



## RESEARCH ARTICLE

### A CRITICAL REVIEW OF THE TECHNOLOGY ACCEPTANCE MODEL

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#### ABSTRACT

Through an exploration of the creation, modification, and extension of the Technology Acceptance Model (TAM), this paper aims to convey an understanding of the Model as it applies to the use of information and communication technology (ICT) in studies within the field of education. By first explaining the original TAM and its foundational elements, and then engaging in discussion around the various subsequent modifications and iterations of the Model, this paper will provide the reader with a solid understanding of the variables involved in each of the Model's versions. It thereby arrives at a conclusion as to why TAM has been considered important in research on ICT use in education and why the Model has merited continued examination and modification over the decades.

## INTRODUCTION

Extensive resources have been invested in technology and information systems, with the intention of providing users with an improved experience, faster access to information, and more effective forms of communication. While some of this implementation has met with great success, some has failed and this, for reasons not readily evident to those responsible for implementation. Simply designing a system for ease of use and efficiency does not seem to be an accurate predictor of how well it will be received by end users, or the degree to which it will be utilised in a school or work environment. In order to determine the likelihood of end users adopting a particular technology, Davis (1986) leveraged a well-known psychological theory, namely the Theory of Reasoned Action (TRA), first proposed in 1967 (as explained further in the following section). By adapting this Theory to an era in which digital communication and a digital workforce was prevalent, Davis sought to arrive at an understanding of the internal and external factors influencing specific groups of users to either adopt or abandon specific technologies and information systems. Over four decades and in as many iterations, Davis' Model has been both praised and criticised as a tool for predicting end-user behaviour in relation to many different types of technology.

### Background and development of the technology acceptance model (TAM)

As mentioned above, TRA - one of the three most influential models of persuasion in the field of psychology - was put forth in 1967, presented by Fishbein and Ajzen to explain the ways in which attitudes influence behaviour within human action. As society has evolved, technology has taken on a central role in both business and personal activity. As part of his doctoral studies and in recognition of this evolution, Davis (1986) proposed an alternative model, or extension of TRA, called the Technology Acceptance Model (TAM). Formulated in 1985, the aim of this Model was to explain human behaviour towards technology and its adaptation into a wide array of disciplines and sectors. Davis' Model addresses human attitudes and the associated actual use of technology. This is the concomitant behaviour referred to in Fishbein and Ajzen's TRA. Prior to the development of TAM, reasoned action was broadly considered to predict individual behaviour, based on pre-existing emotional inclinations. According to TRA, an individual's decision to engage in or avoid a particular activity was evidenced as the result of beliefs concerning the anticipated outcomes of that activity. According to Davis, the exponential growth observed in technology over the decades warranted a deeper understanding of the motivational factors inclining or disinclining individuals toward the use of these tools. TAM was capable of providing "an explanation of the determinants of computer acceptance that is general and capable of explaining user [attitudes] and behaviour across a

broad range of end-user computing technologies and user populations” (Davis, Bagozzi and Warshaw, 1989, p.985). Therefore, the Model was introduced, not only to reveal users’ acceptance of information systems and technology, but also to explain the common determinants of technology use (See Figure 1, below).

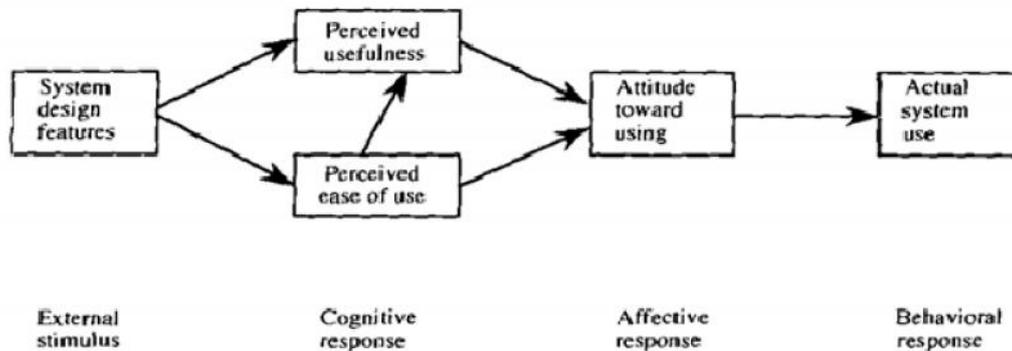


Figure 1. The Technology Acceptance Model (TAM) (Davis, 1986)

As shown in the above Figure, the essential components (factors) of TAM are ‘perceived ease of use’ (PEOU) and ‘perceived usefulness’ (PU) with regard to any given technology. PEOU is defined as “the degree to which a user believes using the system to be free of effort”, whilst the PU factor is defined as “the degree to which a user believes that using a specific application system will enhance his or her performance” (Davis, Bagozzi and Warshaw, 1989, p.985). TAM is based upon the essential foundational concept that an individual’s attitudes towards the use of any technology are influenced by the two main median components of PEOU and PU. In fact, TAM considers these components to be the internal beliefs determining an individual’s acceptance of technology, as well as their attitude towards that technology. Each of these internal factors will directly influence the attitude of the individual and mediate the relationship between that attitude to technology and the external variables acting upon technology use.

### Rationale behind the technology acceptance model (TAM)

One of the stated objectives of TAM is to introduce a starting point for presenting and testing the effect of external variables or ‘external stimuli’ -as it is referred to in Figure 1 - on individuals’ internal beliefs, attitudes and actual use of technology (Davis, 1993). Stated differently, one of the key purposes of TAM is to provide a basis for tracing the impact of external factors on internal beliefs and attitudes (Davis, Bagozzi and Warshaw, 1989, p.985). According to Davis (1986, pp.24-25), the design features variable applied in his study falls into the category of external variables, also indicated by Fishbein and Ajzen (1967) in the TRA Model. TRA utilises a differentiated set of mediated external factors to test individual attitudes to any object. Similarly, Davis stated that any variables considered for investigation in relation to individual attitudes fall into the category of external variables and may thus be examined in relation to individual acceptance of technology using this Model. The theories behind both TAM and TRA depend upon an analysis of internal factors, as impacted by external or mediating factors, in order to determine attitudes and outcomes. By endeavouring to understand how external factors can influence attitudinal components, such as PEOU and PU, TAM is designed to provide answers concerning the likelihood of specific

technology being implemented in specific populations. Consequently, the application of TAM is intended to determine whether a population will be inclined to accept or reject the use of a technology (Davis, 1993) and it may assist researchers in identifying why particular “systems may be unacceptable [and] to pursue appropriate corrective steps” (Davis, Bagozzi and

Warshaw, 1989, p.985). It is worth mentioning here that the TAM framework was - and indeed still is - being used as a framework in many studies. It has been widely used to clarify users’ attitudes and actual technology use across different user groups and across a range of contexts. However, the application and validity of TAM has primarily been approved and found successful in the contexts of higher education and ICT. For example, the following studies indicate the use of TAM as a means of reaching conclusions about ICT and higher education, namely regarding ICT use in higher education (Edmunds, Thorp and Conole, 2012); the acceptance of Moodle (Sanchez and Hueros, 2010); Internet use in universities (Li and Kirkup, 2007; Sayel and Rahman, 2003; Porter and Donthu, 2006), and the acceptance of information technology (IT) in the workplace (Davis, 1993).

### Modifications to the technology acceptance model (TAM)

In 1989, as a response to studies proposing the inclusion of external variables in the original Model, Davis, Bagozzi and Warshaw created what they termed an ‘extended TAM’, capable of exploring external effects on users’ attitudes. In a study investigating students’ acceptance of computer use, the above authors included behavioural intention (BI) as a new variable to mediate the relationship, wherein BI was considered part of the attitude factor. This modified TAM suggested that there were potential cases of individuals with a strong BI to use a system, but without any associated attitudes; they simply perceived the system to be useful (Davis, Bagozzi and Warshaw, 1989). Therefore, new direct links were introduced between usefulness and BI, and between attitudes and factors of BI. It should also be mentioned that modified TAM has been widely used in studies investigating individual BI and actual use of a system or technology. Likewise, it has been utilised in studies investigating the direct relationship between a technology’s usefulness and an individual’s BI. For example, the modified TAM has formed part of studies on the acceptance of ICT in public organisations (Chanasuc *et al.*, 2012); WebCT (Ngai, Poon and Chan, 2007); e-learning, (Alenezi, Abdul Karim and Vello, 2010); Moodle use (Sumak *et al.*, 2011), and the Internet (Shih, 2004). The process of developing and adjusting the Model, however, was not complete with the advent of the second, modified iteration. Subsequent to the development of modified TAM, a third

model was created, driven by the belief that both TAM and modified TAM possessed significant limitations for explaining the reasons why an individual would perceive a given system as useful. Therefore, Venkatesh and Davis (2000) presented a third framework derived from TAM, referred to as TAM2. The TAM2 framework introduced additional external variables and drew direct links between these and the PU factor; ignoring any possible effect of these external variables on the PEOU factor. The above authors proposed that external factors could have a strong influence on the PU variable and as a result, they could provide a significant explanation of why individuals may perceive the usefulness, or otherwise, of any given technology in their workplace. Under TAM2, both the PEOU and PU factors mediate the relationship between external variables and the BI factor – the latter being directly linked to individual usage behaviour (Chuttur, 2009).

An important extension to TAM was later made by Venkatesh (2000) in a longitudinal study, whereby he tested his proposed framework in three different organisations, in order to predict users' BI in relation to technology. Venkatesh was specifically interested in identifying the impact of antecedent factors on the PEOU variable. Accordingly, as a first step, he identified two main groups of antecedent factors. The first of these, referred to as the Anchor Group, consisted of four factors explaining general beliefs about computers and computer usage, namely computer self-efficacy; perceptions of external control; computer anxiety, and computer playfulness. The second group of antecedents, the Adjustment Group, consisted of two factors explaining individuals' beliefs following their previous experience with the specific technology used. However, both these Groups were exclusively linked in a direct relationship with the PEOU variable. While retaining the BI factor as an essential component, the extended TAM omitted the factors of attitudes and usage behaviour from the framework. Furthermore, it retained the location of TAM's original variables – PEOU and PU - as median variables between the antecedent Groups and the BI factor (Chuttur, 2009; Venkatesh, 2000).

### Criticisms of the technology acceptance model (TAM)

Although there is significant applicability and validity attributed to TAM in most experienced research in education (Alenezi, Abdul Karim and Vello, 2010), multiple criticisms have been levelled at its use as a framework for identifying individual technology acceptance, or for promoting its adoption and use in institutions, regardless of the quality and efficiency of the technology involved. An overview of these criticisms of TAM has been presented by Hirschheim (2007), who is strongly in favour of critically examining TAM and its extensions. He believes such examination to be warranted, given that so much effort had been invested in refining and expanding the Model. In his paper, Hirschheim introduces several articles by prominent scholars, who have published extensively concerning the current status of TAM, presenting their criticisms of the Model. One of these articles, by Lucas, Swanson and Zmud (2008), observe that TAM provides relatively few implications for management, with regard to the implementation of new technology. The above authors also claim that the Model seems to have discouraged further study, since most of the research conducted in the area of technology implementation has exclusively utilised survey methods. In another paper, authored by Benbasat and Barki (2007), it is indicated that although TAM has fulfilled its main purpose and

made significant contributions in most areas (particularly in IT), subsequent attempts by researchers to expand the original TAM and test several of its factors have moved their attention away from the Model's original goal. Unfortunately, this has resulted in a state of confusion for information system researchers as to the most suitable version of TAM for use in their research. Benbasat and Barki (2007, p.211) state:

The independent attempts by several researchers to expand TAM in order to adapt it to constantly changing IT environments have led to a state of theoretical chaos and confusion in which it is not clear which version of the many iterations of TAM is the commonly accepted one.

Among the papers mentioned in Hirschheim's article is a commentary by Goodhue (2007) arguing that just like any other theory, TAM offers a particular view of reality and considers the relationships between important factors, while simultaneously blurring other facts and results. He states that "TAM has left us with some significant blind spots" (Goodhue, 2007, p.220), believing that TAM is limited in the questions it poses, such as: "What causes users to utilise a technology?" when the important question is rather: "By what means do technologies affect performance?" This blurred line between intent and actuality may ultimately have a negative effect on academic fields. Nevertheless, despite the criticisms of TAM and its extensions, the Model has proven to be a valuable framework for furthering understanding of and explaining usage behaviour in information system implementation. In fact, TAM has been examined in many empirical studies and the tools associated with the Model have proven to be of quality, yielding statistically reliable results (Legris, Ingham and Collette, 2003). Due to the simplicity of the framework and its capacity to elucidate individual behaviour in relation to technology, TAM and its extensions have been widely used in ICT research (King and He, 2006).

### Consideration of the technology acceptance model (TAM) and its applications

The original TAM, without its extensions, is considered appropriate for studies on ICT use, because the Model has since excluded and/or added certain factors that may or may not be significant for arriving at an understanding of individual acceptance or rejection of technology. For example, in the modified TAM framework, Davis (1989) added the BI variable to mediate the relationship between attitudes and actual use. As explained earlier, BI is defined as "the degree to which a person has formulated conscious plans to perform or not perform some specified future behaviours" (Warshaw and Davis, 1985, p.214). However, according to Bagozzi (2007), the relationship between BI and the actual use variable could be theoretically poor. Therefore, BI may not be strongly representative of actual use, since the time period between the intention to use a technology and its actual use may be full of uncertainties or hindrances that affect peoples' decisions to use technology (Konerding, 1999; Bagozzi, 2007). In fact, the BI variable was discarded in the basic framework of a study by Ngai, Poon and Chan (2007), who point out that BI is not considered to be a strong variable for predicting the validity of an individual's actual use. The above authors argue that even if individuals have positive attitudes to technology, they might not have any intention to use it, unless asked by their tutors to do so. Therefore, students' intention to use ICT could be impacted by other variables. For example, tutors' insistence on

their students using ICT seems to be a major influence on their actual use of ICT for learning. In other words and for varying reasons, students may not have any intention to use ICT, but this intention could change, if they are motivated to obtain better grades, rewards, support and encouragement from their tutors. In a nutshell and as indicated by Chuttur (2009), the adjustments and changes made to the original TAM framework have been based on researchers wishing to explore new and specific factors that may influence the behaviour of individuals using technologies and to present more reasonable findings for their behaviour.

## Conclusion

By considering both prevailing psychological theory and the internal and external factors motivating individuals, Davis created TAM to describe and predict ways in which individuals were likely to behave, with regard to technology implementation and usage. Recognising that attitude comprises components associated with individual behaviour, Davis felt that his Model was appropriate for predicting behavioural outcomes. Later researchers then added variables and components to this Model in attempts to refine its use and more accurately pinpoint its actual outcomes, as opposed to those anticipated within the original Model. This paper has adopted a broad-based view of the various versions of TAM, analysing each for its appropriateness to the proposed research, as a means of understanding individual behaviour in relation to ICT use.

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