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Review of Relationships Among Variables in TAM*

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Abstract: The technology acceptance model (TAM) is an important tool in information technology research. Many scholars have applied the classical TAM to various research domains. However, the relationships between variables in these TAM models are not strongly desired. Thirty-four articles selected from international journals were analyzed to show that most of the relationships in the classical TAM are significant, but the stabilities of these relationships differ. The significant positive relationships between perceived ease of use and its independent variables are more stable than the others. Various factors can strengthen or weaken these relationships.

Key words: technology acceptance model (TAM); information system; adoption

Introduction

Although information systems (IS) have played an important role in modern enterprises, the implementation of IS is costly and has a relatively low success rate. Since the middle 1980s, researchers have begun to concentrate on predicting the effect of IS implementation by exploring the user's IS adoption mechanism. In this research, technology acceptance model (TAM)[1] is one of the most important models. With nearly 20 years of development, TAM has become the main model for explaining the IS adoption mechanism. This article reviews the development of TAM by analyzing the variable relationships to provide a reference for future research.

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1 Classical TAM

The classical TAM includes two main variables as shown in Fig. 1[1], the perceived ease of use (PEOU) and the perceived usefulness (PU). External variables affect attitude towards using (AT) and the behavior intention (BI) through PEOU and PU, which finally affects the use (U) of IS.

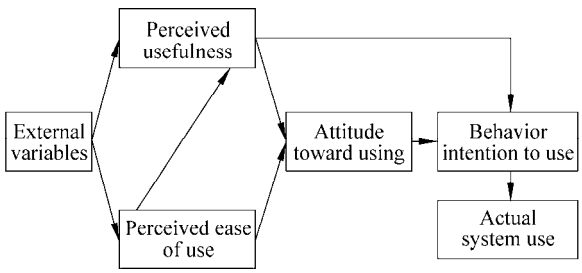

Fig. 1 TAM structure

2 TAM Variable

2.1 Independent variables

Almost all the extended TAM structures use PEOU and PU as independent variables and the subjective norm

(SN) as a third independent variable. Variable selection largely depends on the research domain. For example, for Internet games, the perceived playfulness (PP) has been proposed into TAM, but in software applications area, researchers have preferred to use computer anxiety (CA) in TAM structure.

PEOU is the degree to which a user expects the target technology to be free of effort and PU is a user's subjective probability that using a specific technology will increase his job performance[1]. SN is the individual's perception of social pressure to engage (or not) in the target behavior[2].

2.2 Dependent variables

AT, BI, and U are the main dependent variables in TAM, but they do not always appear in each model at the same time. BI or the combination of AT and BI are usually seen in research models, but all three are seldom in one model.

Attitude is the user's feeling about something. In TAM, AT is the connection between belief variables (PEOU, PU, etc.) and BI. BI is the trend of the user's cognition about likes or dislikes to use the IS. U is the final IS use behavior.

2.3 Control variables

Control variables strongly affect the prediction ability of a model. Venkatesh et al.[3] analyzed eight models and found six models which had enhanced prediction ability due to additional relative control variables. Gender, experience, volunteer attitude, playfulness, and age are some commonly used control variables.

2.4 External variables

The using of external variables depends on the type of research and reflects the flexibility of TAM. External variables have an important effect on TAM, but there are no distinct modes for control variable design. Not all research models have used external variables.

3 Research Hypothesis

Extended models were built by adding new variables or relationships into the classical TAM. However, most extended TAM models have still been built on the classical TAM structure.

To compare the variable relationships in different models, the classical TAM variable relationships were classified to PU-AT, PU-BI, PU-U, PEOU-AT, PEOU-BI, PEOU-U, PEOU-PU, AT-BI, BI-U, and AT-U. Also, the analysis concentrates on the significance of SN. All these relationships are supposed to positively correlate.

4 Research Methodology

Ninety articles were selected using academic search engines like IEEE Xplore, Springer, Elsevier, EBSCO, and Blackwell, using the keywords TAM and technology acceptation model for dates from 1980 to 2005. These 90 articles were published in the journals listed in Table 1.

Table 1 Journals for TAM research

No.	Name of journal
1	*MIS Quarterly*
2	*Decision Sciences*
3	*Management Science*
4	*Journal of Management Information Systems*
5	*Information Systems Research*
6	*Information & Management*
7	*Journal of Information Technology*
8	*International Negotiation*
9	*Academy of Management Journal*
10	*Computer Standards & Interfaces*
11	*Government Information Quarterly*
12	*Human-Computer Studies*
13	*Decision Support Systems*

Most of the articles were about model applications. These applications did not rigidly adhere to previous methods, but created many new models by combining various theories. Thirty-four articles were then chosen for analysis based on the following four criteria: (1) TAM is used in at least one empirical study. (2) Extended TAM models were built but contained the main classical TAM[1] structure. (3) The research methodology was well designed and the model results are credible and complete. (4) The research covered a broad research domain.

5 Research Findings

The analysis of the 34 articles led to results shown in Fig. 2. All bibliographical references are listed in

Table 2.

The left number to the colon is the number of significant relationships while the right number is the number of insignificant relationships in Fig. 2.

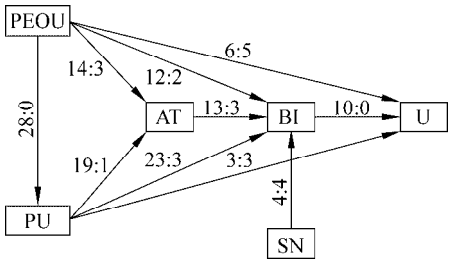

Fig. 2 Relationship statistics

The number of significant relationships between PU and its dependent variables totaled 45（19+23+3）, with only 7（1+3+3）insignificant relationships. Thus, significant stable relationships exist between PU and the dependent variables.

Of the relationships between PEOU and its dependent variables, 32（14+12+6）are significant, while 10（3+2+5）are insignificant. Thus, as compared to the relationships between PU and its dependent variables, these relationships are less stable.

There are 28 significant relationships between PEOU and PU, but no insignificant relationships. Thus,

Table 2 Model relationships

Author(s)	Model(s)	PU			PEOU			PEOU-PU	AT-BI	BI-U	AT-U	SN-BI
		PU-AT	PU-BI	PU-U	PEOU-AT	PEOU-BI	PEOU-U					
Davis[1]		+	+			+		+	+	+		–
Venkatesh & Davis[4]			+			+		+		+		+
Al-Gahtani & King[5]					+						+	
Venkatesh & Morris[6]	Male		+			–	+					–
	Female		+			+	+					+
Oh et al.[7]		+			+			+				
Venkatesh[8]			+			+		+				
Liaw[9]			+			+		+				
Ahuja & Thatcher[10]												
Drennan et al.[11]				+			–	+				
Koeszegi et al.[12]	PRC	–			+					+		
	USA	+			–					+		
Gefen & Straub[13]				+			+					
Dasgupta et al.[14]				–			+	+				
Hung & Chang[15]		+	+					+	+	+		
Chaua & Hu[16]		+	+						+			
Shih[17]		+			+			+				
Roberts & Henderson[18]				+								–
Hu et al.[19]			+					+				+
Dishawa & Strong[20]		+					–	+	+			
Chang et al.[21]		+			+		+		+			
Lai & Li[22]		+	+		+		–	+	+			
Amoako-Gyampah & Salam[23]		+	–		–			+	+			
Flett et al.[24]			+			–						
Thong et al.[25]			+			+		+				

(Continued)

Author(s)	Model(s)	PU			PEOU			PEOU-PU	AT-BI	BI-U	AT-U	SN-BI
		PU-AT	PU-BI	PU-U	PEOU-AT	PEOU-BI	PEOU-U					
Yanga & Yoo[26]	TAM	+	+		+			+	+		+	
	TAM+TPB	+			+			+	+		+	
Hsu & Lu[27]		+	–		+		+					
Ong & Lai[28]	Male		+			+		+				
	Female		–			+		+				
Yang[29]		+			–			+				
Wu & Chen[30]		+	+		+			+	+			–
Wang[31]			+			+		+				
Yu et al.[32]		+	+		+			+	+			
Van der Heijden[33]			+			+		+				
Taylor & Todd[34]	Experience	+	+		+			+	–	+		
	No experience	+	+		+			+	–	+		
Szajna[35]	Pre-implementation		+	–		+	–	+		+		
	Post-implementation		+	–		+	–	+		+		
Taylor & Todd[36]		+	+		+			+	–	+	–	+

Notes: "+" means significant and "–" means insignificant.

the relationship between these two belief variables is significant and stable.

However, some articles indicated that this relationship (PEOU-PU) is affected by user experience, with observation like "the more the user experienced, the lower the effect of PEOU to PU"[37]. The reason is that an experienced user can more easily accept a new technology, so usefulness may be the key motivation to use. With new users, difficulties in a technology are obstacles that one must deal with, and how well he masters the technology decides his perception of the usefulness.

There are 10 significant relationships between BI and U, but no insignificant relationships. Thus, this relationship is stable and significant. Venkatesh and Davis[3] stated that "BI is a good independent variable for predicting use."

6 Discussion and Conclusions

The significant relationship between PEOU and PU is not persistence, which is reflected in different stages of user acceptance. "Empirical studies show that in the initial stage of user acceptance, there are direct relationships between PU and BI, but with the process of acceptance, these relationships become more and more indirect (through the PEOU)"[4,37].

The relationships between AT and BI or U are strongly significant. However, some researchers have noted that the significant relationships between AT and BI are not that strong. Ong and Lai stated that, "This uncertain phenomenon can be explained by a case as follows: If a person finally accepts a technology, he may have high behavior intention, although not necessarily have a positive attitude to use"[38].

There are other explanations for the uncertainty in the relationship between AT and BI. Researchers think AT can be divided into several aspects. Yanga and Yoo[26] decomposed AT into an affective attitude (AA) and a cognitive attitude (CA) to get better forecasting ability. Thus, further research about attitude decomposition is necessary.

SN-AT and SN-BI are the main relationships for SN, but they are not significant in Fig. 2 with only four significant relationships and four insignificant relationships. Therefore, the effect of SN in the TAM should also be studied more in the future.

TAM is strongly supported by the theory of reasoned action (TRA) which implies that one can realize his intent to use without any restrictions if only he intends to act. However, in reality, there are many restrictions to the final behavior, such as personal ability, time, environment or organization, and unconscious habits. All of these will be obstacles to realizing the intention to act. This problem has not been discussed in studies of classical TAM. Therefore, the classical TAM still has limitations.

The trend to integrate TAM with other theories will continue to evolve. The most important theories are the theory of innovation diffusion (TID), the theory of planned behavior (TLB), and the social cognitive theory (SCT). The selection of external variables and control variables will also lead to future model development.

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