



Adoption of Technology: A Comparative Study of TRA, TPB, TAM and UTAUT Models

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Abstract

Technology has pervaded in every aspect of human life whether it is health related, economic, governance, entertainment or education. The main objective of this study is to compare the technology models with each other. The main four models which were used in this study was- Theory of Reasoned Behavior, Theory of Planned Behaviour, Technology Acceptance Model and last but not the least is Unified Theory of Acceptance and Use of Technology. In this study 5 figures and 3 tables were used which showed the different models. This paper was purely based upon the secondary data. The conclusion of this paper is based on articles and journals published in between 1974 and 2010. The results of the study showed that TPB model is different from the TRA model in the extra addition of the construct of perceived behaviour control. The TAM model have two main variables which were perceived usefulness and perceived ease of use. UTAUT gives a refined view of how the determinants of intention and behaviour evolve over time. For explaining and predicting the system use Technology Acceptance Model was very popular. It was very helpful in helping to understand and explain use behaviour in technology implementation.

Keywords- Technology Acceptance Model, technology adoption, Theory of Reasoned Action, Theory of Planned Behaviour and Unified Theory of Acceptance and Use of Technology.

Introduction

Computer systems can't improve itself the performance of an organisation, if they are not used by anyone. The needs of technology were growing from 1970's, when Information and Communication Technology (ICT) revolution has given rise in the term 'learning economy' in which a person can learn how to create new knowledge and adapt the latest technology. It is an enabler to spread knowledge. Technology helps the organisation, individual or a group of people in their performance or skills improvement. A lot of technology was failed because users do not adopt it, they resist the new technology. Technology has pervaded in every aspect of human life whether it is health related, economic, governance, entertainment or education. The term technology in education is not new. The first use of the word technology was start in Harvard university in 1816 (Samaradiwakara & Gunawardena,2014). The key driver to the teaching and learning is the integration of technology. The researchers were interested in identifying the various factors which effect on technology adoption and its usage. Several models were developed to help in forecasting the use of technology (Teo & Lee,2010).

Technologies acceptance models:

A model is the systematic description of a system. A large number of models have been designed to explore the intention to use the technology. This paper examines the comparative study of Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT). This research paper is purely based upon the secondary data. This review is based on articles and Journals published in between 1974 and 2010 from the following research journals like Organizational Behavior and Human Decision processes, MIS quarterly, Campus-Wide Information Systems, Information systems research, International Technical Sciences Journal, Journal of Experimental Social Psychology, Management Science, Working Papers on Information Systems etc. Articles related to technology models like TRA, TPB, TAM and UTAUT are featured in this review.

The paper proceeds as follow. In the next section, the theoretical models (TRA, TAM, TPB and UTAUT) were explained. In table 3 comparison of these models were explained. Next section provides the conclusion and the last section explain limitations and suggest some direction for future research.

1. Theory of Reasoned Action

TRA was the first theoretical model in technology acceptance research which was developed by Ajzen and Fishbein in 1975. It is the widely studied model from social psychology.

The casual diagram of TRA theory was

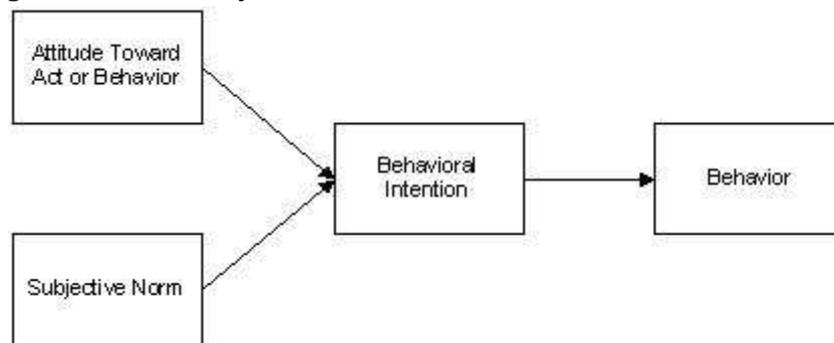


Figure 1 Basic Components of TRA (Fishbein and Ajzen 1975).

In this theory

$$BI = A + SN \tag{1}$$

Where BI= Behavioural Intention

A= Attitude

SN= Subjective norm

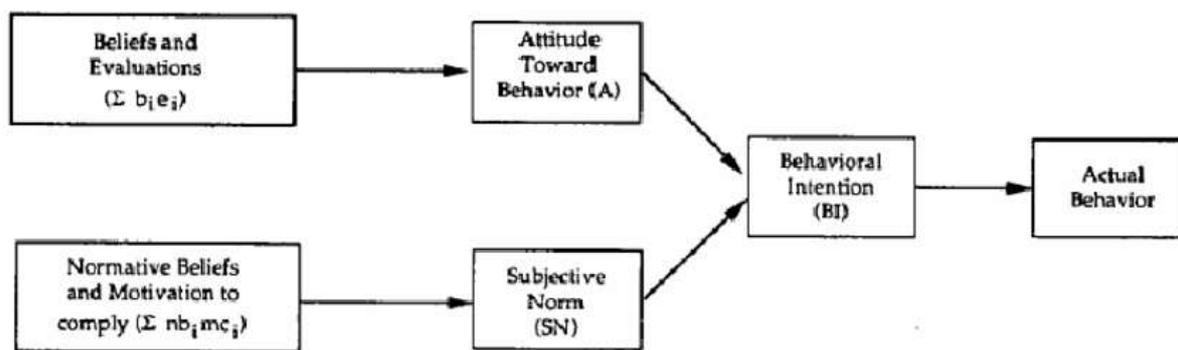


Figure 2- Theory of Research Action (Fishbein & Ajzen, 1975)

In fig.2 TRA model has been explained in which behavioural intention is influence by attitudes toward behaviour and subjective norm. According to TRA model actual behaviour of a person towards the use of technology is determined by the intention to use the technology. 'A'= attitude explain the negative and positive behaviour about the acceptance of technology. Subjective norms talk about "the person perception that most people who are important to him think he should or should not perform the behaviour in the question" (Fishbein & Ajzen, 1975).

In the above figure the person's attitude towards behaviour (A_B) is the attitude towards the behaviour and this attitude is the sum of salient beliefs which is denoted by b_i and the evaluation (e_i) of those consequence:

$$A_B = \sum b_i e_i \quad (2)$$

TRA explained that a person subjective norms are a function of two components first is the perception of how significant other feel about performance of volitional behaviour and second is one motivation to comply with the desires of significant others. SN is calculated by multiplication of normative beliefs (nb_i) and motivation to comply (mc_i).

$$SN = \sum nb_i mc_i \quad (3)$$

The TRA model showed that the behavioural intentions are influenced by the attitudes toward the volitional behaviour. This theory showed that normative beliefs, motivation to comply and subjective norms have strong direct relation, but some research criticise the TRA theory. Most research reports a stronger relationship between attitude and intention than between subjective norms and intention. Some other study showed that attitudes and subjective norms correlate in different ways with behavioural intentions (Greene et al., 1997 & Miller & Grush, 1986). The least understood aspects of TRA was Subjective Norms as a determinant of BI. For the better understanding of the model TAM was developed in which Subjective Norms was not included as a determinant of BI because of its uncertain theoretical and psychometric status.

2. Theory of Planned Behaviour (TPB)

Theory of Planned Behaviour is developed in 1985 by Ajzen, this model is the extension of Theory of Reasoned Action and very similar to Theory of Reasoned Action Model. It is known as TPB. In this theory attitude, subjective norm and perceived behavioural control (PBC) were inter-related to each other as shown in the figure. PBC influences the individual decision through behavioural intention. PBC is defined as a person's perception of how easy or difficult it would be to carry out a behaviour (Ajzen, 1991). Subjective norm refers to a person's perception that most people who are important to him or her and think that he or she not perform the behaviour in a particular question. Subjective norms were proposed to have a direct effect on perceived usefulness (Venkatesh & Zhang, 2000). Attitude is defined by the individual response; it can be negative or it can be positive. The success of a theory is always depending upon the support and attitudes of an individual response. If a teacher thought that the technology will not help them in the teaching, then they are less likely to introduce technology in their teaching-learning process.

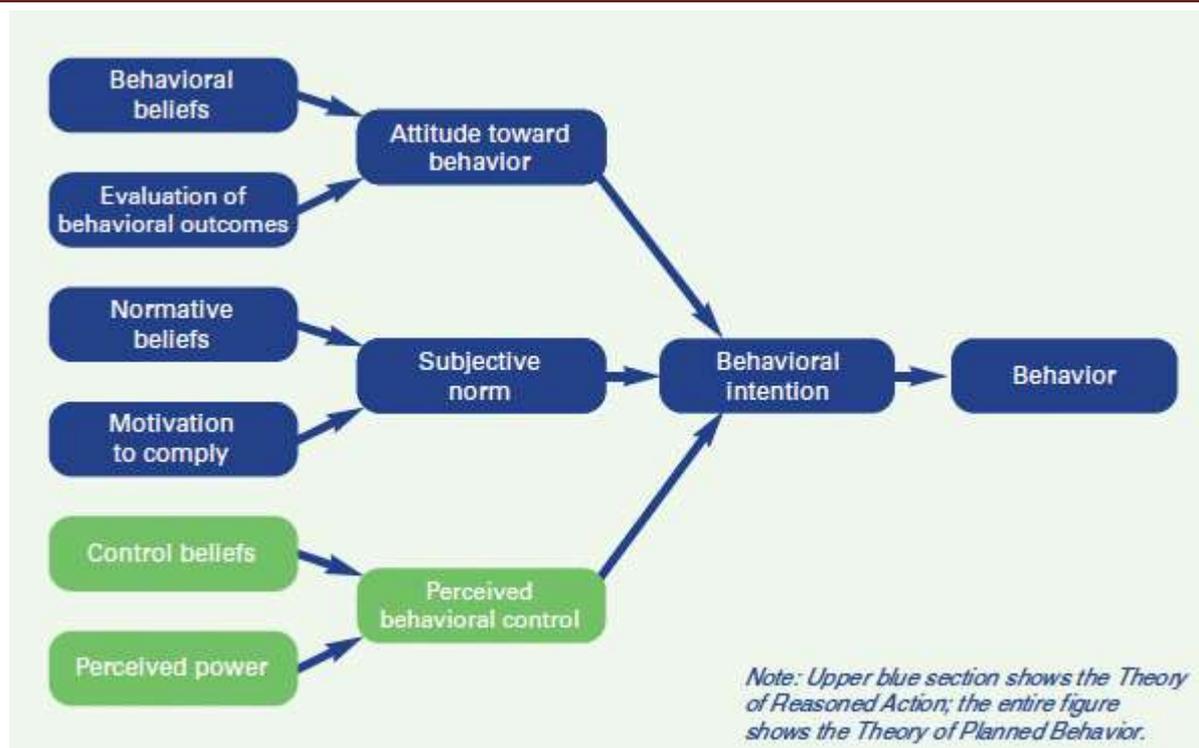


Figure 3- Theory of Planned Behaviour, Ajzen (1985), Mathieson (1991)

In the above TPB figure the blue constructs is as similar in Theory of Reasoned Action and the green constructs show those construct which was added in TRA model for making it TPB

Perceived usefulness play an important role in the theory of planned behaviour. This theory is different from the theory of reasoned action in the addition of perceived behaviour control. Ajzen, (1991) tried to showed that the theory of planned behaviour delivers a valuable conceptual framework for dealing with the difficulties of human social behaviour. The theory includes some of the central concepts in the social and behaviour sciences, and it explains these concepts in a way that permits prediction and understanding of particular behaviours in specified contexts. Attitudes toward the behaviour, subjective norms with respect to the behaviour, and perceived control over the behaviour are usually found to predict behavioural intentions with a high degree of accuracy. In turn, these intentions, in combination with perceived behavioural control, can account for a considerable proportion of variance in behaviour. By using the TPB model, the study showed that attitude towards computer use and subjective norm have significant effect on behavioural intention to use technology (Teo & Lee, 2010).

3. Technology Acceptance Model (TAM)

One of the well-known models related to technology acceptance and use is TAM which was introduced originally by Davis in 1985 is an adaptation by TRA. Technology Acceptance Model is a structure for predicting and explaining consumers' adoption of Information Technology (IT). TAM is one of the most widely used models for information technology adoption. Why users accept or reject information technology? This model is very helpful in finding this concept. It was the first model to mention psychological factors affecting technology acceptance. In this theory it is easily find out that why a user accepts or rejects technology. In fact, TAM has become so popular that it has been cited in most of the research that contracts with user acceptance of technology and the research on TAM is still ongoing.

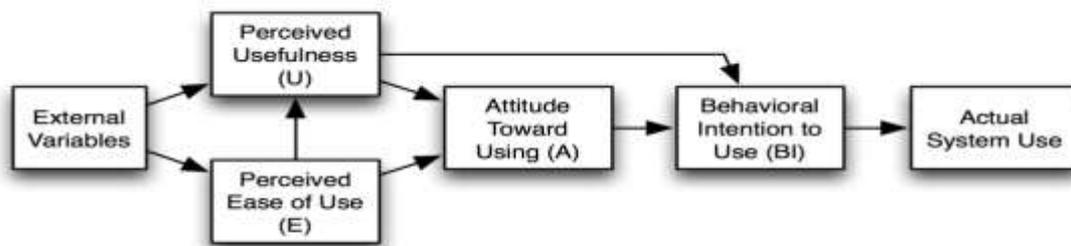


Figure 4- Technology Acceptance Model (Davis,1989)

Users motivation can be explained by three factors in TAM: *Perceived Ease of Use, Perceived Usefulness and attitude toward using the technology.* (Davis, 1985) The model suggests that user acceptance of a new system is determined by the users' intention to use (IU) the system, and the intention is influenced by the users' beliefs about the system's perceived usefulness (PU) and perceived ease of use (PEU).

$$BI=A+U$$

$$A= U+Eou$$

Where BI= Behavioural intention, A= Attitude, U=Perceived usefulness, EOU= Ease of Use

In the TAM theory various external factors affect intention and actual use through the perceived usefulness and perceived ease of use. The actual usage of technology is directly or indirectly influenced by the user behavioural, intentions and attitudes. Several study explained how people adopt and use technology with the explanation of TAM.

Perceived usefulness: "The degree to which an individual believes that using a particular system would enhance his or her job performance" (Davis,1985).

Perceived ease of use: "The degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis,1985).

In the first stage Davis (1989), evaluate 14 statements which was suitable for measurement scale for Perceived usefulness and perceived ease of use which was analysed on 1 to 7 Likert Scale 1 was for Good and scale 7 was used for Bad and 4 stands for Neutral. Perceived usefulness and perceived ease of use both have 14 statements. After testing 14 statements on 15 experienced computer users Davis found that 4 statements were eliminated because 4 statements did not cluster with the other statements and after eliminating four statements ten statements were left. Davis (1989) again conducted a field study on 112 employees which were working for IBM in Toronto, Canada to test the validity and reliability on 10 statements which was left after eliminate. The results of the study showed that the self-reported usage was significantly correlated with both perceived ease of use and perceived usefulness. The tests showed a high reliability and validity for the 10 statements. Davis (1989) again refined the above 10 statements into 6 statements. Davis do the statements short because he thought that keeping the statement small would be more practical in real world situations. Spearman-Brown prophecy formula were used to reduce the number of statements to six. On these six statements Davis found very good reliability which was .97. The six statements were shown as below in table 1 and table 2.

Table 1 Statements for perceived usefulness towards CHART-MASTER

S.No	Statements for perceived usefulness
1	Using CHART-MASTER in my job would enable me to accomplish tasks more quickly.
2	Using CHART-MASTER would improve my job performance.
3	Using CHART-MASTER in my job would increase my productivity.
4	Using CHART-MASTER would enhance my effectiveness on the job.
5	Using CHART-MASTER would make it easier to do my job.
6	I would find CHART-MASTER useful in my job

Source- Davis, 1989. From Table 4, p.

Table 2 Statements for perceived ease of use towards CHART-MASTER

S.No.	Statements for perceived ease of use
1	Learning to operate CHART-MASTER would be easy for me.
2	I would find it easy to get CHART-MASTER to do what I want to do.
3	My interaction with CHART-MASTER would be clear and understandable.
4	I would find CHART-MASTER flexible to interact with.
5	It would be easy for me to become skilful at using CHART-MASTER.
6	I would find CHART-MASTER easy to use.

Source- Davis, 1989. From Table 4.

A laboratory study with 40 participants were conducted on the above statements to validate the TAM model. These statements were used on two PC- graphics systems in which one was Chart-master and other was Pen-draw. These two computers programs were never used before by the participants. It was the participant first experience on these on that software. So Davis, (1989) provide one-hour experience on that software so that the participant feels little familiar in using the software. Davis wants to found the correlation between the above six statements and the participants asked to rate the perceived usefulness and perceived ease of use statements. The results obtained in his experiment found a positive correlation between the scales and self-predicted future usage.

4. Unified Theory of Acceptance and Use of Technology (UTAUT)

Another important model is Unified Theory of Acceptance and Use of Technology which was introduced by Venkatesh, Davis and Davis in 2003. This model was explained with main five constructs which was adopted from TAM, Motivational Model (MM), Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT). UTAUT define the four main determinants of intention and usage of a technology which was as following- 1) performance expectancy, 2) effort expectancy, 3) social influence and 4) facilitating conditions.

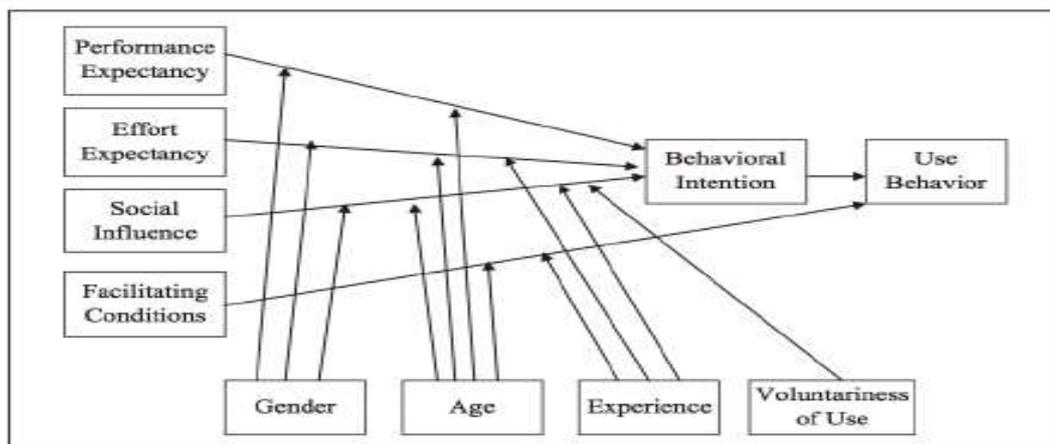


Figure 5 UTAUT model, Venkatesh et al. 2003

Performance expectancy is defined “the degree to which an individual belief that using the system will help him or her to attain gains in job performance” (Venkatesh et al., 2003).

Effort expectancy is defined “the degree of ease associated with the use of the system”. (Venkatesh et al., 2003). But some researcher suggest that effort expectancy is more significant for women in comparison of men (Bem and Allen 1974; Bozionelos 1996).

Facilitating conditions are defined “the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system” (Venkatesh et al., 2003).

Table 3- Technology acceptance theories/ model comparison and their constructs

S.No.	Model Name	Independent Variables	Intermediate Variables	Dependent Variables
1	Theory of Reasoned Action (TRA)	Beliefs and evaluation, Normative beliefs and motivation to comply	Attitudes towards Behaviour, Subjective Norms, Behavioral intention	Behavioral intention, Actual Behavior
2	Theory of Planned Behaviour (TPB)	Behavioral intention, Evaluation of behavioural outcomes, Normative beliefs, Motivation to comply, Control Beliefs, Perceived power	Attitude, Subjective Norms, Perceived Behavioural Control.	Intention, Behaviour.
3	Technology Acceptance Model (TAM)	External Variables, Perceived Usefulness, Perceived ease of use	Attitudes towards using, Behavioral intention to use	Actual system use
4	Unified Theory of Acceptance and Use of Technology (UTAUT)	Gender, Age, Experience, Voluntariness of use Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions.	Behavioural Intention	Use Behavior.

Conclusion:

The results of the study showed that TPB model is different from the TRA model in the extra addition of the construct of perceived behaviour control. The TAM model have two main variables which were perceived usefulness and perceived ease of use. TRA and TAM suggest that external variables interfere indirectly and influence attitudes and subjective norms in the model TRA and influence PEOU and PU in the TAM. In these models attitudes towards using and behavioural intention to use are common (Legris et al. 2003). The most important limitation of TAM is in considering information system to be an independent issue in organisational dynamics. Mathieson, 1991 showed that TPB did not provide as complete explanation of intention as TAM provides. TAM is useful in predicting IT usage behaviour and TPB provides a complete understanding of behavioural intention which helps to better manage the system implementation process in the organisation that influence IT usage (Taylor & Todd. 1995). There is a strong relationship in UTAUT between performance expectancy and intention, and between effort expectancy and intention, the author consider that, consistent with the logic developed here, attitude toward using technology will not have a direct or interactive influence on intention. UTAUT suggests three direct elements of intention to use which are performance expectancy, effort expectancy and social influence and two direct determinants of usage behaviour that are intention and facilitating conditions. Influences of experience, voluntariness, gender and age were confirmed as integral features of UTAUT. UTAUT gives a refined view of how the determinants of intention and behaviour evolve over time (Venkatesh et al., 2003). For explaining and predicting the system use Technology Acceptance Model was very popular. After the proposed of TAM model it has been tested and extended by many researchers. It is very helpful in helping to understand and explain use behaviour in technology implementation.

Limitations and Future Directions

This study symbolizes a careful and systematic effort to find four models of IT usage. The main limitation of this study is that it is based only upon the secondary data. Time constraint is also another limitation of the study. The future research for the researcher is to analysis how these models effect on the adoption of technology through the primary data. Future research is to consider how other models like DTPB, TAM2, ELAM effect on the adoption of technology. These models can apply in the education sector also.

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