System Characteristics, User Perceptions and Attitudes in the Prediction of Information Technology Acceptance: A Structural Equation Model

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Abstract

Recently, researchers in IS have begun to rely on the theories of innovation diffusion to study implementation problems. A major focus of these studies has been how potential users' perceptions of the information technology (IT) innovation influence its adoption. User acceptance of IT has been a primary focus in the MIS implementation research for the past decade. Why do users accept or reject information systems? How user acceptance is affected by system characteristics, perceived usefulness, perceived ease of use, and attitude toward acceptance behavior? The present research addresses these questions. The technology acceptance model (TAM) is used as a base model to produce a causal model resembling a network of relationships among the study's constructs. A field study of 324 users regarding an end-user system was conducted to validate measures used to operationalize model variables and to test the hypothesized network of relationships. Partial Least Squares (PLS) is a second-generation multivariate analysis technique was used to estimate the parameters of the proposed causal model. The study findings indicate that system features variable has the largest influence on IT acceptance, followed by perceived usefulness. Both constructs have significant direct effects on IT acceptance but also exhibit their indirect effects through perceptions and/or attitude towards acceptance. Ease of use and attitude towards acceptance were found to have an equivalent influence on IT acceptance. Suggestions for future research and implications of findings are discussed.

Introduction

Recently, researchers in IS have begun to rely on the theories of innovation diffusion to study implementation problems (Brancheau and Wetherbe, 1990; Moore and Benbasat, 1991; Prescott, 1995). A major focus of these studies has been how potential users' perceptions of an IT innovation influence its adoption (Moore and Benbasat, 1991). The Rogers' seminal work *Diffusion of Innovations* (1995) is one of the most often cited reviews of the perceived innovation characteristics literature. Rogers, in a survey of several thousand innovations studies, identified five antecedents: relative advantage, complexity, compatibility, observability, and trialability affecting the rate of diffusion of a technology.

Davis' Technology Acceptance Model (TAM) was quite similar to a diffusion of innovations model. Davis included two constructs, perceived usefulness and perceived ease of use. The similarity between these constructs and Rogers' perceived relative advantage and perceived complexity are clear (Davis et al., 1989). Usefulness and ease of use are both believed to be important factors in determining acceptance of IT (Davis, 1989; Davis et al., 1989; Igbaria, 1993; Igbaria et al., 1997; Keil et al., 1995). The scales of both constructs demonstrate a high degree of test-retest reliability (Hendrickson et al., 1993). From this platform, these two constructs were thought to be of paramount importance to be researched in this study.

There is enormous interest in human factors of computer systems due to the recognition of how poorly designed many current systems are the desire to produce design and implementation guidelines that foster computer technology acceptance (Shneiderman, 1987). Additionally, Davis (1993) called for the examination of a more finely grained representation of system design features rather than merely comparing two different systems (i. e., using a dummy variable. p. 478).

Therefore, in order to produce design and implementation guidelines that foster acceptance, we need to gain a more complete understanding of the factors contributing to IT acceptance. Specifically, this paper focuses on two main factors affecting IT

acceptance: perceived usefulness and perceived ease of use while they are both related to a more specific design features of the system under investigation.

User acceptance is often the pivotal factor determining the success or failure of information system projects (Davis, 1993). TAM is used to address why users accept or reject an IT system and how user acceptance is influenced by system characteristics across users perceptions and their attitudes toward the system. This will enable system designers, developers and end-users to improve user acceptance of the system in the workplace through the design choices of the system (Davis, 1993). Moreover, management can better understand user perceptions and their attitudes toward a given IT system. Implementing all of that via corrective technical and managerial measures will eventually lead to system success.

Numerous indicators of success have been used in the MIS literature. These include user satisfaction (e.g., Amoroso & Cheney, 1991; Igbaria, 1990; Rivard & Huff, 1988), and system usage (Adams et al., 1992; Davis et al., 1989; Igbaria et al., 1997; Thompson et al., 1991; Straub et al., 1995) which are considered the most widely used measures of success. Al-gahtani and King (1998) investigated both measures and suggested that system usage is a more clearly defined measure and better be used as an indicator of IT acceptance. In addition, Igbaria et al. (1997) reported that system usage has been considered the primary indicator for IT acceptance, thus system usage was considered the most appropriate indicator of IT acceptance for this study.

Why do users accept or reject information systems? How user acceptance is affected by system characteristics, perceived usefulness, perceived ease of use and attitude toward usage? To address these issues, this paper reports on a study of university students with one year full-time job in industry and their views of an IT system during their placement in industry. Thus the purpose of this paper is to replicate the study of Davis (1993) in investigating the factors related to IT acceptance using a structural equation modeling (SEM) technique with Partial Least Squares (PLS). SEM allows for the simultaneous examination of the effects of the antecedents on user acceptance as opposed to ordinary regression analysis.

Conceptual Model and

Research Hypotheses

Why are some users able to exhibit greater acceptance of information systems? How user acceptance is affected by system characteristics, perceived usefulness, perceived ease of use and attitude toward usage? According to the theory of reasoned action (TRA) from psychology (Fishbein & Ajzen, 1975: p.396), external stimuli influence a person's attitude toward a behavior indirectly by influencing his or her salient beliefs about the consequences of performing the behavior. The research general model is depicted as per figure 1.

Take Figure 1 about here

The technology acceptance model (TAM), developed by Davis based on TRA, offers a promising theoretical base for examining the factors contributing to IT acceptance in natural settings. The proposed TAM is shown in Figure 2 (Davis, 1993). Briefly, a prospective user's overall attitude toward using a given system is hypothesized to be a major determinant of whether or not a person actually uses it. Attitude toward using, in turn, is a function of two beliefs: perceived usefulness and perceived ease of use. Ease of use has a causal effect on perceived usefulness. Overall perceived system characteristics directly influence perceived usefulness and perceived ease of use.

Take Figure 2 about here

Within the proposed TAM, attitude toward using the system is defined as "the degree of evaluative affect that an individual associates with using the target system in his/her job." Two specific beliefs, perceived usefulness and perceived ease of use, have been identified as important user acceptance criteria by previous research (Davis, 1989; Goodwin, 1987; Gould et al., 1991; Hill et al., 1987). In summary, attitude theory from psychology provides a rationale for the flow of causality from system characteristics through perceptions to attitude and finally to user acceptance. Figure 3 depicts the proposed IT acceptance conceptual model that incorporates the current research variables and hypothesized linkages among them which are discussed subsequently.

Take Figure 3 about here

Information Technology acceptance

Researchers have identified several indicators of IT acceptance. The most generally accepted measures appear to be user satisfaction and system usage. However, system usage has been the primary indicator of technology acceptance (Adams et al., 1992; Davis et al., 1989; Straub et al., 1995; Szajna, 1996; Thompson et al., 1991). Straub et al. (1995) noted that "system usage has a notable practical value for managers interested in evaluating the impact of IT" (p. 1328). Further, as the focus of this research was on discretionary system use rather than mandatory use, system usage is used as the primary indicator of IT acceptance.

Attitude toward using

Attitudes play a central role in the system to value causal chain due to its power and functionality. More specifically, attitudes guide perceptions, information processing and behavior (Fazio, 1988). There are many definitions of the attitude construct. What concerns information system (IS) researchers here is a definition that is sound by psychologists and compatible with the interests of IS researchers. Ajzen (1988) described attitude as a pre-disposition to respond favorably or unfavorably to an object, person, event, institution, or another discriminable aspect of the individual's world. Ajzen's definition of attitude emphasizes the notion of evaluation (e.g., pro-con, positive-negative, favorable-unfavorable).

To this extent, Melone (1990) tailored this definition to IS research so that a user attitude can be defined as: *a predisposition to respond favorably or unfavorably to a computer system, application, system staff member, or a process related to the use of that system or application*. She further elaborates that although the tailored definition is useful contribution to IS research, a much potential contribution is only when we consider the structure of attitudes and the implications this structure has on user cognition and behavior. This research is an attempt to investigate such structure and

potential network of relationships of attitude with two cognitive variables — perceived usefulness and perceived ease of — and system usage behavior as the key outcome variable (i.e., IT acceptance). Hence, the following hypothesis is derived.

H1: Attitude toward using will have a positive direct effect on IT acceptance.

Perceived usefulness

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his/her job performance" (Davis; 1989: p. 320). The importance of perceived usefulness as an important determinant of user acceptance derives from the TAM model, which proposes that perceived usefulness affect IT usage due to the reinforcement value of outcomes. Adams et al. (1992), Davis (1989), Davis et al. (1989), Straub et al. (1995), and Szajna (1996) reported that user acceptance of an IT system is driven to a large extent by perceived usefulness. Davis (1993) argues that perceived usefulness is the most influential determinant of system usage underscoring the importance of incorporating the appropriate functional capabilities in new systems. Further, positive association between perceived usefulness and system usage has been reported by several studies (e.g., Al-gahtani & King, 1998; Davis, 1993; Thompson et al., 1991). Thus, the following hypotheses are suggested.

H2: Perceived usefulness will have a positive direct effect on IT acceptance.
H3: Perceived usefulness will have a positive direct effect on attitude toward using.

Perceived ease of use

Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of physical and mental efforts" (Davis; 1989: p. 320). Davis et al. (1989) found that ease of use is an important determinant of system usage operating through perceived usefulness. Goodwin (1987) argues that the effective functionality of a system, i.e., perceived usefulness, depends on its usability, i.e., perceived ease of use. Later, Davis (1993) suggests that perceived ease of use may

actually be a prime causal antecedent of perceived usefulness. TAM also postulates that perceived ease of use is an important determinant of attitude toward using a system. Therefore, the following hypotheses are proposed.

H4: Perceived ease of will have a positive direct effect on perceived usefulness.
H5: Perceived ease of use will have a positive direct effect on attitude toward using.

System characteristics

Although TAM provided insights into the user acceptance of computer technology, past research conducted by Adams, Nelson, and Todd (1992), Davis et al. (1989), and Mathieson (1991) has focused only on the determinants of usage rather than on the external factors affecting these determinants (e.g., usefulness and ease of use). This research incorporated one external variable as an antecedent affecting the acceptance of the IT system under investigation.

External variables could be system features, user characteristics, organizational structure and the like (Davis et al., 1989). In this research, system characteristics variable is the single external stimuli hypothesized to indirectly influence system usage through users' perceptions about using the system. Several studies reported the impact of system characteristics on ease of use and usefulness or similar constructs (e.g., Dickson et al., 1986; Benbasat et al., 1986; Benbasat & Dexter 1986). Further, Davis (1993) reported a significant link between system features and attitude toward using. Therefore, the following hypotheses are proposed.

H6: System characteristics will have a positive direct effect on perceived ease of use.
H7: System characteristics will have a positive direct effect on perceived usefulness.
H8: System characteristics will have a positive direct effect on attitude toward using.
H9: System characteristics will not have a positive direct effect on user acceptance of IT.

Research Methodology

Sample and procedure

Data for this study were collected using questionnaire survey administered in the United Kingdom. University students with a year of full-time placement in industry were approached directly when they return to school for their final year. Students were registered in business, engineering and science, and were required by the university to spend one year in industry in the same area of specialization. The respondents had been employed in a variety of manufacturing, services, merchandising, and financial organizations in a wide range of functional areas throughout UK. They were approached in normal class lectures to make sure they have used spreadsheets (the IT system under investigation) and to minimize the number of *don't knows* and *no answers* and to maximize response rate (Babbie, 1973).

These students are not traditional students as they have spent one year in the work environment. They consider the year out as a prerequisite for employment which offers them more motivation to behave and think as company employees. Also, in many modern organizations students during their year in industry are given the same training as full time employees since they are required to apply the same skills on the same type of work. In many ways these students are treated as normal employees during their placement year in the work environment. Since the study concerned their behavior during that year and was administered very soon after their return to the academic environment, these students could be considered as representatives of a junior management group of employees and thus suitable respondents to handle the issues being researched (Al-Gahtani & King, 1998).

Many IS researchers have utilized students as surrogate for general employees. Ein-Dor and Segev (1982) utilized graduate students who were assigned individual projects guided by a questionnaire which finally to be endorsed by the relevant MIS director. Davis et al., (1989) collected data from MBA students. Galletta et al., (1993) approached undergraduate students in classroom sessions for data collection. Carlsson (1988) collected data from trainees on spreadsheets training courses.

By examining the university records of which students went on placements, the total number of potential respondents was found to be 497 which includes those who did not use spreadsheets. Based on the aforementioned criteria, 324 responded and completed the survey questionnaire achieving a response rate of 65%. The majority of respondents were studying some type of business program (59%), 34% were engineering program, and 7% a science program. Of the respondents, 68% were males, and 32% were females.

Measures

Information technology acceptance. Following researchers in this area (e.g., Davis, 1993; Davis et al., 1989; Igbaria, 1993; Straub et al., 1995), system usage was selected as the primary indicator of information technology acceptance. Based on several studies (Igbaria, 1993; Lee, 1986; Raymond, 1985; Trice & Treacy, 1988; Thompson et al., 1991), five indicators of system usage were included in the survey questionnaire (the fourth indicator was deleted in the final analysis):

1. The actual time was spent using the system per day. Individuals were asked to indicate the amount of time spent using spreadsheets per day, using a six-point scale ranging from (1) "almost never" to (6) " more than three hours per day."
2. Frequency of use of the system. Frequency of use has been proposed by Raymond (1985) to reflect another dimension of use that is different from actual time spent using the system. Frequency of use was measured using a six-point scale ranging from (1) "less than once a month" to (6) "several times a day."
3. Level of sophistication of spreadsheet applications. Individuals were asked to indicate the level of sophistication of spreadsheet applications, which includes menus, using macros, and data validation. Level of sophistication was measured using a five-point scale anchored with (1) for "least sophisticated" and (5) for "highly sophisticated."
4. Number of different spreadsheet applications. The variety of applications used by the respondent is also an indicator of system usage. Respondents were asked to indicate how many different spreadsheet applications they have worked with or used during their placement year.

5. Variety of spreadsheet software packages. Most users have a wide variety of spreadsheet software packages to use. In such a case, the different software packages and level of usage can provide a good indication of spreadsheets acceptance. Hence, respondents were asked to indicate which package they used from a list of six generic spreadsheet packages (e.g., excel, lotus 1-2-3, quatro-pro, etc.) and to indicate their level of usage ranging from (1) "none" to (5) "extremely extensive."

Perceived usefulness. This construct was measured using a six-item scale adapted from Davis (1989) with appropriate modifications to make them specifically relevant to spreadsheets. Individuals were asked to indicate the extent of agreement or disagreement with six statements concerning spreadsheets on a five-point Likert-type scale anchored with (1) strongly disagree and (5) strongly agree. A sample item: "Using spreadsheets improved the quality of some tasks of my work in industry".

Perceived ease of use. This construct was measured using a six-item scale adapted from Davis (1989) with appropriate modifications to make them specifically relevant to spreadsheets. Individuals were asked to indicate the extent of agreement or disagreement with six statements concerning spreadsheets on a five-point Likert-type scale anchored with (1) strongly disagree and (5) strongly agree. A sample item: "I believe that it was easy to get spreadsheets to do what I want it to do while in industry".

Attitude toward using the system. Based on the work of Ajzen and Fishbein (1980), an attitude scale was developed. Attitude toward using the system refers to the person's general feeling of favorable or unfavorable for the use of spreadsheets. The semantic differential method was used to assess attitude toward using the system. The instrument asked individuals to rate the five items according to how they feel about using spreadsheets by making a check mark in the place that best describes their opinion. Five different pairs form the evaluation dimensions of the semantic differential were used (good/bad, wise/foolish, favorable/unfavorable, beneficial/harmful, positive/negative) and participants were asked to respond on a five-point semantic differential items.

System characteristics. Overall system characteristics was assessed by the following item "For the spreadsheet package that I mostly used in industry, I found the overall characteristics to be" on a five-point scale ranging from (1) poor to (5) excellent.

Data Analysis

The statistical analysis method chosen for this study was Partial Least Squares (PLS); a powerful approach to analyzing structural models involving multiple constructs with multiple indicators. PLS is a second-generation multivariate technique that facilitates testing of the psychometric properties of the scales used to measure a variable (i.e., the measurement model), as well as estimation of the parameters of a structural model which involve the direction and strength of the relationships among the model variables. Together, the measurement and structural models form a network of measures and constructs (Bagozzi, 1982; Fornell, 1982; Fornell & Bookstien, 1982).

The researcher first has to assess the measurement model, and then to test for significant relationships in the structural model. The measurement model consists of the relationships between the constructs and the indicators (i.e., items) used to measure them. This implies the examination of the convergent and discriminant validity of the research instrument, which indicate the strength of the measures used to test the proposed model. The structural model assesses the explanatory power of the independent variables and examines the size and the significance of the path coefficients.

To assess the convergent validity, three tests are recommended: (1) item reliability, which indicates the amount of variance in a measure due to the construct rather than the error. Hair et al., (1987) recommended retaining indicators (items) with factor loading of at least 0.50 and considered them very significant. (2) composite reliability of each measure, the Nunnally's (1978) guideline for assessing reliability coefficients was used for evaluating the composite reliability of each measure. (3) average variance extracted (AVE) by each construct, which indicates the amount of variance in the item explained by the construct relative to the amount due to measurement error (Fornell & Larcker,

1981; Grant, 1989), Fornell and Larcker's criterion that the AVE should be ≥ 0.50 was used to assess the AVE for all constructs.

Discriminant validity refers to the degree to which items differentiate between constructs or measure different concepts. To assess discriminant validity, the correlation between the measures of two constructs are examined. The variance shared between measures of two different constructs (r^2) should be lower than the AVE by the items measuring each construct (Grant, 1989).

The assessment of the measurement model was carried out while examining for the convergent and discriminant validity of the research instruments. The revised measurement model was developed based on the results of the assessment. Following the assessment of the measurement model, the structural model was evaluated. To test the estimated path coefficients, t-statistics were produced using jackknifing which is a nonparametric test of significance (Wildt et al., 1982). The program used for this analysis was LVPLS 1.6 (Latent Variables Path Analysis using Partial Least Squares), developed by Lohmoller (1981).

The path coefficient of an exogenous variable represents the direct effect of that variable on the endogenous variable. An indirect effect represents those effects interpreted by the intervening variables; it is the product of the path coefficients along an indirect route from cause to effect via tracing arrows in the headed direction only. For more than one indirect path, the total indirect effect is their sum. The total effect of a variable on an endogenous variable is the sum of the direct and the indirect effects (Alwin & Hauser, 1975; Ross, 1975).

Results

Testing the measurement model

The results of the assessment of the measurement model show that one indicator (item) of the user acceptance construct (i.e., system usage) loaded very low (0.328).

Following the recommendation of Hair et al., (1987), it is concluded that this indicator did not contribute to the model and thus was deleted. The results of the revised measurement model are presented in Table 1. In general, the results show that the convergent validity of the survey measures was strong. The average extracted variances of the constructs were all 0.50 or above except that for usefulness (0.49). Since all the factor loadings for this construct are considered very significant ($\lambda \geq 0.64$) and the reliability of the construct exceeded 0.80, as recommended by Nunnally, this construct was considered satisfactory and thus retained.

Take Table 1 about here

Discriminant validity of the research instruments was also tested applying the approach used by Grant (1989), results are presented in Table 3. The diagonals represent the AVE as reported in Table 1 while the other entries represent the shared variance which is the squared correlations. By examining the matrix in Table 3, the 10 non-diagonal entries were found not to exceed the diagonals of the specific construct and thus no single violation of the conditions for discriminant validity.

Take Table 2&3 about here

It can be concluded that, the convergent validity of the study survey measures was adequate. Average variance extracted and the individual item reliabilities of the constructs appear to be satisfactory, and the composite reliability of all scales exceeded 0.80. Once confidence is gained with respect to the measurement model assessment, the structural model can be evaluated.

Testing the structural model

The results of the analysis of the structural model are presented in Tables 4 and 5. To assess the statistical significance of the loadings and the path coefficients (i.e., standardized β's), a jakknife analysis was performed. The use of jackknifing, as opposed to traditional t-tests, allows the testing of the significance of parameter estimates from data which are not assumed to be multivariate normal (Barclay et al., 1995). The Eight of the nine direct paths in the structural model were significant at the 0.001 level.

The predicting variables of the four endogenous constructs and their direct, indirect, and total effects to the target endogenous construct and the variance explained (R^2) are presented in Tables 4 and 5. The results of these are as follows:

Take Table 3&4 about here

Perceived Ease of Use

Table 4 shows that system characteristics had a very significant direct effect on perceived ease of use (γ=0.32). According to the research conceptual model, system characteristics was the only exogenous variable predicting perceived ease of use which explained 0.11 of its variance.

Perceived Usefulness

Table 4 shows that system characteristics and perceived ease of use had significant direct effects on perceived usefulness (γ=0.13 and β=0.25 respectively). These tow variables explained 0.10 of the usefulness variance.

Attitudes Toward Usage

Table 5 shows that each of perceived ease of use and perceived usefulness had a strong direct effect on attitudes toward usage (β=0.33 and β=0.38 respectively). The variance explained of this construct by these tow predictors was 0.33.

Information Technology Acceptance

The results of Table 5 show that all of system characteristics, perceived usefulness, and attitudes toward usage variables had significant direct effects on information technology acceptance (γ=0.31, β=0.24, β=0.25 respectively). The three variables explained 0.34 of the information technology acceptance variance.

Discussion

This study proposed and tested a structural equation model examining the role of system characteristics, user perceptions, and attitudes in the promotion of information

technology acceptance. TAM was expanded by examining system characteristics as an external variable which was operationalized not as a dummy variable while incorporating TAM's main constructs (two beliefs, attitude, and actual system use) in the research model. Since system characteristics has a significant direct effect on system usage, the TAM motivational constructs (attitude toward using, perceived usefulness and perceived ease of use) were not fully mediating the effect of system design features on usage. This finding is inconsistent with Davis (1993) who reported otherwise.

Trying to reconcile this inconsistency, this suggests that perceived usefulness and perceived ease of use may not be the only beliefs mediating between system and usage. Davis (1993) used the same fix when he found a significant direct influence of system features on attitude toward using and concluded that "this leads us to consider possible beliefs that should be added to the model" (p. 483).

With the exception to the system → attitude and system → usage links, the results indicate strong support for the proposed linkages among the model variables and provide interesting insights into the routes through which the antecedent variables influence IT acceptance. The results demonstrate the relative contribution of system characteristics, beliefs (perceived ease of use and perceived usefulness), and attitudes to variations in IT acceptance.

Davis (1993) hypothesized that the system → attitude link is insignificant but found to be significant. This study tried to replicate this finding and was found to be insignificant. Davis was after the point that the two beliefs (ease of use and usefulness) should be the only beliefs mediating between system and attitude which our results is confirming.

However, this study hypothesized that the system → usage link is insignificant but the results proved otherwise. Davis called for considering the role of additional variables within TAM which could capture the extra effect of system and make it operate through these additional variables. By augmenting TAM with additional motivational variables similar in spirit to "normative beliefs and motivation to comply" and "subjective norm"

(Ajzen and Fishbein, 1980) and related to the system implementation environment, such constructs might mediate the effect between system and usage.

Consistent with prior research (Davis et al., 1989; Davis, 1993) the total effect of perceived usefulness is greater than that of perceived ease of use on usage. Comparatively, results point out that usefulness is twice as important as ease of use in influencing usage. This finding is inconsistent with Igbaria et al. (1997) as they reported that the total effect of perceived ease of use on usage is greater than that of perceived usefulness. Igbaria et al suggested that a user's level of experience is a possible explanation for their finding as the majority of their subjects (over 75%) reported a low level of experience in many aspects related to system use.

Not surprisingly, system features stood up to have the greatest total effect on usage. This suggests that users were driven to accept information technology primarily on the basis of system features and functionality and secondarily by ease of use and friendliness.

The strong positive effect of system features on perceived ease of use suggests that as the system possesses rich features, especially a friendly interface, the more the system is perceived to be easy to use by users. System features has a small but significant positive effect on perceived usefulness, which might reflect that users will maintain a higher level of perception that the system is useful due to greater features the system attains.

The findings indicate that perceived usefulness is a key intervening variable linking the external variable (i.e., system features) with perceived ease of use and attitudes and IT acceptance. The importance of perceived usefulness is further confirmed by its direct effect on system usage in addition to rank the 2nd in terms of total effect among the predictors of IT acceptance in our research model.

Consistent with prior research (Davis et al., 1989; Davis, 1993; Igbaria et al., 1997) perceived ease of use has a strong positive effect on perceived usefulness. This suggests how important for the system to be user friendly and easy to use in order to be perceived useful by users. Although this link is significant, several studies concluded that its effect

is mostly potential at the early stage of introducing the system and diminishes with time of continuous system use (e.g., Adams et al., 1992; Davis et al., 1989).

Perceived ease of use has a strong positive direct effect on attitudes toward using. It also has a small indirect effect on attitude via usefulness. Perceived usefulness has a stronger positive direct effect on attitudes toward using. The links of these two belief variables to attitude and their relative strength are in agreement with the findings of Davis (1993) and Davis et al. (1989). Compared to usefulness, the total effect of ease of use on attitude exceeds the total effect of usefulness on attitude. This substantiates the importance of the system to be easy to use in order to promote a strong positive attitude toward usage.

Perceived usefulness has a strong positive direct effect on IT acceptance over and above its indirect effect via attitude. Although inconsistent with TRA, there are some theoretical (Triandis, 1977) and empirical (Bagozzi, 1982) antecedents for an effect of beliefs on behavior over and above their indirect effect via attitude. This finding declares how important the functionality of the system is, and that a system perceived rich with functions will lead to a higher acceptance rate compared to an inferior one.

Attitude towards using the system has a strong positive direct effect on IT acceptance. Linking attitude directly to IT acceptance has been found to be significant in several studies (e.g., Algahtani & King, 1998; Davis, 1993; Guimaraes & Igbaria, 1997; Igbaria, 1993).

Implications for Research and Practice

The present study model has a number of implications for research and practice. This study extends Davis' call for future research to consider the role of additional constructs within TAM. Igbaria (1994) researched an augmented TAM with two constructs from TRA "subjective norm" and "normative beliefs and motivation to comply" parallel to TAM motivational variables (attitude, ease of use, and usefulness). Igbaria used several external variables as antecedents to both lines of constructs and found them to be

applicable; unfortunately, system design features was not among those external variables. This confirms the call for future research *per se*.

Another area of future research is applying several analytical approaches to the same research model. This study used PLS while Davis (1993) used ordinary least-squares (OLS) regression, both techniques were applied to almost the same model and constructs. Using different analytical approaches could help uncover the reason behind several inconsistencies and might lead to different conclusions. The work of Chin and Gopal (1995) is an excellent step in this direction. Meanwhile, for fruitful and robust future research, the need for substantive knowledge to derive modeling, exploration, and interpretation of results should be observed (Chin & Todd 1995).

The results demonstrated the advantage of the technology acceptance model applied to information technology. The findings suggest that system features, perceived usefulness, and ease of use are of most influential variables in the IT acceptance respectively. This suggests that system features and functionality of the system must be emphasized to potential users. Thus software developers must address rich system features and powerful system functionality as important design objectives when developing systems. Also, ease of use must not be overlooked as a moderate determinant of IT acceptance. Efforts to improve perceived ease of use, like training, could be used, which will enhance self-efficacy (Bandura, 1982) of system users.

The TAM model provides diagnostic measures that could help practitioners identify and evaluate strategies for enhancing user acceptance. It lends a practical promising tool for early user acceptance testing (Davis, 1993). To guide investment in systems development, it is desirable to forecast user acceptance as early as possible in the design process (Gould et al., 1991; Shneiderman, 1987; Swanson, 1988). In an early stage of the systems development process, key decisions are made, a small fraction of development costs has been incurred, and greatest flexibility exists to modify the design (Davis, 1993). If sufficient user acceptance tests (using prototypes, video mockups, …etc.) are performed early in the design, the risk of user rejection could be reduced and preventive and predictive measures could be applied to ensure future user acceptance.

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