Personal Computing: Toward a Conceptual Model of Utilization[1]

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Abstract

Organizations continue to invest heavily in personal computers for their knowledge workers. When use is optional, however, having access to the technology by no means ensures it will be used or used effectively. To help us gain a better understanding of factors that influence the use of personal computers, researchers have recently adapted the theory of reasoned action proposed by Fishbein and Azjen (1975). This study uses a competing theory of behavior proposed by Triandis (1980). Responses were collected from 212 knowledge workers in nine divisions of a multi-national firm, and the measures and research hypotheses were analyzed using partial least squares (PLS). The results show that social norms and three components of expected consequences (complexity of use, fit between the job and PC capabilities, and long-term consequences) have a strong influence on utilization. These findings confirm the importance of the expected consequences of using PC technology, suggesting that training programs and organizational policies could be instituted to enhance or modify these expectations.

Keywords: Personal computing, information technology utilization, attitudes, behavior

ACM Categories: K.0, K.6.0, K.8, K.m

Introduction

Many information systems (IS) researchers have stressed the need to build IS research on a cumulative tradition, using referent disciplines and theoretical arguments as a foundation (Goodhue, 1988; Keen, 1980; Robey, 1979). The value of referent disciplines, Keen (1980) argues, is to keep IS researchers from "falling into the framework of the month trap" (p.11).

Research investigating the relationship between attitudes and computer utilization is one area where many IS researchers have been remiss, to date, in using existing models or theories, particularly those from the social psychology literature (Davis, et al., 1989; Goodhue, 1988; Robey, 1979). This lack of theoretical justification provides a potential explanation for the mixed empirical support found for the hypothesis that attitudes influence computer use (Davis, et al., 1989; Lucas, 1975; 1978; Pavri, 1988; Robey, 1979; Schewe, 1976; Schultz and Slevin, 1975; Swanson, 1982).

IS researchers have recently adopted Fishbein and Azjen's (1975) theory of reasoned action into the context of information technology use (see Davis, et al., 1989; Pavri, 1988). This theory, widely tested in sociological and psychological research, has been found to be lacking in certain respects. Triandis (1980) has proposed a theory that incorporates many of the same concepts and contructs but also modifies and redefines them. For example, while Fishbein and Azjen's theory considers *all* beliefs that a person has about an act or behavior, Triandis makes a distinction between beliefs that link emotions to the act (occurring at the *moment of action*) and beliefs that link the act to *future consequences*. He argues that behavioral intentions are determined by feelings people have toward the behavior

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(*affect*), what they think they should do (*social factors*), and by the *expected consequences* of the behavior. Behavior, in turn, is influenced by what people have usually done (*habits*), by their *behaviorial intentions,* and by *facilitating conditions.*

Despite the acceptance of Triandis' (1980) theory within the psychological literature, it has not been used within the IS context. Accordingly, the purpose of the study described in this article is to conduct an intitial test of a model of personal computer (PC) utilization using a subset of Triandis' (1980) theory of attitudes and behavior. This theory implies that the utilization of a PC by a knowledge worker in an optional use environment would be influenced by the individual's feelings (affect) toward using PCs, social norms in the work place concerning PC use, habits associated with computer usage, the individual's expected consequences of using a PC, and facilitating conditions in the environment conducive to PC use.

Conceptual Model and Research Hypotheses

The theoretical grounding for this research comes from the work of Triandis (1971; 1980). In earlier work, Triandis (1971) argued that behavior is determined by what people would like to do (attitudes), what they think they should do (social norms), what they have usually done (habits), and by the expected consequences of their behavior. He suggested that attitudes involve cognitive, affective, and behavioral components. The cognitive component of attitudes involves beliefs. In the context of PCs, for example, a person may hold a belief that PCs make work more efficient. The affective component of attitudes has a like/dislike connotation. Thus, the statement "I hate computers" is considered an indication of the affective component of attitudes. Behavioral intentions are simply what individuals intend to do. For example, the assertion "I will start to learn a software package tomorrow" represents a behavioral intention. Thus, attitudes involve what people believe (cognitive), feel (affective), and how they would like to behave (behavioral) toward an attitude object.

Later, Triandis (1980) presented a more comprehensive model of interpersonal behavior. The major statement of this model (see Figure 1) is that social factors, affect, and perceived consequences influence behavioral intentions, which in turn influence behavior. In addition, Triandis states that habits are both direct and indirect determinants of behavior. He further acknowledges that even when intentions are high, behavior may not occur if the "geography" of the situation (i.e., facilitating conditions) makes the behavior impossible. Thus, if someone intends to use a PC but does not have easy access to one, usage is less likely to occur. The model includes other variables, not germane to this study, such as culture, the social situation, and genetic biological factors that can influence behavior.

In this study, we test a subset of Triandis' (1980) theory applied to the context of PC use. Specifically, we examined the direct effects of social factors, affect, perceived consequences, and facilitating conditions on behavior. Behavioral intentions were excluded from the model becuase it was actual behavior (i.e., PC utilization) in which we were interested. Habits were excluded because, in the context of PC utilization, habits (i.e., previous use) have a tautological relationship with current use. The relevant constructs are discussed in more detail below, and a further discussion of the role of habits is also presented.

Social factors

Triandis (1971) argued that behavior is influenced by social norms, which depend on messages received from others and reflect what individuals think they should do. In his later work, Triandis (1980) expanded this term and called it *social factors,* that is, "the individual's internalization of the reference groups' subjective culture, and specific interpersonal agreements that the individual has made with others, in specific social situations" (p. 210). Subjective culture consists of *norms* (self-instructions to do what is perceived to be correct and appropriate by members of a culture in certain situations); *roles* (which are also concerned with behaviors that are considered correct but relate to persons holding a particular position in a group, society, or social system); and *values* (abstract categories with strong affective components).

Empirical support for the relationship between social norms and behavior can be found in many

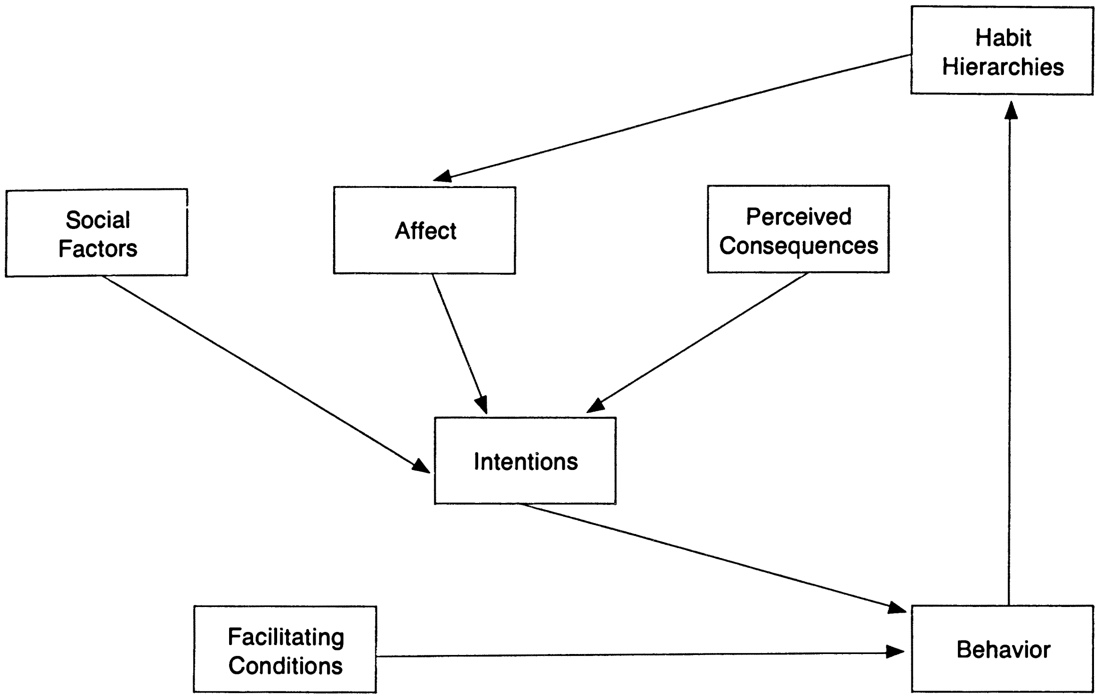

Figure 1. Factors Influencing Behavior (a subset of the model proposed by Triandis, 1980)

studies. For example, Tornatsky and Klein (1982), in a meta-analysis of 75 studies of the relationship betweeen innovation characteristics and adoption, found that compatibility of the innovation with the norms of the potential adopters had a significant influence on adoption. The relationship is also consistent with the theory of reasoned action proposed by Fishbein and Ajzen (1975), a theory that has already been tested within the IS context (Davis, et al., 1989; Pavri, 1988). More specifically, Pavri (1988) reports a positive relationship between social norms and the utilization of PCs by managers in optional use environments. Although Davis, et al. (1989) report no significant relationship between social norms and usage, they attribute this unexpected finding to the weak psychometric properties of their social norms scale, and the particular IS context (i.e., use of a word processing system) in which their research was conducted. Consistent with Triandis' (1980) theory and the evidence supporting this relationship, the hypothesis to be tested is:

H1: There will be a positive relationship between social factors concerning PC use and the utilization of PCs.

Affect

Triandis (1971) defines *attitude* as "an idea, charged with affect, that predisposes a class of actions to a particular class of social situations" (p. 2). He acknowledges that attitude is an imprecise term that is more useful for discussions where precision is not necessary. For research involving a link between attitudes and behavior, however, Triandis (1980) argues for precision through the separation of the affective and cognitive components of attitudes. To do this, Triandis (1980) uses the term *affect*, which refers to "the feelings of joy, elation, or pleasure, or depression, disgust, displeasure, or hate associated by an individual with a particular act" (p. 211).

According to Goodhue (1988), most IS researchers have not made a distinction between the affective component of attitudes (which have a like/dislike connotation) and the cognitive component or beliefs (which are the information a person holds about an object, issue, or person). For example, a close examination of Schultz and Slevin's (1975) operationalization of user attitudes (a single construct) toward mainframe systems suggests that many questions tap the cognitive as well as the affective components. If these are in fact separate components, combining them into a single component makes it impossible to assess their relative influence. Similarly, Lucas (1978) also used a mixture of cognitive and afffecting questions to measure the single construct of attitudes.

Controversy also remains among those researchers who acknowledge the differences between the affective and cognitive components. Burnkrant and Page (1982) suggest that although there may be a theoretical justification for separating the cognitive from the affective component, when it comes to measurement they should be treated as the same construct. Goodhue (1988), on the other hand, states that mixing the measurement of the components within the same construct could introduce additional bias or random error because the affect toward the object could influence the responses to the cognitive questions. To be consistent with Triandis' (1980) theory, we have made a distinction between the affective and cognitive components of attitudes, leading to the following hypothesis:

H2: There will be a positive relationship between affect toward PC use and the utilization of PCs.

Perceived consequences

According to Triandis (1971), another important factor influencing behavior is the expected consequences of the behavior, later re-named *perceived consequences* (Triandis, 1980). He argues that each act is perceived as having potential consequences that have value, together with a probability that the consequence will occur.

The perceived consequences construct is consistent with the expectancy theory of motivation proposed by Vroom (1964) and developed further by Porter and Lawler (1968). The basic premise of expectancy theory is that individuals evaluate the consequences of their behavior in terms of potential rewards and base their choice of behavior on the desirability of the rewards. Robey (1979) suggests that future research on attitudes should be done within the context of the expectancy theory of behavior and proposed a model based on this theory.

In her study of the optional use of a decision support system by senior undergraduate students, DeSanctis (1983) finds weak-to-moderate support for her hypotheses derived from expectancy theory. Beatty (1986) also uses expectancy theory as the basis for her investigation of the use of computer-aided design and manufacturing (CAD/CAM) systems. She finds a stronger relationship between expectations and actual use. Based on expectancy theory, if the expected consequences of using a PC are attractive (such as the increased opportunity for preferred future job assignments), and the probability of obtaining the consequences are high, then utilization of a PC will be greater.

Perceived consequences are likely to have many dimensions. For example, enhanced job satisfaction and more job flexibility may be two different constructs that could be labelled perceived consequences. Triandis (1971) acknowledges that the perceived consequences construct in his model is not unidimensional, possibly having several components. This is consistent with conceptual arguments and empirical findings of other researchers, who suggest there are multiple components (Fishbein and Azjen, 1975; Lucas 1978; Schultz and Slevin, 1975).

In this study, three dimensions of perceived consequences are defined. Two of these are near-term in nature, while the third is more future-oriented. The first of the near-term consequences relates to perceptions about the complexity of using a PC.

Complexity

According to Rogers and Shoemaker (1971) *complexity* is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 154). Tornatzky and Klein (1982) find that the more complex the innovation, the lower its rate of adoption. If PC utilization can be viewed within the context of innovation adoption, then these results suggest a negative relationship between complexity and utilization. Within the IS literature, Davis, et al. (1989) propose a technology acceptance model that includes a construct that they term *perceived ease of use.* This is defined as the degree to which the user expects the system to be free of effort. In their study they find a positive correlation between perceived ease of use and behavioral intentions. In this study, we examined *complexity* of PC use, the opposite of ease of use. The related hypothesis is therefore:

H3: There will be a negative relationship between the perceived complexity of a PC and the utilization of PCs.

Job Fit

The second near-term component relates to the capabilities of a PC to enhance an individual's job performance. More specifically, this dimension is defined as perceived *job fit* and measures the extent to which an individual believes that using a PC can enhance the performance of his or her job (e.g., obtaining better information for decision making or reducing the time required for completing important job tasks).

The positive relationship between perceived job fit and PC utilization has empirical support. In Tornatsky and Klein's (1982) meta-analysis of innovation adoption, they find that an innovation is more likely to be adopted when it is compatible with individuals' job responsibilities. Robey (1979) finds that the "performance factor," as operationalized by Schultz and Slevin (1975), is the strongest predictor of utilization. Their construct is similar to Floyd's (1986) "system/work fit" (i.e., facilitating accomplishment of core tasks, improving individual job productivity, and improving quality of work output), which he found to be positively related to the use of mainframe-based information systems. It is also similar to Davis, et al.'s (1989) "perceived usefulness" construct (defined as the user's subjective probability that using a specific application system will increase his or her job performance), which they find to be strongly correlated with utilization. Additional support is offered by Goodhue (1988), who suggests that an important predictor of use is the correspondence between job tasks and the capabilities of the information system to support the tasks. Cooper and Zmud (1990), in a study of the adoption of MRP systems, also find task-technology compatibility to be a major factor in explaining adoption behaviors. Building on these findings, the hypothesis to be tested is:

H4: There will be a positive relationship between perceived job fit and the utilization of PCs.

Long-Term Consequences of Use

The third and final component of perceived consequences included here is defined as *long-term consequences of use*. These are outcomes that have a pay-off in the future, such as increasing the flexibility to change jobs or increasing the opportunities for more meaningful work. For some individuals, the motivation to adopt and use PCs may relate more to building or planning for the future than to addressing current needs.

Empirical support for this construct is provided by Beatty (1986), who finds a strong positive relationship between perceived long-term consequences of use and actual use of CAD/CAM systems. Interviews with adopters revealed that they believed that use of the system would enhance their career mobility, even though they were not convinced it would assist them greatly on their current job. Therefore, the next hypothesis is:

H5: There will be a positive relationship between perceived long-term consequences of use and the utilization of PCs.

Facilitating conditions

Triandis (1980) states that behavior cannot occur if objective conditions in the environment prevent it. He defines *facilitating conditions* as "objective factors, 'out there' in the environment, that several judges or observers can agree make an act easy to do" (p. 205). In the context of PC use, the provision of support for users of PCs may be one type of facilitating condition that can influence system utilization. By training users and assisting them when they encounter difficulties, some of the potential barriers to use are reduced or eliminated. Schultz and Slevin (1975) consider "support/resistance" (the system has top management, technical, implementation, and organizational support, and not undue resistance) as one factor influencing utilization. Robey (1979) finds a positive correlation between "support/resistance" (as defined and measured by

Schultz and Slevin, 1975) and use of a system. The next hypothesis is:

H6: There will be a positive relationship between facilitating conditions for PC use and the utilization of PCs.

Habits

Although habits are not specifically tested in this study, they are clearly an important determinant of behavior and must be acknowledged. According to Triandis (1971), *habits* are situation-behavior sequences that occur without self-instruction. The individual is usually not conscious of these sequences.

Prior research has shown that habits are a strong predictor of behavior. For example, Sugar (1967) measured the attitudes, norms, and habits of college students concerning cigarette smoking. On a separate occasion, the same students were offered a cigarette. The strongest single predictor of behavior was habit, followed by norms; the least important predictor was attitudes. This would be expected because frequent, repetitive past behavior (i.e., a habit) generally would be highly correlated with current behavior. For this study, however, including the habit construct presents a major difficulty.

At a conceptual level, one could argue that habit should play a role in the utilization of a PC; the PC might be used for certain tasks simply because it has been used in the past, not necessarily because it is the most efficient or effective approach. At a measurement level, however, difficulties exist. Triandis (1980) notes that habits can be measured by the frequency of occurrence of behavior. This is precisely identical to our measure of utilization, which leads to a tautology. For this reason, we did not include the habit construct in this study.

To summarize, we have adapted the theory of interpersonal behavior proposed by Triandis (1980) to the context of PC use by knowledge workers in optional use environments. This theory suggests that affect, perceived consequences, social factors, facilitating conditions, and habits are the primary determinants of behavior. Two modifications to the theory were made in order to test the model within the IS context. First, three distinct cognitive components of perceived consequences (complexity, job fit and long-term consequences) were identified. Second, the habit construct was excluded from the analysis. The conceptual model illustrating the research hypotheses is shown in Figure 2.

Methods

Operationalization of constructs

To operationalize the constructs, we referenced the work of many researchers, including Amoroso (1986), Beatty (1986), Floyd (1986), Howard (1985), and Pavri (1988). We were unable to use exact replications of many of the instruments used in these studies because they were originally designed within the context of mainframe-based systems. Instead, we developed nine items (using the work of other researchers for guidance), modified 14 items from previous scales, and used nine items directly from prior studies. Table 1 lists, in an abbreviated format, all of the measurement scale items that were ultimately selected. The instructions provided to the respondent and scale anchors are also shown for one construct as an example.

Social factors were operationalized by asking respondents: (1) the proportion of their co-workers who regularly used a PC; (2) the extent to which senior management of the business unit supported PC use; (3) the extent to which the individual's boss supported the use of PCs for the job; and (4) the extent to which the organization supported the use of PCs. These questions were designed to tap the norms for PC use at the peer, superior, and organizational level. The four items were adopted from Pavri (1988).

The *affect* construct was operationalized with three items: (1) PCs made work more interesting; (2) working with PCs was fun; and (3) PCs were all right for some jobs but not the kind of job wanted (reverse scored). The first two items were taken from Howard (1985), while the third was developed specifically for this study. A five-point, Likert-type scale was used, with anchors ranging from strongly disagree to strongly agree.

The *complexity* scale included statements such as "working with PCs is complicated" and "it takes too long to learn how to use a PC to make it worth the effort." Respondents were asked to rate the degree to which they agreed or disagreed with each statement, on a scale from 1 (strongly

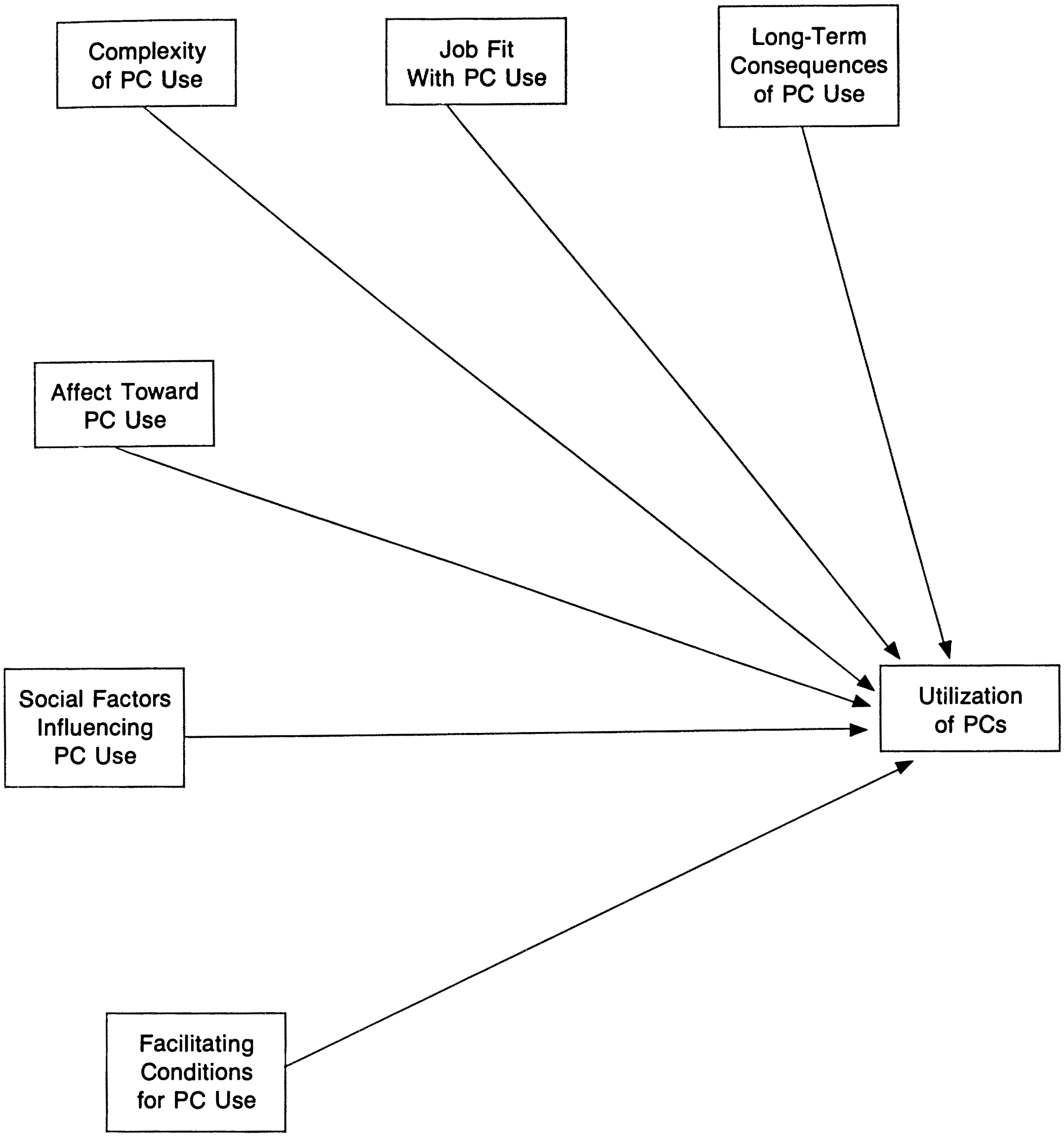

Figure 2. Factors Influencing the Utilization of Personal Computers (adapted from the model proposed by Triandis, 1980)

disagree) to 5 (strongly agree). The measurement scale was developed on the basis of work conducted by Howard (1985) and Pavri (1988). Neither of their instruments were appropriate for this study, however, and four items were therefore modified for our purpose.

For *job fit*, respondents were asked to indicate the extent to which they agreed with statements relating to the potential application of PCs for job-related efficiency, effectiveness, quality, and overall performance improvement. The six statements used for the measures, such as "for

Table 1. Operationalization of Constructs

Measure	Construct
	Social Factors
SF1.	The proportion of departmental co-workers who use a PC.
SF2.	The senior management of this business unit has been helpful in introducing PCs.
SF3.	My boss is very supportive of PC use for my job.
SF4.	In general, the organization has supported the introduction of PCs.
	Affect
AF1.	PCs make work more interesting.
AF2.	Working with a PC is fun.
AF3.	PCs are okay for some jobs but not the kind of job I want (reverse scored).
	Near-Term Consequences: Complexity
CO1.	Using a PC takes too much time from my normal duties.
CO2.	Working with PCs is so complicated, it is difficult to understand what is going on.
CO3.	Using a PC involves too much time doing mechanical operations (e.g., data input).
CO4.	It takes too long to learn how to use a PC to make it worth the effort.
	Near-Term Consequences: Job Fit*
JF1.	Use of a PC will have no effect on the performance of my job (reverse scored).
JF2.	Use of a PC can decrease the time needed for my important job responsibilities.
JF3.	Use of a PC can significantly increase the quality of output of my job.
JF4.	Use of a PC can increase the effectiveness of performing job tasks (e.g., analysis).
JF5.	A PC can increase the quantity of output for same amount of effort.
JF6.	Considering all tasks, the general extent to which use of PC could assist on job.
	Long-Term Consequences
LT1.	Use of a PC will increase the level of challenge on my job.
LT2.	Use of a PC will increase the opportunity for preferred future job assignments.
LT3.	Use of a PC will increase the amount of variety on my job.
LT4.	Use of a PC will increase the opportunity for more meaningful work.
LT5.	Use of a PC will increase the flexibility of changing jobs.
LT6.	Use of a PC will increase the opportunity to gain job security.
	Facilitating Conditions
FC1.	Guidance is available to me in the selection of hardware and software.
FC2.	A specific person (or group) is available for assistance with software difficulties.
FC3.	Specialized instruction concerning the popular software is available to me.
FC4.	A specific person (or group) is available for assistance with hardware difficulties.
	Utilization
UT1.	The intensity of job-related PC use (minutes per day, at work).
UT2.	The frequency of PC use.
UT3.	The diversity of software packages used for work (number of packages).

*The instructions to the respondents for these items were: "In this section we wish to determine how useful you believe a personal computer could be for your current job responsibilities. Please tell us how much you agree or disagree with each of the following statements (1 = strongly diagree; 2 = somewhat disagree; 3 = neither agree nor disagree; 4 = somewhat agree; 5 = strongly agree)." (*Note*: the instructions and scale anchors differed for other constructs.)

my current position, use of a PC could substantially decrease the time needed to perform my important job responsibilities," were developed specifically for this study, using the work of Floyd (1986) and Schultz and Slevin (1975) as a guide. A five-point, Likert-type scale was employed, with anchors ranging from strongly disagree to strongly agree.

The *long-term consequences of PC use* were measured using a shortened version of the scale developed by Beatty (1986) for her study investigating the use of CAD/CAM systems. Six items relevant to the use of PCs were identified, and a five-point scale was employed. The respondents were asked to indicate whether they thought that using a PC would decrease or increase each particular work outcome, such as the opportunity for preferred future job assignments. The scale anchors were: (1) extreme decrease, (2) slight decrease, (3) neither increase nor decrease, (4) slight increase, and (5) extreme increase.

Facilitating conditions were operationalized in terms of technical support for PC use, with four questions adapted from Amoroso (1986). The respondents were asked to give their level of agreement or disagreement with four statements: (1) guidance is available for the selection of hardware and software; (2) a specific person is available for assistance with software difficulties; (3) specialized instruction is available for popular software packages; and (4) a specific person is available for hardware problems. A five-point, Likert-type scale was employed, ranging from 1 (strongly disagree) to 5 (strongly agree).

The *utilization of PCs* scale was taken from Pavri (1988), who in turn based his measurement scale on the work of Cheney (1984) and Raymond (1985). Three dimensions were suggested for the utilization of PCs: (1) intensity of use, (2) frequency of use, and (3) diversity of software packages used. Intensity of use was measured by giving the respondent a selection of five time categories for daily use ranging from less than 15 minutes (category 1) to more than 120 minutes (category 5). Frequency of use was operationalized with four categories, ranging from less than once per week to several times a day. The diversity of use was calculated by counting those software packages for which the response for extent of use was "to some extent" or greater (3, 4, or 5 on a five-point scale).

Sample

The study was conducted in a large multinational manufacturing organization. The population of interest was knowledge workers (defined as managers or professionals) who used a PC in their jobs. The study excluded individuals who were required to use a PC. Four hundred and fifty-five questionnaires were distributed throughout the organization. A total of 278 questionnaires were returned, for a gross response rate of 61 percent. Thirty-six respondents reported that they did not have access to a PC, nine respondents did not answer questions concerning PC utilization, and 21 individuals indicated that they were required to use a PC as part of their jobs. These respondents were removed, leaving a final sample of 212 knowledge workers (a net response rate of 47 percent). The respondents represented a wide variety of job classifications across the nine divisions of this organization. Ninety percent of the respondents were male, and more than 70 percent held undergraduate or graduate degrees. The majority of respondents were between 30 and 50 years of age (60 percent), with the remainder being split roughly between those younger than 30 and older than 50. About 43 percent of respondents classified their job function as engineer or professional, 32 percent as managerial or supervisory, 20 percent as staff specialist, and 5 percent as executive. Descriptive statistics relating to the respondents' utilization of PCs are shown in Tables 2 and 3.

Procedure

A contact person within the participating organization arranged for the distribution of questionnaires to managers and professionals who used PCs to some extent. The survey package contained a cover letter from the organization as well as a cover letter from the researchers. All respondents were guaranteed confidentiality of individual responses, and only summary statistics were returned to the participating organization. One follow-up letter was sent to non-respondents.

The data were collected using the DISKQ method developed by Higgins, et al. (1987). This method replaces the traditional pencil-and-paper survey with an interactive questionnaire presented on a

Table 2. Intensity and Diversity of Use of Personal Computers by Respondents

Measure	Intensity of Use*	Diversity of Use**
First quartile;	30 - 45 minutes	1 package
Median:	60 - 90 minutes	2 packages
Third quartile:	> 120 minutes	3 packages
Range:	< 15 min. to > 120 min.	1 to 5 packages

Table 3. Frequency of Use of Personal Computers by Respondents

Measure	Frequency of Use	Percent
1. Once or twice per month	4	2%
2. Once or twice per week	49	23%
3. About once per day	53	25%
4. Several times per day	106	50%

*Minutes per day, home and office use.

**Number of different software packages used.

PC. In their research on DISKQ, Higgins, et al. (1987) demonstrated that it was an efficient technique that obtained higher response rates than traditional methods. They also showed no statistical differences in answers to socially desirable and highly personal questions.

The use of the DISKQ method could raise the possibility of non-response (selection) bias. If we had included non-users in the study, then selection bias would definitely be a concern. Since we included only those who used PCs, however, we believe the potential for bias was minimized.

Data analysis

To test the research hypotheses, partial least squares (PLS) analysis was used. PLS is a regression-based technique, with roots in path analysis (Pedhazur, 1982; Wold, 1985). It has emerged as a powerful approach to studying causal models involving multiple constructs with multiple measures. It has been used in marketing (Barclay, 1986), organizational behavior (Higgins and Duxbury, forthcoming; Howell and Higgins, 1990), and MIS (Grant, 1989; Rivard and Huff, 1988).

Fornell (1982; 1984) refers to techniques such as PLS and its close cousin LISREL (Joreskog and Sorbom, 1981) as second generation multivariate analysis techniques. These second generation techniques are superior to traditional regression and factor analysis because the items measuring a construct (i.e., the measurement model) are assessed within the context of the theoretical model. In contrast, computing factor scores and importing them into a regression model assumes that the scores are portable, an assumption that Fornell (1982) argues is not tenable.

PLS allows one to do a combined regression and principal components factor analysis within the same statistical technique. The factor structure is a result of the simultaneous assessment of item intercorrelations within the context of the hypothesized relationships between the constructs. If the PLS model is run with no hypothesized paths, the factor pattern matrix is identical to that obtained using principal components analysis. The computer program used for this analysis was LVPLS 1.6 (Latent Variables Path Analysis using Partial Least Squares), developed by Lohmoller (1981). For more information on PLS, the interested reader can refer to Fornell (1982; 1984) and Wold (1985).

Test of measures

The internal consistency of the measurement model was assessed by computing Cronbach's alphas. These reliability coefficients are displayed for each of the constructs in Table 4. The Cron-

Table 4. Factor Pattern Matrix of Measurement Scales Using PLS Analysis

Measure		Construct 1	2	3	4	5	6	7	Cronbach's Alpha
1. Complexity	CO1	.69	.26	.25	.37	.13	.12	.20	.60
	CO2	.80	.17	.04	.37	.18	.05	.23	
	CO3	.36	.25	.11	.20	.03	.01	.10	
	CO4	.59	.19	.11	.26	.06	−.07	.17	
2. Job Fit	JF1	.30	.44	.12	.34	.27	.12	.17	.82
	JF2	.14	.53	.22	.30	.19	.19	.20	
	JF3	.18	.80	.25	.42	.13	.11	.31	
	JF4	.24	.61	.29	.38	.17	.12	.23	
	JF5	.31	.49	.24	.39	.14	.11	.19	
	JF6	.34	.90	.22	.50	.22	.12	.34	
3. Long-Term Consequences	LT1	.02	.19	.73	.27	.18	.15	.18	.76
	LT2	.16	.15	.53	.20	.16	.00	.13	
	LT3	.09	.18	.68	.28	.10	.00	.17	
	LT4	.18	.23	.79	.29	.17	.05	.20	
	LT5	.03	.17	.50	.17	.06	−.08	.12	
	LT6	.10	.13	.45	.23	.10	.02	.11	
4. Affect	AF1	.40	.40	.40	.65	.27	.16	.21	.61
	AF2	.28	.26	.21	.29	.12	.09	.09	
	AF3	.43	.48	.32	.95	.24	.09	.30	
5. Social Factors	SF1	.12	.11	.07	.22	.78	.18	.30	.65
	SF2	.18	.15	.19	.16	.50	.29	.10	
	SF3	.17	.19	.30	.23	.68	.31	.11	
	SF4	.05	.15	.15	.08	.54	.58	.11	
6. Facilitating Conditions	FC1	.03	.14	.01	.07	.31	.76	.07	.86
	FC2	.06	.12	.10	.10	.39	.88	.06	
	FC3	.12	.13	.09	.12	.37	.78	.07	
	FC4	.04	.09	.12	.12	.37	.90	.14	
7. Utilization	UT1	.25	.35	.24	.29	.26	.10	.90	.64
	UT2	.23	.35	.19	.28	.25	.13	.85	
	UT3	.16	.13	.13	.14	.21	−.01	.51	

bach's alpha values range from .60 (for complexity) to .86 (for facilitating conditions). The lower reliabilities for the scales can be partly attributed to the small number of items in the scales because the calculation of Cronbach's alpha is affected by scale length. Given the exploratory nature of the study, the scales were deemed adequate to continue but indicate that future studies should develop stronger measures.

The primary criterion for discriminant validity is that each indicator must load more highly on its associated construct than on any other construct. Table 4 provides the factor pattern matrix that shows the loadings of each item on all constructs. For those unfamiliar with PLS, the factor pattern matrix can be interpreted in the same manner as principal components factor analysis. With one exception, the conditions for discriminant validity were satisfied, indicating that the measures distinguished between constructs. This exception occurred between two constructs, social factors and facilitating conditions, where one item (SF4) loaded slightly higher on facilitating conditions (see Table 4).

To provide a comparison with more traditional techniques, the results from an exploratory factor analysis (using principal components analysis) are displayed in Table 5. Several differences are apparent. First, the analysis extracted eight factors instead of seven. The extra factor (column 6, items LT5, LT6) appears to be a component of long-term consequences, although an examination of the questions did not indicate any substantive reason for this result. A more serious problem occurred between social factors and facilitating conditions where two items (SF2, SF4) loaded more highly on facilitating conditions than on social factors. A third item, SF3, also loaded highly on both factors. This result is also apparent in Table 4, although it was not as serious. The problem is likely a result of our operationalization of facilitating conditions as technical support. It appears that for many respondents, technical support may be indistinguishable from organizational support (or norms) for PC utilization.

These results demonstrate some of the differences between PLS and traditional techniques. First, PLS performs a restricted factor analysis in the sense that the analysis is limited to the number of user-defined factors (constructs). This is similar to specifying the number of factors to be extracted using factor analysis (for example, using the "N=" option on the FACTOR procedure of SAS). Second, both techniques identify weaknesses in discriminant validity between the social factors and facilitating conditions constructs, although the exploratory factor analysis indicates that the weakness is more severe. As a general comment, we believe that more weight should be given to the results produced by second generation techniques such as PLS. Factor analysis is atheoretical in the sense that the factors are constructed without reference to the nomological network in which the factors are being used. However, factors get their meaning from the empirical data and the theoretical model in which they are imbedded (Bagozzi and Phillips, 1982). Thus, PLS, by explicitly considering the measurement and structural models simultaneously, provides a more complete analysis for the inter-relationships in the model (Fornell, 1982).

Table 6 presents the intercorrelations between the constructs obtained from the PLS analysis. This table indicates, as expected, some multicollinearity between social factors and facilitating conditions and between affect and the three perceived consequences constructs.

Results

Table 7 shows the path coefficients, which are standardized regression coefficients, generated from the PLS analysis. Jackknifing (Fornell and Barclay, 1983) was used to calculate the statistical significance levels for these coefficients. This is a non-parametric technique that does not require the usual assumptions of normality associated with regression models.

The tests of hypotheses provide moderate support for our model of PC utilization based on Triandis' (1980) theory of behavior. Four of the six hypothesized relationships were statistically significant ($p < .01$), and the amount of variance in utilization explained by the model was 24 percent.

Support was found for Hypothesis 1, which postulated that social factors would positively influence the utilization of PCs (path = .22; $p < .005$). Hypothesis 2 was not supported. The path from affect to utilization was .02, which was not statistically significant. For Hypothesis 3, as predicted, there was a significant, negative relationship between perceptions about complexity of use and the utilization of PCs (path = -.14; $p < .01$). Similarly, Hypothesis 4, which stated that job fit would be a predictor of utilization, was supported by the results (path = .26; $p < .005$). For Hypothesis 5, the path coefficient between long-term consequences and utilization was positive and statistically significant (path = .10; $p < .01$), providing support for the hypothesis. Facilitating conditions (Hypothesis 6) had a small, negative influence on utilization, which was not statistically significant (path = −.04).

Table 5. Principal Components Analysis of Measurement Scales

Measure		Factor 1	2	3	4	5	6	7	8
Job Fit	JF1	.51	.04	.03	.23	−.08	−.10	.01	.46
	JF2	.67	.17	−.02	.11	.15	.19	−.08	−.08
	JF3	.74	.01	.15	−.01	.14	.06	.20	.12
	JF4	.77	.07	.22	.10	.05	.05	.06	.09
	JF5	.79	.10	.10	.24	.01	.06	.13	.01
	JF6	.74	−.01	.03	.20	.19	.04	.16	.14
Facilitating Conditions	FC1	.15	.77	−.21	−.02	.04	.14	.11	−.04
	FC2	.07	.87	.04	−.07	−.01	−.06	.06	.04
	FC3	.01	.77	.07	.05	.04	−.13	.01	.06
	FC4	.05	.82	.12	−.02	.01	−.10	.07	.01
Long-Term Consequences	LT1	.17	.08	.61	−.10	.04	.10	.06	.04
	LT2	−.01	.03	.61	.22	−.01	.33	.04	02
	LT3	.03	−.05	.70	−.05	.08	.07	.15	.08
	LT4	.18	.04	.76	.11	.10	−.02	.08	−.07
	LT5	.14	−.12	.47	.01	.08	.66	.03	−.11
	LT6	.15	−.03	.22	−.03	.05	.74	.12	−.06
Complexity	CO1	.26	.11	.14	.65	.06	−.05	.26	−.08
	CO2	−.05	.03	−.06	.48	.25	.07	.16	.42
	CO3	.28	.02	−.03	.61	.05	.01	−.12	−.02
	CO4	.11	−.12	.03	.73	.03	.01	.05	.05
Utilization	UT1	.25	.03	.09	.14	.83	.04	.01	.01
	UT2	.11	.06	.08	.01	.83	.04	.20	.12
	UT3	.07	−.03	.21	.20	.49	−.02	−.38	.34
Affect	AF1	.27	.13	.28	.08	.10	.10	.68	.23
	AF2	.12	.10	.15	.21	.05	.14	.76	−.01
	AF3	.32	−.07	.19	.31	.20	−.02	.41	.26
Social Factors	SF1	.17	.09	−.02	−.11	.17	−.07	.10	.69
	SF2	.05	.43	−.08	.07	.07	.55	.17	.40
	SF3	.05	.34	.32	.17	.03	.12	.02	.41
	SF4	.03	.72	.01	.02	.01	.38	−.09	.20

Discussion

In this study, a theory proposed by Triandis (1980) was adopted as a basis for examining the strength of different components of expected consequences of use on PC utilization, as well as the relative influence of social factors, affect, and facilitating conditions. Specifically, the findings showed that social factors, complexity, job fit, and long- term consequences had significant effects on PC use. There was no evidence

Table 6. Intercorrelations Between Constructs

Construct	Intercorrelations 1	2	3	4	5	6	7
1. Complexity	1.00						
2. Job fit	.28	1.00					
3. Long-Term Consequences	.17	.28	1.00				
4. Affect	.48	.52	.39	1.00			
5. Social Factors	.19	.21	.24	.28	1.00		
6. Facilitating Conditions	.07	.14	.11	.13	.43	1.00	
7. Utilization	.28	.38	.25	.32	.31	.11	1.00

Table 7. Tests of Hypotheses Based on Path Coefficients

Hypothesis	Path Coefficient
H1. Social Factors to Utilization	.22**
H2. Affect to Utilization	.02
H3. Near-Term Complexity to Utilization	−.14**
H4. Near-Term Job Fit to Utilization	.26**
H5. Long-Term Consequences to Utilization	.10*
H6. Facilitating Conditions to Utilization	−.04
$R^2 = .24$	

*$p < .01$; **$p < .005$

that affect and facilitating conditions (as defined) influenced PC use.

The model proposed by Triandis (1980) includes habits as one factor influencing behavior. As discussed, we did not include habits within this study because there was not a clear distinction between the independent variable (habits of PC use) and the dependent variable (PC use). Undoubtedly, the amount of variance explained in utilization would have increased if we could have operationalized habits without introducing problems of discriminant validity. We can be reasonably confident, however, that within the context of this study, factors other than habits have a significant influence on PC utilization.

This study was an initial test of Triandis' theory within the IS context. Several limitations of the work are apparent and must be considered in future tests of this theory. First, the respondents were from one organization. Hence, the generalizability of these results to other organizations remains to be determined. A second limitation is that utilization was operationalized based on the perceptions of our respondents. A better approach would have been to obtain precise usage statistics through an electronic monitor to confirm or disconfirm the perceptions of the respondents. This approach has been suggested by many IS researchers (e.g., Robey, 1979). However, it is currently difficult to implement monitors on PCs, essentially making it feasible only with mainframe-based systems.

A third limitation relates to our measurement model. First, there was the problem of discriminant validity between social factors and facilitating conditions. Triandis defines facilitating conditions as objective factors that make a behavior easy to do. For example, one important facilitating condition is the ease with which an individual can access a PC. Others include the ease with which software or hardware upgrades can be purchased or the extent to which home computers are offered as part of the job package. In retrospect, it appears that technical support is only one type of facilitating condition; others should have been included. In fact, technical support provided by the organization appears to be closely related to social factors. Clearly, if the organization has positive norms concerning PC use, it would be predisposed to providing technical support. Finally, the affect construct needs to be revisited. While we believe that the items chosen in this study measure affect, they do not measure all possible facets of affect toward PC use. This scale needs to be bolstered by including other items.

Turning to the results, the relationship between social factors and utilization is positive and significant. This is consistent with Triandis' theory as well as the theory of reasoned action proposed by Fishbein and Azjen (1975). However, the nonsignificant relationship between affect and utilization is inconsistent with Triandis' theory. One possible explanation is that PCs do not evoke strong emotions, either positive or negative, among managers or professionals. If PCs are seen simply as tools, and not as technology to be liked or disliked, then affect would not have an impact. This result is inconsistent with Davis, et al. (1989), who find a significant, positive relationship between affect (attitude) and behavioral intentions. The differences may be a result of the varying contexts being studied. Davis, et al.'s research looked at affect to a particular software package, while we examined the like/dislike component to using PCs in general. It is more likely, however, that the observed differences are a result of the different theoretical structures. Davis, et al. measured the indirect influence of affect on usage through intentions, while our model employs a direct link from affect to use.

Although the affective component of attitudes was not significantly related to utilization, the cognitive components as measured by perceived consequences were significant predictors of PC utilization. The negative relationship between complexity and utilization is consistent with many previous studies (Davis, et al., 1989; Tornatzky and Klein, 1982). The strong positive relationship between job fit and utilization was also expected and supports previous research (Davis, et al., 1989; Robey, 1979). The relationship between long-term consequences and utilization was also significant but weaker than the path from near-term consequences to utilization. The weaker relationship for long-term consequences is consistent with expectancy theory (Porter and Lawler, 1968). A key component of this theory states that payoffs that occur closer to the behavior are more motivating than payoffs in the future. Thus, near-term conseqeunces would be more likely to motivate PC use than long-term consequences.

In their technology acceptance model, Davis, et al. (1989) find a stronger relationship between perceived usefulness and utilization than between ease of use and utilization. Our results are similar in that job fit (operationalized similar to Davis, et al.'s perceived usefulness) was a stronger predictor of utilization than complexity (similar to Davis, et al.'s ease of use when reversed scored). The stronger link between perceived usefulness and utilization than between affect and utilization found by Davis, et al. is consistent with our results, although, as discussed previously, affect was not significant in our research.

The small, negative relationship between facilitating conditions (operationalized as technical support) and PC utilization is inconsistent with most previous studies (Amoroso, 1986; Jobber and Watts, 1986; Lucas, 1978). We cannot conclude, however, that there is no relationship between facilitating conditions and utilization because we only measured one aspect of facilitating conditions. As noted earlier, other measures of facilitating conditions should have been used, such as ease of access to a PC and/or ease of purchasing software or hardware upgrades. Interestingly, Davis, et al. (1989) do not find a significant effect of accessibility on behavior in their study. They reasoned that accessibility was not an issue for the respondents in their research. This suggests that the operationalization of facilitating conditions must take context into account. In other words, if everyone has a PC on his or her desk, then facilitating conditions operationalized as access would not have any variance.

Managerial Implications

It is interesting to speculate whether any of the variables in this study could be influenced by management action. In this respect, Cheney, et al. (1986) identify several factors that they believed influence the "success" of end-user computing (EUC). These factors were then classified as controllable, partially controllable, and uncontrollable. Cheney, et al. suggest that focusing on controllable or partially controllable factors would lead to a stronger potential to influence EUC success.

One partially controllable factor may be the beliefs about the level of correspondence between job tasks and the PC environment (i.e., job fit). Specifically, communication aimed at increasing the awareness of potential applications of PC technology for current job positions may influence the perception of job fit. Similarly, education aimed at strengthening the expected consequences of using PCs, such as greater effectiveness and efficiency in performing job functions, could have a positive influence on utilization.

Enhancing the perceived relationship between job tasks and PC utilization could be accomplished through role models. In his work on social learning theory, Bandura (1986) postulates that role models could positively influence innovation adoption. Empirical support for this contention is provided by a multitude of field and case studies that link the presence of a champion—an individual who enthusiastically promotes an innovation through critical organizational stages—and innovation success (Achilladelis, et al., 1971; Burgelman, 1983; Ettlie, et al., 1984). Thus, encouraging highly regarded, visible organizational members to use PCs may be an effective way of championing use throughout the organization. Social factors may also be a partially controllable factor; for example, it may be possible to influence norms by publicizing the successes of early adopters of technology.

Another partially controllable factor may be perceptions about the complexity of using a PC. Specifically, training aimed at reducing the perceived difficulty of using a PC could have a positive influence on actual use. This is also related to experience levels and learning curves; as individuals gain experience with different software packages, for example, their perceptions concerning the difficulty of using a PC may decrease.

In addition to providing implications for managers, this study has provided possibilities for future research. One such possibility involves the role of experience with personal computers and the concept of the relative influence of different factors changing as experience changes. Triandis (1980) argues that experience influences expected consequences of behaviors. The influence of experience on expected consequences could be tested by comparing the paths in the model across samples of experienced and inexperienced PC users. Triandis (1971) also proposes that experience changes the influence of other factors, such as social norms. Within this context, it could be hypothesized that norms exert a strong influence on utilization for inexperienced users but less influence on utilization for more experienced users.

In conclusion, this research has provided a number of contributions, the most significant being the testing of Triandis' (1980) theory within the IS context. The results suggest that future research on computer utilization within the IS context can productively use Triandis' work as a frame of reference.

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