Is TAM Still Valid? A Test of the Technology Acceptance Model (TAM) In Software Usage

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ABSTRACT

The widely accepted Technology Acceptance Model (TAM) developed by Davis et al. (1989) is an excellent model to predict system usage. This study attempted to see if the earlier results of TAM are still valid after recent advances in systems and technology affecting systems usage. Data were collected from a company in the Pacific Northwest of the United States. From the 250 employees who received the questionnaire via e-mail, 118 returned usable responses. The results indicated that management support and system quality does not affect usage and TAM was supported substantially well.

INTRODUCTION

To compete globally, many organizations have invested heavily in computer-based tools and information systems to support organizational decision-making, and planning. As technical barriers disappear, a pivotal factor in harnessing this expanding power becomes our ability to create applications that people are willing to use. The scope of this research study was to examine the relationship between user acceptance of database application interface and four antecedents: perceived usefulness, perceived ease of use, management support and system quality. As the technology acceptance model (TAM) was introduced by Davis (1985), this research study attempted to see if the earlier results were still valid after recent advances in systems and technology affecting systems usage. Therefore, this study will help organizations identify and improve user acceptance of MS Access as a software application interface to database systems.

The technology acceptance model (TAM) (Davis et al., 1989) provided a theoretical base for examining the factors contributing to technology acceptance in organizations. Although TAM was derived from the TRA model, both models were found to predict intentions and usage satisfactorily. However, TAM attitudinal determinants outperformed TRA's with a much larger set of measures. The theoretical insights of TAM thus provide a strong basis from which to examine factors contributing to users acceptance in technology. Although providing insights into the user acceptance of technology, (Davis et al., 1989) research focused only on the determinants of usage and did not include management support and system quality that affect usage directly.

Thus, this study adopts the technology acceptance model (TAM) as described above with usage as the dependent variable and perceived usefulness (U) and ease of use (EOU) as independent variables from the original model. In addition, two external variables are introduced in this study. External variables have been used in past TAM research as an extension to the technology acceptance model.

Technology Acceptance Model (TAM)

As a key dependent variable in the IT research literature, usage is of increasing theoretical interest. It is also of increasing practical importance as the usage of IT becomes more pervasive. From a pragmatic point of view, understanding the determinants of IT usage should help ensure effective deployment of IT resources in an organization (Taylor & Todd, 1995). Such usage is a necessary condition for ensuring productivity payoffs from IT investments (Davis, 1989; Mathieson, 1991).

Davis et al. (1989) define perceived usefulness as "the degree to which a person believes that using a particular system would enhanced his or her job performance" (p.320). Within the organizational context, people are generally reinforced for good performance by raises, promotions, bonuses, and other rewards (Pfeffer, 1982; Schein, 1980). A system high in perceived usefulness, in turn, is one which a user believes will lead to a positive use-performance relationship.

Perceived ease of use, in contrast, refers to "the degree to which a person believes that using a particular system would be free of effort" (p.320). This follows from the definition of "ease": "freedom from difficulty or great effort." Effort is a finite resource that a person may allocate to the various activities for which he or she is responsible (Radner & Rothschild, 1975). Since Davis (1989) elucidation of these constructs, numerous researchers have discovered that technology acceptance theory yields consistently high explained variance for why users choose to utilize systems (Adams et al., 1992; Mathieson, 1991; Pavri, 1988; Thompson et al., 1991).

Management support was previously studied as an external factor that affects usage through perceived usefulness and perceived ease of use. Management support was identified as one of the key recurring factors affecting system success (Cerveny & Sanders, 1986; Kwon & Zmud, 1987; Lucas, 1981). In contrast, this study introduces management support as a direct influence on usage.

Systems Quality is another external factor that affects usage through perceived usefulness and perceived ease of use (Davis et al., 1989; Azjen & Fishbein, 1980). Again, in contrast to prior studies, this study tests system quality as a factor that affects usage directly rather than indirectly through perceived usefulness and perceived ease of use.

The model for this study appears in Figure 1. It illustrates the proposed relationships among the study variables, the constructs in the original TAM (PU, EOU, and System usage) and the external variables (MS and SQ).

RESEARCH DESIGN

Data were gathered by means of a questionnaire survey administered in an organization in the Pacific Northwest of the United States. Survey research has been widely used and justified in information technology literature. The research methodology for this study was similar to that of Davis et al. (1989) in order to maintain continuity of research on the technology acceptance model (TAM). As such, this

Figure 1: Model of this study
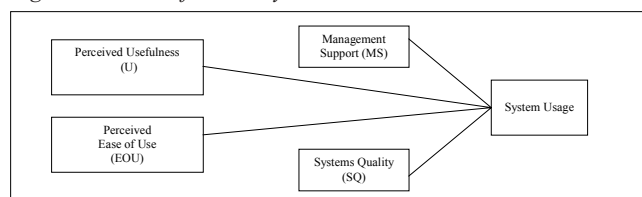
study used a survey design using instruments identical or similar to those used by Davis et al. (1989).

The population of this study consisted of full-time employees of an information technology company in the Pacific Northwest of the United States. The population consisted of 250 employees of a branch office that provides systems support, marketing and sales activities in a multinational company with headquarters in New Jersey, USA.

The constructs in the model were measured using multi-item scales. The instruments used in past research, have demonstrated acceptable levels of reliability and validity. They were modified for this study by substituting "MS Access" for the specific system examined in previous studies. Five-point Likert scales were pre-tested for measuring the independent variables (perceived usefulness, perceived ease of use, management support and system quality) and dependent variables (usage)To stay within the same analytical techniques used by Davis et al., (1989); Szjana, (1996); and Straub et al., (1997), this study adopted the multiple regression analysis technique they used. Multiple regression analysis is an ideal method for the present analysis because it identifies the contribution of each independent variable to the outcome variable, system usage.

The questionnaire was located at an internal web site within the organization's intranet. An E-mail message was distributed to users of the organization's E-mail system to guide them to the web site. They included workers across managerial, staff, and technical ranks. After completing the questionnaire, respondents submitted it by clicking on a 'Submit' button. The completed questionnaire was sent to the author's e-mail address.

Hypothesis
Perceived Usefulness
Davis et al. (1989), Straub et al., (1997) and Szajna (1996) reported that user acceptance of systems is driven to a large extent by perceived usefulness. Other studies have also reported that perceived usefulness is positively associated with system usage (Igbaria et al., 1997; Thompson et al.,1991).

Therefore, the following hypothesis was proposed:

$H1_O$: Perceived usefulness of MS Acess is negatively related, or not related, to system usage.

$H1_A$: Perceived usefulness of MS Access is positively related to system usage

Perceived Ease of Use
Davis et al., (1989) identified ease of use as an important determinant of system usage through perceived usefulness. Matheison (1991) and Szajna (1996) each reported that ease of use explains a significant amount of the variance in perceived usefulness. Adams et al. (1992) found that both perceived usefulness and perceived ease of use are important determinants of system usage.

Therefore, the following hypothesis was proposed:

$H2_O$: Perceived ease of use of MS Access is negatively related, or not related, to system usage

$H2_A$: Perceived ease of use of MS Access is positively related to system usage

Management Support
Previous studies have demonstrated that management support influences system usage in organizations through perceived usefulness and perceived ease of use (Cerveny & Sanders, 1986; Kwon & Zmud, 1987; Lucas, 1981). Management support ensures sufficient allocation of resources and acts as a change agent to create a more conducive environment for IS success. Additionally, TAM proposes that management support affects perceived usefulness as well as perceived ease of use. However, instead of testing management support that affects system usage through perceived usefulness and perceived ease of use, this study posits that management support directly affects system usage. Therefore, the following hypothesis was proposed:

$H3_O$: Management support is negatively related, or not related, to system usage

$H3_A$: Management support is positively related to system usage

Systems Quality
Many studies excluded the importance of software quality as a factor that influences usage. Davis (1989) explicitly suggested that system quality affects usage as an external factor through beliefs of perceived usefulness and perceived ease of use. Other studies have confirmed this relationship (Dickson et al., 1986; Igbaria et al., 1995). Other studies have also shown that system quality has a direct effect on usage (Fuerst & Cheney, 1982; Igbaria et al., 1995; O'Reilly, 1982).

Therefore, the following hypothesis was proposed:

$H4_O$: System quality is negatively related, or not related, to system usage

$H4_A$: System quality is positively related to system usage

Pilot Study
Pilot testing was conducted to determine if there were any problems in completing of the instrument and to estimate the time required to complete the questionnaire. Twenty-eight undergraduate students with majors in Computer Science and Information Systems completed the questionnaire in ten minutes and reported no confusion or problems in answering.

RESULTS
Descriptive statistics, a correlation matrix, and demographic findings are presented. Then the hypothesis testing results are presented. SPSS was used for data analysis. The questionnaire was located at an internal web site within the organization's internet. An e-mail message was distributed to 250 associates in the organization. A total of 118 responses were returned to the researcher's e-mail address box within two weeks. Four responses were discarded due to several unanswered questions for an overall response rate of 45.6 percent.

It was not surprising that all respondents attended some college and that 60.5 percent of the respondents had a college degree. The educational levels ranged from some college to beyond post-graduate. The distribution of educational levels is: (a) some college (18.4%), (b) college degree (60.5%), (c) post graduate degree (13.2%), and (d) beyond post graduate degree (7.9%).

Age was distributed widely across the categories except for "over 65" which received no responses. Among the other six categories, age was distributed as follows: (a) 18-25 (10.5%), (b) 26-33 (21.1%), (c) 34-41 (42.1%), (d) 42-49 (21.1%), (e) 50-57 (2.6%), (f) 58-65 (2.6%). The above results indicate that there are more employees in this organization that are between the age of 34 to 41 (42.1%) than any other age group.

The positions of respondents in this organization included telecommunication, customer relationship management, and networks. Most respondents were directly employed in technical fields. Job positions were grouped into three distinctive categories. The results were distributed as follows: (a) management (31.6%), (b) technical (57.9%), and (c) staff (10.5%).

Descriptive Statistics (means and standard deviations) are reported, with the correlation coefficients for all scales. Reliability was assessed using the Cronbach alpha coefficient. According to Nunnally (1975), reliability estimates of .50 to .60 are considered as sufficient for basic research. Table 1 summarizes the reliability estimates obtained in this study and in previous analyses.

Validity Estimates of Study Variables
Principle components with varimax rotation was used to assess the validity of the constructs. For adequate construct validity, the decision rule was that each item show a loading of greater than 0.50 on one underlying dimension. According to Szjana (1996) and Straub et al., (1997) this represents good discriminant validity.

Table 1: Scale reliability

Construct	# of items	Agarwal et al., (1997)	Davis et al., (1989)	Igbaria et al., (1995)	Current Study
MS Access Usage	4	.92			.86
Perceived Usefulness	6		.98		.95
Ease Of Use	6		.94		.97
Management Support	4			.83	.88
System Quality	5			.85	.60

Hypothesis Testing

Multiple regression analysis was used to test the hypothesis. The four hypothesis examined the effects of antecedents on MS Access usage. The Durbin Watson for the four independent variables (perceived usefulness, perceived ease of use, management support, and system quality) was 1.806. The plots of the residuals show no significant difficulty with auto-correlation of residuals among the study variables. The parameter estimates and the inferential tests are first approximations, however the residuals were heteroscedastic.

The R is .657, and the R^2 of .431 indicates that 43% of the variance in MS Access usage can be explained by the independent variables (Perceived Usefulness, Perceived Ease of Use, Management Support, and System Quality). The results indicate that two variables are significantly related to MS Access usage and two variables are not. Table 2 summarizes the results of regressing MS Access Usage on the independent variables. Now the results are applied to the hypothesis.

Table 2: Multiple regression results for MS Access usage

Usage	R	R^2	Std. Error	Standardized Coefficients Beta	Sig. (Alpha 0.05)
	.657	.431			
(Constant)			.412		.097
Perceived Usefulness			.089	.544	.000
Ease of Use			.073	.255	.004
Management Support			.080	-.052	.505
System Quality			.166	-.035	.730

(H1). The regression coefficient (beta) for Perceived Usefulness is .544 (p=.000, p < =.05). The regression results in Table 9 indicate that the null hypothesis can be rejected. Therefore, the alternative hypothesis stands. Perceived usefulness of MS Access is positively related to the user's MS Access usage. This result is similar to that of Davis et al. (1989), Straub et al. (1997), Szajna (1996), Igbaria (1997) and Thompson et al. (1991) that perceived usefulness is positively related to usage.

(H2). For the second hypothesis, the regression coefficient is .255 and the significance level is .004 (p <.05). Therefore, the null hypothesis can be rejected. Ease of use is positively related to MS Access usage. This is consistent with the results reported by Davis et al. (1989), Matheison (1991), Szajna (1996), Adams et al. (1992), Rogers (1995), and Straub et al. (1997) that perceived ease of use of a system is positively related to MS Access usage.

(H3). The regression coefficient is -.052 and the significance level is .505. This is greater than the .05 significance level. Therefore, the null hypothesis cannot be rejected. Management support is not related to MS Access usage.

(H4). The regression coefficient is -.035 and the significance level is .730. This is greater than the .05 significance level. Therefore, the null hypothesis cannot be rejected. System Quality is not related to MS Access usage. This result suggests that system quality is not a factor that would affect system usage. This result is similar to the results of Fuerst and Cheney, (1982), Igbaria, et al. (1997), Igbaria et al. (1995), and O'Reilly (1982) that system quality is negatively related to system usage.

SUMMARY AND CONCLUSIONS
Significant Findings

The questionnaire included three items for demographics. The results shown in Table 5 suggested these significant findings:

a) 60.5% of the respondents hold a college degree;
b) all of the 114 respondents had some college and beyond;
c) a majority of the respondents (42.1%) were in the age group between 34-41, and only 5.2% were above the age of 50;
d) more than half of the respondents (58.9%) hold technical positions and 10.5% hold positions other than management or non-technical positions.

The results indicated that two independent variables (Perceived usefulness, and Perceived ease of use) were positively related to MS Access usage, as predicted. However, management support and system quality were not related to MS Access usage.

Therefore, the research question was answered: perceived usefulness and perceived ease of use affect MS Access usage positively while management support and system quality do not affect MS Access usage. These results partially supported the results from prior studies for perceived usefulness and perceived ease of use, but not for management support and system quality. The differences of results between this study and prior studies was that this study combined the constructs used in different studies, as shown in Table 3, to test MS Access usage as a model. Furthermore, the study also confirms that TAM is valid for additional applications even though it was first introduced by Davis et. al, (1989).

CONCLUSION

Acceptance is one of the crucial keys to successful software choice and use (Borthick, 1988). Clearly, many factors influence technology acceptance (Adams et al., 1991; Davis et al., 1989; DeLone & McLean, 1992; Igbaria et al., 1995; Mathieson, 1991; Moore & Benbasat, 1991; Straub et al., 1995; Szajna, 1996; Taylor & Todd, 1995; Thompson et al., 1991). Results indicated that there are positive and significant relationship between perceived usefulness and perceived ease of use to system usage, but no relationship between the independent variables of management support and system quality and system usage.

The results reported above partially supported the findings of previous studies. Summary and descriptive statistics, along with reliability estimates, validity estimates and multiple regression were conducted using SPSS software. There were 114 usable returned survey from a population of 250 potential participants or a return rate of 45.6%. This indicated a good response rate for the analysis of the results. The regression results indicate that perceived usefulness, and perceived ease of use are related to MS Access usage while management support and system quality are not related to MS Access usage. The Durbin-Watson values indicate that there were no significant auto-correlation of residuals. The findings of this study partially supported the hypothesis.

Implications of this Study

The increasing importance and proliferation of microcomputers and end-user computing represents a significant development in the information systems (IS) field (Davis et al., 1989; DeLone, 1988; Igbaria, 1993; Rivard & Huff, 1988). This proliferation has helped make technology acceptance a significant activity in organizations (Raymond & Bergeron, 1992). Many organizations face substantial risks and problems with their computerization: they have a general lack of computer knowledge, have inadequate hardware and software, need to rely on outside resources, experience a lack of financial resources and technical support, have recruitment difficulties, and have a short-range management perspective imposed by a volatile competitive environment (Soh et al. 1992).

Cragg and King (1993) suggested that organizations can enhance the usage of computers by increasing the number and type of applications available to them. Some examples of software applications in-

clude spreadsheet and database software to prepare plans or analyze debtors, sales, marketing activities, costs and support services (Raymond & Bergeron, 1992). This study examined user acceptance of MS Access as a database interface tool.

As a result of this study, application programmers and application developers in software manufacturing organizations are able to take into consideration the issues that affect application usage when developing software applications—perceived usefulness and ease of use.

Limitations of this Study

Firstly, data collection was conducted through an e-mail to direct participants to the company's internal web site where the survey is located. Although this is the best method for a quick response, it could not ensure that the respondents answered the survey only once. However, due to the promise of anonymity and to increase participation of the survey, the author has reminded the participants to respond only once.

Secondly, this study was conducted at a northwest organization in the United States. Different geographic regions may yield different results.

Thirdly, the participants of this study are working for a high tech company. If this survey were given to participants from non-high tech. companies, the results may have been quite different.

Recommendations for Future Research

Future researchers may pursue a number of different options. Firstly, introducing other external variables that may affect system usage to the current study. Secondly, by studying system usage in a different country where technology is not widely accepted or is newly introduced. The result would enable local software manufacturing companies to localized software applications to specified country needs.

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