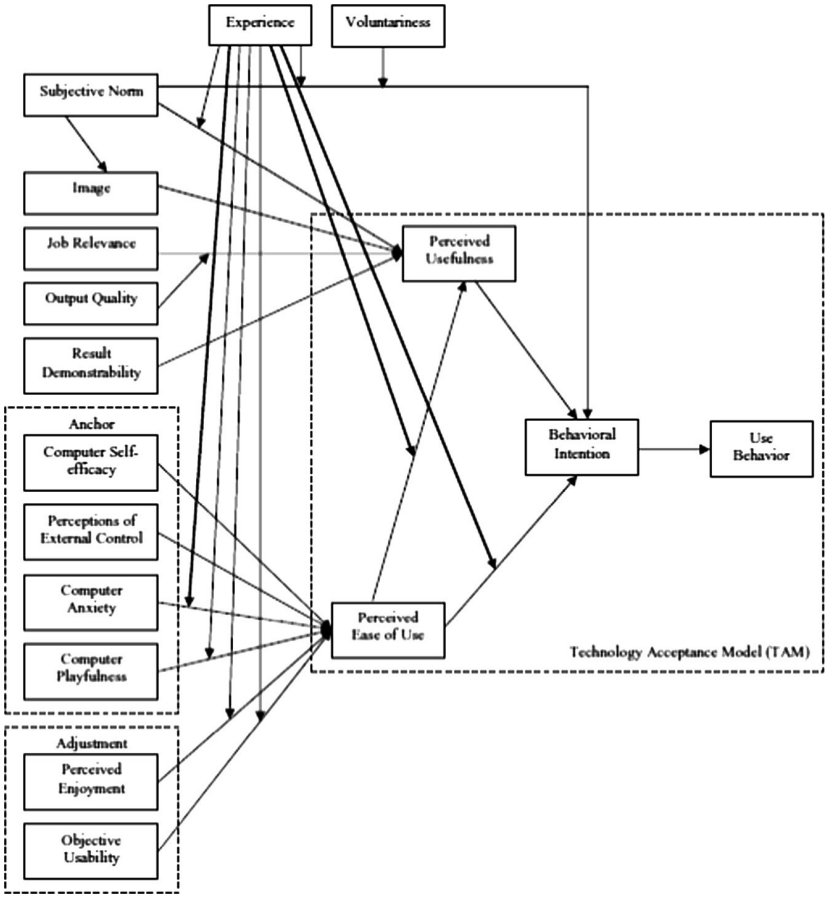

Fig. 11. Technology Acceptance Model 3 (TAM3) [33]

Conditions and Behavioural Intention was drawn, which is influenced by gender, age and experience. As the model Fig. 12 indicates, Hedonic Motivation is also moderated by gender, age, and experience, while the effect of Price Value is moderated by gender and age. Habit has both influence on Behavioural Intention and Use Behaviour, and is affected by age, gender and experience. Venkatesh et al. expand the whole framework with regard to technology use; however, voluntariness has been ignored.

3.13 UTAUT Extensions

There have been several UTAUT extensions in the past few years which can be classified in four main types: exogenous mechanisms, new endogenous mechanisms, new moderating mechanisms and new outcome mechanisms. Figure 13 illustrates the four types of UTAUT extensions at a more abstract level and Table 1 below summarises the four types of UTAUT extension studies.

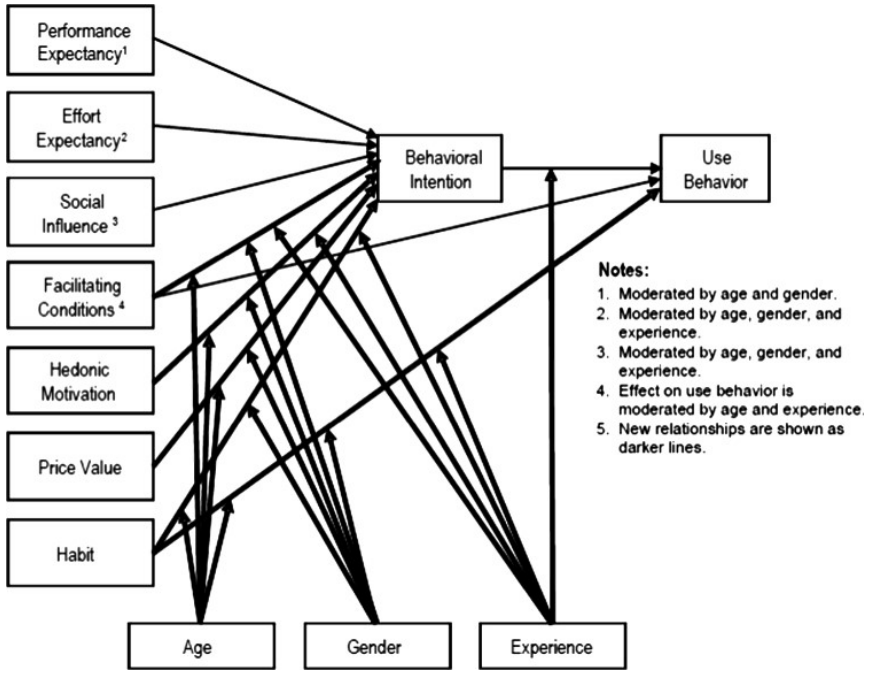

Fig. 12. Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) [34]

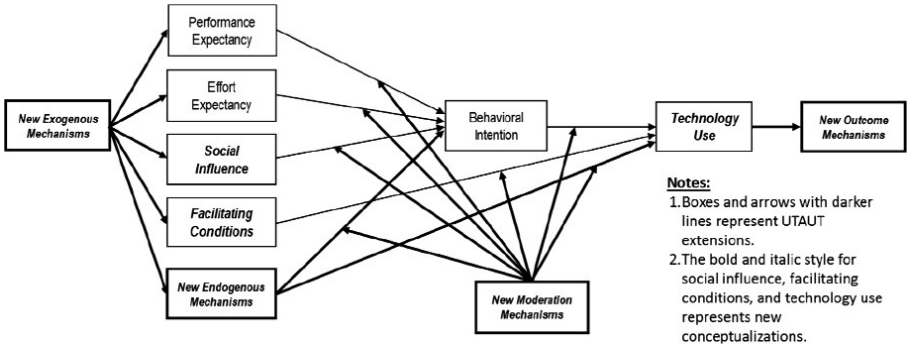

Fig. 13. Types of UTAUT Extensions [43]

Table 1. Types of UTAUT Extensions [43]

Source	New exogenous mechanisms	New endogenous mechanisms	New moderation mechanisms	New outcome mechanisms
Alaiad and Zhou (2013)		Trust		
Al-Gahtani, Hubona and Wang (2007)			Culture (Saudi Arabia vs. USA)	
Alshare and Mousa (2014)			Espoused culture values	
Borrero, Yousafzai, Javed and Page (2014)			Technology readiness	
Bourdon and Sandrine (2009)		Enriching social influences; enriching facilitations		
Brown et al. (2010)	Collaboration-related constructs: technology characteristics, individual characteristics, group characteristics, task characteristics, and situational characteristics			
Carter and Schaupp (2008)		Trust, self-efficacy, and experience		
Casey and Wilson-Evered (2012)	Trust and Innovativeness			
Chiu and Wang (2008)	Computer self-efficacy	Task value, task cost, and computer self-efficacy		
Dasgupta and Gupta (2011)	Organizational culture			
Eckhardt et al. (2009)		Enriching social influences	Adopter vs. non-adopter	
Im et al. (2011)			Culture (Korea vs. USA)	
Lallmahomed, Ab Rahim, Ibrahim and Rahman (2013)		Hedonic performance expectancy, enriching system use		
Liang et al. (2010)	Team climate for innovation			
Liew, Vaithilingam and Nair (2014)		Adoption perceived economic benefit, and perceived social benefit, enriching use	Ethnicity, religion, language, employment, income, education, and marital status	

(*continued*)

Table 1. (*continued*)

Source	New exogenous mechanisms	New endogenous mechanisms	New moderation mechanisms	New outcome mechanisms
		behavior(economic use and social use)		
Loose, Weeger and Gewald (2014)		Perceived threats		
Lu, Yu and Liu (2009)			Income and location	
Martins, Oliveira and Popovic (2014)	Perceived risk	Perceived risk		
McKenna, Tuunanen and Gardner (2013)	Adaptive service components, computational service components, collaborative service components, and networking service	Self-efficacy		
McLeod, Pippin and Catania (2009)		Tax performance expectancy; privacy and risk	Professionals vs. novices	
Neufeld et al. (2007)	Charismatic leadership			
Niehaves and Plattfaut (2010)			Income, education, and migration background	
Oh and Yoon (2014)		Trust and flow experience	E-Learning vs. online game	
Park et al. (2011)		Organizational facilitating conditions	Organizational facilitating conditions	
Saeed (2013)		Perceived financial control and ease of navigation		
Schaupp, Carter and McBride (2010)		Optimism bias and perceived risk	Schaupp, Carter and McBride (2010)	
Shibl, Lawley and Debuse (2013)	Professional development, time, cost, training, security, integration, and workflow	Involvement	Shibl, Lawley and Debuse (2013)	Professional development, time, cost, training, security, integration, and workflow
Sun et al. (2009)	Perceived work compatibility			Individual performance
Thong et al. (2011)			IT service type; Adoption vs. continued use	

(*continued*)

Table 1. (*continued*)

Source	New exogenous mechanisms	New endogenous mechanisms	New moderation mechanisms	New outcome mechanisms
Venkatesh and Zhang (2010)			Culture	
Venkatesh et al. (2008)		Behavioral expectation Duration, frequency, and intensity of use	Age, gender, and experience moderate the impacts of facilitating conditions on behavioral expectation; experience moderates the impacts of behavioral intention and behavioral expectation on use	
Venkatesh et al. (2012)		Hedonic motivation, habit, and price value	Age, gender, and experience moderating the impacts of hedonic motivation, habit, and price value on intention and use respectively	
Wang et al. (2012)		Trust	Type of recommender system; type of product	
Wang, Jung, Kang and Chung (2014)	Perceived innovativeness with IT and computer self-efficacy	Enriching social in fluence, knowledge sharing outcome expectancy, and security.	User groups (silent vs. social users)	
Weerakkody, El- Haddadeh, Aı-Sobhi,: Shareef and Dwivedi (2013)	Trust of Internet and trust of Intermediaries			
Xiong, Qureshi and Najjar (2013)		Job fit, attitude, self-efficacy, and anxiety		Economic development
Yuen, Yeow, Lim and Saylani (2010)		Attitude, anxiety, perceived credibility, and self-efficacy	Culture	

4 Comparative Study

See Table 2

Table 2. Technology Acceptance models and theories comparison study

Models and Theories	Characteristics	Core constructs	Reference and Applications
Theory of Reasoned Action (TRA) (1975)	• Developed by Ajzen and Fishbein in 1975 • Drawn from social psychology • One of the most important and influential theories of human behaviour • Links the perception, norms and attitudes to the intentions of a person in making a decision and from there predicts the person behaviour • The starting point of TAM • Does not consider the individual's ability to control	• Attitude toward behaviour • Subjective Norm	Fishbein and Ajzen 1975 [3]
Social Cognitive Theory (SCT) (1986)	• Developed by Albert Bandura • Proposes that environmental factors, personal factors and behaviours are determined reciprocally • Learning occurs in a social context with a dynamic and reciprocal interaction of personal factors, environmental factors, and behaviours	• Outcome Expectations Performance • Outcome Expectations Personal • Self-efficacy • Affect • Anxiety	Compeau and Higgins 1995b [8]
Technology Acceptance Model (TAM) (1986, 1989)	• Developed by Fred Davis in his doctoral study • TAM originated as an adaptation of the more generalised TRA and was developed more specifically later to predict and explain technology usage behaviour • TAM has been used to study the adoption of different technologies and it has become the most significant theory in this field • TAM is tailored to IS contexts and was designed to predict information technology acceptance and usage on the job	• Perceived Usefulness • Perceived Ease of Use • Subjective Norm	• The case of cellular telephone adoption (Kwon and Chidambaram 2000 [38]) • Behavioural intention to use e-books (Wen-Chia Tsai 2012 [39]

(*continued*)

Table 2. (*continued*)

Models and Theories	Characteristics	Core constructs	Reference and Applications
	• In contrast with TRA. the TAM does not include subjective norms because of the weak psychometric results which are generated • Researchers of ICT have criticised this model for not including subjective norms,		
Theory of Planned Behaviour (TPB) (1991)	• Developed by Ajzen in 1991 as an extension of TRA, with the additional determinant of intention perceived behaviour control • TPB has a greater ability to predict behaviour than TRA	• Attitude toward behaviour • Subjective Norm • Perceived behavioural control	• Ajzen 1991 [13] • Taylor and Todd 1995b [30]
Model of PC Utilization (MPCU) (1991)	• Thompson, Higgins and Howell (1991) predicted PC utilisation behaviour model • Derived largely from Triandis' (1977) theory of human behavior, this model presents a competing perspective to that proposed by TRA and TPB • However, the nature of the model makes it particularly suited to redict individual acceptance and use of a range of information technologies. It predicts usage behavior rather than intention	• Job-fit • Complexity • Long-term consequences • Affect towards use • Social factors • Facilitating conditions	Thompson et al. 1991. p.129 [17]
Motivation Model (MM) (1992)	• This model is based on the psychological aspects of technology acceptance	• Extrinsic Motivation • Intrinsic Motivation	Applied by Davis, Bagozzi and Warshaw to study ICT adoption and use (1992) [19]
Innovative Diffusion Tlieory (IDT) (1962, 1971, 1983, 1995)	• Developed by Rogers in 1995 • Grounded in sociology and has been used since the 1960s to study a variety of innovations, ranging from agricultural tools to organisational innovation • Appropriate in both an individual or organizational context • Is one of the most well -known theories associated with the adoption of new technology	• Relative advantage • Ease of use • Image • Visibility • Compatibility • Results demonstrability • Voluntariness of use	Moore and Benbasat 1991, p. 195 [27]

(*continued*)

Table 2. (*continued*)

Models and Theories	Characteristics	Core constructs	Reference and Applications
Decomposed Theory of Planned Behavior (DTPB) or Combined TAM - TPB (1995)	• Developed by Taylor and Todd in 1995.	• Attitude toward behaviour • Subjective Norm • Perceived Behavioral Control • Perceived Usefulness	Taylor and Todd 1995a [29]
Extension of TAM (TAM2) (2000)	• Developed by Venkatesh and Davis in 2000 by adding two more determinants to the original TAM (social influences and cognitive instrumental processes)	• Voluntariness • Experience • Subjective norm • Image • Job relevance • Output Quality • Result Demonstrability	Venkatesk and Davis 2000 [31]
Unified Theory of Acceptance and Use of Technology (UTAUT) (2003)	• Developed by Venkatesh, Morris, Davis, G. and Davis. F. in 2003 • Integrates the components of eight technology acceptance models and theories: TRA, TAM. the motivational model. TPB, combined TAM-TPB, the model of PC utilization, innovation diffusion theory, and social cognitive theory • It is considered to be more robust than other technology acceptance models in evaluating and predicting technology acceptance • This theory has been criticised for having too many	• Performance expectancy • Effort • Expectancy • Social Influence • Facilitating conditions	Venkatesh, Morris, Davis, G. and Davis, F 2003 [2]

5 Technology Acceptance and the Decision to Invest in Information Security

Information security refers to any process, activity, or task that protects the integrity, accessibility, and confidentiality of information [41]. In today's digital society with the increased abilities of hackers and information theft, security is becoming a crucial aspect of everyday life although its importance is well recognised by current information security literature [44]. Certainly, for any technology to be successfully acceptance in organisations, the security aspect has to be reviewed with a great level of

detail. Information security is vital for protecting important assets of organisations, including the information resources and the organisation's reputation. In addition, some studies have reported that users' concern about security has increased and it has been known as one of the most significant factors for technology acceptance [42]. Furthermore, the paucity of empirical research exists to explain an organization's motivation to invest in (or not to invest in) information security. Since the introduction of e-mail and the World Wide Web, information security breaches have increasingly become a major threat to organizations. The Fig. 14 below is an adaptation based on TAM, information security investment and decision-making which explores information security investment decisions making and acceptance [44].

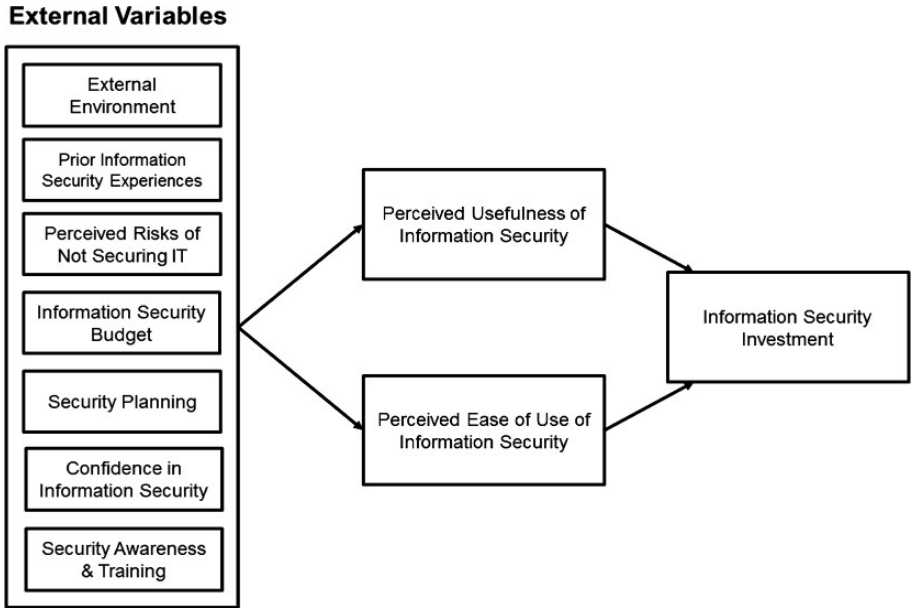

Fig. 14. Conceptual model for decision to invest in Information security [44]

The proposed model identifies a set of external variables influencing perceived usefulness of information security and also affecting the perceived ease of use of information security, which are key factors playing a major role in any information security investment. In this list of external variables, security awareness and training are amongst the most important components of information security and acceptance as awareness about technology causes users to look forward to try technology while enjoying the various benefits that the system will provide. It might also provide guidance to managers in their efforts to justify and receive funding for information security.

6 Discussion

The UTAUT has proven to be a useful theoretical model in helping to understand and explain use behaviour in information system implementation. It has been tested in many empirical research studies and the tools used with the model have proven to be of quality and to yield statistically reliable results. In today's society, the globalization of business has highlighted the need to understand the effectiveness of IS that span different cultures and social classes. Multinational and trans-cultural organizations use IT to achieve economies of scale, coordinate operations, and facilitate collaborative work across locations and cultures. Cultural differences have become an important issue in the evaluation of computer applications and new technologies as a whole. To make valid comparisons, models should be robust across cultures. Culture is often partially blamed when organisations experience failure. For example, the Columbia and Challenger disasters experience by NASA were in part attributed to a culture that valued conformity to rules resulting in the overlooking of potential risks [40]. On the other hand, social class to some extent plays a major role in technology adoption. This may be related to the level of convenience, social/institutional safeguards, or the pursuit of social class membership. Therefore, developing new models that will take into consideration culture effect as a new construct on the basis of Hofstede's cultural dimensions and social class as a moderating factor possibly combined with the Actor Network Theory as a framework to analyse external variables influencing consumers' behavioural intention of using technology, would be our next challenge.

7 Conclusion and Future Work

TAM has been widely used in information and communication technology research to help understand as well as explain user behaviours. This paper has summarised technology acceptance models and theories. We made explicit the assumptions underlying these TA models and theories including factors relevant to each model, and have attempted to review the origins and the evolution of TAM from 1975 to 2016. TAM has succeeded in providing a robust model which is applicable across a broad range of end-user computing technologies. More importantly, we identified a significant body of literature that reports inconsistent results with these models and the lack of consideration of the cultural influence and social class in acceptance of new technology makes these models incomplete. It is suggested that future researchers shall start with simple or most fundamental models and then add new variables for different targets. Furthermore, it is essential to recognise that effective Information security management is critical in ensuring important assets of organisations, such as information and reputation, receive appropriate protection. Future work will be use a theory such as the actor-network theory to further explore external variables and other relevant entities influencing behavioural intention and use of technology.

References

1. Bailey, J., Pearson, S.: Development of a tool for measurement and analyzing computer user satisfaction. Manage. Sci. **29**(5), 530–575 (1983)
2. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D.: User acceptance of information technology: toward a unified view. MIS Q. **27**(3), 425–478 (2003)
3. Fishbein, M., Ajzen, I.: Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research. Addison-Wesley, Reading (1975)
4. Ajzen, I., Fishbein, M.: Understanding Attitudes and Predicting Social Behavior. Prentice Hall, NJ (1980)
5. Davis, F.D., Bagozzi, R., Warshaw, P.: User acceptance of computer technology: a comparison of two theoretical models. Manage. Sci. (1989). doi:10.1287/mnsc.35.8.982
6. Yusuf, M., Derus, A.M.: Measurement model of corporate Zakat collection in malaysia: a test of diffusion of innovation theory. Humanomics **29**(1), 61–74 (2013)
7. Bandura, A.: Social Foundations of Thought and Action: A Social Cognitive Theory. Prentice- Hall Inc., Englewood Cliffs (1986)
8. Compeau, D.R., Higgins, C.A., Huff, S.: Social cognitive theory and individual reactions to computing technology: a longitudinal study. MIS Q. **23**(2), 145–158 (1999)
9. Bandura, A.: Social cognitive theory. In: Vasta, R. (ed.) Annals of Child Development, vol. 6. Six Theories of Child Development, pp. 1–60. JAI Press, Greenwich (1989)
10. Shroff, R.H., Deneen, C.C., Ng, E.M.W.: Analysis of the technology acceptance model in examining students' behavioural intention to use an e-portfolio system. Australas. J. Education. Tech. **27**(4), 600–618 (2011)
11. Wu, M., Chou, H., Weng, Y., Huang, Y.: TAM2-based study of website user behavior — using web 2. 0 websites as an example. Wseas Trans. Bus. Econ. **8**(4), 133–151 (2011)
12. Legris, P., Ingham, J., Collerette, P.: Why do people use information technology? a critical review of the technology acceptance model. Inf. Manag. **40**(3), 191–204 (2003)
13. Ajzen, I.: The theory of planned behavior. Organ. Behav. Hum. Decis. Process. **50**(2), 179–211 (1991)
14. Kok, G., DeVries, A., Muddle, N., Strecher, V.: Planned health education and role of self-efficacy: Dutch research. Health Educ. Res. **6**(2), 231–238 (1991)
15. Liang, T., Huang, J.: An empirical study on consumer acceptance of products in electronic markets: a transaction cost model. Decis. Support Syst. **24**(1), 29–43 (1998)
16. Ajzen, I.: Constructing a TpB Questionnaire: Conceptual and Methodological Considerations. World Wide Web (2006). http://www.people.umass.edu/aizen/pdf/tpb.measurement.pdf. Accessed 14 May 2016
17. Thompson, R.L., Higgins, C.A., Howell, J.M.: Personal computing: toward a conceptual model of utilization. MIS Quarterly **15**(1), 125–143 (1991)
18. Triandis, H.: Interpersonal Behavior. Brooke/Cole, Monterey, CA (1977)
19. Davis, F., Bagozzi, R., Warshaw, P.: Extrinsic and intrinsic motivation to use computers in the workplace. J. Appl. Soc. Psychol. **22**(14), 1111–1132 (1992)
20. Venkatesh, V.: Determinants of perceived ease of use: integrating perceived behavioral control, computer anxiety and enjoyment into the technology acceptance model. Inf. Syst. Res. **11**(4), 342–365 (2000)
21. Rogers, E.M.: Diffusion of Innovations, 1st edn. The Free Press, New York (1962)
22. Rogers, E.M.: Diffusion of Innovations, 3rd edn. The Free Press, New York (1983)
23. Rogers, E.M.: Diffusion of Innovations, 4th edn. The Free Press, New York (1995)
24. Rogers, E.M., Shoemaker, F.F. (eds.).: Communication of Innovations: A Crosscultural Approach. Free Press, New York (1971)

25. Karahanna, E., Straub, D.: The psychological origins of perceived usefulness and ease-of-use. Inf. Manag. **35**(4), 237–250 (1999)
26. Agarwal, R., Sambamurthy, V., Stair, R.M.: The evolving relationship between general and specific computer efficacy: an empirical assessment. Inf. Syst. Res. **11**(4), 418–430 (2000)
27. Moore, G.C., Benbasat, I.: Development of an instrument to measure the perceptions of adopting an information technology innovation. Inf. Syst. Res. **2**(3), 192–222 (1991)
28. Surendran, P.: Technology acceptance model: a survey of literature. Int. J. Bus. Soc. Res. **2** (4), 175–178 (2012)
29. Taylor, S., Todd, P.: Assessing it usage: the role of prior experience. MIS Q. **19**(4), 61–70 (1995a). Accessed 30 March 2016
30. Taylor, S., Todd, P.: Understanding information technology usage: a test of competing models. Inf. Syst. Res. **61**, 44–76 (1995b). Accessed 30 March 2016
31. Venkatesh, V., Davis, F.D.: A theoretical extension of technology acceptance model: four longitudinal field studies. Manage. Sci. **46**(2), 186–204 (2000)
32. Levy, J.A.: Intersections of gender and aging (1988). http://search.epnet.com/login.aspx?direct=true&db=aph&authdb=epref&an=SQ.BI.DGI.LEVY.IGA
33. Venkatesh, V., Bala, H.L: Technology acceptance model 3 and a research agenda on interventions. Decis. Sci. J. Innovative Educ. **39**(2), 273–315 (2008)
34. Venkatesh, V., Thong, J., Xu, X.: Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS Q. **36**(1), 157–178 (2012)
35. Stofega, W., Llamas, R.T.: *Worldwide Mobile Phone 2009-2013 Forecast Update, IDC Document Number 217209*. IDC, Framingham (2009)
36. Brown, S.A., Venkatesh, V.: Model of adoption of technology in households: a baseline model test and extension incorporating household lifecycle. MIS Q. **29**(3), 399–426 (2005)
37. Coulter, K.S., Coulter, R.A.: Distortion of Price Discount Perceptions: the Right Digit Effect. Journal of Consumer Research **34**(2), 162–175 (2007)
38. Kwon, H.S., Chidambaram, L.: A test of the technology acceptance model-the case of cellular telephone adoption. In: Proceedings of the 33rd Hawaii International Conference on System Sciences (2000)
39. Wen-Chia, T.: A study of consumer behavioral intention to use e-books: the technology Acceptance Model perspective. Innovative Marketing **8**(4), 55–66 (2012)
40. Vaughn, D.: The Challenger Launch Decision: Risky Technology, Culture and Deviance at NASA. University of Chicago Press, Chicago (1996)
41. NIST (National Institute of Technical Standards) An introduction to computer security: the NIST handbook, Special Publication 800–12, (1995)
42. Vijayasarathy, L.R.: Predicting consumer intentions to use online shopping: the case for an augmented technology acceptance model. Inf. Manag. **41**(6), 747–762 (2004)
43. Venkatesh, V., Thong, J.Y.L., Xu, X.: Unified theory of acceptance and use of technology: a synthesis and the road ahead. J. Assoc. Inf. Syst. **17**(5), 328–376 (2016)
44. Johnson, A.M.: The technology acceptance model and the decision to invest in information security. In: Proceedings of the Southern Association of Information Systems Conference (2005)