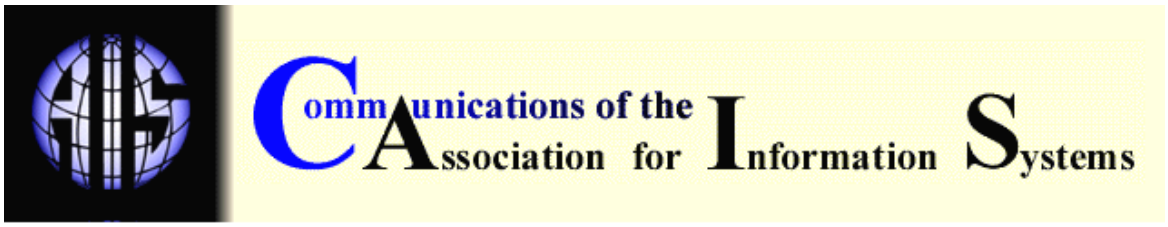

THE TECHNOLOGY ACCEPTANCE MODEL: PAST, PRESENT, AND FUTURE

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ABSTRACT

While the technology acceptance model (TAM), introduced in 1986, continues to be the most widely applied theoretical model in the IS field, few previous efforts examined its accomplishments and limitations. This study traces TAM's history, investigates its findings, and cautiously predicts its future trajectory. One hundred and one articles published by leading IS journals and conferences in the past eighteen years are examined and summarized. An open-ended survey of thirty-two leading IS researchers assisted in critically examining TAM and specifying future directions.

Keywords**:** IT adoption, technology acceptance model, meta-analysis

I. INTRODUCTION

The prolific stream of research on information systems use takes a variety of theoretical perspectives. Of all the theories, the Technology Acceptance Model (TAM) is considered the most influential and commonly employed theory for describing an individual's acceptance of information systems. TAM, adapted from the Theory of Reasoned Action [Ajzen and Fishbein, 1980] and originally proposed by Davis [1986], assumes that an individual's information systems acceptance is determined by two major variables:

- Perceived Usefulness (PU) and
- Perceived Ease of Use (PEOU).

During the past eighteen years, the information systems community considered TAM a parsimonious and powerful theory [Lucas and Spitler, 1999; Venkatesh and Davis, 2000]. Further supporting the notion of TAM's popularity, Venkatesh and Davis [2000] found that the first two

TAM articles, by Davis [1989] and Davis et al. [1989] received 424 journal citations in the Social Science Citation Index (SSCI) by the beginning of 2000. Extending the citation search further, we found to 698 journal citation by 2003. TAM has been applied to different technologies (e.g. word processors, e-mail, WWW, GSS, Hospital Information Systems) under different situations (e.g., time and culture) with different control factors (e.g., gender, organizational type and size) and different subjects (e.g. undergraduate students, MBAs, and knowledge workers), leading its proponents to believe in its robustness. Currently, researchers in the IS field consider TAM one of the information systems fields' own theories, and still put much effort into the study of research using the theory.

Despite its great success, however, few previous systematic efforts trace its history or investigate and evaluate its findings, limitations, and future [e.g., Doll et al., 1998; Gefen and Straub, 2000; Legris et al., 2003]. Evaluation is crucial for the IS community in that it helps researchers of IS adoption understand TAM's past research findings, identify possible research topics, and conduct future studies. In addition, it helps educate current IS doctoral students in examining how a well-known IS-owned theory evolved.

The present study goes back to 1986, traces the TAM research trajectory, and extensively investigates TAM's findings. The research purpose of the study is to answer the following five questions:

- How much progress did TAM make over the past eighteen years (1986-2003)?
- What are the findings and discoveries of TAM research?
- Who published what and where did they publish it?
- What do leading IS researchers currently think about TAM research?
- What are future directions for TAM research?

In all, one hundred and one articles published in information systems journals during 1986-2003 and survey results from thirty-two leading IS researchers were analyzed.

II. RESEARCH METHODS

Both a meta-analysis of previous TAM literature and a survey were conducted. Meta-analysis is a research technique that uses statistical procedures to combine the results of independent studies [Glass, 1981; Hwang, 1996; Mahmood et al., 2001]. This analytical method is appropriate for the research goals of tracing the history of TAM studies and for investigating previous findings in a systematic manner. Using this methodology, previous studies can be effectively and quantitatively analyzed and the inconsistencies among their findings resolved [Hwang, 1996; Hwang and Wu, 1990]. In addition, meta-analysis can enhance the general validity of interpretations [Cook, 1991], and include studies taking place over a long period of time and with a large scope [Mahmood et al., 2001]. Meta-analysis is successfully applied in IS. [e.g., Dennis and Gallupe, 1993; Farhoomand and Drury, 1999].

This study includes TAM research conducted from 1986 to June, 2003. An exhaustive electronic search using Social Science Citation Index, ABI/INFORM, and Business Source Premier resulted in 101 papers. The papers were published in IS journals such as Data Base, Decision Sciences (DS), Information & Management, Information Systems Research (ISR), Journal of Management Information Systems (JMIS), Management Science (MS), and MIS Quarterly, rated as leading journals in IS and reflecting the major research stream of the IS field [Barki et al., 1993; Cheon et al., 1993; Claver et al., 2000; Farhoomand and Drury, 1999). In addition, papers published at two Information Systems conferences, namely the *International Conference on Information Systems* (ICIS) and the *Hawaii International Conference on Systems Science* (HICSS), and other papers published in interdisciplinary journals closely related to IS field were included (e.g., Decision Support Systems).

Before starting the analysis, the authors jointly developed a protocol to ensure consistent analysis. Twenty-four MIS Quarterly, Information & Management, and ISR papers were first analyzed by two of the authors. To measure inter-rater reliability, the initial analysis results were compared to the analysis scales (e.g., major themes, type of IS, external variables). A 90% inter-rater reliability was found. Discrepancies were resolved through follow-up discussions. The second reliability test was performed after finishing the coding. Three doctoral students familiar with TAM participated in and performed the reliability test. For twenty randomly selected papers, a 93% consistency was found.

To supplement the findings of the meta-analysis, a survey of thirty-two leading IS researchers was conducted. Nine survey questions in open-ended format were used. Example questions included:

- In what ways has TAM added value to the IS field?
- In what ways has TAM detracted from the IS field?
- What do you feel is TAM's future?

We initially selected two groups of IS researchers: TAM researchers and non-TAM researchers. The selection was based on the publication productivity of researchers, especially in the MIS Quarterly and ISR during the 1990s. Twenty TAM researchers and twenty-four non-TAM researchers were selected. The participation was solicited through an invitation letter. A total of thirty-two researchers (16 of them TAM researchers and 16 Non-TAM researchers) completed the survey, a response rate of 76%.

III. RESULTS

The analysis in this section is divided into three parts. First, the chronological progress of TAM across four separate periods is presented. Second, findings and limitations of past TAM research are summarized. Finally, future directions are addressed.

THE CHRONOLOGICAL PROGRESS OF TAM RESEARCH

TAM did not maintain its original form. Like an organic being, TAM has ceaselessly evolved. We investigated how TAM has made progress by dividing the past 18 years into four periods: introduction, validation, extension, and elaboration, as shown in Figure 1.

Model Introduction Period

After introducing information systems into organizations, user technology acceptance received fairly extensive attention [Rogers, 1983; Kwon and Zmud, 1987; Swanson, 1988]. Researchers and practitioners expended substantial research effort determining what factors affect users' beliefs and attitudes on the IS acceptance decision, and what factors contribute to user resistance [Lucas et al., 1990]. As an output from those streams of research, TAM evolved from Ajzen and Fishbein's [1980] Theory of Reasoned Action (TRA) to "provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified" [Davis et al. 1989, p. 985].

After the introduction, researchers in this period performed several TAM studies mainly focused on two streams.

- The first attempted to replicate TAM with other technologies, longitudinal situations, and research settings, to verify whether it is a parsimonious model.
- The other stream compared TAM and its origin, TRA, to investigate whether TAM can be differentiated from TRA, and whether TAM is superior to TRA.

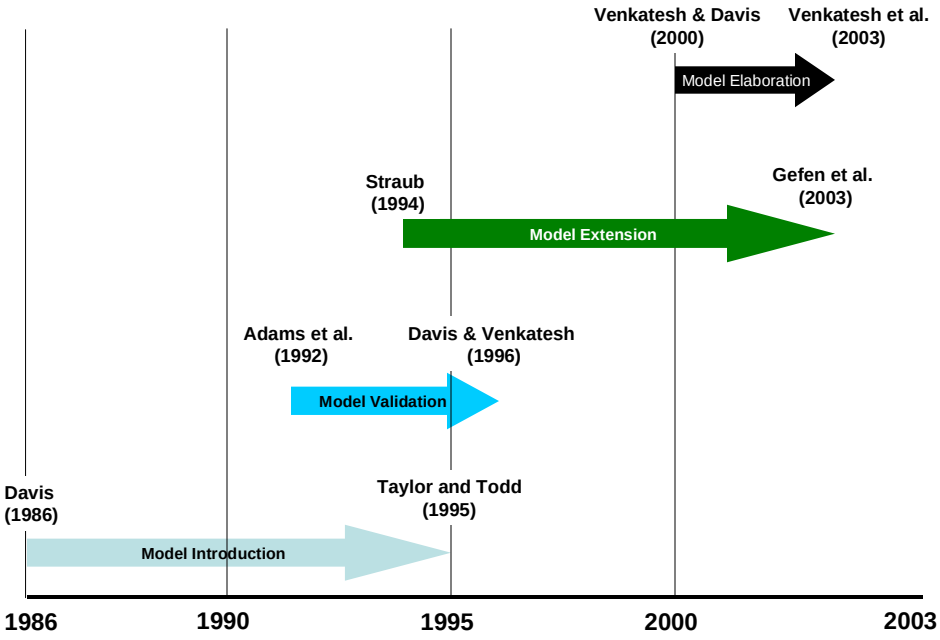


Figure 1 Chronological Progress of TAM Research

Replication Studies. Several replication studies appeared in this period. Adams et al. [1992] examined TAM in 5 different applications—word processors, graphics, spreadsheets, e-mail, and v-mail—and found that, in general, TAM maintained its consistency and validity in explaining users' IS acceptance behavior. Davis [1993] replicated his previous study [Davis et al., 1989] using e-mail and a text editor with 112 knowledge workers, and found that TAM successfully explained the adoption of both technologies (R^2 =0.36). Sambamurthy and Chin [1994] applied TAM to study group attitudes toward GDSS use, and found that the ratio PU/PEOU successfully predicted group attitude to GDSS use. Finally, Subramanian [1994] performed the replication of the original TAM with two mailing systems' acceptance, and found that TAM variables showed results consistent with previous studies.

Relation of TAM and TRA. In another stream of research, researchers tried to differentiate TAM from TRA. For example, Davis et al. [1989] compared TRA and TAM in how they measure an MBA student's relative facility with a word processor across two time periods—immediately after introducing the system and 14 weeks later. They found that TAM (R^2 = 0.47 at time 1, R^2 = 0.51 at time 2) better explained the acceptance intention of the users than TRA (R^2 = 0.32 at time 1, R^2 = 0.26 at time 2). Hubona and Cheney [1994] compared both TAM and the Theory of Planned Behavior (TPB) model and found that TAM offers a slight empirical advantage and is a much simpler, easier to use, and more powerful model to explain users' technology acceptance. Taylor and Todd [1995b] compared TAM, TPB, and Decomposed TPB through a longitudinal study of 786 students who used a computer information resource center (CIRC). They found that Decomposed TPB and TPB gave a fuller explanation than TAM. They asked for a cautious interpretation of the results because of the trade-off between explanatory power and complexity. TAM addressed use intention and use with slightly lower variances, while Decomposed TPB increased the explained variance up to only 2% of use, and to 8% of usage intention, paying the high cost by adding 7 more variables.

In sum, through the studies in this period, it was found that TAM could successfully predict IS acceptance behavior under different technologies and different situations. In addition, it was found that TAM was a much simpler, easier to use, and more powerful model of the determinant of user acceptance of computer technology than TRA [Igbaria et al. 1997, p. 281]**.**

Model Validation Period

Similar to researchers who insisted that most IS instruments are in the early stage of development and thus require a rigorous validation of their measurement instruments [Jarvenpaa et al., 1985; Moore and Benbasat, 1991; Straub, 1989], researchers in the model validation period initiated validation studies of TAM's original instruments. Supported by Bejar's [1980] suggestion noting that robust instruments greatly enhance the value of research, researchers wanted to confirm that TAM truly uses an accurate measurement of the user's acceptance behavior under different technologies, situations, and tasks.

Adams et al. [1992] replicated and extended the Davis 1989 study and found both validity and reliability of measurement for both PU and PEOU across different settings and different information systems. Hendrickson et al. [1993, 1996] examined the test-retest reliability of the PU and PEOU scales and found the TAM instrument to be reliable and valid in terms of test-retest analysis.

Segars and Grover [1993] found results contrary to the previous researchers. Through confirmatory factor analysis, they found that instead of the two-factor model (PU and PEOU), a three-factor model, including effectiveness as a new TAM variable, is more salient. They contended that the Adams et al. [1992] results could be attributed to its use of classical statistical techniques.

Segars and Grover's [1993] study earned both support and objections. Barki and Hartwick [1994] asserted that original PU consists of distinct constructs within it and can be measured with both items assessing perceived usefulness and perceived increase in productivity, effectiveness, and performance. However, Segars and Grover's study was refuted by Chin and Todd [1995]. After performing a structural equation modeling (SEM) analysis, they concluded that a single factor PU measure has reasonable psychometric properties, thus there is no substantive rationale to separate PU into two dimensions (PU and effectiveness). They contend that the Segars and Grover findings resulted from the confounding effect of changing scales and constructs in an additive fashion to examine the overall model fit, and small numbers in the sample size.

Szajna [1994] investigated the predictive validity of TAM measurements that identify whether the measurement can successfully predict future behavior. She found good predictive validity for PU and PEOU through discriminant analysis of DBMS selection behavior by 47 MBA students. Davis and Venkatesh [1996] examined whether item grouping generates bias when comparing intermixed items. They found item grouping vs. item intermixing had no significant effect. Therefore, Davis and Venkatesh concluded that original grouped items could be used for predicting IS acceptance.

In sum, studies in this period extensively investigated whether TAM instruments were powerful, consistent, reliable, and valid and they found these properties to hold. Researchers checked for validation of the instruments every time, even when used in a different context, noting that

> *"no absolute measures for those constructs exist across varying technological and organizational context.… Measurement models must be rigorously assessed and, if necessary, respecified"* [Segars and Grover 1993, p. 525].

Model Extension Period

After validation efforts confirmed the saliency of the measurement instruments, prolific expansion efforts began to introduce new variables postulating diversified relationships between constructs

and the search for antecedents (or external) variables of the major TAM constructs, PU and PEOU, in an attempt to identify boundary conditions.

One distinctive feature of TAM studies in this period was to attempt model extension with external variables which include individual, organizational, and task characteristics. For instance, Agarwal and Prasad [1999] extended TAM with five kinds of individual difference variables as the external variables of PU and PEOU. They found that the relationship between participation in training and PU, between prior experiences, role with regard to technology, tenure in workplace, level of education, and prior experience and PEOU, were predicted successfully. Igbaria et al. [1995] investigated the effects of organizational factors and found that user training, computing support, and managerial support significantly affect both PU/PEOU and microcomputer usage. Karahanna and Limayem [2000] conducted a study with two technologies, e-mail and voice-mail, and found that the determinants of the system usage and those of PU and PEOU are different among the technologies. PU did not influence e-mail usage but social influence did, and the result was reversed in the case of voice-mail.

Another effort in the extension period was to identify and investigate TAM's boundary conditions. As suggested by Adams et al. [1992], the moderating effects for TAM variables such as culture, gender, task, user type, and IS type needed to be examined. For example, Straub [1994] applied the TAM model in two countries with different cultures, and found that culture played an important role in the attitude toward and choice of communication media. He found that Japanese workers perceived fax to be more useful than did U.S. workers, but in the case of e-mail, the perception was reversed. Gefen and Straub [1997] also investigated the effect of gender difference on IS acceptance, and determined that gender significantly moderates the effects of PU, PEOU, and social presence. They found that men are more affected by PU, while women are more affected by PEOU and Subjective Norm. The influence of task type was examined by Gefen and Straub [2000] who divided WWW usage tasks into information inquiry and product purchasing, and found that PEOU responded differently according to the task type. PEOU significantly predicted WWW usage for a purchasing task, but not for an inquiry task. Similarly, Moon and Kim [2001] applied TAM in the Internet context, differentiating tasks into entertainment and work–related task. They found that the significant factors affecting Internet usage depend on the task type. Perceived playfulness was most pivotal for an entertainment task and PU for a work-related task on the Internet. For different user types, Karahanna et al. [1999a] found a significant difference between potential adopters' IS adoption and current users' continuous IS adoption over time. Subjective norms significantly affect the adoption intention of potential adopters, while attitudes significantly affect current users. Finally, Ridings and Gefen [2000] applied TAM in a situation where both the old IS and new IS are used in parallel. The PU of the new IS increases the preference for the new IS adoption, while that of the old IS decreases it; and PEOU of the new and old IS is the significant determinant of PU of the new and old IS respectively.

In sum, studies during this period made tremendous strides to develop a "greater understanding [that] may be garnered in explicating the causal relationships among beliefs and their antecedent factors" [Chin and Gopal 1995, p. 46].

Model Elaboration Period

This period can be characterized as the elaboration of TAM in two key ways: to develop the next generation TAM that synthesizes the previous effects and to resolve the limitations raised by previous studies.

First, in 2000, Venkatesh and Davis [2000] and Venkatesh [2000] introduced TAM II, a new millennium version of original TAM. TAM II synthesizes the previous efforts, and reflected the previous request for the model's elaboration. It clearly defines the external variables of PU and PEOU, and provided a concrete means to advance the multi-level model. For example, Venkatesh and Davis [2000] define the external variables of PU, such as social influence (subjective norms) and cognitive instruments (job relevance, image, quality, and result demonstrability). Venkatesh [2000] provides the external variables of PEOU, such as anchor

(computer self-efficacy, perceptions of external control, computer anxiety, and computer playfulness) and adjustments (perceived enjoyment and objective usability). Through both efforts, the explained variance increases to 60% of PEOU (R^2 = 0.6) and 40% to 60% of PU (R^2 = 0.4 ~ 0.6), while at the same time the variance of intention increased to 60% (R^2 = 0.6).

Second, studies were performed to resolve several problems in TAM. For example, Venkatesh [2000] performed a TAM study considering both voluntary and mandatory situations. This longitudinal study, including Subjective Norm excluded by Davis [1989], used employees in a working environment and measured actual usage instead of self-reported usage. Venkatesh and Davis [2000] performed a longitudinal study with four different subject groups and information systems in a working environment considering both voluntary and mandatory situations.

Jointly, the efforts of this period helped delineate uncovered determinants of PEOU and PU, and thus advanced TAM as a salient theory, laying the foundation for further research. In sum, with the inspection of the development of TAM studies across four periods, we find that TAM has evolved continually. It underwent a normal evolution through those years of efforts, culminating in the introduction of TAM II.

FINDINGS OF PAST TAM RESEARCH

TAM studies have been performed by many different researchers with different research purposes, subjects, information systems, and tasks applying diverse research methodology under different environments. Several new variables were incorporated into the original TAM, combined with other theoretical models, re-specifying their causal relationship with major TAM variables. These extensive research projects were published in the leading information systems journals, drawing interest from both researchers and practitioners alike. This section investigates the findings of these TAM studies examining a number of variables including

- Types of Information Systems
- External Variables
- Numbers of Publications by Year and by Journals
- Characteristics of Research Subjects
- Relationships Between Major TAM Variables
- Major Limitations,
- Most Published Authors
- Research Methodology

Types of Information Systems

Over 30 different types of information systems were used as target systems. We classified them into four major categories:

- communication systems,
- general-purpose systems,
- office systems, and
- specialized business systems.

Each type of system was evenly applied in TAM studies (Table 1). General-purpose systems include Windows, personal computers, microcomputers, workstations, the Internet, and other computer facilities. More recently, the Internet was the most widely applied target technology in TAM studies. Communication systems included e-mail, v-mail, fax, dial-up systems, and other systems mainly used for communications. E-mail was the predominantly researched target system, especially during the early 1990s.

Table 1. Summary of Information Systems Used in TAM Studies

Type	# of IS	ISs of Each Category	References
Communication Systems	25 (20%)	E-mail (13)	Karahanna and Straub [1999], Straub [1994]
		V-mail (6)	Karahanna and Limayem [2000]
		FAX (1)	Straub [1994]
		Dial-up Systems (1)	Subramanian [1994]
		Others (e.g., cellular) (4)	Kwon and Chidambaram [2000]
General Purpose Systems	34 (28%)	Windows (1)	Karahanna et al. [1999]
		PC (or Microcomputer) (9)	Igbaria et al.[1995], Agarwal & Prasad [1999]
		WWW(or e-commerce) (17)	Gefen and Straub [2000]
		Workstation (3)	Lucas and Spitler [1999, 2000]
		Computer Resource Center(2)	Taylor and Todd [1995]
		Groupware (2)	Lou et al. [2000]
Office Systems	33 (27%)	Word processor (16)	Adams et al. [1992], Hubona and Geitz [1997]
		Spreadsheet (7)	Methieson[1991],Venkatesh and Davis[1996]
		Presentation S/W (6)	Doll et al. [1998], Hendrickson et al. [1993]
		Database programs (2)	Szajna [1994], Doll et al. [1998]
		Groupware (2)	Malhotra and Galletta [1999],Lou et al. [2000]
Specialized Business Systems	30 (25%)	Computerized Model (1)	Lu et al. [2001]
		Case Tools (4)	Xia and Lee [2000], Dishaw and Strong [1999]
		Hospital IS (Telemedicine) (5)	Lu and Gustafson [1994], Rawstorne et al.[2000]
		DSS, GSS, GDSS (7)	Sambamuthy and Chin [1994], Vreede et al[1999]
		Experts support System (2)	Gefen and Keil [1998], Keil et al. [1995]
		Others (e.g. MRP) (11)	Gefen [2000]

Office systems include word processors and spreadsheets, the most commonly used technologies in the office systems category. Specialized business system includes special usage purposes and company developed systems. Case tools, DSS, MRP II, and Expert Systems are some examples of this technology.

Relationships between Major TAM Variables

TAM's four major variables are: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Behavioral Intention (BI), and Behavior (B). PU is used as both a dependent and independent variable since it is predicted by PEOU, and predicts BI and B at the same time. Behavior was usually measured using frequency of use, amount of time using, actual number of usages, and diversity of usage. As shown in Table 2, the relationship between PU and BI is strongly significant. 74 studies showed a significant relationship between the two variables. These studies stated that PU is a stronger determinant of BI (or B), noting that users willingly use the system that has a critically useful functionality [e.g. Davis, 1989].

However, only 58 studies showed a significant relationship between PEOU and dependent variables, indicating that PEOU is an unstable measure in predicting BI (or B). The results are similar to the studies of Gefen and Straub [2000] — raising the controversy of the role of PEOU in TAM — and Keil et al. [1995], who questioned the overall effects of PEOU in TAM, noting that "no amount of PEOU will compensate for low usefulness" [p. 89].

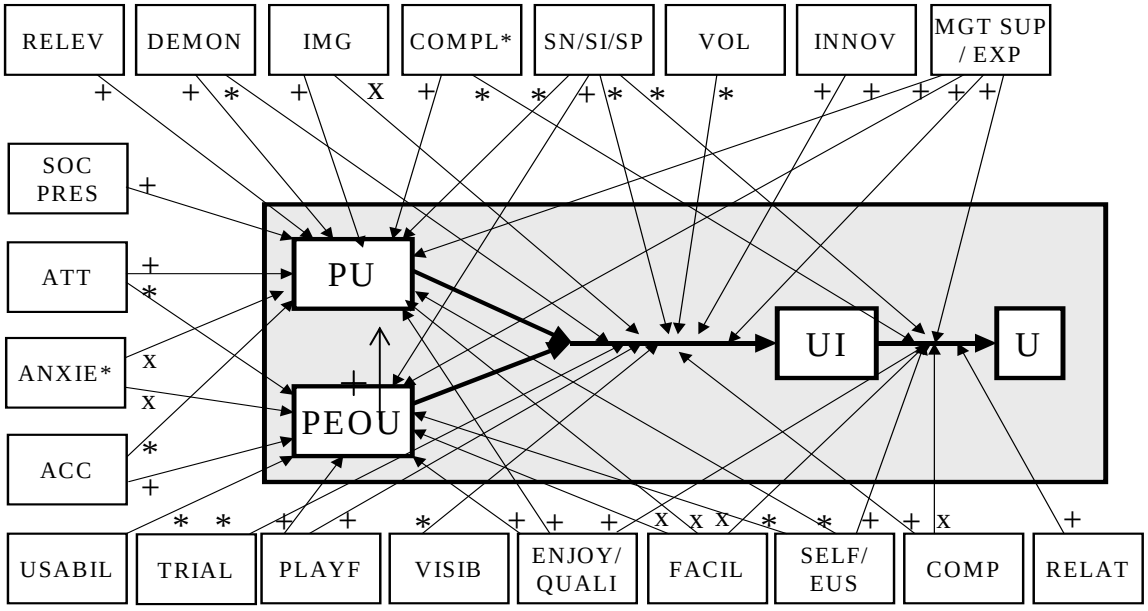
Table 2. Relationships between Major TAM Variables

	PEOU → PU	PU → BI or B	PEOU→ BI or B	BI → B
Significant	69	74	58	13
Non-significant	13	10	24	2
Not Applicable	19	17	19	86
Total	101	101	101	101

Many studies found reasons for that non-significance. For example, Subramanian [1994] asserted that, when systems used in studies are by their inherent nature relatively easy to use, PEOU has less or no impact on the IS acceptance decision. Igbaria et al. [1995a] explained that the hard reality of organizations might put priority on the usefulness of computer systems rather than the pleasure brought by them. Finally, PEOU was found as a significant antecedent of PU, rather than a parallel, direct determinant of acceptance, and thus it can affect indirectly the acceptance through PU [Davis et al., 1992]. As shown in Table 2, 69 studies showed a significant relationship between PEOU and PU.

External Variables

A number of external variables were introduced into TAM as suggested by Davis [1989]. Figure 2 and Table 3 show the most frequently referred external variables that affect PU, PEOU, BI, or B, and their relationships. The most frequently introduced variables are system quality [e.g., Igbaria et al., 1995b], training [e.g., Igbaria et al., 1995a], compatibility, computer anxiety, self-efficacy, enjoyment, computing support, and experience [e.g., Chau, 1996].



•ACC: Accessibility, ANXIE: Anxiety, ATT: Attitude, COMP: Compatibility, COMPL: Complexity, DEMON: Result Demonstrability, ENJOY: Perceived Enjoyment, EUS: End User Support, EXP: Experience, FACIL: Facilitating Conditions, IMG: Image, RELEV: Job Relevance, MGT SUP: Managerial Support, PLAYF: Playfulness, INNOV: Personal Innovativeness, RELAT: Relative Advantage, SELF: Self-Efficacy, SI/SN/SP: Social Influence, Subjective Norms, and Social Pressure, SOC PRES: Social Presence, TRIAL: Trialability, USABIL: Usability, VISIB: Visibility, VOL: Voluntariness,

*: mixed, +: significant, x: insignificant relationship

Figure 2 Relationships between External Variables and Major TAM Variables

Table 3. Summary of Variables Used in TAM[1]

Variable	Definition	Origin	Referred Articles
Voluntariness	The degree to which use of the innovation is perceived as being voluntary, or of free will	Moore and Benbasat [1991]	Barki and Hartwick [1994]; Venkatesh and Davis [2000]
Relative Advantage	The degree to which an innovation is perceived as being better than its precursor	Rogers [1983]	Moore and Benbasat [1991]; Premkumar and Potter [1995]
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters	Rogers [1983]	Chin and Gopal [1995]; Xia and Lee [2000]
Complexity	The degree to which an innovation is perceived as being difficult to use	Rogers [1983]	Premkumar and Potter [1995], Igbaria et al. [1996]
Observability	The degree to which the results of an innovation are observable to others	Rogers [1983]	Moore and Benbasat 1991
Trialability	The degree to which an innovation may be experimented with before adoption	Rogers [1983]	Moore and Benbasat[1991]; Karahanna et al. [1999]
Image	The degree to which use of an innovation is perceived to enhance one's image or status in one's social system	Rogers [1983]	Karahanna et al. [1999]; Venkatesh & Davis [2000]
Self efficacy	The belief that one has the capability to perform a particular behavior	Bandura[1977]	Fenech [1998]; Venkatesh and Speier [2000]
End User Support	High levels of support that promotes more favorable beliefs about the system among users as well as MIS staffs	Igbaria et al. [1995]	Igbaria et al. [1996]; Karahanna and Limayem [2000]
Objective Usability	A construct that allows for a comparison of systems on the actual level of effect regarding to complete specific tasks	Card et al. [1980]	Venkatesh and Davis [1996]; Venkatesh [2000]
Personal Innovativeness	An individual trait reflecting a willingness to try out any new technology	Agarwal and Karahanna [2000]	Agarwal and Prasad [1998]; Agarwal and Karahanna [2000]
Computer Playfulness	The degree of cognitive spontaneity in microcomputer interactions	Webster and Martocchio [1992]	Moon and Kim [2001]; Agarwal and Karahanna [2000]
Social Presence	The degree to which a medium permits users to experience others as being psychologically present	Fulk et al. 1987	Karahanna and Straub [1999]; Karahanna and Limayem [2000]
Subjective Norms/ Social Influence	Person's perception that most people who are important to him think he should or should not perform the behavior in question	Fishbein and Ajzen [1975]	Malhotra and Galletta [1999]; Venkatesh and Morris [2000]
Visibility	The degree to which the innovation is visible in the organization	Rogers [1983]	Xia and Lee [2000]; Karahanna et al. [1999]
Job Relevance	The capabilities of a system to enhance and individual's job performance	Thompson et al. [1991]	Venkatesh and Davis [2000]; Thompson et al. [1991]
Computer Attitude	The degree to which a person likes or dislikes the object	Ajzen and Fishbein[1980]	Chau [2001]

[1] We did not analyze the magnitude of effects of each variable since each study was performed with different statistical methods, information systems, and subjects. Averaged values (e.g. coefficient, or correlation) will deliver contaminated interpretations. Instead, we analyzed consistency of the findings with respect to always significant, mixed, and insignificant relationship.

Accessibility	- Physical accessibility: the extent to which someone has physical access to the hardware needed to use the system - Information accessibility: the ability to retrieve the desired information from the system	Karahanna and Limayem [2000]	Karahanna and Straub [1999]; Karahanna and Limayem [2000]
Result Demonstrability	The degree to which the results of adopting/using the IS innovation are observable and communicatable to others	Rogers [1983]	Karahanna et al. [1999]; Venkatesh and Davis [2000]
Management Support	The degree of support from managers to ensure sufficient allocation of resources and act as a change agent to create a more conductive environment for IS success	Igbaria et al. [1997]	Igbaria et al. [1997]; Liao and Landry [2000]
Computer Anxiety	An individual's apprehension, or even fear, when she/he is faced with the possibility of using computers	Simonson et al. [1987]	Montazemi et al. [1996]; Gopal et al. [1994]
Perceived Enjoyment	The extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system usage	Davis et al. [1992]	Chin and Gopal [1995]; Teo et al. [1999]
System (Output or Information) Quality	The perception how well the system performs tasks that match with job goals	Venkatesh and Davis [2000]	Lucas and Spitler [2000]; Lederer et al. [2000]
Facilitating Conditions	The control beliefs relating to resource factors such as time and money and IT compatibility issues that may constrain usage	Taylor and Todd [1995b]	Taylor and Todd [1995b]; Karahanna and Straub [1999]
Prior Experience	Experience gained	Various	Jackson et al. [1997]; Dishaw and Strong [1999]

Major Limitations of TAM studies

Self-reported usage is the most commonly reported limitation. Instead of measuring actual usage, 36 studies relied mainly on self-reported use assuming that self-reported usage successfully reflects actual usage. However, self-reported usage is known to be subject to the common method bias, which distorts and exaggerates the causal relationship between independent and dependent variables [Agarwal and Karahanna, 2000; Podsakof and Organ, 1986]. The second most cited limitation of the studies is the tendency to examine only one information system with a homogeneous group of subjects on a single task at a single point of time, thus raising the generalization problem of any single study. The use of student subjects also deteriorates generalizability of the findings. The dominance of cross-sectional study is also an important limitation. Since the user's perception and intention can change over time, it is important to measure these quantities at several points of time. However, only 13 studies performed a longitudinal comparison. The cross-sectional study's major weakness is that it cannot infer the causality of the research results [Agarwal and Karahanna, 2000]. Low explanations of variance were referred to as a major problem of TAM studies. In general, 30-40% of the variance of the causal relationship was explained, but in some cases, only 25% was explained by the independent variables [e.g., Chin and Gopal, 1995; Gefen and Straub, 2000]. The majority of the studies with lower variance explanations did not consider external variables other than original TAM variables. Other suggested limitations of TAM studies included single measurement scales, relatively short exposure to the technology before testing, and self-selection biases of the subjects. The detailed limitations are summarized in Table 4.

Numbers of Publications by Year and by Journals

A total of one hundred one articles using TAM in the leading information systems (IS) journals and conferences were examined. As shown in Table 5, while there was no specific trend, the publication of TAM studies has increased steadily. Some years had a heavier concentration of

Table 4. Summary of Limitations in TAM Studies

Limitations	# of Papers	Explanation	Examples
Self-reported Usage	36	Did not measure the actual usage	Venkatesh and Davis[2000]
Single IS	18	Use only a single information system for the research	Venkatesh[1999]
Student Samples (or University Environment)	15	Inappropriate to reflect the real working environment	Agarwal and Karahanna [2000]
Single Subject (or Restricted subjects)	13	Only one organization, one department, MBA students	Karahanna and Straub [1999]
One Time Cross Sectional Study	13	Mainly performed based on cross-sectional study	Karahanna et al.[1999]
Measurement Problems	12	Low validity of newly developed measure, use single item scales	Agarwal and Prasad [1998]
Single Task	9	Did not granulize the tasks, and test them with the target IS	Mathieson [1991]
Low Variance Scores	6	Did not adequately explain the causation of the model	Igbaria et al. [1997]
Mandatory Situations	3	Did not classify mandatory and voluntary situation, or assume voluntary situation	Jackson et al.[1997]
Others	15	Small sample size, short exposure time to the new IS, few considerations of cultural difference, self-selection bias	Gefen and Straub[1997]

Table 5. Publications by Years and Journals

	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	Total
MIS Quarterly	1		1	1	2	2	2		2		2	2	2		2	19
Information Systems Research			2			1	1			1		1	1	2	1	10
Journal of Management Information Systems							1	3			3		1	1	1	10
Decision Sciences						2		1	1	1	2					7
Management Science	1						1	1				1				4
Information & Management							1	1	1		2	1	1	2	3	12
Data Base							2	1	1	1		1	1			7
International Conference on Information Systems						1						2	2			5
Hawaii International Conference on System Sciences											1	2			2	5
Others				1	1	1	2	3		1	2	7	4			22
Total	2	0	3	2	3	7	10	10	5	4	12	17	12	5	9	101

papers. In 2000 alone, 17 papers were published in the major IS journals. TAM studies were evenly published across all the leading IS journals with the MIS Quarterly the leader. A total of 19 articles were published in the MIS Quarterly. In all but 4 of the last 15 years, at least one TAM study was published in the MIS Quarterly. Over 10 articles each were published in ISR, JMIS, and I&M.

Considering that only 16-20 research articles are published in leading IS journals per year (e.g. ISR, MISQ), TAM studies occupy around 10% of total publications. The most prolific authors are listed in Table 6, including authors who published at least 4 papers. Those authors were shown as author or co-authors in 50 of the one hundred one articles, thus 50% of the papers included the dominant authors.

Table 6. Most Prolific Researchers Based on Journals in Table 5

Authors	University	# of Articles
Viswanath Venkatesh	University of Maryland	12
Fred D. Davis	University of Arkansas	9
Detmar W. Straub	Georgia State University	8
Elena Karahanna	University of Georgia	6
David Gefen	Drexel University	6
Patrick Y.K. Chau	University of Hong Kong	6
Magid Igbaria	Claremont Graduate University	5
Peter A. Todd	University of Houston	4
Anthony R. Hendrickson	Iowa State University	4
Wynne W. Chin	University of Houston	4
Michael G. Morris	Air Force Institute of Technology	4

Characteristics of Research Subjects

As shown in Table 7, the research subjects of TAM studies may be divided into two groups: students and real-world knowledge workers. 46 studies used student subjects and 60 used knowledge worker subjects.[2] The average sample size of the studies was 211. Gender was fairly evenly distributed across TAM studies. Thirty one studies mentioning the gender proportion showed that 0.565 were male, and 0.435 were female. Average age of student subject was early 20's and that of knowledge workers was early 30's.

Table 7. Summary of Research Subjects

Subject Type	Subcategory	# of Studies of Each Type
Students	Undergraduate	28
	MBA or Graduate Students	13
	Merged	3
Knowledge Workers		60
Sample Size	211.2 (μ), 220.5 (σ)	
Gender Proportion	Men: 56.5 %, Women: 43.5%	
Ages	21.23 (student subjects), 32.31 (knowledge workers)	

Research Methodology Used

Our research yielded only 13 longitudinal studies out of the 101 TAM papers studied (Table 8). Most studies used a one-shot cross-sectional method after exposing the subjects to the new IS through hands-on sessions or training. The majority of research incorporated questionnaire-based field study. Only three studies used qualitative data, such as participatory observations and

[2] Some studies used both students and practitioner subjects.

content analysis. Laboratory experiments were mainly conducted on students in a university environment. Data was analyzed using regression with software such as SPSS and SAS, and structural equation modeling, with Partial Least Square (PLS), LISREL, and AMOS. In recent studies, LISREL was the predominantly data analysis method used.

Table 8. Summary of Research Methodology

Methodology	Details	
Longitudinal Study	13 (Yes)	Venkatesh[2000];Venkatesh and Morris [2000]
	88 (No)	Straub [1994]; Taylor and Todd [1995]
Methodology	Field Study (86)	Igbaria et al. [1995]; Agarwal and Prasad [1999]
	Lab Experiment (12)	Mathieson[1991]; Doll et al.[1998]
	Qualitative Study (3)	Briggs et al.[1999] De Vreede et al.[1999]
Analysis Method	PLS (18)	Sambamuthy and Chin [1994]; Agarwal and Karahanna[2000]
	LISREL (30)	Taylor and Todd[1995] Karahanna and Limayem [2000]
	AMOS (7)	Chin and Todd[1995] Fenech[1998]
	Regression (32)	Lucas and Spitler[1999] Venkatesh[1999]
	Others (e.g., Conjoint Analysis) (14)	Discriminate Analysis: Szajna [1994], Conjoint Analysis:Chin and Gopal [1995]

LEADING IS RESEARCHERS' PERSPECTIVE OF TAM RESEARCH

To strengthen our observations and prognostications, we contacted leading IS researchers to identify their perception of TAM research. Thirty-two of forty-four queried responded to the study. As discussed earlier, the sample included TAM researchers based on an extended Table 6 and the authors with the most publications in ISR and MISQ from 1996 through 2001. A list of respondents is included in the acknowledgements at the end of this paper. In this section, we report their responses in summarized form.

Value Added by TAM Research

Question asked: "In what ways has TAM added value to the IS field?"

Two major points were made:

TAM provided a parsimonious model to examine factors leading to IS acceptance. It includes a systematic grounding for research and focuses previously scattered work. This standardization allows an examination of findings to bring greater meaning to mixed or inconclusive results, thus leading to further work. Building on prior IS research, TAM conceptualized usefulness and ease of use as important perceptions leading to intentions to adopt new systems. The IS field contains few such foundations for its research.

"it has also provided a starting point for many extensions and elaborations, and has compared favorably to alternative or competing models of user acceptance." Fred Davis

TAM provided a stream of research papers to aid and grow our knowledge about IS acceptance.

TAM strengthened the IS field by its research rigor. It is a theory "owned" by the IS research community. In the IS field where theories are scarce, TAM served as an example for other areas of IS research. Growing and refining the theoretical foundation with tested measurement instruments will serve to legitimize the field in the eyes of other business disciplines. For example, some marketing studies use TAM as a theoretical foundation.

Shortcomings of TAM Research

Question asked: “In what ways has TAM detracted from the IS field?”

The responses from persons who felt TAM may have detracted from the field fall into four categories.

TAM researchers may have fallen into the trap of following an incremental approach based on replicating previous studies with minor adjustments. Some people see researchers attempting to take advantage of the previous investment in this area and the broad appeal of TAM in the IS field. Other disciplines built on this “cumulative tradition,” but some respondents felt this idea may have been carried too far.

TAM research may be overdone. However, it could be argued that although possible, it was necessary.

> *“it has likely focused us too much on this one theory to the detriment of others.”* Detmar Straub.

> *“it has received disproportional amount of attention in IS research detracting research from more relevant research problems which may not be as easy to investigate rigorously.”* Juhani Iivari

TAM narrows what is included in studies of technology adoption. TAM’s narrow focus reduced attention on the role of technology and design.

> *“it has acted as an inhibitor to more advanced theories of IS use in that people seem stuck or distracted by the model.”* Anonymous

TAM’s simplicity makes if difficult to put into practice. Practitioners may not be well served by TAM.

> “*imagine talking to a manager and saying that to be adopted technology must be useful and easy to use. I imagine the reaction would be "Duh! The more important questions are what makes technology useful and easy to use*.” Alan Dennis

The following words are indicative of detractors of TAM:

> *“TAM's simplicity and ease of operationalizability also appears to have attracted many researchers into conducting quick and easy studies by adding a variable or relationship to TAM and comparing the slightly modified versions of TAM with its original version. While most such studies don't get published because of lack of contribution, they still represent scarce research efforts being somewhat wasted.”* Henri Barki

Further Exploration Needed

Question Asked: “Are there areas of TAM that need more exploration?”

From conducting the meta-analysis and the survey, three major future directions for TAM came to the forefront.

Incorporating More Variables and Exploring Boundary Conditions. Although TAM has aided the understanding of information systems acceptance, it was concluded that a deeper understanding of factors contributing to ease of use and usefulness is needed. One neglected area is examining different information systems and environments. Researchers including Venkatesh [1999] suggested studies on multi-user systems, team-level IS acceptance, and more complex technologies. Opportunities in study of the Internet may also exist. Previous TAM

studies investigated the effects of different environments and individual differences (e.g. cultural difference [Chau, 1996; Hu et al., 1999; Straub et al., 1997] and gender [Gefen and Straub, 1997]), but more efforts to examine the broader environmental factors including emotion, habit, personality difference, technology change, even going beyond individual acceptance to organizational and societal acceptance [Taylor and Todd, 1995] are necessary. Further, mandatory settings need further study [Davis et al., 1992; Davis, 1993; Taylor and Todd, 1995b; Venkatesh, 2000].

Social influence plays a crucial role in human behavior and decision making [Azjen, 1991; Barki and Hartwick, 1994; Taylor and Todd, 1995b]. While TAM studies attempted to investigate the effect of social influence on the technology acceptance decision, results were mixed. Davis [1989], Barki and Hartwick [1994], and Mathieson [1991] found weak associations between subjective norm and other variables. Lucas et al. [1999], Moore and Benbasat [1993], Taylor and Todd [1995], and Thompson et al. [1991] found a significant relationship. These questions still remain for future study. Some studies attempted to include social influence into TAM and to start finding the boundary conditions that affect the significance of social influence [e.g. Karahanna and Limayem, 2000; Lee et al., 2001; Venkatesh and Morris, 2000; Venkatesh and Davis, 2000]. Barki and Hartwick [1994] found that subjective norm is more important in the early stage of system development. Taylor and Todd [1995] found subjective norm is a better predictor of intention with inexperienced subjects. Venkatesh and Davis [2000] found that subjective norm significantly affected intention under mandatory situations, and that it weakened over time. However, this issue is still in the early stages of investigation, requiring more research to find the causal linkage between social influences and IT adoption and the incorporation of new socially influential factors. For example, social identity and norms as new social factors in social psychology fields are candidates for investigation [Corner and Armitage, 1998].

One of the major problems of TAM studies was that TAM was applied to tasks that were too broad. Previous studies were mainly performed by assigning a single task to a single IS. However, many studies of task-technology fit [Goodhue, 1995], revealed that perception of the technology varies according to task type. For example, Karahanna and Straub [1999] recognized that the research findings cannot be generalized under task-dependent situations. Heeding the warning by Goodhue and Thompson [1995] that the lack of task focus in evaluating IS caused the mixed results in IS acceptance**,** future TAM studies need to specify tasks more granularly.

Finally, as shown in Table 8, TAM studies mainly focused on cross-sectional studies which may not find causal linkage between research variables [Doll and Ahmed, 1983; Igbaria et al., 1996; 1997]. Doll and Ahmed [1983] stressed the importance of longitudinal study, indicating that users' expectations might change as they become more familiar with IS technology, and what was once acceptable may no longer be adequate. Qualitative study, another natural extension in method is a more useful alternative to determine richer information with a small number of subjects. IS researchers also recommended triangulation methods to uncover richer results than can be found using only a single method [Karahanna et al., 1999; Lee, 1991].

Investigation of Actual Usage and the Relationships Between Actual Usage and Objective Outcome Measures. The investigation of actual usage and the relationships between actual usage and objective outcome measures was another suggestion. Self-reported usage is widely used assuming that it is a reasonable predictor of actual system usage [e.g. Agarwal and Prasad, 1999; Jackson et al., 1997; Sheppard et al., 1988]. However, the risk of distorted research findings by using self-reported usage instead of actual objective usage was cautioned by several studies [Lederer et al., 2000; Karahanna and Straub, 1997; Rawstorne et al., 2000; Straub et al., 1995; Szajna, 1996]. For example, Straub et al. [1995] found that research based on self-reported usage shows distinctly different results with that of actual usage. Self-reported usage was also found to be the major reason for common method bias [Igbaria et al., 1997], and derives its socially desirable answers from the halo effect [Orne, 1979]. The problem was negatively interpreted by cognitive dissonance theory [Festinger, 1957] and self-perception theory [Bem, 1967]. While it is difficult to measure actual usage under diverse restrictions such as privacy consideration, research should continue to pursue measuring actual usage. The investigation of

the relationships between actual usage and objective outcome measures (e.g. performance, productivity, quality) is another issue to be examined. TAM studies were performed under the general assumption that relationship between IS usage and satisfaction, productivity, and quality is positive [e.g., Chau, 1996; Trice and Treacy, 1986]. For example, Bowen [1986] asserted that performance gains by using IS did not materialize if users did not willingly accept the systems. However, only a few studies attempted to verify those relationships [Igbaria et al., 1995; Lucas and Spitler, 1999]. Therefore, new studies are required to determine whether that assumption can be supported by empirical testing. This recommendation follows Davis et al.'s [1989] suggestion that

> *"practitioners and researchers should not lose sight of the fact that usage is only a necessary but not sufficient, condition for realizing performance improvements due to information technology"* [p. 1000].

That is, usage does not assure bottom line benefits. TAM will provides more insightful value if the model examines the causal chain between IS investment, IS use, and objective IS value.

Significant Changes in TAM Research. Some of the IS scholars surveyed suggested major rather than incremental changes in TAM research. For example,

> *"I think it will be well-used in future work, but that more studies of TAM per se will die out, unless someone can find a new addition to TAM and the paradigm shifts."* Alan Dennis

TAM certainly made a contribution, but it may be time to address issues of concern to IS practitioners that can greatly impact their bottom line, and increase their longevity in IS management. Furthermore, a number of other theories that have been applied to the causal linkage of a user's IS acceptance behavior may be aligned with TAM research. Social Cognitive Theory, Diffusion of Innovation Theory, the Theory of Reasoned Action/Theory of Planned Behavior, the Triandis Model, Human Computer Interaction research, the Technology Transition Model [Briggs et al., 1999], and Social Network Theory [Robertson, 1989] are representative examples. Integration efforts are required to obtain a better understanding of IT adoption [Hu et al., 1999]. Examples of such efforts include TAM II [Venkatesh and Davis, 2000] and the Unified Theory of Acceptance and Use of Technology [Venkatesh et al., 2003].

IV. CONCLUSIONS

This study examined the progress of TAM and the findings of TAM research through the meta-analysis of 101 articles published between 1986 and 2003. This study found that TAM has progressed continually during that time and was elaborated by researchers, resolving its limitations, incorporating other theoretical models or introducing new external variables, and being applied to different environments, systems, tasks, and subjects. In addition, through a meta-analysis and a survey of IS researchers, this study identified many of TAM's rich findings. and carefully predicted the future trajectory of TAM studies.

TAM has come a long way. While there are still contradictory views on TAM research considering the previous and current research trends, many exciting directions remain for making future discoveries.

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APPENDIX I. REFERENCES INCLUDED IN META-ANALYSIS

Authors	Year	Title	Journal	Page
Adams, D. A., R.R. Nelson, P.A. Todd	1992	Perceived usefulness, ease of use, and usage of information technology: A replication	MISQ 16(2)	227-247
Agarwal, R., J. Prasad	1998	A conceptual and operational definition of personal innovativeness in the domain of information technology	ISR 9(2)	204-215
Agarwal, R., J. Prasad	1999	Are individual differences germane to the acceptance of new information technologies?	DS 30(2)	361-391
Agarwal, R., E. Karahanna	2000	Time flies when you're having fun cognitive absorption and beliefs about information technology usage	MISQ 24(4)	665-694
Atkinson, M., C. Kydd	1997	Individual characteristics associated with world wide web use: an empirical study of playfulness and motivation	Data Base	53-62
Barki, H., J. Hartwick	1994	Measuring user participation, user involvement, and user attitude	MISQ 18(1)	59-82
Bhattacherjee, A.	2001	An empirical analysis of the antecedents of electronic commerce service continuance	DSS (32)	201-214
Bhattacherjee, A.	2001	Understanding information systems continuance: an expectation-confirmation model	MISQ 25(3)	351-370
Briggs, R.O., M. Adkins, D. Mittleman, J. Kruse, S. Miller, J.F. Nunamaker	1999	A technology transition model derived from field investigation of GSS use abroad the U.S.S. CORONADO	JMIS 15(3)	151-195
Briggs, R.O., G. D. Vreede, J.F. Nunamaker	2003	Collaboration engineering with ThinkLets to pursue sustained success with group support systems	JMIS 19(4)	31-64
Chau, P.Y.K.	1996a	An empirical investigation on factors affecting the acceptance of CASE by systems developers	I&M 30(6)	269-280
Chau, P.Y.K.	1996b	An empirical assessment of a modified technology acceptance model	JMIS 13(2)	185-204
Chau, P.Y.K.	2001	Influence of computer attitude and self-efficacy on IT usage behavior	J. of End User Computing 13(1)	26-33
Chau, P.Y.K., P.J. Hu	2002	Examining a model of information technology acceptance by individual professionals: an exploratory study	JMIS 18(4)	191-229
Chau, P.Y.K., P.J. Hu	2002	Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories	I&M (39)	297-311
Chen,L., M.L. Gillenson, D.L. Sherrell	2002	Enticing online consumers: an extended technology acceptance perspective	I&M (39)	705-719
Chin, W.W., P.A. Todd	1995	On the use, usefulness, and ease of use of structural equation modeling in MIS research: A note of caution	MISQ 19(2)	237-246
Chin, W.W., A. Gopal	1995	Adoption intention in GSS relative importance of beliefs	Data Base 26(2&3)	42-63
Chismar,W.G., S.W. Patton	2003	Does the extended technology acceptance model apply to physicians	HICSS-36	
Davis, F.D.	1989	Perceived usefulness, perceived ease of use, and user acceptance of information technology	MISQ 13(3)	319-340

Davis, F.D.	1993	User acceptance of information technology system characteristics, user perceptions and behavioral impacts	Int'l Journal of Man-Machine Studies 38(3)	475-487
Davis, F.D., R.P. Bagozzi, P.R. Warshaw	1989	User acceptance of computer technology: A comparison of two theoretical models	MS 35(8)	982-1003
Davis, F.D., R.P. Bagozzi, P.R. Warshaw	1992	Extrinsic and intrinsic motivation to use computers in the workplace	J. of Applied Social Psychology 22(14)	1111-1132
Davis, F.D., V. Venkatesh	1996	A critical assessment of potential measurement biases in the technology acceptance model: three experiments	Int'l Journal of Human-Computer Studies 45(1)	19-45
Devaraj,S. M. Fan, R. Kohli	2002	Antecedents of B2C Channel Satisfaction and Preference: Validating e-Commerce Metrics	ISR 13(3)	316-333
Dillon, A., M.G. Morris	1996	User acceptance of information technology theories and models	Annual Review of Information Science and Technology 31	3-32
Dishaw, M.T., D.M. Strong	1999	Extending the technology acceptance model with task-technology fit constructs	I&M 36(1)	9-21
Doll, W.J., A. Hendrickson, X. Deng	1998	Using Davis's perceived usefulness and ease-of-use instruments for decision making: A confirmatory and multigroup Invariance Analysis	DS 29(4)	839-869
Featherman,M., M. Fuller	2003	Applying TAM to e-services adoption: the moderating role of perceived risk	HICSS-36	
Fenech, T.	1998	Using perceived ease of use and perceived usefulness to predict acceptance of the World Wide Web	Computer Networks and ISDN Systems 30	629-630
Gefen, D., E. Karahanna, and D.W. Straub	2003	Trust and TAM in online shopping: an integrated model	MISQ 27(1)	51-90
Gefen, D., D.W. Straub	1997	Gender difference in the perception and use of e-mail: An extension to the technology acceptance model	MISQ 21(4)	389-400
Gefen, D., M. Keil	1998	The impact of developer responsiveness on perceptions of usefulness and ease of use: An extension of the technology acceptance model	Data Base 29(2)	35-49
Gefen, D., D.W. Straub	2000	The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption	J. of the Association for Information Systems 1	
Gefen, D.	2000	It is not enough to be responsive: The role of cooperative intentions in MRP II adoption	Data Base 31(2)	65-79
Heijden, H.	2003	Factors influencing the usage of websites: the case of a generic portal in The Netherlands	I&M 40	541-549
Hendrickson, A.R., M.R. Collins	1996	An assessment of structure and causation of IS usage	Data Base 27(2)	61-67
Hendrickson, A.R., P.D. Latta	1996	An evaluation of the reliability and validity of Davis's perceived usefulness and perceived ease of use instrument	Journal of Computer Information Systems 36(3)	77-82
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LIST OF ACRONYMS

ATT	Attitude
B	Behavior
BI	Behavioral intention
Decomposed TPB	Decomposed theory of planned behavior
DSS	Decision support systems
PEOU	Perceived ease of use
PU	Perceived usefulness
PE	Perceived enjoyment
SN	Subjective norm
TAM	Technology acceptance model
TRA	Theory of reasoned action
TPB	Theory of planned behavior

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