A STUDY OF INDIVIDUAL COMPUTER SELF-EFFICACY AND PERCEIVED USEFULNESS OF THE EMPOWERED DESKTOP INFORMATION SYSTEM

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The sustained investment and deployment of modern Information Systems (IS) in U.S. corporations have increased interest in the study of factors influencing end-user acceptance and utilization of IS. Since utilization has been shown to be a critical element of IS success, great attention has been given to the factors that positively influence end-users to utilize Information Technology (IT) platforms. This study concentrates on the research of early indicators of utilization of a recently deployed IS, known as the Empowered Desktop, at Pacific Bell.

Survey questionnaires were gathered from 58 participants located at the Alhambra, California Network Engineering Center. The study findings provided substantial support for the proposed research model. Perceived usefulness was identified as the principal determinant of system utilization. Computer Self-efficacy was found to be a significant but less substantive influence on usage directly and indirectly through perceived usefulness. Of the two environmental variables, social pressure was found to be the most significant. The results of this study were similar to other IS studies involving a different set of demographic groups. The higher correlation of environmental variables provided and the accentuated importance of perceived usefulness provided significant contributions to the study of IS utilization in a more typical corporate organizational environment.

Introduction

Background

The acceptance and effective utilization of Information Systems (IS) by individuals and organizations are areas of research that have gained importance in recent years. The Technology Acceptance Model (TAM), introduced by Davis and associates (Davis, 1989; Davis et al., 1989), is one of the most widely used research constructs in the study of IS utilization. Studies using a variety of computer-related scenarios have provided the TAM with extensive empirical support (Davis, 1989; Davis et al., 1989; Mathieson, 1991; Adams et al., 1992; Igbaria, 1993; Subramanian, 1994; Igbaria et al., 1996; Szajna, 1996).

The TAM uses two distinct but interrelated beliefs, perceived usefulness and perceived ease of use, as the basis for predicting end-user acceptance of computer technology. Of the two TAM variables, studies have found perceived usefulness to have the strongest influence (Davis et al., 1989; Keil et al., 1995; Satzinger & Olfman, 1995; Taylor & Todd, 1995a; Igbaria et al., 1996).

Researchers have extended the TAM's general measures by explicitly including other IT acceptance variables, such as extrinsic and intrinsic motivators (Davis et al., 1992; Igbaria et al., 1995), task-to-technology fit (Keil et al., 1995; Satzinger & Olfman, 1995), prior experience (Taylor & Todd, 1995b), and computer self-efficacy (CSE) (Compeau & Higgins, 1995; Igbaria & Iivari, 1995), among others.

Using a variety of IS research models, social influences have also been found to play a key role in the prediction of IT usage. With the pervasive proliferation of computers in the workplace and the reliance of corporations on IT as an enabler of competitive advantage, it is expected that social influences will continue to play an important role in IT utilization (Pollalis & Frieze, 1993). The two organizational influences of interest in this study are organizational support and social pressure.

Statement of the Problem

This study uses the CSE and TAM's perceived usefulness constructs to study managers' utilization of the Empowered Desktop Information System (EDIS) in the Network Engineering organization at Pacific Bell. The goal of this research is to perform an analysis of the relationship between CSE, organizational influences, and perceived usefulness on managerial utilization of the EDIS during the early system implementation stage. These findings may reveal the answers to the following research question:

How does perceived usefulness, individual computer self-efficacy, and organizational influences affect the utilization of an Information Technology during the early implementation phase?

The Current State of IS Deployment in the U.S.

Desktop computer technology continues to be deployed in corporate environments at an accelerated pace (Igbaria & Iivari, 1995). The reliance of competitive businesses on IT can be derived from the following corporate statistics (Strassmann, 1996, p. 64):

- For U.S. companies, IT expenditures account for an average of 2% of revenue.
- In a 1994 survey of 1,926 companies, it was found that nine out of ten companies spent more on information management than on shareholder equity.
- The number of executives who say they will increase their spending on IT has more than doubled in the last five years.
- In 1982, IT spending outperformed basic industrial spending in U.S. corporations. By 1994, IT spending was almost three times that of basic industrial spending.

The heavy investment in IT by U.S. corporations has put pressure on managers and IS professionals to realize the potential economic and organizational benefits anticipated by the introduction of IT. To a great extent, the success of businesses is dependent on the successful implementation of the enabling IT platforms. This is particularly evident in process improvements efforts currently underway in the U.S., including reengineering (Hammer & Champy, 1993).

Organizations that invest in IT that is not used effectively, or is not used at all, are making an unwise investment (Markus & Keil, 1994). The negative repercussions of bad IT investments are compounded by the remaining and unsolved business problems, opportunities lost, and discouraged end users. For these reasons, IS personnel and management are under pressure to realize the potential financial and organizational benefits from the IT investment. To assist managers and IS practitioners, it is desirable to determine the motivators and demotivators of IT usage as early as possible to reduce cost and maximize return on investment.

Assessment of IS impact in organizations continues to be a major challenge for managers and researchers. Empirical studies on this topic have produced mixed and inconclusive results. In a 1994 study of IT spending, researchers found that computers have indeed increased productivity for U.S. corporations (Hitt & Brynjolfsson, 1994). However, the study also reported a lack of noticeable improvements in financial performance. Barua et al. (1995) have argued that the deficiency in measuring IT contribution is associated with measurement techniques (Barua et al., 1995). In addition to methodology issues, Hitt & Brynjolfsson (1994) identified three additional problems for the estimation of IT benefits: mismanagement, possible lags between IT investment and impacts, and redistribution of outputs within an industry.

Based on the studies referenced in this section, the estimation of IT impact is an area that requires further empirical research.

Proposed Research Model and Research Hypotheses

Proposed Research Model

Figure 1 shows the proposed research model of IS usage. It is based on theoretical constructs of behavior applied to the specific context of IS utilization. The proposed model includes social influences from Fishbein & Ajzen's (1975) Theory of Reasoned Action (TRA) and Ajzen's (1985) Theory of Planned Behavior (TPB), perceived usefulness from Davis' (Davis, 1989; Davis et al., 1989) Technology Acceptance Model (TAM), and computer self-efficacy based on Bandura's (1977) self-efficacy theory.

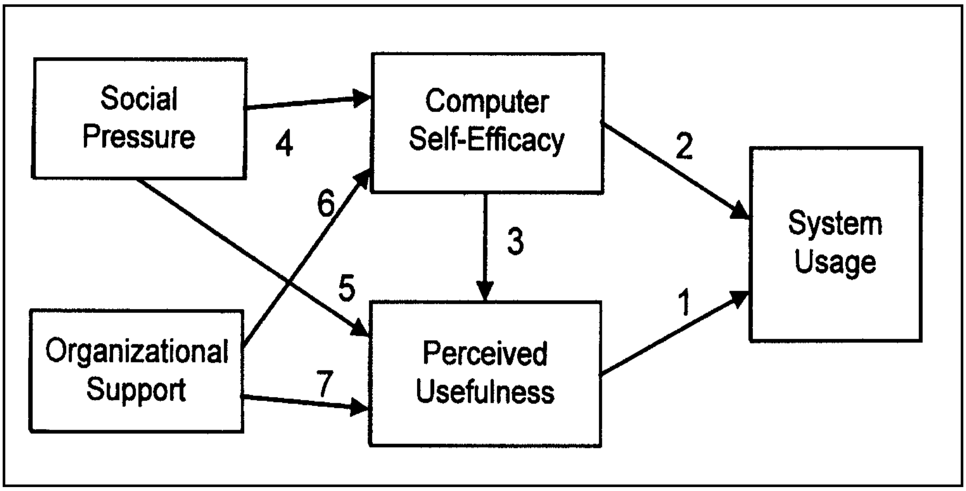

Figure 1. Proposed Research Model (numbered arrows correspond to the hypotheses tested in this study).

The proposed model incorporates the TRA's proposition that social influences are a determinant of behavior (Fishbein & Ajzen, 1975). Since the behavior being studied was not under complete volitional control, it was necessary to introduce a measure of an individual's capability to perform a specific behavior (Ajzen, 1991). This was accomplished by the use of self-efficacy (Bandura, 1977), which is similar to the TPB's Perceived Behavioral Control concept (Ajzen, 1991). With the inclusion of the TAM's perceived usefulness construct, the model reflected the importance of performance considerations in a real organizational setting (Taylor & Todd, 1995a).

Hypotheses

Perceived Usefulness

A significant number of studies have shown that perceived usefulness is an important antecedent of computer utilization (Davis et al., 1989; Davis et al., 1992; Igbaria & Iivari, 1995; Keil et al., 1995; Satzinger & Olfman,1995; Igbaria et al., 1996). In these studies, perceived usefulness has proven to be the strongest of the two TAM variables, with perceived ease of use having mixed and inconclusive results. Taylor & Todd (1995a) recently tested a decomposed TPB model, in which they found that for business environments, perceived usefulness had a strong direct effect on an individual's intention to utilize an IT. The researchers provided support for Davis et al. (1989) argument that in a real work environment, behavioral intentions are based primarily on performance-related elements, rather than on the individual's attitude towards the behavior (Taylor & Todd, 1995a). Thus, the first hypothesis is:

Hypothesis 1: Perceived usefulness will be positively related to the utilization of the EDIS.

Computer Self-efficacy

Compeau & Higgins (1995) developed and tested a measurement of computer self-efficacy. Their research investigated the relationship between computer self-efficacy, the environment and IT usage. Compeau & Higgins' (1995) research showed self-efficacy as a mediator between environmental variables and outcome expectations as well as actual usage. This was an important finding, since previous research considered a direct relationship between organizational influences and use. In this study, the Compeau & Higgins' outcome expectation variable is considered to be similar to the TAM's perceived usefulness, since Compeau & Higgins concentrated on performance-related outcomes and personal outcome expectations (Compeau & Higgins, 1995). In accordance with this review of computer self-efficacy, the second hypothesis is proposed as follows:

Hypothesis 2: Computer self-efficacy will be positively related to the utilization of the EDIS.

Recent studies have provided empirical support for the relationship between self-efficacy and outcome expectations. Hill et al. (1987) showed that computer self-efficacy is an important determinant of an individual's decision to use computer technology. In a different study, Compeau & Higgins (1995) found self-efficacy to play an important role in determining computer usage, both directly and through outcome expectations. Igbaria & Iivari (1995), on the contrary, found self-efficacy to have an insignificant direct effect on perceived usefulness, although self-efficacy had a strong indirect effect through perceived ease of use. Since the self-efficacy and perceived ease of use constructs have proposed to be similar (Davis, 1989), the exclusion of the perceived ease of use variable in this study will allow for measurement of the direct relationship between self-efficacy and perceived usefulness, similar to Compeau & Higgins (1995). Based on this discussion, hypothesis 3 is proposed as follows:

Hypothesis 3: Computer self-efficacy will be positively related to perceived usefulness of the EDIS.

Social Pressure

Recent studies performed in business environments have shown social pressure to influence individual self-efficacy and IS usage. Compeau & Higgins (1995) found that self-efficacy mediated the effect of environmental elements, such as the encouragement of system use by peers and superiors, on computing behavior. Igbaria et al. (1996) found that social pressure was a relatively small motivator of IT utilization, although they argued that social pressure was a mediator of antecedent variables and perceived complexity. In a separate study, Taylor & Todd (1995b) found subjective norm to be a more important predictor of intention for individuals with little or no experience on the particular behavior. Taylor & Todd's (1995b) findings were relevant to this study, since this research measured IT usage during the early implementation phase. Furthermore, subjective norm has been found to be more important in the early stages of system development (Hartwick & Barki, 1994). Therefore, the following hypothesis is proposed:

Hypothesis 4: Social pressure will be positively related to computer self-efficacy.

Reinforcing the performance-reward beliefs associated with perceived usefulness, Compeau & Higgins (1995) found that persuasion from peers and managers had a significantly higher correlation with computer usage, when compared to social pressure from friends and subordinates. Furthermore, when outcome expectations were split into job-related and personal-related expectation, job-related expectations were found to be stronger than personal-related outcome expectations (Compeau & Higgins, 1995). In their study, Compeau & Higgins (1995) found significant support for their model, shown in Figure 5, in terms of the social pressure - outcome expectations relationship. In another study, Igbaria et al. (1996) showed social pressure to be positively related to IT usage. This gives rise to the following hypothesis:

Hypothesis 5. Social pressure will be positively related to perceived usefulness of the EDIS.

Organizational Support

According to Self-efficacy theory, "people who are socially persuaded that they possess the capabilities to master difficult situations and are provided with provisional aids for effective action are likely to mobilize greater effort than those who receive only the performance aids" (Bandura, 1977, p. 198). Researchers have also argued that by providing computer support to end-users, their ability is improved, which in turn results in higher judgments of self-efficacy (Compeau & Higgins, 1995; Igbaria & Iivari, 1995).

Based on this discussion, hypothesis 6 is proposed as follows:

Hypothesis 6: Organizational support will be positively related to computer self-efficacy.

Based on Davis et al. (1989) TAM, perceived usefulness is directly affected by organizational support (Igbaria, 1993). Computer-related support, in addition to increasing end-user ability, serves as an indication of how important the system is perceived to be in the organizational context. Organizations that expend great effort in providing computer and management support are sending a strong signal to end users that they are expected to use the IT, and that its use will result in individual performance improvements. Therefore, the final hypothesis is proposed as follows:

Hypothesis 7: Organizational support will be positively related to perceived usefulness of the EDIS.

Research Methodology, Survey Design, and Instrumentation

In order to test the model depicted in Figure 1, a field study was conducted to assess the relationships between perceived usefulness, computer self-efficacy, social pressure, organizational support and managerial utilization of the Empowered Desktop Information System (EDIS) a few months after system deployment. The data for this study were gathered by means of a survey instrument.

Context of the Study: The Alhambra Network Engineering Center and Empowered Desktop Information System

The Alhambra Network Engineering Center was established in 1995 as a result of Pacific Bell's reengineering efforts. Approximately 400 employees work at this site, involved in the planning, deployment and support of Pacific Bell's telecommunications network in the Los Angeles region.

In support of reengineering efforts, Pacific Bell is in the process of implementing a comprehensive IS platform, known as the Standard or Empowered Desktop. The Empowered Desktop consists of a client/server Local Area Network environment and Pentium computers, a suite of business applications, including MS Exchange for electronic mail, group scheduling and groupware, MS Office applications (Excel, Word, etc.), and Internet access. The ultimate goal of the EDIS is to create an Empowered Enterprise at Pacific Bell, where employees and the corporation as a whole use a standard set of IT tools that allows them to perform in an increasingly competitive telecommunications market (Beckman, 1995). The implementation of the EDIS is the first company-wide IT standardization effort. It is expected that by the end of 1997 all employees will have the EDIS installed.

Data Collection Procedures

Primary data were collected by means of a questionnaire that was especially developed for this study. Survey instruments were distributed to 100 managers in the Alhambra, California, engineering center. Survey recipients were informed that the data were being collected for a Master's thesis.

This study was limited to Pacific Bell Network Engineering managers, since they comprised a larger percentage of empowered desktop users. Additionally, the study was restricted to management in an effort to control the complexity and variety of tasks performed by the study participants. As the system was in the early implementation phase, it was deemed appropriate to provide an EDIS information sheet for infrequent users.

The questionnaires were distributed on November 11, 1996, with a requested response date of November 18. A self-addressed company mail envelope was provided for the anonymous return of completed surveys. The survey participants provided demographic and construct data for conducting quantitative analysis, including analysis of the means and structural equation modeling.

Participants

Study participants were divided equally between males and females. Age was designated as an optional item in the survey, with 67.2% of the participants providing a response.

The average age was 46.1 years (Standard Deviation, SD = 7.4). Average years of company service was reported at 21.9 years (SD = 4.7), while the current job tenure averaged 5.4 years (SD = 4.7).

The participant group included a high percentage of managers with college degrees, with averages of 44.8% and 22.4% for holders of Bachelor's and advanced degrees, respectively. The majority of respondents were second level managers, representing 53.5% of the sample population, followed by first level managers with 44.8%, and one third level manager, representing 1.7% of the participants.

Results

The Structural Model

Research model evaluation involved the assessment of the structural model. For this task, the data obtained were used to test the seven hypotheses of this study as well as to investigate related issues. Figure 2 shows the path diagram of the Generalized Least Squares analysis. The path coefficients shown in Figure 2 represent standardized regression weights (r), or coefficients of correlation, between two variables. r is a number between -1.00 and 1.00 that indicates both the direction and the strength of the linear relationship between two variables. It has been proposed that the lower limit of substantive regression coefficients is 0.05 (Compeau & Higgins, 1995), although the researchers preferred a critical value of 0.10 and higher (r > 0.10) for substantive correlations.

In Figure 2, estimates of squared multiple correlations (R^2) are shown for the endogenous variables labeled system usage, computer self-efficacy and perceived usefulness. R^2 values represent the percent of the variance of the particular dependent variable that is explained by the antecedent variables. As seen in Figure 2, the structural model accounted for 33% of the variance in system usage, as well as 19% and 11% of the variation in computer self-efficacy and perceived usefulness, respectively.

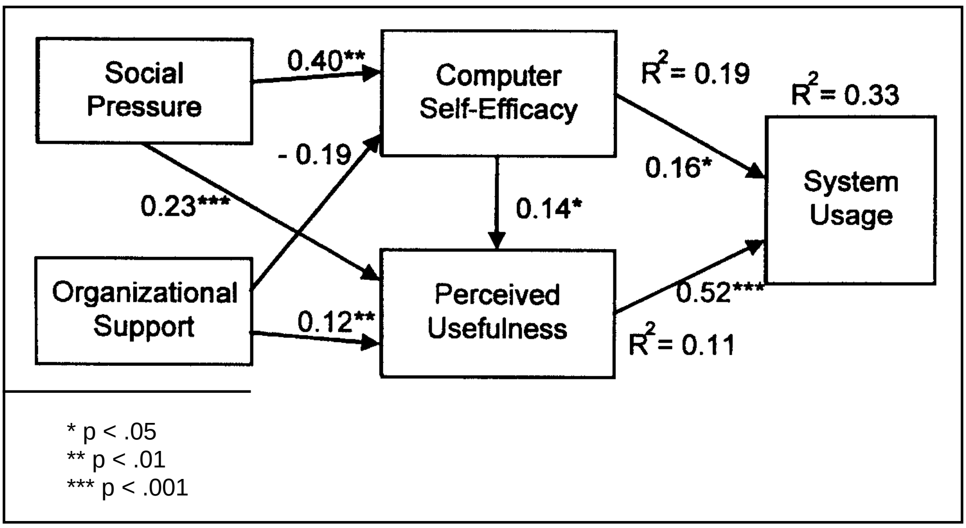

Figure 2. Research Model With Correlation Coefficients and Squared Multiple Correlations

Table 1 provides a summary of the hypotheses results.

Hypothesis	Supported	Correlation
1. Perceived usefulness will be positively related to the utilization of the EDIS	Yes	0.52***
2. Computer self-efficacy will be positively related to the utilization of the EDIS	Yes	0.16*
3. Computer self-efficacy will be positively related to perceived usefulness of the EDIS	Yes	0.14*
4. Social pressure will be positively related to computer self-efficacy	Yes	0.40**
5. Social pressure will be positively related to perceived usefulness of the EDIS	Yes	0.23***
6. Organizational support will be positively related to computer self-efficacy	No	- 0.19
7. Organizational support will be positively related to perceived usefulness of the EDIS	Yes	0.12**

* p < .05
** p < .01
*** p < .001

Table 1. Hypothesis Results

Summary, Conclusions, and Recommendations

Summary

The results of this study suggest that perceived usefulness, computer self-efficacy, and environmental influences are important determinants of IS utilization in an organizational environment. The primary data obtained from early adopters of the EDIS platform supports the findings in recent studies that outcome expectations, and perceived usefulness in particular, are the most relevant and significant motivators of IT utilization. Individuals' beliefs about their ability to use computers were also confirmed to be a distinct and relevant construct in the determination of IS usage. In addition, the study provides support for the mediating role of the TAM's perceived usefulness and Social Cognitive Theory's computer self-efficacy constructs. Subjective norm, in the form of social pressure and organizational support, was also found to exert strong influence in a workgroup environment.

Conclusions

The findings of this study indicate that in a modern organization, individual performance outcome expectations take precedence over other influences related to the utilization of an IS. The results support the proposition that perceived usefulness can be a powerful medium for improving acceptance and utilization of innovative information technologies. Therefore, complementary constructs such as computer self-efficacy and normative influences must be directed towards improving the perceived usefulness of an IS. This is derived from the fact that individuals in a competitive environment will not use a system if it does not provide any performance benefit relative to existing or legacy systems.

Recommendations for Future Research

The scope of this research was limited to the study of system utilization in an engineering organization. It is recommended that the scope be expanded to include other variables that have in recent years shown promise in the understanding of IS success. One element that was not explicitly included in this study is the effect of task-to-technology characteristics. The limited measure of this variable in this study found it to be of importance in an organizational setting.

Further research is recommended in the areas of theoretical model development and testing. A recommendation is made for performing a similar study using a larger sample, to improve the structural equation model reliability characteristics. In addition, it is recommended that a follow-up longitudinal study be performed to research the effects of time in the development of beliefs, attitudes, and subjective norm.

Finally, it would be helpful to study the requirements for the new roles of IS practitioners and organizational managers in promoting and supporting modern systems such as the EDIS. This recommendation is based on the important role of subjective norm, and especially social pressure and organizational support, in realizing IS utilization. These studies could provide further insights into the critical factors that influence IS and organizational success.

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