

## SOURCES OF INFLUENCE ON BELIEFS ABOUT INFORMATION TECHNOLOGY USE: AN EMPIRICAL STUDY OF KNOWLEDGE WORKERS<sup>1</sup>

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### **Abstract**

*Individual beliefs about technology use have been shown to have a profound impact on subsequent behaviors toward information technology (IT). This research note builds upon and extends prior research examining factors that influence key individual beliefs about technology use. It is argued that individuals form beliefs about their use of information technologies within a broad milieu of influences emanating from the individual, institutional, and social contexts in which they interact with IT. We examine the simultaneous effects of these three sets of influences on beliefs about usefulness and ease of use in the context of a contemporary technology targeted at autonomous knowledge workers. Our findings suggest that beliefs about technology use can be influenced by top management commitment to new technology and the individual factors of personal innovativeness and self-efficacy. Surprisingly, social influences from multiple sources exhibited no significant effects. Theoretical and practical implications are offered.*

**Keywords:** Technology adoption, technology beliefs, belief antecedents

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<sup>1</sup>Allen Lee was the accepting senior editor for this paper.

## Introduction

It is widely acknowledged that organizations increasingly depend on information technology (IT) for the execution of a variety of operational, tactical, and strategic processes (Applegate et al. 2003). However, although senior managers might make primary adoption decisions related to IT, it is the individuals within firms who are the ultimate users and consumers of the technology. Thus, the true benefits and impacts of IT are contingent on the extent to which individual users appropriate and use IT in their ongoing work activities that, in turn, contribute to organizational productivity.

Not surprisingly then, the determinants of individual acceptance and use of information technologies in organizations continue to be a significant area of inquiry for IS researchers (Agarwal 2000). A variety of theoretical models have attempted to develop explanations of this phenomenon, with each garnering varying levels of theoretical and empirical support. Within these studies, a central construct and recurrent theme is the notion of an individual's cognition about the outcomes associated with the use of the target technology, also referred to in the literature as beliefs (e.g., Ajzen and Fishbein 1980; Ajzen and Madden 1986; Davis 1989; Davis et al. 1989). Beliefs represent the cognitive structures that an individual develops after collecting, processing, and synthesizing information about an information technology, and incorporate individual assessments of various outcomes associated with technology use. Beliefs have been shown to have a profound impact on subsequent individual behaviors toward information technology. Hence, the belief formation process is clearly worthy of further investigation (Agarwal 2000).

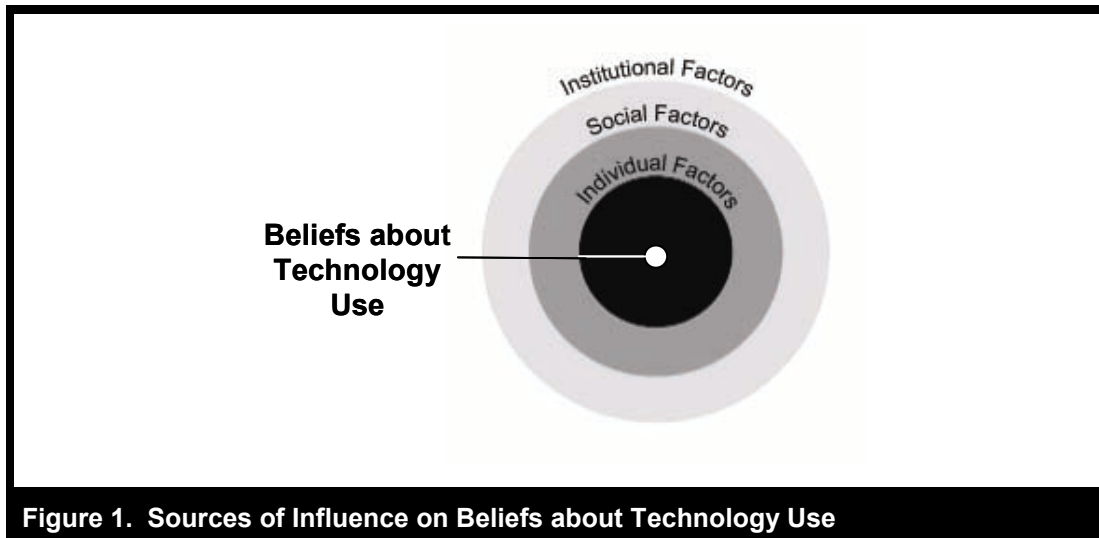
Although prior empirical studies have traced some of the factors that drive beliefs (e.g., individual differences, managerial interventions in the form of training, and situational factors) (Agarwal 2000), most of these studies have chosen to focus upon a specific and limited set of antecedents (Agarwal and Prasad 1999; Venkatesh 2000; Venkatesh and Davis 2000). The fundamental argument

made in this research note is that individuals form beliefs about information technologies within a milieu of influences emanating from the institutional and social context in which they interact with information technologies. Yet, extant research has not examined how these factors collectively shape individual beliefs about information technologies within the context of a single empirical study. The primary purpose of this note, therefore, is to present empirical evidence that institutional forces, social forces, and individual characteristics exhibit significant and *differential* impacts on two key individual beliefs about the use of information technologies: beliefs related to usefulness and ease of use. Research hypotheses are investigated through an empirical study of the acceptance of Internet technologies by autonomous knowledge workers for use in a key work process.

The remainder of this note is organized as follows. The following section describes the theoretical frame for the study and develops the research hypotheses. The methodology used to test the hypotheses, including the study context and sample, construct operationalization, and results are presented next. The fourth section discusses the results, including the significant and non-significant findings, while the final section reflects on the theoretical and practical implications that ensue.

## Theoretical Background and Research Hypotheses

Several theoretical bases inform the conceptual frame for this study. Figure 1 presents a graphic representation of this frame, which essentially suggests that an individual's beliefs about technology use are influenced by three dominant sources of influence at varying distance from internal psychological processes: institutional influences, social influences, and individual factors. It is important to point out that we are not hypothesizing that the belief drivers themselves are causally related. Rather, we are suggesting that



**Figure 1. Sources of Influence on Beliefs about Technology Use**

it is useful, from a conceptual perspective, to begin to develop a taxonomy of such factors by categorizing them on the basis of how distal they are from the target of technology acceptance, viz., the individual user. Beliefs about IT use represent the core dependent variables for this research. The discussion below elaborates upon each of the key constructs.

### ***Beliefs about Information Technology Use***

Perceptions about the characteristics of technology are not invariant across individuals. Indeed, individuals perceive a new technology from the vantage point of their own internal cognitive processes and develop beliefs about them. Technology acceptance models such as the technology acceptance model (TAM; Davis et al. 1989) and the theory of reasoned action (TRA; Ajzen and Fishbein 1980), upon which TAM is based, dominate the IS literature and suggest that the influence of all other variables on technology acceptance outcomes is mediated by individual beliefs about technology use. However, while there is considerable agreement that beliefs drive usage behavior, and while numerous studies have established the significance of the impact of

beliefs on intentions and usage, more work is needed to understand the determinants of beliefs (Agarwal and Prasad 1999; Venkatesh and Davis 2000). Pragmatically, such examinations are warranted because while beliefs are internal, psychological constructs, their determinants are external variables that may be controlled through appropriate managerial interventions.

There is considerable support in the literature for the importance of beliefs in technology acceptance behavior. Such beliefs have been utilized to both explain system usage (Adams et al. 1992; Moore and Benbasat 1991) and usage intentions (Davis et al. 1989; Mathieson 1991). In general, perceived usefulness (beliefs concerning instrumental outcomes associated with technology use) and perceived ease of use (beliefs that technology use will be relatively free of cognitive burden) have recurred as highly salient predictors of key acceptance outcomes in prior empirical examinations of technology acceptance. Given the recurrence of these beliefs, we focus on usefulness and ease of use as the two primary dependent variables.

In our research model (Figure 2), consistent with the theoretical arguments underlying TAM (Davis et al. 1989), we anticipate direct impacts of per-

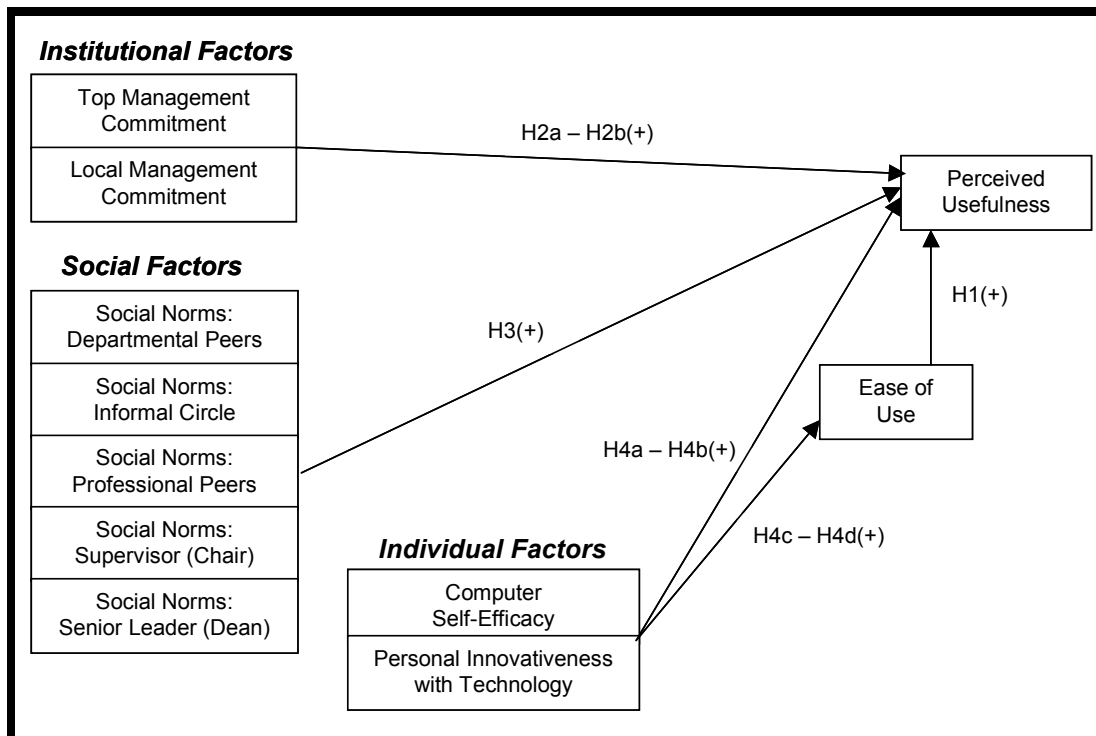


Figure 2. Research Model

ceived ease of use on perceived usefulness. When individuals perceive the technology to be relatively free of cognitive effort, they will view it as releasing important cognitive resources that may be productively applied to other activities. In other words, they are more likely to perceive the technology to be useful in their work activities.

Based on these arguments, we test the following hypothesis:

*H1: Beliefs about the ease of use of a technology have a significant positive influence on beliefs about the usefulness of the technology.*

### The Construction of Beliefs

What causes individuals to construct beliefs about a specific information technology? In order to sort out the range of factors that shape these mental

models, we propose the conceptualization of concentric sources of influence (see Figure 1), starting with the most proximate set of factors: individual characteristics. Next lies a more distal set of influences, namely those emanating from the social milieu within which the individual is situated. Finally, the most distal set of influences are the result of institutional forces that surround the individual. It is important to emphasize that our theorizing is focused on the use of IT by individuals embedded within an organizational context, and not on the personal use of IT for non-work related activities that might occur, for example, at home. Furthermore, we restrict our scope to IT that is initially adopted by senior management (such as an ERP or a CRM system) and then needs to be diffused more broadly throughout the organization. Finally, our goal is to demonstrate the relevance of factors belonging to all three antecedent categories within a single empirical study. Thus, the choice of specific factors is driven by their relative prominence in the

research literature, and the factors are offered as illustrative rather than exhaustive.

### Sources of Influence: Institutional Factors

The role of institutional factors in influencing individual behavior toward technology has long been a subject of interest in IS research. As noted over two decades ago, "MIS can and does fail where...organizational factors are ignored by system designers" (Robey 1979). In the effort to understand technology use, numerous attributes of organizations have been studied, including user training (Fuerst and Cheney 1982; Leonard-Barton 1987; Raymond 1988; Sanders and Courtney 1985); knowledge management (Boynton et al. 1994; Pennings and Harianto 1992); and organizational support (Delone 1988; Leonard-Barton and Deschamps 1988; Monge et al. 1992). Collectively, these studies suggest that institutional factors have a highly significant influence on individual technology use. Among the range of institutional factors proposed in prior work, our research model focuses on managerial commitment and support, the importance of which has been alluded to by numerous scholars (Yoon et al. 1995; Zmud 1984).

Although prior research has unequivocally established the importance of management support for technology use, less work has specifically linked this construct to *beliefs* about the technology (exceptions include Igbaria, Guimaraes, and Davis [1995] and Igbaria et al. [1997]). However, institutional theory provides the conceptual underpinnings of how and why the thoughts and actions of individuals within organizations are significantly influenced by the prevailing organizational norms, values, culture, and history. Scott (1995; see also Orlikowski 1992) identifies three ways in which the institutional milieu influences individual cognition and subsequently behavior: through processes of signification, legitimization, and domination.

Signification implies that individuals use information from the institutional milieu to understand how they should form their beliefs about new technologies that are introduced into the organi-

zation. Legitimization is suggestive of the validation of specific beliefs and actions of individuals: messages emanating from top management are used as normative templates to reassure oneself about the organizational legitimacy of beliefs and actions. Finally, domination reflects the notion that the institutional milieu regulates individual beliefs. To the extent that organizational workers seek to comply with organizational directives emanating from top management, they will develop cognitions that are consistent with the institutional context. In other words, the *attitudes* of top management are likely to influence the perceptions and attitudes of organizational workers (Massey et al. 2001). This logic is also embedded in Orlikowski's (2000) notion of technology-in-practice: essentially she argues that individuals' use behavior is deeply influenced by the institutional context within which that behavior is enacted.

Of the two beliefs examined here, we expect differential impacts for management commitment and support. Top management commitment and support set up the structures of signification, legitimization, and domination that reveal to individuals the ways in which the technology might be useful in their work process and task activities. For instance, top management commitment and support shapes individuals' beliefs that the technology is useful for work activities and that its use in the salient work activities will be normatively valued and instrumentally rewarded (Purvis et al. 2001). However, we do not expect management commitment and support to influence ease of use beliefs. This is because the organizational distance between the day-to-day activities of managers and subordinates is likely to render information regarding the complexity of a technology less salient.

In large organizations, the influence of management commitment and support plays out at multiple levels. Individuals in these organizations experience two primary sources of influence: top management at the enterprise level and the senior management of the departmental unit to which the individual belongs. While top management signals the importance of the technology to the enterprise

through their funding and resources provisioning actions, local or departmental management also influences individual behaviors by reinterpreting and reinforcing the signals emanating from enterprise management (Leonard-Barton 1987). Indeed, the day-to-day cognition and behavior of organizational actors are as much influenced by messages and signals relayed by their immediate supervisors as those communicated by top management. Thus, studies that incorporate managerial support as an explanatory variable should include support at the organizational and local levels. Based on these arguments, we hypothesize that

*H2a: Perceived top management support for the use of a technology has a significant positive influence on individual beliefs about the usefulness of the technology.*

*H2b: Perceived local management support for the use of a technology has a significant positive influence on individual beliefs about the usefulness of the technology.*

### **Sources of Influence: Social Factors**

Various conceptualizations and associated operationalizations of social influence have been offered in the IS literature. One dominant conceptualization, embedded in studies based on behavior models from social psychology such as TRA and TPB, is that of subjective norm (e.g., Mathieson 1991; Taylor and Todd 1995b; Thompson et al. 1991), defined as the "perceived social pressure to perform or not perform the behavior" (Ajzen 1991; p. 188). A second conceptualization, emerging from research on the adoption and diffusion of communication technologies, draws upon social information processing theory to suggest that information conveyed via individuals' social networks influences their cognition about a target technology (Fulk 1993; Schmitz and Fulk 1991).

While much evidence exists for the salience of social influence, technology acceptance models have treated the placement of this construct differently. TAM excludes social influence from its formulation (Davis et al. 1989) based on its uncertain psychometric properties, whereas studies in the TRA and TPB tradition posit that social influence affects usage intentions in a manner similar to attitude (e.g., Karahanna et al. 1999; Taylor and Todd 1995b). Recent extensions to the TAM model, however, argue that in addition to its effects on intentions, social influence has an important relationship with beliefs about the usefulness of a technology (Venkatesh and Davis 2000). Drawing upon Kelman's (1958) theoretical arguments, the authors suggest that this effect is manifest via the psychological pathways of internalization and identification. Via internalization, the individual incorporates the opinion of an important referent as part of her own belief structure: in essence, the referent's beliefs become one's own. Via identification, the individual seeks to believe and act in a manner similar to those possessing referent power. Therefore, compelling messages received from important others are likely to influence one's cognition about the expected outcomes of technology use.

In our conceptualization of social influence, we draw upon the work of Fulk (1993) and Schmitz and Fulk (1991). Fulk argued and empirically demonstrated that the extent to which salient others view technology use as valuable has a positive influence on one's own perceptions of usefulness. In other words, if a peer, supervisor, or some other actor in a relevant social network believes that a technology is useful, through a process of shared cognition, so will the target individual. However, Fulk's conceptualization did not include a measure of the importance of the referent other, also referred to in the TRA tradition as "motivation to comply." Doubtless, the potency of the influence will vary, depending on the significance an individual assigns to internalizing another's beliefs or identifying with them. Given the concerns expressed over the subjective norm operationalization used in TAM studies and subsequent equivocal findings in other work that employs it (e.g., Davis et al. 1989; Taylor and

Todd 1995b), we thus adopt an expectancy formulation of social influence that is slightly different from the subjective norm operationalization used in the TAM tradition. Consistent with other work, however, we suggest that this form of social influence will amplify an individual's beliefs about the usefulness of an information technology. However, no such relationship is expected between social influence and ease of use beliefs. Thus, we propose that:

*H3: Perceived social influence from referent others has a significant positive influence on individual beliefs about the usefulness of the technology.*

### Sources of Influence: Individual Factors

The final and most proximate influence on an individual's cognitive interpretations of information technology is factors related to the individual. Although prior research has tested the influence of numerous individual factors on technology acceptance outcomes (e.g., Agarwal and Prasad 1999), two constructs that have received consistent support as important predictors are computer self-efficacy and personal innovativeness with technology. Self-efficacy has its theoretical roots in Bandura's (1977) social cognitive theory, which posits that by watching others perform a behavior, an individual's perception of his own ability to perform the behavior, or self-efficacy, is influenced as well as the outcomes that he or she expects to occur. Bandura defines efficacy expectation as the conviction that one can successfully execute the behavior required to produce a desired outcome. In subsequent work, IS researchers have found that self-efficacy tailored to a computer/information technology context is an important determinant of a variety of user perceptions of technologies. For instance, in a study of the relative merits of different training approaches, Compeau and Higgins (1995) argued that self-efficacy influences outcome expectations, which they subsequently found to comprise of two distinct constructs: performance outcomes, including items very similar to those found in perceived

usefulness, and personal outcomes, relating to an individual's expectations of an enhanced status within the organization (i.e., image.) Venkatesh and Davis (1996) and Agarwal et al. (2000) posited and found empirical support for a significant relationship between general computer self-efficacy beliefs and perceptions about the ease of use of a specific technology.

Personal innovativeness represents the degree to which an individual is willing to try out any new information technology (Agarwal and Prasad 1998). Prior conceptualizations of this construct (Rogers 1995; Rogers and Shoemaker 1971) have defined it as the time at which an individual adopts an innovation during the diffusion process. Thus, individuals are characterized as *innovative* if they are early to adopt an innovation (Agarwal and Prasad 1998). In a reconceptualization of personal innovativeness, Agarwal and Prasad point out that in order to predict individual behavior toward an innovation, the construct must be domain specific as opposed to global in nature. They treat personal innovativeness in the domain of information technology as an individual propensity that, in general, is associated with more positive beliefs about technology use. Drawing upon Rogers' theory of the diffusion of innovations, they argue that individuals develop beliefs about new technologies by synthesizing information from a variety of channels, including mass media and interpersonal channels. For the same exposure to different types of channels, individuals with higher personal innovativeness are expected to develop more positive beliefs about the target technology.

Based on the studies cited above, coupled with the predominant findings from previous theoretical and empirical research, which suggest that individual characteristics influence information system usage via their effects on beliefs (Agarwal and Prasad 1999), we hypothesize that:

*H4a: Computer self-efficacy has a significant positive influence on individual beliefs about the usefulness of a technology.*

*H4b: Personal innovativeness in the domain of information technology has a significant positive influence on individual beliefs about the usefulness of a technology.*

*H4c: Computer self-efficacy has a significant positive influence on individual beliefs about the ease of use of a technology.*

*H4d: Personal innovativeness in the domain of information technology has a significant positive influence on individual beliefs about the ease of use of a technology.*

In summary, drawing upon multiple theoretical frames, we conceptualize the formation of beliefs about technology use as being driven by three core sets of antecedent factors: those emanating from the institutional environment, a set of social influences, and a set of characteristics internal to the individual. Moreover, we posit that the effects of these factors are not symmetric in that certain factors influence certain beliefs and not others. Empirical tests of the hypotheses are described next.

## Methods and Results

### Study Context and Sample

The hypotheses described in the preceding section were tested in the context of the adoption and use of Internet technologies by faculty and instructors in their teaching activities at a large, public university in the United States. The university setting was selected because it provides an autonomous, decentralized environment where knowledge workers comprise the bulk of organizational personnel. Further, multiple sources of influence are likely to manifest themselves on an individual's interpretations about use of Internet technology for teaching, ranging from the strategic direction of the university as espoused and communicated by senior administration officials, to

influence exercised by the immediate social circle of an individual faculty member, to messages emanating from the peer group comprised of external colleagues.

The state research university selected for this study has approximately 31,000 graduate and undergraduate students and 1,600 faculty. About 1,000 faculty members are full-time instructors. Specifically, they receive appointments to teach one or more courses for at least nine months per year. In the recent past, like many other such institutions, the university took notice of the multitude of operational and strategic benefits arising from the use of the Web to support teaching activities. As a result, several university-wide initiatives aimed at increasing the use of the technology among members of the faculty were undertaken: (1) the awarding of Web technology use grants, (2) the inclusion of Web-based course listings on the university's Web site, and (3) the introduction of a course Web site development tool.

For the study purposes, all full-time instructional faculty members from all departments at the university were included in the target sample. Excluded were faculty who did not teach full-time (e.g., adjunct, instructors) and those who held purely administrative positions (e.g., dean, provost, etc.). This was done in order to gather data only from individuals who were commonly influenced by the institutional and social factors in existence in the organization.

A total of 1,121 academic faculty members across a variety of academic disciplines were invited to participate in the survey, which was delivered in paper form via campus mail. They were reminded about the prevailing interest of the university administration in encouraging greater use of the Internet for teaching and told that the objective of our study was to understand their beliefs about the use of Internet technologies in their teaching activities. Of these, 229 responses were received, 226 of which were completed questionnaires (three respondents hand-wrote that they were on academic leave and returned the survey without completing it.) An additional three respondents



were discovered to be on academic leave, resulting in a total of six respondents who did not teach a course at the university during the spring. Since the sampling frame should have been comprised of only active, instructional faculty from the spring semester of that year, these were deleted from the data set. Of the 223 remaining responses, 161 had complete responses for a majority of the constructs and hence this set comprised the final sample used for data analysis, yielding an effective response rate of 14 percent.

### **Construct Operationalization**

The constructs in the research model were operationalized through items validated in prior research studies. The instrument was pilot-tested to ensure that the respondents in this study would properly interpret the items. The pilot questionnaire was tested on a total of 132 full-time faculty members from 52 departments across 14 academic units. Based on the results of the pilot, revisions and additions were made to the instrument. Pilot participants were included in the main data gathering effort since they were part of the population of interest; the main data collection was done almost 11 months after the pilot, thereby ensuring that their recollections would be fuzzy, at best. Final scales and items are listed in Appendix A.

The five-item usefulness scale and the four-item ease of use scale were derived from the work of Davis (1989) and Moore and Benbasat (1991). Managerial commitment and support at the level of the university as well as at the level of the department were measured using five items each based on a modification of the scales described by Leonard-Barton and DesChamps (1988) and Trevino and Webster (1992). The multiple potential sources of social influence on an individual faculty member's beliefs about the technology (*viz.*, departmental peers, informal groups, professional peers, department chairs, and deans) were assessed using an expectancy formulation with a pair of items for each source that were multiplied to yield the final social influence score for each referent. One item tapped into the extent

to which the referent other would view use of the target technology favorably (e.g., "People in informal groups to which I belong think using a course Web site is valuable for teaching"), while the second measured the respondent's motivation to comply with the wishes of the referent other (e.g., "The opinions of the people in informal groups to which I belong are important to me"). Such an expectancy formulation of social influence is a widely accepted operationalization for this construct (e.g., Ajzen and Fishbein 1980; Taylor and Todd 1995b). Finally, the two individual factors of self-efficacy and personal innovativeness with IT were operationalized using the rigorously developed and validated scales described by Agarwal and Prasad (1998) and Compeau and Higgins (1995).

### **Data Analysis and Results**

The sample of 161 respondents in this study came from a wide variety of academic departments, with a total of 48 unique departments represented. Approximately two-thirds (64.6 percent) had tenure in their respective academic areas. Women represented 14 percent of the respondents. The majority of respondents (94 percent) had knowledge of at least one of the three university initiatives aimed at diffusing Web technology for teaching, while 14 percent were aware of all three programs.

PLS, a latent structural equations modeling technique, was utilized to test the posited research hypotheses. PLS uses a component-based approach to estimation that places minimal demands on sample size and residual distributions (Chin 1998). It also permits simultaneous analysis of both the measurement model and the structural model. Descriptive statistics for the research constructs are shown in Table 1.

Recall that all the scales were derived from previously developed and validated measures. Psychometric properties of these scales were assessed via item loadings, discriminant validity, and internal consistency. Acceptable item loadings and internal consistencies are those that

**Table 1. Descriptive Statistics**

	Valid N	Mean	Std. Deviation
USEFUL	155	4.02	1.191
EASEUSE	150	4.13	1.089
MCDEP	153	4.11	1.317
MCUNV	155	4.95	1.007
Social Influence: Organizational peers	157	23.64	9.455
Social Influence: Informal circle	159	24.91	8.814
Social Influence: Professional peers	160	25.12	8.775
Social Influence: Supervisor	158	27.27	10.459
Social Influence: Senior leader	155	24.83	9.981
SE	158	6.79	2.213
PIIT	155	4.84	1.156

Notes: USEFUL = usefulness, EASEUSE = ease of use, MCDEP = local managerial commitment and support, MCUNV = top management commitment and support, SE = self-efficacy, PIIT = personal innovativeness with IT

are .70 or higher (Fornell and Bookstein 1981). The results of the confirmatory factor analysis (Table 2) and the composite reliability scores (Table 3) show that the scales used in this study largely meet those requirements. The only exceptions are the second personal innovativeness item and the fourth top management support item. However, since neither item loads highly on any of the other constructs, and the loadings themselves are very close to the recommended cut-off (.69 and .67, respectively) they raise no concerns about discriminant validity. Discriminant validity is determined by whether the indicators load more strongly on their corresponding construct than on other constructs in the research model (Chin 1998) and whether the square root of the average variance extracted (AVE) is larger than the inter-construct correlations. As shown in the CFA results in Table 2, all indicators load more highly on their own construct than on others. Further-

more, as evidenced by comparing the inter-construct correlations and AVE (shared leading diagonal) in Table 3, all constructs share more variance with their indicators than with other constructs. Finally, the composite reliability scores of all multi-item constructs indicate good internal consistency. The scores range from .84 for ease of use to .95 for local managerial commitment.

Figure 3 shows the path coefficients and explained variance for the proposed structural model. In the analysis, paths hypothesized as significant as well as those argued to be non significant were included. For ease of exposition, only significant relationships are shown. Ease of use did not exhibit a significant influence on perceived usefulness. However, the individual factor of personal innovativeness and institutional factor of top management commitment had significant relationships with perceived usefulness.

**Table 2. Results of Factor Analysis**

	UF	EO	TC	LC	SIDEP	SIINF	SIPRO	SIDN	SICHR	SE	PI
U1	.84	.43	.33	.33	.37	.34	.38	.30	.38	.09	.34
U2	.88	.42	.35	.31	.38	.36	.44	.41	.41	.18	.56
U3	.82	.45	.34	.22	.27	.35	.37	.24	.30	.08	.35
U4	.86	.50	.36	.36	.47	.38	.49	.39	.47	.18	.52
U5	.85	.38	.30	.29	.31	.29	.36	.32	.35	.24	.48
EOU1	.38	.74	.35	.35	.27	.23	.27	.28	.33	.41	.46
EOU2	.24	.72	.11	.03	.17	.12	.08	.05	.12	.25	.27
EOU3	.50	.80	.29	.20	.32	.23	.28	.30	.33	.19	.26
EOU4	.44	.77	.26	.32	.25	.26	.20	.12	.25	.23	.47
MCUNV1	.23	.21	.87	.43	.20	.07	.23	.24	.29	.09	-.00
MCUNV2	.33	.40	.78	.45	.33	.20	.33	.29	.34	-.01	.01
MCUNV3	.20	.18	.88	.39	.20	.12	.24	.20	.26	.06	.03
MCUNV4	.38	.25	.69	.53	.32	.18	.25	.26	.32	-.05	.15
MCUNV5	.45	.29	.74	.46	.33	.27	.35	.34	.46	.11	.28
MCDEP1	.23	.19	.48	.92	.52	.32	.32	.47	.63	-.04	.09
MCDEP2	.34	.32	.55	.93	.50	.29	.31	.44	.65	-.03	.08
MCDEP3	.22	.21	.42	.86	.50	.33	.30	.43	.62	.01	.13
MCDEP4	.42	.34	.52	.83	.47	.31	.31	.44	.58	-.05	.18
MCDEP5	.35	.27	.48	.89	.54	.33	.33	.45	.70	-.02	.15
SI_DEP	.42	.33	.35	.58	1.00	.62	.70	.65	.76	.08	.26
SI_INF	.40	.28	.21	.37	.62	1.00	.71	.49	.53	.06	.37
SI_PRO	.48	.28	.35	.35	.69	.71	1.00	.58	.58	.05	.33
SI_DN	.39	.26	.35	.52	.66	.50	.59	1.00	.69	.15	.33
SI_CHR	.44	.34	.41	.72	.75	.52	.59	.68	1.00	.16	.28
SE1	.14	.32	-.05	-.14	-.08	-.05	-.09	.06	.01	.81	.47
SE2	.17	.37	.02	-.12	-.04	-.06	-.01	.12	.07	.80	.43
SE3	.09	.30	.02	-.05	.02	-.07	-.03	.08	.10	.83	.37
SE4	.16	.33	.04	-.00	.04	.03	.03	.11	.16	.86	.39
SE5	.17	.21	.04	-.04	.08	.07	.06	.09	.08	.75	.34
SE6	.15	.21	.06	.02	.11	.09	.07	.12	.14	.80	.32
SE7	.11	.30	.11	.07	.13	.12	.11	.18	.20	.82	.43
SE8	.25	.27	.05	-.07	.06	.06	.07	.14	.11	.79	.47
SE9	.12	.25	.07	-.00	.16	.14	.16	.13	.16	.74	.31
SE10	.10	.24	.07	.08	.13	.13	.08	.17	.23	.81	.35
PI1	.50	.39	.09	.19	.31	.35	.34	.34	.31	.35	.88
PI2	.34	.45	.12	-.02	.05	.27	.22	.18	.12	.41	.67
PI3R	.35	.32	.04	.09	.11	.25	.17	.21	.15	.43	.83
PI4	.54	.44	.12	.17	.34	.36	.35	.34	.31	.43	.92

UF = Usefulness; EO = Ease of Use; TC = Top Management Commitment and Support; LC = Local Managerial Commitment and Support; SIDEP = Social Influence – department; SIINF = Social Influence – informal; SIPRO = Social Influence – professional; SIDN = Social Influence – dean; SICHR = Social Influence – department chair; SE = Self-Efficacy; PI = Personal Innovativeness with IT

**Table 3. Inter-Construct Correlations**

	Reliability	UF	EO	TC	LC	SIDEP	SIINF	SIPRO	SIDN	SICHR	SE	PI
UF	0.93	.85										
EO	0.84	.51	.75									
TC	0.90	.38	.33	.79								
LC	0.95	.35	.30	.56	.88							
SIDEP	1.00	.42	.33	.34	.57	1.00						
SIINF	1.00	.40	.28	.20	.36	.62	1.00					
SIPRO	1.00	.48	.28	.35	.35	.69	.71	1.00				
SIDN	1.00	.39	.25	.33	.50	.65	.49	.58	1.00			
SICHR	1.00	.44	.34	.41	.71	.75	.52	.58	.67	1.00		
SE	0.95	.18	.35	.05	-.03	.08	.06	.05	.15	.16	.80	
PI	0.90	.53	.48	.11	.14	.26	.37	.33	.33	.27	.48	.83

Notes:

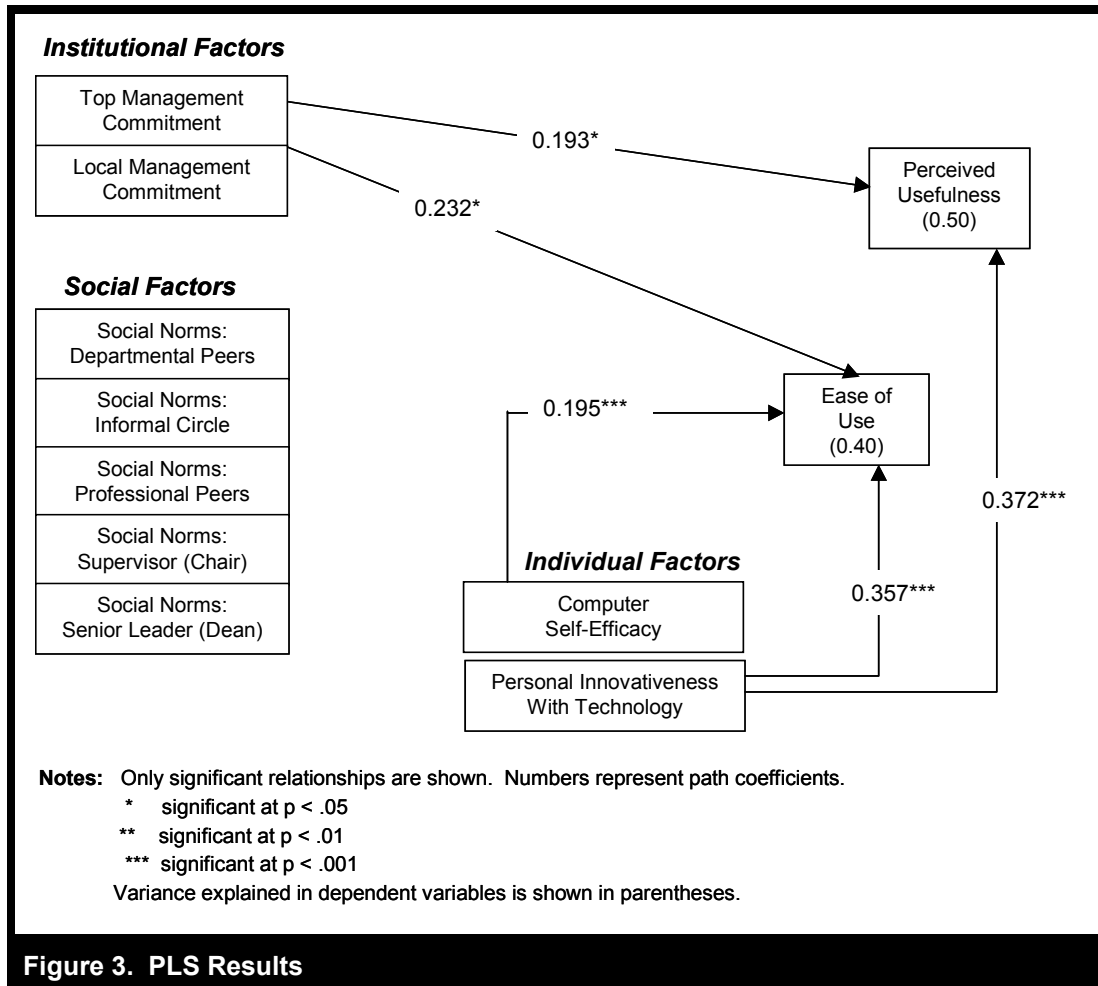
1. Composite Reliability =  $\rho_c = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + \sum \text{var}(\epsilon_i)]$  where  $\lambda_i$  is the component loading to an indicator and  $\text{var}(\epsilon_i) = 1 - \lambda_i^2$
2. Shaded numbers on the leading diagonal are the square root of the variance shared between the constructs and their measures.
3. Off diagonal elements are correlations among constructs.
4. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

Together these predictors explained 50 percent of the variance in usefulness. Significant determinants of ease of use included top management commitment and support, and both the individual factors of computer self-efficacy and personal innovativeness. These predictors collectively accounted for 40 percent of the variance in the dependent variable.

## Discussion

While the empirical results of the study provide some support for the overall structure posited in the research model, they also reveal some unexpected relationships that are opposite to what was hypothesized (Table 4). Additionally, they provide insights into what influences specific beliefs about the target technology. Arguably, the broad conceptual frame proposed here that incorporates multiple sources of influence as drivers of individual beliefs about technology use,

finds empirical support. The fact that usefulness beliefs were not influenced by ease of use perceptions suggests that, for this sample, the cognitive resources released by an easy to use technology are not important to individuals' assessments of instrumental outcomes. One explanation for this unexpected finding is that the technology is perceived to be inherently easy to use, thereby diminishing the level of resources it releases, and rendering the effects of ease of use on usefulness as nonsignificant. However, given that the mean value for ease of use for the sample was approximately at the mid-point of the scale, this explanation is not supported by the data. Another possible explanation is that the respondents in the sample were relatively inexperienced in use of the technology. Several studies have suggested that an individual's level of experience with the focal technology can influence the strength of relationships in the TAM model (Davis, et al. 1989; Taylor and Todd 1995b); thus it may be that experience moderates the relationship between ease of use and usefulness.



**Figure 3. PLS Results**

The institutional factor of top management commitment exhibited an expected positive influence on usefulness beliefs. However, contrary to expectations and surprisingly, we discovered a significant relationship between top management commitment and ease of use. The significance of this relationship likely arises from the individual's assessment of the resource allocation implications of top management commitment and support. Such support might help overcome obstacles in learning to use the technology through the availability of assistance. In essence, a plausible explanation for this finding is that the individual believes that if management is committed to the use of the technology, it will "pave the way" for making technology easy to use.

Among the five sources of social influence examined here, as posited, none were significantly related to ease of use beliefs.<sup>2</sup> Unexpectedly, none exhibited significant effects on usefulness beliefs. However, prior research also has found mixed support for social influence (e.g., Karahanna et al. 1999). Although, at first, the finding of non-significance appears puzzling, there is a plausible explanation. As noted earlier, university

<sup>2</sup>This finding should be interpreted with caution, however. Power analysis revealed that to achieve a conventional power level of 0.8 (Cohen 1988), a sample size of 687 would be required. Future research is needed to provide a more rigorous examination of these relationships.

<b>Table 4. Summary of Results</b>			
<b>Hypothesis</b>	<b>Statement of Relationship</b>	<b>Result</b>	<b>Comments</b>
H1	Beliefs about the ease of use of a technology have a significant positive influence on beliefs about the usefulness of the technology.	Not Supported	This result is not consistent with the findings of most other previous investigations of the TAM model.
H2	Perceived top and local management support for the use of a technology has a significant positive influence on individual beliefs about the usefulness of that technology.	Partially supported	Top management commitment enhanced usefulness beliefs. Surprisingly, it also had a positive influence on ease of use beliefs.
H3	Perceived social influence from referent others in support of the use of a technology has a significant positive influence on individual beliefs about the usefulness of that technology.	Supported	None of the five sources of social influence influenced usefulness beliefs.
H4	Computer self-efficacy and personal innovativeness towards a technology have a significant positive influence on individual beliefs about the usefulness and ease of use of that technology.	Partially supported	Personal innovativeness with information technology has a positive influence on beliefs about the ease of use and usefulness of the technology. Computer self-efficacy had a significant influence only on ease of use beliefs.

faculty members have long been recognized for their autonomy and university environments have diminished roles for the traditional hierarchical structures and governance arrangements that characterize bureaucratic organizations. Indeed, independence and democracy are the two most salient defining characteristics of faculty work in an academic institution. It is not surprising, therefore, that messages emanating from the referent group of the academic dean and the department chair were not significant in shaping individual beliefs about technology use. Further, even though the university encouraged the use of the

Internet in teaching, individual decisions about the nature and extent of use were voluntary in nature. Therefore, in such voluntary use contexts, the opinions of a senior leader may not have a significant influence on individual beliefs about the use of the technology. Faculty members value their autonomy and possibly view the hierarchical relationship between themselves and the department chair, and themselves and the dean, as an administrative necessity rather than an authoritative reporting structure. Thus, their opinions about the technology are not salient in determining the individual's beliefs about technology use.

Likewise, the self-governance that characterizes academic life possibly tempers the influence exerted on faculty by the opinions of their professional peers as well as their departmental peers in regard to the use of technology for teaching activities. Finally, one plausible explanation for the non-significance of influence emanating from the informal circle rests in the nature of the technology and task context examined here. Data collection was anchored to the use of the Web in teaching activities, which is a core component of a respondent's work requirements but has little to do with their life outside the workplace. Thus, it is feasible that any messages supportive of technology use from this referent source either did not exist or, even if they did exist, had little influence on how the individual perceived the technology in the context of her work because of the potential lack of credibility associated with such messages.

Among the individual characteristics, as expected, personal innovativeness with IT exhibited strong effects on the posited consequences of perceived usefulness and perceived ease of use, whereas computer self-efficacy had a significant effect on ease of use alone. The fact that computer self-efficacy did not affect perceived usefulness is inconsistent with the empirical results of Compeau and Higgins (1995). It appears that for this sample, perceived instrumental outcomes associated with technology use are not influenced by individual judgments of their ability to engage in technology use. A speculative explanation is offered here: the usefulness of this technology and the intended use to which the study was anchored was readily apparent to the sample. Arguably there has been much media coverage and discussion associated with the use of the Internet and the benefits of such use for a variety of activities in business and academic environments. This may have rendered the effects of self-perceptions of ability on usefulness beliefs as irrelevant.

Prior to discussing the implications of these findings, certain limitations inherent in the study need to be acknowledged. The research design was cross-sectional in nature, thereby limiting the

extent to which causality can be inferred from the findings. We used a single method, a survey, and a single set of respondents to assess predictors and consequences in the research model. Thus, the potential for common method variance exists. We had a response rate of 14 percent, which, while not atypical of mail surveys, is less than ideal. We did not have access to a profile of the entire sampling frame, which limited our ability to test for nonresponse bias and must be kept in mind while interpreting findings. Nevertheless, the distribution of responses across a broad set of academic departments, and the fact that the sample includes both tenured and non-tenured faculty mitigates this issue somewhat. We were unable to determine reliability scores for the single item measures used for social influence. Finally, there is the issue of external validity of the study. To the extent that use of the Web for teaching by university faculty represents a unique context and sample, our findings may not generalize to other contexts and samples. However, to the extent that the task examined here is a consequential, work-related activity, and the sample exists in the type of decentralized, democratic, and autonomous work environment that businesses are actively seeking to nurture (Mohrman et al. 1998), we believe that the findings have broader applicability.

## Implications and Conclusion ■

The research presented here was motivated by the recognition that information technology is increasingly becoming a core component of organizational work, and managers and researchers alike need to better understand what drives individual behaviors toward such technologies. Arguing that individuals make adoption and usage decisions within rich, complex organizational and social contexts, we sought to offer a holistic perspective on the factors that influence an individual's cognitive beliefs about IT use. To this end, we examined the simultaneous effects of three critical sets of factors: institutional, social, and individual in the context of a single empirical study focused on the use of a contemporary

technology by autonomous knowledge workers. The theoretical rationale for these factors drew upon multiple streams of research including institutional theory, technology acceptance models, social influence models, and cognitive psychology.

Several theoretical and practical implications follow. From the perspective of theory advancement, we provide additional evidence regarding salient predictors of key beliefs in technology acceptance. Our posited predictors explained between 40 percent and 50 percent of the variance in beliefs, suggesting that the model serves as an adequate conceptualization of the phenomenon of interest. Researchers have long suggested that institutional factors are important in technology use behaviors, but limited work has specifically examined the effects of these factors on beliefs. Similarly, aside from the work of Venkatesh and Davis (2000), the influence of social factors has generally been studied in the context of dependent variables such as usage intentions and actual usage rather than on beliefs. Given that there is sufficient evidence regarding the mediating role played by beliefs (e.g., Agarwal and Prasad 1999), researchers need to pay careful attention to the placement of constructs such as institutional forces and social influence in their theoretical models.

Our findings help sift out and provide initial insights into the relative effects of these predictors on the target beliefs. We posited and confirmed that the effects of all factors are not invariant across beliefs. Institutional influences were most salient for instrumental outcomes, and individual factors, in contrast, were significant antecedents of both usefulness and ease of use. Finally, the non-significance of social influences in this study is an interesting finding. It is possible that social influences manifest effects through beliefs not specifically examined in this work, such as image. Indeed, Venkatesh and Davis (2000) found a significant relationship between subjective norm and image beliefs. This merits further examination: it may be the case that certain *external* variables exhibit their effects on perceived usefulness only indirectly via their effects on other beliefs. If this conjecture finds support in other work, it may

have important implications for the types of beliefs that managers should seek to develop first.

From a pragmatic perspective, it is evident that the institutional context for technology use is a critical predictor of individual behavior toward information technologies, via its effects on the mediating construct of beliefs. Our findings suggest that managers need to focus careful attention on exhibiting commitment to a new technology for contingent adoption decisions. Unless individuals perceive the power elite within the organization as strongly behind the use of a new technology through the messages conveyed as well as overt and specific resource provisioning actions, they are unlikely to develop positive beliefs about the usefulness of that technology. Managerial commitment and support serves the key role of providing structures for the signification and legitimization of technology use. As observed by others (e.g., Compeau and Higgins 1995), it is important for technology implementers to assist individuals in developing positive perceptions about their ability to use the new technology. Finally, as suggested by Agarwal and Prasad (1998), individuals who are personally more innovative in the use of information technology could be utilized as important change agents because they are likely to exhibit positive beliefs about technology use.

Several areas remain for future research. Although the measures used in this study exhibited adequate psychometric properties, conceptually there are some overlaps between institutional factors and social influences, particularly when the latter emanates from supervisors. Thus, it would be useful in future research to develop measures that more accurately discern between the distal and proximate nature of institutional and social influences, respectively. Researchers may also consider postulating and empirically testing the existence of causal relationships among the belief drivers. For instance, one could ask if institutional influences operate through social influences, rather than directly.

We examined the posited model within the context of a single technology and research site. Testing



the robustness of these relationships across multiple workplace contexts and technologies would be a fruitful area for research. For instance, the nonsignificance of social influence was attributed to the nature of the work environment, which we characterized as valuing autonomy and democracy. This is consistent with the idea that in positions with high autonomy, job outcomes depend increasingly on the individual's own efforts, initiatives, and decisions rather than on the adequacy of instructions from the boss or on a manual of job procedures (Hackman and Oldham 1976). It may be the case that variables such as workplace autonomy need to be included as potential moderators of the relationship between social influences and other constructs. As autonomy increases and the workplace becomes less hierarchical, the effects of social pressures from referent others, particularly senior leaders, might diminish.

As noted earlier, some research (e.g., Taylor and Todd 1995a) has suggested that experience moderates the relationships embedded in technology acceptance models such as TAM and TPB. Our data were collected at a fairly early stage of the organizational life cycle of the target technology, i.e., at a point in time when the technology was still relatively new to the sampling frame, and the findings therefore apply to early adoption rather than continued use scenarios. An interesting question to examine next would be the extent to which experience moderates the effects of the posited belief antecedents. Finally, the intriguing non-significance of computer self-efficacy for perceived instrumental outcomes raises some interesting questions. It is possible that as we move deeper into the information age, individuals are becoming increasingly more socialized with information technology and information technology itself is becoming more ubiquitous both in and out of the workplace. Thus, it might be the case that the relevance of self-efficacy as an important variable in explaining personal and performance outcomes will gradually erode over time. This speculation merits a closer look.

In conclusion, the primary contribution of this work is two-fold. First, we extended prior research in

information technology acceptance by offering a conceptual model of the drivers of beliefs that synthesized multiple theoretical perspectives. The focus of this integration was on the complexities of the organizational and social context within which individuals with varying characteristics form these beliefs. Second, we tested the effects of these drivers within the context of a single empirical study. Field data provided support for the theoretical relationships, and allowed us to make several theoretical and practical recommendations. These results will help refine our understanding of individual behaviors toward information technology as it continues to pervade organizations at an accelerating rate.

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## Appendix A

### Scales and Items

#### Perceived usefulness

1. Using a course Web site enables me to accomplish my teaching tasks more quickly.
2. Using a course Web site improves the quality of my teaching.
3. Using a course Web site makes teaching easier.
4. Using a course Web site enhances my teaching effectiveness.
5. Using a course Web site gives me greater control over my teaching.

#### Perceived ease of use

1. My interaction with a course Web site to support my teaching is clear and understandable.
2. When using a course Web site to support my teaching, it is easy to get the software tools that I use to do what I want them to do.
3. Overall, I believe that it is easy to use a course Web site to support my teaching.
4. Learning to use a course Web site to support my teaching is easy for me.

#### Top management commitment

1. The University is committed to a vision of using course Web sites in teaching.
2. The University is committed to supporting my efforts in using course Web sites for teaching.
3. The University strongly encourages the use of course Web sites for teaching.
4. The University will recognize my efforts in using course Web sites for teaching.
5. The use of course Web sites for teaching is important to the University.

**Local management commitment**

1. My department is committed to a vision of using course Web sites in teaching.
2. My department is committed to supporting my efforts in using course Web sites for teaching.
3. My department strongly encourages the use of course Web sites for teaching.
4. My department will recognize my efforts in using course Web sites for teaching.
5. The use of course Web sites for teaching is important to my Department.

**Social norms**

**Organizational peers**

1. My departmental faculty colleagues think that using a course Web site is valuable for teaching.
2. The opinions of my departmental faculty colleagues are important to me.

**Informal circle**

**When responding to the following two statements, consider the people you interact with on an informal basis as friends both at and away from work.**

1. People in informal groups to which I belong think using a course Web site is valuable for teaching.
2. The opinions of the people in informal groups to which I belong are important to me.

**Professional peers**

**When responding to the following two statements, consider the people outside your department who you would interact with as colleagues on a formal basis.**

1. People in my academic discipline think that using a course Web site is valuable for teaching.
2. The opinions of the people in my academic discipline are important to me.

**Supervisor**

1. My department chair thinks that using a course Web site is valuable for teaching.
2. The opinions of my department chair are important to me.

**Senior Leader**

1. My dean thinks that using a course Web site is valuable for teaching.
2. The opinions of my dean are important to me.

**Personal innovativeness with technology**

1. If I heard about a new information technology, I would look for ways to experiment with it
2. Among my peers, I am usually the first to try out new information technologies.
3. In general, I am hesitant to try out new information technologies.
4. I like to experiment with new information technologies.

**Computer self efficacy**

Often in our jobs we are told about software packages that are available to make work easier. For the following questions, imagine that you were given a new software package for some aspect of your work. It doesn't matter specifically what this software package does, only that it is intended to make your job easier and that you have never used it before.

The following questions ask you to indicate whether you could use this unfamiliar software package under a variety of conditions. For each of the conditions, please indicate whether you think you would be able to complete the job using the software package. Then, for each condition that you answered "yes," please rate your confidence about your first judgment by circling a number from 1 to 10, where 1 indicates "Not at all confident," 5 indicates "Moderately confident," and 10 indicates "Totally confident."

1	2	3	4	5	6	7	8	9	10
<b>Not at all confident</b>			<b>Moderately confident</b>				<b>Totally confident</b>		

I COULD COMPLETE THE JOB USING THE SOFTWARE PACKAGE...

- |                                                                                       |          |   |   |   |   |   |   |   |   |   |    |
|---------------------------------------------------------------------------------------|----------|---|---|---|---|---|---|---|---|---|----|
| 1. ...if there was no one around to tell me what to do as I go.                       | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 2. ...if I had never used a package like it before.                                   | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 3. ...if I had only the software manuals for reference.                               | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 4. ...if I had seen someone else using it before trying it myself.                    | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 5. ...if I could call someone for help if I got stuck.                                | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 6. f someone else had helped me get started.                                          | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 7. ...if I had a lot of time to complete the job for which the software was provided. | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 8. ...if I had just the built-in help facility for assistance.                        | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 9. ...if someone showed me how to do it first.                                        | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |
| 10. ...if I had used similar packages before this one to do the same job.             | YES..... | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|                                                                                       | NO       |   |   |   |   |   |   |   |   |   |    |

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