

Dialectic Antidotes to Critics of the Technology Acceptance Model: Conceptual, Methodological, and Replication Treatments for Behavioural Modelling in Technology-Mediated Environments

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Abstract

The technology acceptance model (TAM) is a prominent and parsimonious conceptual lens that is often applied for behavioural modelling in technology-mediated environments. However, TAM has received a great deal of criticism in recent years. This article aims to address some of the most pertinent issues confronting TAM through a rejoinder that offers dialectic antidotes—in the form of conceptual, methodological, and replication treatments—to support the continued use of TAM to understand the peculiarities of user interactions with technology in technology-mediated environments. In doing so, this article offers a useful response to a common but often inadequately answered question about how TAM can continue to be relevant for behavioural modelling in contemporary technology-mediated environments.

Keywords: Technology acceptance model (TAM); technology-mediated environment.

1 Introduction

The technology acceptance model (TAM), which was *proposed* by Davis (1986), *refined* by Davis et al. (1989) and Davis (1993), and *finalized* by Venkatesh and Davis (1996), is a popular theoretical lens from the information systems and technology discipline that is commonly applied to understand how users come to accept and use a particular technology (Chuttur, 2009; see Table 1).

TAM is generally intuitive and easy to use, and it has been cited more than 79,000 times on Google Scholar. However, many scholars who use TAM in their investigations tend to (1) ignore the criticisms the model has received and/or (2) offer inadequate support for its continued use.

To this end, this article aims to offer a succinct but useful response to the extant criticisms of TAM and to support, through dialectic antidotes, the continued use of TAM for behavioural modelling—that is, to understand user interactions with and, therefore, acceptance and usage of technology—in contemporary technology-mediated environments.

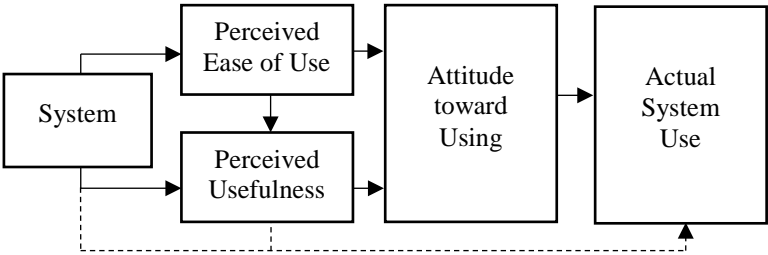
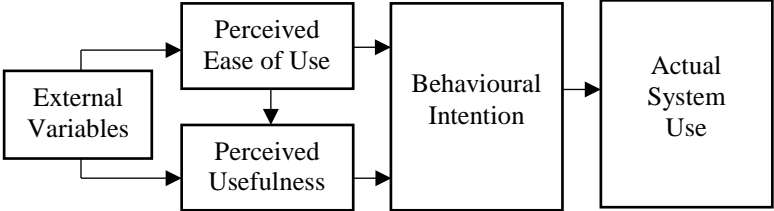
2 What Is TAM?

TAM, which is one of the most influential extensions of the theory of reasoned action (Ajzen and Fishbein, 1980; Fishbein and Ajzen, 1975), suggests that two factors influence the decision of users about a particular technology, namely perceived usefulness, or the degree to which a user believes that using a particular technology will enhance his or her performance, and perceived ease of use, or the degree to which a user believes that using a particular technology will be free from effort. A user's perception of usefulness and ease of use of a particular

technology can (1) be influenced by external factors and (2) influence his or her intention toward that technology, which in turn influences his or her actual use of that technology (Venkatesh and Davis, 1996). More important, TAM has undergone several revisions over the years (see Table 1), and thus scholars interested in modelling user behaviour in technology-mediated environments should be cognizant of the model's development and base their investigations on the finalized (or latest) model (i.e. Venkatesh and Davis, 1996).

Version	Details	Citation
Proposed TAM in 1986	<p style="text-align: center;">Model</p> <p style="text-align: center;">Design feature Cognitive response Affective response Behavioural response</p> <p style="text-align: center;">Note: X = design feature; $i = 1, 2 \dots n$; $n = \text{total}$.</p> <p style="text-align: center;">Number of Citations</p> <p>Google Scholar A technology acceptance model for empirically testing new end-user informat</p> <p>Articles</p> <p>Any time [PDF] A technology acceptance model for empirically testing new end-user information systems: Theory and results</p> <p>Since 2017 FD Davis - 1985 - dspace.mit.edu</p> <p>Since 2016 ABSTRACT The goal of this research is to develop and test a theoretical model of the effect of system characteristics on user acceptance of computer-based information systems. The model, referred to as the technology acceptance model (TAM), is being developed with two major objectives in mind. First, it should improve our understanding of user acceptance processes, providing new theoretical insights into the successful design and ...</p> <p>Since 2013 ☆ 📄 Cited by 5094 Related articles All 6 versions 📄</p> <p>Custom range...</p> <p>Sort by relevance</p> <p>Sort by date</p> <p style="text-align: center;">Note: Google Scholar search result on December 25, 2017.</p>	Davis (1986, p. 24)

Version	Details	Citation
Revised TAM + Revised scale in 1989	<p style="text-align: center;">Model</p> <pre> graph LR EV[External Variables] --> PEU[Perceived Ease of Use] EV --> PU[Perceived Usefulness] PEU --> ATU[Attitude toward Using] PEU --> BIU[Behavioural Intention to Use] PU --> ATU ATU --> BIU BIU --> ASU[Actual System Use] PEU --> ASU </pre> <p style="text-align: center;">Number of Citations</p> <p>Google Scholar <input type="text" value="User acceptance of computer technology: a comparison of two theoretical models"/></p> <p>Articles</p> <p>Any time Since 2017 Since 2016 Since 2013 Custom range...</p> <p>Sort by relevance Sort by date</p> <p>User acceptance of computer technology: a comparison of two theoretical models FD Davis, RP Bagozzi, PR Warshaw - Management science, 1989 - pubsonline.informs.org Computer systems cannot improve organizational performance if they aren't used. Unfortunately, resistance to end-user systems by managers and professionals is a widespread problem. To better predict, explain, and increase user acceptance, we need to better understand why people accept or reject computers. This research addresses the ability to predict peoples' computer acceptance from a measure of their intentions, and the ...</p> <p>☆ 99 Cited by 19805 Related articles All 26 versions</p> <p style="text-align: center;">+</p> <p>Google Scholar <input type="text" value="Perceived usefulness, perceived ease of use, and user acceptance of information technology"/></p> <p>Articles</p> <p>Any time Since 2017 Since 2016 Since 2013 Custom range...</p> <p>Sort by relevance Sort by date</p> <p>[PDF] Perceived usefulness, perceived ease of use, and user acceptance of information technology FD Davis - MIS quarterly, 1989 - JSTOR Valid measurement scales for predicting user acceptance of computers are in short supply. Most subjective measures used in practice are unvalidated, and their relationship to system usage is unknown. The present research develops and validates new scales for two specific variables, perceived usefulness and perceived ease of use, which are hypothesized to be fundamental determinants of user acceptance. Definitions for these two variables were ...</p> <p>☆ 99 Cited by 37336 Related articles All 19 versions</p> <p style="text-align: center;">Note: Google Scholar search result on December 25, 2017.</p>	Davis et al. (1989, p. 985) + Davis (1989)

Version	Details	Citation
Revised TAM in 1993	<p style="text-align: center;">Model</p>  <p>Note: --> Linked hypothesized insignificant but found significant.</p> <p style="text-align: center;">Number of Citations</p> <p>Google Scholar <input type="text" value="User acceptance of information technology: system characteristics, user perc"/></p> <p>Articles</p> <p>Any time Since 2017 Since 2016 Since 2013 Custom range...</p> <p>Sort by relevance Sort by date</p> <p>User acceptance of information technology: system characteristics, user perceptions and behavioral impacts FD Davis - International journal of man-machine studies, 1993 - Elsevier Abstract Lack of user acceptance has long been an impediment to the success of new information systems. The present research addresses why users accept or reject information systems and how user acceptance is affected by system design features. The technology acceptance model (TAM) specifies the causal relationships between system design features, perceived usefulness, perceived ease of use, attitude toward using, and actual usage ...</p> <p>☆ 99 Cited by 3886 Related articles All 14 versions</p> <p>Note: Google Scholar search result on December 25, 2017.</p>	Davis (1993, p. 481)
Finalized TAM in 1996	<p style="text-align: center;">Model</p>  <p style="text-align: center;">Number of Citations</p> <p>Google Scholar <input type="text" value="A theoretical extension of the technology acceptance model: Four longitudina"/></p> <p>Articles</p> <p>Any time Since 2017 Since 2016 Since 2013 Custom range...</p> <p>Sort by relevance Sort by date</p> <p>A theoretical extension of the technology acceptance model: Four longitudinal field studies V Venkatesh, FD Davis - Management science, 2000 - pubsonline.informs.org The present research develops and tests a theoretical extension of the Technology Acceptance Model (TAM) that explains perceived usefulness and usage intentions in terms of social influence and cognitive instrumental processes. The extended model, referred to as TAM2, was tested using longitudinal data collected regarding four different systems at four organizations (N= 156), two involving voluntary usage and two involving mandatory ...</p> <p>☆ 99 Cited by 13538 Related articles All 19 versions</p> <p>Note: Google Scholar search result on December 25, 2017.</p>	Venkatesh and Davis (1996, p. 453)

Version	Details	Citation
<p>TAM2: Extension of TAM in 2000</p>	<p style="text-align: center;">Model</p> <pre> graph TD subgraph External_Variables Exp[Experience] Vol[Voluntariness] SN[Subjective Norm] Image[Image] JR[Job Relevance] OQ[Output Quality] RD[Result Demonstrability] end subgraph Finalized_TAM PEU[Perceived Ease of Use] PU[Perceived Usefulness] BI[Behavioural Intention] ASU[Actual System Use] end Exp --> PEU Vol --> BI SN --> PEU SN --> PU Image --> PEU Image --> PU JR --> PEU JR --> PU OQ --> PEU OQ --> PU RD --> PEU RD --> PU PEU --> BI PU --> BI BI --> ASU </pre> <p style="text-align: center;">Note:</p> <p>TAM2 is an example of how the finalized TAM can be conceptually contextualized (i.e. external variables in organizational settings) and employed to understand the peculiarities of user interactions with technology in specific technology-mediated environments, specifically employees' mandatory and voluntary usage of proprietary systems for accounting and financial services and manufacturing activities during the systems' pre- and post-implementation stages in the organization (Venkatesh and Davis, 2000). The same approach can be used to understand user interactions with technology (e.g. digital natives' and digital immigrants' interactions with artificial intelligence, blockchain, big data, cloud computing, and internet of things at the individual and organizational level) in contemporary technology-mediated environments (e.g. augmented reality, blended spaces, and sharing economy).</p> <p style="text-align: center;">Number of Citations</p> <p style="text-align: center;">Note: Google Scholar search result on December 25, 2017.</p>	<p>Venkatesh and Davis (2000, p. 188)</p>

Table 1 Evolution of TAM

3 Why Was TAM Criticized?

Despite its frequent application, TAM has been widely criticized for its supposed triviality (e.g. putative predictors of user behaviour, uncritically accepted assumption of user intention–

behaviour linkage), limited explanatory and predictive power (e.g. neglect of self-regulatory and social aspects of user behaviour), and lack of novelty and practical value (e.g. limited discovery of predictors not subsumable under existing predictors of user behaviour, limited reconciliation or transformation of reasons for users' technology resistance), among others (see Bagozzi, 2007; Benbasat and Barki, 2007; Chuttur, 2009).

Moreover, user adoption of technology in emerging domains with an array of new technological and technology-mediated products stimulated by the evolving socioeconomic environment (e.g. growing emerging markets, increasing number of consumers who have better economic wellbeing, higher levels of education, improved internet access, and greater desire for instancy) and technological proliferation (e.g. augmented and virtual environments, delegation to autonomous technology, enhanced consumer connection to the internet of things, facilitated information processing, and ubiquitous computing) has raised concerns about the relevance of TAM to help understand the peculiarities of user interactions with technology in contemporary technology-mediated environments (Lowe et al., 2016).

4 Revisiting TAM

Given the extant criticisms of TAM, this article contends that it is necessary to revisit TAM—in terms of its conceptual assumption, methodological application, and replication strategies—to find and offer greater support to demonstrate the relevance of TAM to understand user acceptance and use of a particular technology, and thus its continued use for future investigations interested in behavioural modelling in contemporary technology-mediated environments.

More specifically, the model's only explicit assumption, to date, suggests that the intention concerning a particular technology is predicated on the perceived usefulness and ease of use of that technology (King and He, 2006; Legris et al., 2003; Turner et al., 2010), whereas the method for applying and testing the model, to date, has largely been regression-based methods, such as multiple linear regression analysis and covariance and partial least squares structural equation modelling, (e.g. Ha and Stoel, 2009; Lim, 2015a; Lim and Ting, 2012). In that sense, the model is likely to suffer from overwhelming replication, with the possibility that endeavours to offer incremental contributions to the field may become extremely difficult, if not nearly impossible—an issue that resonates with many in the information systems and technology discipline (Lim, 2016).

Further conceptual assumptions to extend the capability of TAM to accommodate contextual peculiarities and to be applied beyond descriptive and exploratory settings should be useful to demonstrate greater utility and practical value of TAM as a conceptual lens for behavioural modelling in contemporary technology-mediated environments. New forms of replication that demonstrate evidence of representing significant and relevant conceptual, methodological, and/or managerial contributions should be worthwhile. The sections that follow elaborate further on these treatment propositions to TAM.

5 Conceptual Treatment to TAM

In order for TAM to continue to be relevant for behavioural modelling of contemporary user interactions with technology, behavioural and technological researchers need to consider TAM as a basic model that offers the benefit and flexibility of integrating extended and contextualized motivational influences and user behaviours based on emerging realities in

contemporary technology-mediated environments. In particular, perceived usefulness and ease of use should be considered as the fundamental tenets of TAM, which have been and will arguably continue to be relevant for understanding user interactions with technology in technology-mediated environments—these motivational influences account for the basic evaluations of usability of a particular technology. More important, TAM will require integration of extended and contextualized motivational influences that explain emerging realities around users and their interaction with technology, such as perceptions and evaluations of value (e.g. connectedness, enjoyment, entertainment, gratification, flexibility, instancy, irritation, impact, newness, recognition, scarcity, self-enhancement), behavioural control (e.g. accessibility, affordability), personal factors (e.g. ability to adapt, resistance to change, self-efficacy), social factors (e.g. social pressure, sense of belonging), and security factors (e.g. privacy, risk, trust), among others.

Moreover, the components of TAM can assume multidimensionality to account for the complexities in contemporary realities of user behaviour in technology-mediated environments (e.g. affective and cognitive perceptions of ease of use and usefulness; attitude toward the corporate and product brand of competing technologies; initial and continued intention to use and recommend, in terms of its frequency and type, a particular technology; and contextualized conceptualizations of motivational influences [e.g. the perception of what constitutes as ‘useful’ or ‘easy to use’ for products using near-field communication technology may differ between young and older consumers]). While these propositions may, to a certain extent, on the surface level, reflect some of the criticisms of TAM, on the deeper level, the act of flipping those concerns around and into conceptual assumptions for using and making TAM relevant in contemporary technology-mediated environments demonstrates a logical and feasible approach to shift the focus of critiquing TAM for its “inadequacies” to preparing future research to apply and extend TAM more appropriately and relevantly for advancement in behavioural modelling in contemporary technology-mediated environments. Thus, to put the articulation herein into perspective, TAM should be considered as:

A conceptual lens that provides the core tenets to user interactions—in the form of perceptions of ease of use and usefulness—with technology and that necessitates novel, meaningful extensions to develop a full fledge model that holistically and rigorously accommodates and purposefully explains contextual peculiarities and behavioural complexities in technology-mediated environments.

It should be noted that though some scholars may have already been engaging in this practice, this article contends that such conceptual treatments to TAM are required in writing to provide greater clarity and support for its continued use for behavioural modelling in contemporary technology-mediated environments—which remains unavailable to date.

6 Methodological Treatment to TAM

While the predominant method of applying and testing TAM is through regression-based methods in descriptive and exploratory investigations, this article contends that behavioural and technological researchers can consider engaging in causal investigations by applying and testing TAM via experimentation over the short- and long-run. More specifically, the method of experimentation allows behavioural and technological researchers to test chronic dispositions and primed responses to manipulated technology-mediated scenarios (Lim, 2015b). That is to say, through experimentation, behavioural and technological researchers

will be able to test for causal effects in the interactions between controllable technology-mediated factors (e.g. product design and interface) and user behaviour (e.g. perception, intention, and usage) (e.g. Teh et al., 2017). In doing so, they will be able to offer empirical and tested solutions for encouraging desired user behaviour, such as purchase and consumption of and satisfaction with a particular technology. Indeed, testing for behavioural changes and effectiveness of user-centric behavioural strategies in the short- and long-run toward competing technologies by means of experimentation (as well as traditional regression-based methods) should help behavioural and technological researchers to obtain an up-to-date understanding about their target users as well as the effectiveness of their user-centric behavioural strategies in encouraging greater desired user behaviour (e.g. encouraging adoption, mitigating resistance) toward an offered technology among its target markets (including to identify and target behavioural change attempts).

7 Replication Treatment to TAM

For behavioural modelling in technology-mediated environments, ground-breaking contributions are often evaluated more favourably than incremental contributions delivered by replications (Coulthard and Keller, 2016; Lim, 2016). Direct replication of previously published empirical studies is challenging because of likely differences in study location, personnel, and time, as well as the threat of evolving socioeconomic changes and rapid technological proliferation, and thus the general understanding of replication herein encapsulates the action or process of repeating the test of similar propositions by using similar and dissimilar methodological procedures for behavioural modelling (e.g. epistemology, ontology, data collection, data analysis, measurement, instrument, sampling).

Replication using similar combinations of propositions and methodological procedures (e.g. same geographic location with the same sample characteristics and information systems and technology within a relatively short period) with no strong grounds (e.g. high impact) is discouraged because of insufficient novelty (i.e. what is new and so what) to warrant spending of scarce resources and unlikely publication at respectable outlets. Corroborations using different combinations of propositions and methodological procedures (e.g. alternative methods of analysing data, different measurement and target population, selective inclusion or omission of constructs), especially if project findings had (i.e. many people relied on the result—e.g. highly cited, such as journal articles receiving more than 100 citations within five years) or will have (e.g. high risk project classification by human research ethics committee) high impact, are encouraged for their conceptual development and extension, generalizability, and rigor.

8 Conclusions

In short, TAM should be viewed as a model that increases opportunities to understand the peculiarities of user interactions with technology in contemporary technology-mediated environments, not limiting them. Despite the limitations of a thought piece (e.g. absence of empirical data and analysis), it is hoped that the articulation herein will help to clarify that TAM can be appropriately and relevantly applied in theoretical and practical behavioural modelling endeavours in contemporary technology-mediated environments characterized with evolving socioeconomic changes and continued technological proliferation. More important, the discussion herein should stimulate further research that aims to examine and understand user relationships with new technologies to use and extend TAM in ways that

advances theory and practice. Among the potentially fruitful areas for further exploration include but not limited to user adoption, use, and disposal of technological and technology-mediated products in new, emerging, and matured markets; user interactions with smart technologies and the internet of things; and user involvement in augmented and virtual environments, among others.

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