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SUPPORTING THE USE OF TECHNOLOGY IN ORGANIZATIONS OVER TIME

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ABSTRACT

In the current research, I introduce a multidimensional construct, system support climate (SSC), and predict that different dimensions of this construct are more or less influential across different stages of the lifespan of a technology in the workplace. Specifically, I seek to address the following: (1) What are the dimensions of SSC that are important to technology acceptance? (2) Do these dimensions predict technology use differentially over time? If so, when are the various dimensions most influential? (3) What are some of the boundary conditions for predicting technology use based on the levels of SSC?

To address these questions, I extrapolate the dimensions of SSC based on a review of past empirical research. I then map these dimensions onto a stage model representing the lifespan of the technology in the organization. Finally, I present preliminary evidence regarding the efficacy of this stage model based on pilot studies and a survey of course management system users across multiple universities.

The results of this research not only extend our scientific understanding of relationships between organizational climate and technology use, but also point to some practical recommendations for organizational leaders seeking to better invest their scarce resources to bolster technology acceptance. Limitations of the current study and recommendations for future research are discussed.

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Thank you to friends and family that helped me on this long and challenging journey. Thank you to Penn State I/O for the opportunity to learn, first hand, many lessons about the process of research. Through this endeavor, I learned that research takes a great deal of time and necessitates great attention to detail. There is a need to track decisions in the design and implementation of research as a programmer might track design rationale while developing a system as a development and research tool (Haynes, Bach, & Carroll, 2008). Unfortunately, I also learned that the bureaucratic structure of research universities does not always facilitate the research process despite the organizational mission to conduct quality research. As practical roadblocks were encountered, compromises in the original study design were made. Some small changes had dramatic effects on results. For example, different sample recruitment strategies yielded large variations in sample size. In sum, I learned first-hand that research reflects a difficult balancing act between rigor and comprehensiveness on one hand and practicality on the other.

Chapter 1

Introduction

The current research introduces the concept of system support climate (SSC), and discusses how different dimensions are likely to be more or less influential across different stages in the lifespan of a technology in the workplace. Climate within organizations reflects expectancies that develop as individuals perceive, attach meaning to, and interpret the environment within which they work (Hofmann & Stetzer, 1998; Schneider & Reichers, 1983). Early research has shown that these perceptions influence the attitudes and behavior (Litwin & Stringer, 1968) by indicating what is expected and rewarded in the organization (Schneider, 1987). This research focused on investigating aspects of climate that lead to increased acceptance and use of technology by individuals. Specifically, this research seeks to answer the following: (1) What are the dimensions of SSC that are important to technology acceptance? (2) Do dimensions of SSC predict technology use differentially across time? If so, when are the various dimensions most influential? (3) What boundary conditions moderate the prediction of technology use based on levels of SSC?

System support climate (SSC) reflects individuals' perceptions of the degree to which an organization provides *user-centered* support and encouragement for technology use. The term *user-centered,* here, stems from the design philosophy of User-Centered Design (UCD), wherein the needs, wants, and limitations of the end user are given priority at each stage in the design process (Norman & Draper, 1986). Similarly, I argue that a user-centered approach toward understanding and building a supportive climate for technology use at each stage of the technology's entry and lifespan in the organization is necessary for ultimately achieving consistent, successful and prolonged use of that technology.

Why is the current study important? Technology and innovation are almost ubiquitous in organizations today. Worldwide expenditures for IT topped 3 trillion in 2007 (Brodkin, 2007). However, evidence suggests the majority of IT investments fail or fall short of their promise (Clegg et al., 1996; James, 1997; Robertson, Roberts, & Porras, 1993) largely as the result of a lack of consideration for the human and organizational issues impacting technology use (Anton, Petouhoff, & Schwartz, 2003; Bikson, Gutek, & Mankin, 1981; Landauer, 1995; McDonagh & Coghlan, 1999). In contrast, technical problems have been found to account for a relatively small fraction, 7%, of IT-related failure (Isaac-Henry, 1997). Therefore, a strong need to examine the social and psychological factors affecting technology use in a way that can be readily transformed into practical recommendations for organizational leaders exists.

Although previous research in Information Science has pointed to the importance of certain social/organizational variables as facilitators or inhibitors of technology acceptance, the choice of variables in this research has been criticized as arbitrary (Legris, Ingham, & Collerette, 2003) and the dependent variable of interest varies from individual use and acceptance to organizational or even societal acceptance. For example, Rogers (1995) suggests the adoption of (i.e., decision to use) an innovation is determined by not only perceived attributes of the innovation but also variables related to the social system (e.g., norms, degree of network connectedness, etc.). The model has been applied most to explain adoption of various innovations in society rather than individual use in organizations. Other models include factors that might reflect climate dimensions, but do not explicitly define their elements. For example, Thompson, Higgins and Howell (1991) suggest that PC utilization (i.e., amount of usage of different system functionality) is determined, in part, by social factors and facilitating conditions. Thompson and Goodhue (1988) suggest user's perceptions of task-technology fit are influenced, in part, by system and services. These concepts could reflect a wide range of concepts. The current research is interested concretely explicating the climate variables that might affect use and acceptance.

For a brief review of some current models predicting technology acceptance (and other related outcomes), see Appendix A; a full review of all models and research supporting each is beyond the scope of this paper. Many of these models were theoretically derived (i.e., Davis, Bagozzi, & Warshaw, 1992); others are based on the experience and intuition of the authors (i.e., Grudin, 1994). The explanatory variables include a range of situational factors, technical characteristics and users' individual differences. In many cases, the situational variables included in these explanatory models are assumed to represent objective reality. The current work takes a different approach, focusing exclusively on users' perceptions of multiple facets of organizational climate supporting technology use.

Organizational climate provides a way to organize disparate situational variables into psychological terms. Recent research provides initial support for the influence of climate on technology use (Klein, Conn, & Sorra, 2001). This previous effort included a unidimensional construct predictive of technology use following implementation. The current research expands this understanding of climate for technology support by extrapolating the content of this construct while also addressing the need to incorporate time in our understanding of organizational research and theory (George & Jones, 2000; Mitchell & James, 2001; Zaheer, Albert, & Zaheer, 1999). In this way, the current approach provides a greater potential to contribute to practice by more precisely implicating prospective points of intervention for organizations.

The current paper is laid out in the following manner: I begin development of the content (i.e., dimensions) of SSC with a review of some previous empirical research on factors impacting technology acceptance. Based on research and theory in organizational behavior, I propose which of these dimensions of SSC are likely to be most influential during different stages of the development, implementation, and use of technology in the workplace. I then describe the methods used to gather content validity evidence for SSC and the stage model as well as preliminary survey evidence from users of course management systems. Results are presented and discussed in lieu of the research questions and related hypotheses. Lastly, I discuss implications and limitations of this research and offer suggestions for future research.

Chapter 2

Background

Organizational climate reflects expectancies and incentives that operate across situations and develop as individuals perceive, attach meaning to, and interpret the environment within which they work (Hofmann & Stetzer, 1998; Schneider & Reichers, 1983). Past research has not always distinguished organizational climate from organizational culture, perceived values that guide the beliefs and thinking of organizational members (Duncan, 1989; Smircich, 1983). Both organizational climate and culture involve perceptions of the work environment. However, climate focuses on perceptions of organizational policies, practices, and procedures that reflect culture, the organization's deeper, less malleable values and beliefs. Since climate is more proximal and easier to manipulate in comparison to culture (Ostroff, 1993), climate is the focus of the current study as it is more likely to reveal practical interventions for facilitating technology use.

In early research, climate was theorized at the organizational level of analysis (Argyris, 1958; Litwin & Stringer, 1968), but later researchers distinguished between individual and organizational conceptualizations of climate, labeling these as psychological and organizational climate respectively (James & Jones, 1974). Later, group- or unit-level conceptualizations were also recognized (Hellriegel & Slocum, 1974; Howe, 1977; Powell & Butterfield, 1978). According to Glick (1985), "Researchers concerned with individual perceptions focus on psychological climate, whereas organizational climate is investigated when organizational attributes are of interest" (p. 602). Since individual perceptions are of interest in the current study, I focus on psychological climate, although I may at times use the terms organizational and psychological climate interchangeably.

Early research suggests climate influences the attitudes, behavior, and performance of individuals in an organization (Litwin & Stringer, 1968). According to Schneider (1987), climate helps employees adapt their behavior by suggesting what is rewarded, supported, and expected. He suggests these influences can be clustered into sets (i.e., different types of climate) depending on the outcome variable of interest (Schneider, 1987). Research suggests these specific types of climate are related to subsequent, relative outcomes: safety climate has been related to safer working environments (Zohar, 1980); service climate has been related to customer satisfaction (Schneider & Bowen, 1985; Schneider, Parkington, & Buxton, 1980). Research has also demonstrated a relationship between implementation climate perceptions and technology use following implementation (Klein et al., 2001).

According to Klein and Sorra (1996), implementation climate is a unidimensional construct that reflects employees' perceptions of the extent to which their use of an innovation is supported and expected in their organization. They argue that climate for implementation, in part, leads to employees' skilled, consistent, and committed use of an innovation which allows the organization to realize other benefits such as increased efficiency (Klein & Sorra, 1996). Klein and colleagues (2001) also suggest that implementation climate is precipitated by organizational policies and practices related to implementation (e.g., availability of training). Although perceptions of organizational policies and practices did not predict implementation climate perceptions as expected in their empirical investigation, Klein and colleagues (2001) found support for the influence of implementation climate on technology use following implementation of manufacturing technology.

In contrast to Klein and colleagues' (1996, 2001) unidimensional approach, other researchers have presented organizational climate as a multidimensional construct (e.g., Schneider, 1985). Common dimensions of climate include: structure, responsibility, reward, risk, warmth, support, etc. (Ostroff, 1993). The argument for a unidimensional climate construct has centered largely on the idea of equifinality, the notion that policies and practices which predict implementation climate may combine in multiple ways to produce similar levels of implementation climate (Holahan, Aronson, Jurkat, & Schoorman, 2004; Klein et al., 2001). Although it is likely that different policies and practices contribute differentially to technology acceptance, conceptualizing the construct broadly offers little in the way of both understanding this variable in concrete terms and making practical recommendations for increasing the strength of climate perceptions. Furthermore, a multidimensional construct does not necessarily negate equifinality; it is possible for overall climate perceptions to be high due to moderate to high levels on multiple dimensions or extremely positive perceptions on a few dimensions at one time. Therefore, I argue that it reasonable to expect SSC be multifaceted. In the following chapter, I extrapolate the dimensions of SSC and propose how it influences technology use not only during implementation but across time.

Chapter 3

System Support Climate (SSC)

SSC represents environmental cues that influence technology acceptance. Specifically, SSC reflects *individuals' perceptions of the degree to which the organization and leaders within provide user-centered support and encouragement for technology use across the lifespan of the technology in the organization*. In the past, researchers have based initial climate content on a literature review of factors differentiating organizations or groups on some dependent variable of interest (Schneider & Gunnarson, 1991). For example, authors developed their initial version of the team climate inventory based on their review of organizational climate and work group literatures (Anderson & West, 1998). Similarly, I review previous empirical research on the Technology Acceptance Model (TAM) to develop the content of SSC. Appendix A provides a description and illustration of TAM.

Although a number of models predicting technology use or adoption exist (see Appendix A), I chose to focus on research investigating TAM as this model has a psychological background, predicts technology use rather than adoption, and has received strong empirical support across situations with different technologies, including e-mail and graphics (Davis, 1989), voice-mail and word processors (Adams, Nelson, & Todd, 1992; Chin & Todd, 1995), spreadsheets (Mathieson, 1991), database management systems (Szajna, 1994), the Internet (Chen, 2000; Fenech, 1998), and geographicalspatial systems (Chin & Gopal, 1995). Hu and colleagues suggest TAM accounts for approximately 40% of the variance in system use (Hu, Chau, Sheng, & Tam, 1999).

TAM has been recently up-dated to more formally include certain external variables like social norms. The inclusion of variables in the follow-up versions of TAM (Venkatesh & Davis, 2000; Venkatesh, Morris, Davis, & Davis, 2003) were largely based on an effort to combine theoretical perspectives rather than a comprehensive consideration of the variables examined empirically in previous research. Unfortunately, there has been relatively limited empirical research confirming the robustness of these extended models. Therefore, I focus on external factors examined using the original TAM for purposes of the current study, although I include the additional factors examined in extended models (i.e., TAM2; UTAUT) in the current review.

Since the choice of external factors studied in previous research has been criticized as arbitrary (Legris et al., 2003), I reviewed, then organized a list of external factors examined in past TAM research into categories based on organizational development literature, which describes organizations as a combination of *structure*, *people*, *tasks*, and *technology*-related factors (Leavitt, 1965). According to Leavitt (1965), *structure* represents an organization's methods of communication, systems of authority, workflow policies and procedures as well as social structures. For ease of interpretation, I relabeled this category: *organizational and social factors*. Leavitt (1965) defines *people* as the actors and that are performing and/or supporting work in the organization and their characteristics. Since the actors in the current study are defined (i.e., end-users), and it is primarily their attributes that are the focus of past technology acceptance research, I relabeled this category *individual differences*. Similarly, it is the characteristics of technology that have been the focus of TAM research and therefore, I label this category in keeping with existing work. A table summarizing this review appears in Appendix B.

Since SSC reflects perceptions of organizational policies, practices, and the social environment, I focus on the factors in the task and organizational/social factors categories from Appendix B to inform the content of this construct. I removed from consideration factors for which generalizability was limited. For example, developer responsiveness refers most to situations in which a system was custom developed rather than purchased off-the-shelf. I also combined some factors with conceptual similarities. For comprehensiveness, I also add perceived critical mass and user disparity (Grudin, 1994). In all, I propose 10 main factors of SSC based on my review of research. The following table (i.e., Table 1) provides definitions of these dimensions listed in no particular order.

Table 1. Dimensions of SSC

Dimension	Definition
Perceived Critical Mass	Perception that enough others are using the system to suggest it would be useful for one to do likewise.
Perceived Information Exchange	Perceived level of information presented regarding why the technology is being chosen and implemented, what benefits it may have for various members of the organization, as well as what procedures will be used to implement the system.
Perceived Evolutionary Development	Perception that the system will evolve over time; be debugged, enhanced etc. given feedback from users.
Perceived Job Relevance	The centrality of the tasks supported by the technology to one's job; perception that the tasks supported by the technology are routine, important to one's position, therefore making the technology also more central to one's job requirements.
Participatory Climate Perceptions	Perceived degree of voice and influence users have regarding decisions about the choice of technology, procedures/policies used to implement it, and weaknesses of the system requiring maintenance or replacement.
Perceived Social Support	The perception that important members of the organization recognize, expect, and support the use of the technology via recognition or rewards for use, which may be formal, tangible and/or informal (i.e., verbal).

Perceived Technical support	Perceived quality and access to hardware and services, such as help desk personnel, to aid in using and learning to use the technology.
Technology Training Perceptions	Perceived availability and quality of formal or informal training for technology use and/or changes to the business processes that result from the technology implementation.
Perceived User Disparity	Perception that the ratio of one's effort to use a system and resulting benefits or outputs is higher (i.e., less favorable) compared to that of other users.
Workload Perceptions	Perceived availability of time to learn and practice using the technology or to seek necessary hardware and support despite work demands and pressure to produce.

Although some of these factors have been operationalized objectively in past research, we have evidence that objective attributes of a job matter less in comparison to perceptions of those characteristics for determining attitudes and behaviors such as employee satisfaction and turnover intentions (Spector & Jex, 1991). Therefore, I hypothesize that perceptions of the above factors will reflect a user-centered climate for supporting technology use.

H1: Perceptions of information exchange, technical support, evolutionary development, participatory climate, job relevance, social support, technology training, and workload will combine to reflect SSC.

SSC overall could be high as a result of the strength of any combination of the dimensions. Moreover, some dimensions are likely to be more influential to technology use than others during certain stages in the technology's lifecycle. In the following section, I discuss the impact of time on the influence of these SSC dimensions.

SSC and Time

To understand the impact of time on dimensions of SSC, I adapt a stage-model from research by Zmud and colleagues (Cooper & Zmud, 1990; Kwon & Zmud, 1987;

Zmud & Apple, 1989). I chose to adapt this process model, because it is based on organizational change research (Lewin, 1952) and is one of few process models in IS that includes more than one stage beyond implementation. The following table (i.e., Table 2) describes the four main stages of the lifespan of technology in an organization that I plan to focus on in the current research.

Table 2. Stages of Technology Lifespan

	Definition
1. Pre-Implementation	**Decision-making stage** that involves the identification of organizational problems and potential IT solutions, decisions to build or purchase an IT solution, as well as decisions about the processes to be used to implement the technology. Users experience with the technology is limited to the information provided by leaders and or use of prototypes during this stage.
2. Implementation	**Training and learning stage** beginning with the introduction of the technology in the organization. Training may be formal, including classroom instruction, and/or informal on-the-job training.
3. Early Acceptance	**Transfer stage** that reflects organizational expectations that employees begin to use the technology on a regular basis in their work. During application, inconsistencies between the needs of the user and the technology may arise. Therefore, the need for modifications or system up-dates are likely to occur during this time.
4. Later Acceptance	**Institutionalization stage** reflecting common use of the system to the degree that the system is no longer recognized as new. Maintenance takes on a smaller role, with a smaller group of technical experts. Problems arising during this or earlier stages may have lead to the avoidance of the system, considerations for major up-dates, or considerations for new technical solutions (feedback to pre-implementation, stage 1).

Quinn and Cameron suggest that the criteria for judging the effectiveness of an organization changes over the organization's lifecycle. Furthermore, they recommend interventions are necessary at particular points in time to make some transitions less painful and costly (Quinn & Cameron, 1983). It is reasonable to expect that the intervention needs for supporting technological change will similarly vary over time. Therefore, I predict that the dimensions of SSC discussed above and confirmed via expert ratings will differentially predict technology use over stages of the lifecycle of a technology in an organization.

H2: Dimensions of SSC most influential to technology use will vary over time.

Figure 1 below reflects the dimensions likely to be central to each of the 4 stages of the lifespan of a technology in an organization.

Stage 1 **Pre-Implementation** (Decision-Making)	**Stage 2** **Implementation** (Training)	**Stage 3** **Early Acceptance** (Transfer)	**Stage 4** **Later Acceptance** (Institutionalization)
Time			
Participatory Climate Perceptions	Technology Training Perceptions	Workload Perceptions	Perceived Job Relevance
Perceived Information Exchange	Perceived Technical Support	Perceived Critical Mass	
Perceived User Disparity		Perceived Evolutionary Development	
Perceived Social Support	Perceived Social Support	Perceived Social Support	Perceived Social Support

Figure 1. System Support Climate Dimensions Across Technology Lifespan

Below, I discuss the rationale for the placement the SSC dimensions in the stage model above.

Social support reflects a combination of subjective norms, managerial support, and rewards/recognition for use. Research on organizational change suggests managerial support is crucial for the success of intervention efforts (Cooper, 2006). Other literature suggests champions or change agents, those who support the use of technology, are influential in getting others to learn and use it (Beath, 1991; Howell & Higgins, 1990; Markus & Benjamin, 1996; Rogers, 1995).

One way organizational members can demonstrate their support is through recognition and rewards. Rewards offer a visible signal regarding what behaviors are supported and expected. Research suggests that rewards in organizational settings can influence behavior including job performance and frequency of citizenship behaviors (Schanke & Dumler, 1997). Although there is some evidence that tangible rewards, such as money, negatively impact intrinsic motivation, meta-analytic evidence suggests that verbal rewards (i.e., positive feedback) increase self-reported interest in certain activities (Deci, Koestner, & Ryan, 1999).

Unlike some other dimensions of SSC, I argue that social support is likely to be important to technology use throughout the lifespan of technology in the workplace. Social support and recognition is likely to garner interest and acceptance of the need for new technology during pre-implementation as user's experience during this period is limited largely to the impressions instilled through the encouragement and attitude of others. During implementation, social support is likely to further enhance use of a newly introduced technology by bolstering user's motivation to learn to use the device. During the early acceptance phase, social support may buffer the stress associated with applying the technology to one's work on a routine basis, and social support may provide the recognition and encouragement needed to maintain technology use once formal measures for training and supporting the technology have diminished (i.e., stage 4). Therefore, I hypothesize that the dimension of social support will be highly related to technology use at all points in the lifespan of the technology in the workplace.

> *H3: The social support dimension of SSC will be highly related to technology use throughout the lifespan of technology in the workplace.*

SSC and the Pre-Implementation Stage

The dimensions of SSC most likely to influence users' intentions to use technology during the pre-implementation stage are those that have been associated with decision-making in past research (i.e., perceived information exchange and participatory climate perceptions) as well as perceived fairness of decisions (i.e., perceived user disparity). The lack of strong empirical support for these variables in past TAM research may be due to a tendency to focus on the implementation phase as opposed to pre-implementation.

When an individual is involved in the decision whether or not to adopt a technology, they are motivated to seek information to decrease uncertainty about the advantages of the innovation (Fidler & Johnson, 1984; Rogers, 1995). According to psychological research, providing information in the form of explanations to employees positively influences responses to management decisions, even those which produce unfavorable outcomes (Greenberg, 1994; Levy & Williams, 1998). Furthermore, since users are unlikely to experience the technology first-hand during pre-implementation, with the possible exception of prototypes, their perceptions during this period of time are based largely on the information they are provided. Therefore, I hypothesize that the perceived degree of information exchange during pre-implementation will be positively related to user's intentions to use a technology.

> *H4a. Perceived information exchange will be more highly, positively related to intentions to use the technology during pre-implementation relative other dimensions of SSC not central to this stage.*

Proponents of user-centered design and participatory design (Namioka & Schuler, 1993) acknowledge the importance of user participation during design phases, prior to implementation. According to McDonagh and Coghlan (1995), user participation is central to successful change in general: "Successful… change depends on individual organizational members'… participation in teams and group meetings, [and] their negotiation of outcomes across the interdepartmental group…" (p.45). Meta-analytic research has demonstrated positive relationships between participation and satisfaction as well as participation and productivity (Miller & Monge, 1986). Although the practical significance of the strength of the relationship between general measures of participation and overall productivity have been questioned (Wagner, 1994), it is likely that the relationship between participation for specific purposes and specific decisions and outcomes (i.e., technology-related decisions and use) would be stronger. Given this evidence and importance of participation as a central tenant of Total Quality Management (Deming, 1982), I hypothesize that participative climate perceptions during pre-implementation will be highly related to user's intentions to use a technology.

> *H4b. Perceived participative climate for technology use will be more highly related to intentions to use the technology during pre-implementation relative other dimensions of SSC not central to this stage.*

In addition to perceptions of information sharing and participation, perceptions related to the fairness of decisions during this stage are likely to affect user's intentions to use the system in the future. Researchers have acknowledged the political nature of technological change (e.g., Dourish, 2001; Grudin, 1994). For example, Dourish (2001) describes how workflow technologies are often perceived by users as accounting mechanisms intended for the benefit of management rather than as a means to improve process flow. In other words, users are likely to develop implicit theories about why and for whom a system or software is being implemented. Perceptions that the system is intended for the benefit of others may lead to resentment over the need to take time to learn the system. Grudin (1994) refers to this as disparity between users.

It is likely that information about potential user disparities are communicated during the decision-making phase or pre-implementation either directly, when providing future users with rationale for the purpose of the system, or indirectly by the choice of system or amount of voice future users are given in the decision-making process. Research suggests perceptions of the equity regarding allocation of resources in organizations affects attitudes and behaviors such as job satisfaction, performance, and withdrawal (Colquitt, Conlon, Wesson, Porter, & Ng, 2001). Therefore, I hypothesize that perceived user disparity will be strongly, negatively, related to intentions to use a system during pre-implementation.

> *H4c. Perceived user disparity will be more strongly related to intentions to use the technology during pre-implementation relative other dimensions of SSC not central to this stage.*

SSC and Implementation Stage

When a technology is first introduced into an organizational setting, employees need to learn about the system and how to use it. The organization can formally support this need through training and technical support. Meta-analytic evidence suggests training in organizations is important and moderately successful for increasing performance depending on the quality of the training (Arthur, Bennet, Edens, & Bell, 2003). A detailed review of different training methodologies and factors associated with training quality is beyond the scope of this paper. For more information, see (Ford, Kozlowski, Kraiger, Salas, & Teachout, 1997). Instead, I focus on the perceptions of training quality from the employee's perspective in the current study. Since the implementation stage is a learning stage, I argue that perceptions of technology training, whether formal or informal, are likely to be key to the acceptance of technology during this learning period.

H5a. Positive perceptions of technology training will be more highly related to technology use during the implementation stage relative other dimensions of SSC not central to this stage.

Perceived technical support reflects the degree to which support features are perceived to be available, including a help desk or other external consulting support (Igbaria, Zinatelli, Cragg, & Cavaye, 1997). According to research, providing support staff is important to help users overcome barriers to technology use (Bergeron, Rivard, & De Serre, 1990). Theory in cognitive psychology suggests this type of support may be most necessary during early stages of skill acquisition (Fitts & Posner, 1967). In comparison to later stages, wherein performance is more automatic and unconscious, users are more likely to exert the most conscious, cognitive effort to understand the device during learning stages. During this time, therefore, users are more likely to interrupt their process of using the technology and seek additional assistance. While the availability of user support alone may signal the importance of a system, perceptions of the quality of that support are likely to be important in determining perceptions of the ease with which additional learning and user occur. Therefore, I hypothesize that…

H5b. Positive perceptions of technical support will be more highly related to technology use during the implementation stage relative other dimensions of SSC not central to this stage.

SSC and Early Acceptance

Since early acceptance reflects a transfer stage, research on the transfer of training is highly applicable to predicting which SSC dimensions will be most influential during this stage. Research on transfer suggests that at this point in time, users may need some slack from their usual workload to practice and apply what they learned during training (Holton, Bates, Seyler, & Carvalho, 1997; Rouiller & Goldstein, 1993; Roullier & Goldstein, 1993). Workload reflects a sense of pressure regarding deadlines and the need to be productive (Kozlowski & Hults, 1987). With heavy workloads and limited time available to practice, users are likely to level-off as poor or intermediate users rather than learning and maintaining use of advanced features of the technology (Carroll & Rosson, 1987). Furthermore, research suggests that as time pressure increases, performance in most tasks declines (Adelman, Yeo, & Miller, 2006). Time pressure has also been found to affect attitudes, such as satisfaction and commitment to the products of one's work (Caballer, Gracia, & Peiró, 2005). Taken together, this research supports the hypothesis that workload perceptions will be highly related to technology use during early acceptance.

> *H6a. Perceptions of workload will be highly related to technology use during early acceptance relative other dimensions of SSC not central to this stage.*

As users begin to apply a system more routinely, they are likely to encounter obstacles or even bugs in the system. Knowledge that the organization plans to alleviate those obstacles with system maintenance is likely to help users accept a new system during early acceptance. Evolutionary development is a term used to describe an approach to software development wherein user experience and feedback are used to make iterative technology enhancements (Davis, 1982; Larman & Basili, 2003). Some researchers suggest iterative development generates a perception that the system is useful and easy to use or will evolve and become so (Behrens, Jamieson, Jones, & Cranston, 2005). Moreover, this perception is likely to increase one's general impression that the organization cares about the user and his or her experience. In other words, the perception of evolutionary development is likely to be directly associated with a user-centered philosophy. Therefore, I hypothesize that…

> *H6b. Perceptions of evolutionary development will be more highly related to technology use during the early acceptance stage relative other dimensions of SSC not central to this stage.*

It is argued that in comparison to single-user systems, acceptance of interactive systems requires the perception that others are also accepting and using the system (Grudin, 1994; Mahler & Rogers, 1999; Rogers, 1995). Some features of collaborative systems are of little value unless they are utilized by everyone. The perception of critical mass provides a sense of utility or even social pressure to use the system. Knowing others are using the system provides an environmental cue that the system is useful to others and therefore likely to be useful to oneself as well. Although users may get a sense of other's intention to use a system during pre-implementation and training (i.e., implementation), it is during transfer, the application of the system to their work, that users are most likely to be directly aware of whether or not others are in fact using the system. Therefore, I hypothesize that perceived critical mass will be particularly strongly related to technology use during the early acceptance stage.

> *H6c. Perceptions of critical mass will be more highly related to technology use during the early acceptance stage relative other dimensions of SSC not central to this stage.*

SSC and Later Acceptance

During the later acceptance stage, visibility of the technology in the workplace is greatly reduced. Once the watchful eye of management eases, employees are likely to find ways around using technology that they have determined to be difficult to use or not useful in their workplace. Furthermore, users which encounter tasks that require system use infrequently or find that system use is not central to ones core job requirements, are more likely to forget what they learned in earlier stages and/or seek alternatives to avoid using the system. Furthermore, Job characteristics theory suggests that when an individual perceives the significance of certain tasks, they are more likely to perceive their work as meaningful, purposeful and valuable (Hackman & Oldham, 1976; Zalesny & Ford, 1990) and therefore increases one's motivation to invest time and energy into completing tasks well (Fried & Ferris, 1987; Grant, 2008). Therefore, it is important that users perceive the technology as central or relevant to one's job in order to maintain consistent use during the later acceptance stage.

H7. Perceptions of job relevancy will be more highly related to technology use during the later acceptance stage relative other dimensions of SSC not central to this stage.

Boundary Conditions for SSC

To be comprehensive in the development of SSC, it is important to identify boundary conditions, situations under which the predictions above may be modified or fail to hold (Whetten, 1989). Theory and research on leadership suggests that elements of the environment or task may act, at times, as substitutes for leadership (Kerr & Jerimer, 1978). For example, in situations where tasks are well-defined and individuals in the workplace are highly motivated, strong leadership presence may not be necessary or influential. I argue that it may be similarly possible for certain individual differences and characteristics of the technology to act as substitutes for SSC, potentially diminishing the need for and impact of the SSC dimensions discussed above.

SSC and Individual Differences

It is beyond the scope of the current research to examine all of the individual differences that could potentially impact technology use. To determine whether individual differences do moderate the relationship between SSC and technology use, I focus on 2 individual difference variables examined in past TAM research, namely computer self-efficacy (CSE) and personal innovativeness with information technology (PIIT).

CSE reflects an individual's assessment of their ability to use a computer or particular software or system (Compeau & Higgins, 1995). I chose to focus on CSE, because it appears to be central to technology acceptance and has been linked to a number of other relevant individual differences including: past computer-related experience (Doyle, Stamouli, & Huggard, 2005), computer anxiety (McFarland & Hamilton, 2006), learning goal orientation (Yi & Hwang, 2003), training experience, educational background, and work experience (Fuerst & Cheney, 1982; Sanders & Courtney, 1985). Although some research suggests demographic variables such as age, gender and tenure also play a role, it is likely via level of experience and/or CSE.

Individuals with high efficacy are more likely to interpret tasks with new systems as a challenge they can readily master rather than an obstacle or threat (Bandura, 1994). Therefore, I hypothesize that individuals high in CSE will be more likely to accept new technology. If CSE is high enough, they may be more likely to do so regardless of SSC. In other words, at high levels, CSE may attenuate the impact of SSC on technology use.

> *H8a: CSE will moderate the relationship between SSC and technology use, such that the relationship between SSC and technology use will be smaller for individuals with higher levels of CSE.*

Similarly, high degrees of personal innovativeness may reduce the need for a supportive environment. Personal innovativeness in the domain of information technology (PIIT) is defined as, "the willingness of an individual to try out any new information technology" (Agarwal & Prasad, 1998, p. 206). According to some researchers, individuals who are exploratory by nature, more willing to change, and less averse to risk are more likely to be willing to innovate with IT (Thatcher, Srite, Stepina, & Liu, 2003). Individuals who are less willing to change will more likely need external "reinforcement," such as managerial influence, before readily using a new technology (Delbecq & Mills, 1985; Leonard-Barton & Deschamps, 1988). Therefore, I hypothesize that the influence of SSC on technology use will be moderated by PIIT, such that the relationship between SSC and use will be stronger for individuals low in PIIT and weaker for individuals high in PIIT.

> *H8b: PIIT will moderate the relationship between SSC and technology use, such that the relationship between SSC and technology use will attenuate with high levels of PIIT.*

SSC and Technology Characteristics

To determine which technical characteristics may moderate SSC-use relationships, I reviewed not only factors examined in past TAM research (see Appendix B), but also usability heuristics (Nielson, 1994) and non-functional requirements (Kulak & Quiney, 2004). I examined factors for conceptual similarities, generalizability, and applicability to users. Reliability, output quality, and functionality are not discussed in the current study as these are seen as necessary conditions. A system must be reliable and available; no amount of SSC would likely overcome resistance to using an unreliable system. Similarly, the system must have the basic functionality necessary to perform tasks in which it was developed to support.

I chose to focus on 2 main dimensions of technology characteristics in the current study: (1) those that describe the process of using the technology or interface, and (2) those that describe the results or outputs of use. Descriptions of the underlying characteristics from these categories are provided in Table 3 below.

Table 3. Potential Technical Moderators of SSC

Technical Characteristics		Description
Process Characteristics	Operability	The system is easy to operate; it (a) speaks the user's language, (b) provides visual displays that communicate system status and allow the user to easily remember steps or processes, and (c) provides a means of error prevention and response (e.g., undo/redo options; easy exits; diagnosis capabilities, etc.).
	Flexibility/ Tailorability	The system is designed in such as way that the user can tailor displays and processes to his or her needs and/or preferences. For example, the system may allow advanced users to shortcut certain processes or tailor tasks so that those which are frequently performed may be completed more efficiently.
Output Characteristics	Result Demon-strability	Degree to which quality results are observable and communicable to users (e.g., ability to produce and print a tangible report summarizing data). Includes ability to demonstrate data/output relevance and accuracy.

While functionality and reliability are necessary, negative reactions to a system that lacks result demonstrability for some users may be mitigated to some degree by SSC, an environment rich with quality training opportunities that provide a high level of information exchange about the benefits of the system for other users in the organization. At the same time, systems with extremely high levels of operability, flexibility/tailorability, and result demonstrability are likely to produce positive perceptions, perhaps even regardless of SSC. In simple terms, the better the system, the less one needs a supportive climate. Since a perfectly operable and tailorable system is unlikely, positive technical characteristics are likely to be enhanced by the effects of a supportive climate. For example, a system that produces tangible results will likely reinforce management's encouragement of system use. Therefore, I hypothesize that perceptions of the technical characteristics discussed above will moderate the relationship between SSC and use, providing an enhancing affect at moderate levels and an attenuating effect at very high levels.

> *H9a: Demonstrability will moderate the relationship between SSC and technology use, such that the relationship between SSC and technology use will reduce with very high levels of demonstrability but will otherwise be enhanced.*
>
> *H9b: Operability will moderate the relationship between SSC and technology use, such that the relationship between SSC and technology use will reduce with very high levels of operability but will otherwise be enhanced.*
>
> *H9c: Flexibility/Tailorability will moderate the relationship between SSC and technology use, such that the relationship between SSC and technology use will reduce with very high levels of Flexibility/Tailorability but will otherwise be enhanced.*

Summary and Conceptual Model

In sum, I predict SSC will influence the use of technology, although the dimensions of SSC that are most influential will likely vary over time (see Figure 1).

Furthermore, the strength of the relationship between SSC and use will likely vary depending on characteristics of the system and individual differences of users (see Figure 2 below). A summary table of all hypotheses appears in Appendix C.

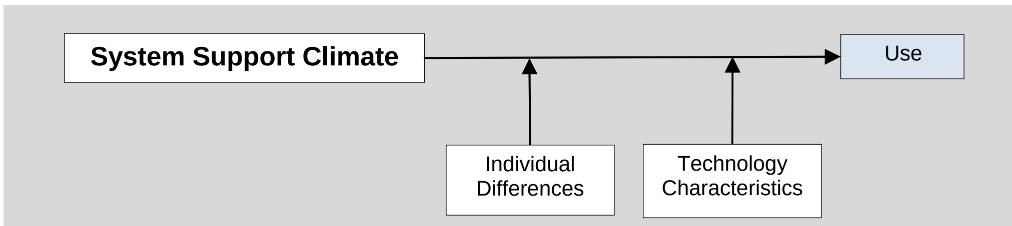


Figure 2. Conceptual Model

In the following sections, I describe two pilot studies conducted to confirm the content of SSC and stage model and develop scales to measure the related variables. I then describe a survey study used to gather preliminary evidence testing the stage model hypotheses as well as the moderating effects illustrated above.

Chapter 4

Scale Development: Phase 1

Before testing hypothesized relationships between SSC and use at different stages, I sought to gather initial content validity evidence for later scale development. Specifically, I sought to find empirical support for the proposed content (dimensions) of SSC (see Figure 1) and placement of the dimensions in the stage model. To do so, I surveyed individuals with experience with technology implementation and/or research and theory in organizational behavior about their perceptions of the importance of the different dimensions to technology acceptance as well as when those constructs might be most influential over time.

Sample

Participants for this pilot study included 9 instructional designers, 7 business consulting personnel, 21 Industrial/ Organizational Psychology (I/O) graduate students and recent alumni, and 10 graduate students from the College of Information Science and Technology (IST). The participants were chosen for their familiarity with decision-making, training, and organizational change literature and/or experience with organizational or technological change.

The participants ranged in age from 23 to 61 (M = 35) years, and included 16 males and 33 females. The education level of the participants ranged from an Associate's degree (typically representing training at a community or junior college) to Ph.D.; with most participants (i.e., the modal response) having received a Masters degree. The comfort level with technology, as measured by a CSE scale ranged from 1.4 to 7 on a 7 point scale (*M* = 4.96).

Procedures

This first pilot study, following informed consent administration, involved 3 main steps. First, participants read a definition of SSC and rated the importance of a number of factors to the overall perceptions of that climate. Thirteen factors total were rated; 3 were included for comparison purposes and were not expected to be related to SSC (i.e., warmth, organizational esprit, and egalitarianism).

Second, participants read definitions of the 4 stages described above and rated the 13 factors for their importance as influences on technology acceptance within each stage. Lastly, participants were asked to choose only 1 of the 4 stages in which each of the 13 factors would be most influential.

Results

To understand which of the 13 factors were seen as most important to SSC, I examined the average importance ratings provided by the participants in the first part of this pilot exercise. Table 4 below presents the mean ratings of the importance of the factors presented to overall SSC. Ratings were collected using a 5-point scale (5 = very important; 3 = moderately important; 1 = not at all important).

Table 4. Importance of SSC factors (Pilot Study 1)

Factors	**Mean**	**SD**
Perceptions of Technical Support	4.60	.66
Perceptions of Job Relevance	4.53	.69
Workload Perceptions	4.33	.64
Perceived Information Exchange	4.15	.83
Technology Training Perceptions	4.15	.95
Perceived Evolutionary Development	3.96	.90
Perceived Participatory Climate	3.75	.87
Perceived Critical Mass	3.55	.98
Perceived Social Support	3.53	.90
Perceived User Disparity	3.16	1.00
Perceived Warmth	2.53	.96
Perceived Organizational Esprit	2.47	.86
Perceived Egalitarianism	2.42	1.07

Confirming expectations, the 3 factors included for comparison purposes (i.e., perceptions of warmth, organizational spirit, and egalitarianism) received the lowest importance ratings, the average of which falls below the mid-point on the scale indicating relative disagreement. After removing these 3 factors, the rank order of the remaining variables was examined across sample sub-groups. Perceived social support and perceived user disparity consistently appeared in the bottom 3 of the remaining ranked factors as demonstrated in the table above. In addition, comments from participants suggested perceived social support was conceptually similar to perceived critical mass. Therefore, I removed perceived social support and perceived user disparity for the sake of parsimony.

Correlations between importance ratings of the remaining 8 factors were also examined to provide evidence of the distinctiveness of these factors. The majority of the relationships between SSC factors were small to moderate (see Table 5 below), suggesting the factors or dimensions of SSC are related but likely distinct.

Table 5. Correlations between SSC dimensions (Pilot study 1)

	1	2	3	4	5	6	7
1. Participatory Climate Perceptions							
2. Perceived Critical Mass	.26						
3. Perceived Evolutionary Development	.04	.07					
4. Perceived Information Exchange	.26	.08	.08				
5. Perceived Job Relevance	.01	.02	.03	.32*			
6. Perceived Technical Support	.11	.32*	.12	.06	.15		
7. Technology Training Perceptions	.18	.23	.07	.23	.19	.27*	
8. Workload Perceptions	.22	.15	.02	.02	.27*	.17	.16

* $p < .05$

To examine whether SSC factors might differentially influence technology acceptance over time, I examined the average importance ratings of SSC factors within stages. The results (see Table 6 below) provide some evidence that different factors are expected to be more or less important during different stages. However, the results also suggest that few factors are expected to be cleanly related to only one stage as originally hypothesized.

Table 6. Mean Ratings for SSC Dimensions Within Stages (Pilot study 1)

Factors	Pre-Implementation (Decision)	Implementation (Training)	Early Acceptance (Transfer)	Later Acceptance (Institutional.)
Participatory Climate Perceptions	4.38 (.92)	3.72 (.80)	3.79 (.93)	2.62 (.97)
Perceived Critical Mass	2.28 (1.10)	3.17 (1.03)	3.96 (1.04)	3.57 (1.33)
Perceived Evolutionary Develop.	3.40 (1.25)	3.66 (1.01)	4.02 (.90)	3.72 (1.02)
Perceived Information Exchange	3.70 (1.06)	4.36 (.76)	4.06 (.84)	3.30 (.95)
Perceptions of Job Relevance	4.04 (1.04)	4.45 (.85)	4.49 (.88)	4.11 (1.15)
Perceptions of Technical Support	3.38 (1.29)	4.34 (.89)	4.63 (.64)	4.24 (.85)
Technology Training Perceptions	3.62 (1.29)	4.76 (.57)	4.11 (.94)	3.60 (1.10)
Workload Perceptions	3.62 (1.23)	4.62 (.64)	4.36 (.70)	3.60 (.95)

Note: Standard deviations appear in parentheses

The above results suggest, for example, that during the pre-implementation stage, participatory climate perceptions and perceived job relevance are likely more predictive of system use intentions in comparison to the other SSC factors. In comparison, perceived information exchange, perceived technical support, technology training perceptions, workload perceptions, and perceived job relevance are expected to be most influential during stage 2.

In addition to mean ratings within stages, the frequency with which participants categorized a particular dimension into one of the four stages was examined. Table 7 below presents the percent agreement into which most participants categorized each of the SSC dimensions.

Table 7. Percentage Agreement SSC-Stage Categorization (Pilot Study 1)

Factors	Pre-Implementation (Decision)	Implementation (Training)	Early Acceptance (Transfer)	Later Acceptance (Institutional.)
Participatory Climate Perceptions	**.94**			
Perceived Critical Mass			.57 ↔ **.82**	
Perceived Evolutionary Development			.35 ↔ .67	
Perceived Information Exchange		.51 ↔ **.75**		
Perceptions of Job Relevance		↔ .63	.35	
Perceptions of Tech Support		↔ .69	.45	
Technology Training Perceptions		**.75** ↔ **.92**		
Workload Perceptions		.35 ↔ .67		

Note: The numbers appearing in the gray arrows reflect the percentage agreement when I included responses from one of the adjoining stages.

The pattern of results presented in the previous two tables is similar and provides initial support for hypothesis 2. The above results also provide partial support for hypotheses 4 through 7. A summary of the hypotheses and support is located in Appendix C.

Discussion

The results of this pilot study confirm the importance of 8 dimensions of SSC, providing partial support for hypothesis 1. With the exception of participatory climate perceptions, the results above also suggest participants had difficulty conceptualizing most of the factors as influential at only one stage. Rather, these results suggest that although the relative influence of the 8 factors likely changes over time (supporting hypothesis 2), it is likely that most factors are more influential at multiple stages in comparison to initial expectations that each factor would be central to one stage.

Altogether, the results from this first pilot study support a stage model that looks something like the following:

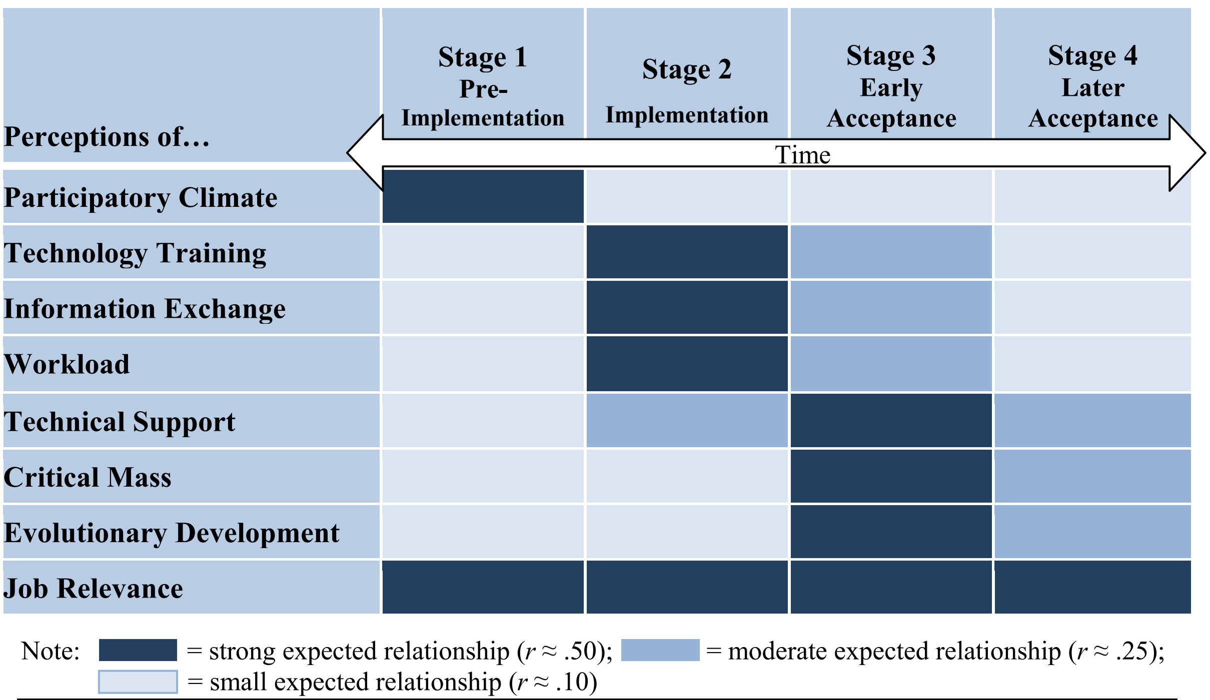


Figure 3. SSC Dimensions Across Technology Lifespan (Results Pilot Study 1)

Note, the SSC dimensions in the darkest cells above indicate strong expected relationships between that SSC dimension and use (or future use intentions as in the case of stage 1). The relationship between job relevance and use, for example, is expected to be strong across all stages according to data collected in this pilot study. The lightest cells in each column reflect a small expected relationship between SSC dimensions and use or use intentions. The moderately shaded cells reflect a moderate relationship between that SSC dimension and use is expected. For example, perceived technical support is expected to be moderately related to technology use during the implementation stage.

Many predictions illustrated in the figure above reflect the original hypotheses. For example, participatory climate perceptions are expected to have a strong relationship with intentions to use technology during the pre-implementation stage according to the figure above. This prediction is similar to the original 4th hypothesis. Adjustments to original hypotheses for each stage based on the results of this pilot study are summarized in Appendix C.

Chapter 5

Scale Development: Phase 2

After gathering some empirical evidence to support the content of SSC and the temporal nature of the dimensions, I sought to develop scales to measure study variables. In this 2nd pilot study, survey items were written to create self-report measures of SSC perceptions as well as a user-centered stage profile scale. Then, data on a retranslation task was gathered to demonstrate content validity of scale items, reduce the number of items per scale for practicality, and demonstrate reliability of the measures.

Sample

Participants included 24 graduate students (10 I/O, 10 from other areas of Psychology, and 4 from IST) and 3 recent I/O alumni (*N* = 27). This sample was chosen for their knowledge of survey research methods and familiarity with item content.

Procedures

Participants were asked to read a list of items which had been developed to tap the factors resulting from the first pilot study. Some of the scales were modified from existing scales; details are presented in the measures section of the following study. Initially, stage profile and SSC subscales included 8 to 12 items (see Appendix D). Participants were asked to categorize the items according to the dimension they felt the item best reflected. Then, participants were asked to rate their agreement with each item on a 7-pt Likert scale based on their past experience using the university course management system.

Results

All items and percentage agreement on the categorization task are presented in Appendix D. For each subscale, items receiving lesson than 60% agreement in the retranslation task were dropped. Scale reliabilities were then examined to determine whether or not additional items could be dropped for ease of later survey administration. Scale reliabilities based on the remaining items are presented in Table 8 below:

Table 8. Scale Reliabilities Following Retranslation (Pilot Study 2)

	# of items	A
Stage Profile Sub-Scales		
Pre-Implementation Stage (Stage 1)	4	.88
Implementation Stage (Stage 2)	4	.91
Early Acceptance Stage (Stage 3)	4	.72
Later Acceptance Stage (Stage 4)	4	.91
SSC Dimension Scales		
Participatory Climate Perceptions	4	.81
Perceived Critical Mass	5	.77
Perceived Evolutionary Development	5	.89
Perceived Information Exchange	6	.76
Perceived Job Relevance	5	.93
Perceptions of Technical Support	4	.94
Technology Training Perceptions	3	.88
Workload Perceptions	5	.80

Almost all scales demonstrate reliability above .80, and all fall above .70, a cut-off commonly accepted as reflecting adequate reliability (Nunally, 1978). Further evidence of the efficacy of the stage profile scale was demonstrated as data suggests users perceived the course management system as being somewhere between stage 3 and 4 (early to late acceptance stages), which is consistent with expectations given reports from information technology personnel working with the system. That is, the results of the stage profile scale appear to reflect reality. Specifically, the average rating for the scale items, indicating agreement with items for the different stages were highest for stage 3 and 4 (M = 3.94; 4.32 respectively) relative stage 1 and 2 (M = 3.13; 2.40).

In addition, correlations between composite ratings of the SSC scales and the outcomes variables of use and future use intentions, provide partial support of the model resulting from the previous pilot study. Figure 3 suggests that perceptions of job relevance, perceived critical mass, perceived evolutionary development, and perceived technical support should be related to acceptance (i.e., use and future use intentions). Support was found for the predicted relationship between ratings of perceived job relevance and perceived critical mass and current use (r = .60 and .49 respectively; $p <$ .05) as well as between perceived critical mass and future use intentions (r = .51, $p <$ .05). The relationship between perceived job relevance and future use intentions approached significance (r = .43; p = .06). Unexpectedly, however, technology training perceptions were also positively related to both current use and future use intentions (r = .44, p = .05). No other relationships were statistically significant.

Discussion

In addition to receiving some content validity evidence of the scale items through the retranslation task and scale reliabilities, this pilot study allowed me to reduce the number of items to be presented to users in the following study. Based on the level of agreement and scale reliabilities made available from participants' ratings, I was able to reduce the number of items per scale to 4 to 6 per dimension (scales originally ranged from 8 to 12 items).

In addition, the correlations between SSC perceptions and use provided partial support for some of the predicted relationships given the stage users' perceived the organization to be in with respect to the target technology. While this provides some confidence in the model, these results should be interpreted with caution. The small sample size may have precluded finding statistically significant relationships between all SSC dimensions predicted to be highly related to use during stage 3 or 4. As sample size increases, statistical power or the probability of committing Type II or false negative errors (i.e., failing to find a relationship between variables when one exists) decreases. Based on formulas provided by Cohen (1988), a minimum sample of 76 individuals would be necessary to reach the recommended level of statistical power ($1-\beta = .80$) with an acceptable confidence level ($p = .05$) given expectations for moderately strong relationships. For further discussions on statistical power, see (Murphy, Myors, & Wolach, 2008).

Furthermore, the purpose of this pilot study was to develop measurement scales. Users in this pilot study were not employees. Although the resulting relationships between SSC dimensions and use for this sample provide some evidence in support of predictions, the results here may not generalize to other organizations. Differences in the relationships between SSC perceptions and use may be reasonable as this sample is less likely to have perceived autonomy in making decisions whether or not to use the system. Therefore, the evidence supporting predicted relationships between SSC dimensions and use are treated here as preliminary at best. In the following chapter, a more systematic test of these relationships using employees across multiple organizations is described.

Chapter 6

Preliminary Test of the SSC Stage Model

To test the stage model of SSC and remaining hypotheses regarding predicted relationships between SSC dimensions and use in different stages as well as moderating influences (i.e., hypotheses 2 through 9), I gathered cross-sectional, survey data from faculty and instructors using course management systems at over a dozen research universities. The samples represented different stages of a technology's lifespan in the respective universities. Using faculty's perceptions of course management systems provided a way to investigate relationships between SSC perceptions and use while maintaining some consistency in the organization type and technology type across samples. This also provided some control over the demographic profile of users and general working environment. That is, users in these samples are likely to have a similar level of education, and all work within a white collar, academic environment.

Course or Learning Management Systems (CMS or LMS), often called virtual learning environments (VLEs), are software packages designed to support various levels of distributed learning via Internet technologies. CMSs include a collection of tools for communicating with students, receiving work from students, assessing and tracking grades, etc. While used mostly for distance education, these tools have also been adopted to facilitate instruction in traditional (i.e., face-to-face) classrooms. Some research examining the acceptance of CMS by students at the college level has been conducted (Martin & Kellermanns, 2004); no studies examining differences in faculty use of CMS across universities has been completed to the knowledge of the current author.

Sample

Information technology (IT) personnel and/or personnel labeled as working directly with the CMS on the website of over 100 research universities across the United States were contacted to elicit support in recruiting CMS users (i.e., faculty) to participate in the survey. Of the 104 universities contacted, 14 IT personnel replied with interest in the project. Approval from the internal review board (IRB) at each university was obtained. Due to university policies and resources of IT personnel, the method used to recruit participation varied across samples. Table 9 below demonstrates how the total sample was distributed across these multiple university settings and summarizes how participation was recruited within each.

Table 9. Study Sample

University	Recruitment Method	*N*	Usable N	CMS Brand	Install Year
A	E-mail Dept Heads; Campus mail flyer	169 (+144 from separate branch campuses*)	133	A	Spring 2002
B	Listserve	153	121	B	2000
C	Listserve	85	72	C	Jan 2008
D	Email from Dept Head	51	36	E	Fall 2008
E	Email from Dept Head	46	36	A	2003
F	Email from Dept Head	38	32	B	2005
G	Email from Dept Head	37	34	D	2005
H	Email from Dept Head	35	*	B	*
I	Email from Dept Head	29	*	B	*
J	Email from Dept Head	19	*	C	*
K	Post to E-Newsletter	15	*	B	*
L	Post to a website	8	*	B	*
M	Post to a blog	6	*	B	*

Note: Usable N represents the sample remaining after removing extreme outliers and systematic non-responses.
* denotes a usable sample < 30.

In all, 825 people from 13 universities and 19 branch campuses responded to the survey. However, sample sizes varied greatly, and samples including less than 30 usable responses were dropped, yielding a usable sample size of 464.

Sample participants included graduate student instructors (about 3%), full- or part-time instructors (22%), lecturers (4%), adjunct faculty (4%), assistant professors (15%), associate professors (10%), professors (32%), department heads or other administrative faculty (8%), and other faculty, rank unknown (3%). Of those that provided voluntary demographic data in the full sample (including all universities), 338 were male; 334 were female, and over 90% self-reported themselves as Caucasian. Years of teaching experience ranged from less than 1 year to 46 years (M = 13.4 years), and age ranged from 21 to 75 years.

Also noted in the table above is the brand of CMS used by the different university samples. Although the CMS utilized by the universities in the sample included similar functionality, 5 different brands were represented.

Procedures

All participants received a similar invitation (either by e-mail, post to a blog site, etc.) which included a brief description of the study and an Internet address to a secure survey hosted by SurveyMonkey. Participants read an informed consent form before proceeding to the on-line survey and completed the survey in their spare time from the location of their choice.

Measures

The survey included scales intended to confirm the stage of the CMS in the university from the users' perspective. The survey also included scales measuring dimensions of SSC as well as the individual differences and perceived technology characteristics previously described as potentially moderating SSC-use relationships. The survey also included measures of self-reported use and future use intentions. Most measures for the current study are based on modifications to previously published, validated scales. Descriptions for these measures below are separated into the following sections: stage profile survey, climate measures, individual differences, technical characteristics, and outcome variables (i.e., use). All items appear in Appendix D.

Technology Stage Profile Survey

Organizations may vary regarding the amount of time invested in choosing a technology (an activity relevant to pre-implementation), training users formally or informally (an activity central to the implementation stage), and so on. Therefore, the stage measure in the current study focuses on the activities rather than chronological time. Although information about the time a system has been in place and the activities related to its adoption and implementation may be easily collected from organizational leaders, the measure developed for the current study focuses on the users' perspective of these events. It is possible that individual perceptions of the stage of the current technology will vary particularly if the organization does not communicate information about the process of technology implementation and change, and/or certain individuals are disconnected or unaware of changes taking place due to a lack of interested or new employee status. Furthermore, there is evidence that implementation of organizational policies and procedures with regard to use of technology drift from the macro-level intentions of organizational leaders when viewed at the local level (Haynes, Schafer, & Carroll, 2007). To afford examination of the implementation practices and procedures likely to be occurring from the perspective of the user, therefore, I developed a scale with items reflecting the perceptions of activities central to each stage for a particular technology. Participants rate the degree to which they agree with the statements using Likert-type response scales ranging from 1 (strongly disagree) to 7 (strongly agree). A 7-point Likert scale was chosen based on research suggesting this is statistically optimal (Cicchetti, Showalter, & Tyler, 1985).

It is possible that activities related to technology adoption and implementation central to one stage may occur simultaneously with activities central to another stage. For example, there may be times when users are expected to learn the technology as they use it, a situation analogous to informal, on-the-job training. In these cases, training and transfer are occurring simultaneously to some extent. Even if activities occur sequentially, it is unlikely there will be a clear end to activities begun during one stage before activities of another ensue. Therefore, the intention is to use responses to the scale to create a profile like that illustrated below, which can be used to identify the stage of the target technology in the organization from the users' perspective.

Figure 4. Example Stage Profile

Note, this example (i.e., Figure 4) indicates activities related to multiple stages may be occurring relatively simultaneously. At the same time, this figure illustrates a greater number of activities reflective of one stage, early acceptance. This evidence in addition to correspondence with organizational contacts should allow one to reliably classify the stage of the target technology in the organization.

Confirmatory factor analysis conducted on 5 university samples (removing 2 university samples for which I was not allowed to include all items in addition to those removed earlier due to low sample size) revealed 4 factors fit the data reasonable well. Although chi square was significant ($\chi^2_{(59)} = 141.75$; p =.00), research indicates that it is unreasonable to expect otherwise in most samples given the sensitivity to sample size (Byrne, 2001). Other fit statistics reached levels indicating reasonable fit (RMSEA = .068; p = .018; CFI = .94; NFI = .90; Bentler, 1990, 1992; Browne & Cudeck, 1993). Descriptions for the content of the subscales appears below.

Pre-Implementation Stage (Stage1). The pre-implementation stage is a decision-making stage. Although there are benefits from involving users in different decisions prior to implementation reflecting the possibility of multiple stages prior to implementation (i.e., identifying the need for technological change, identifying possible technical solutions, choosing a particular system, etc.), it is likely many organizations do not comprehensively do so. That is, organizations are not likely to include all users in each decision or users at all in every decision. From the general users' perspective, therefore, this stage simply represents a period of time before they are introduced to the technology. Therefore, this subscale includes items, such as: "I heard a new system has been chosen, but I have not seen it yet." Results from the current study suggest reliability for the 3-item pre-implementation subscale reached acceptable levels (α = .78).

Implementation Stage (Stage 2). Implementation reflects a training stage in which users are introduced to and begin to learn how to use a new system. The type of training may be formal or informal, on-the-job training, therefore many items focus on learning rather than any particular training technique. An example item reads, "I have just begun to learn the system." Results from the current study suggest reliability for a 3-item subscale reached acceptable levels (α = .73).

Early Acceptance Stage (Stage 3). Early acceptance reflects a transfer stage during which employees begin to apply what they have learned in stage 2 to their everyday work. An example item reflecting this stage reads, "I am first trying to apply what I have learned about the system to my job." Unfortunately, reliability for this subscale was low (α = .49), potentially indicating a difficulty in distinguishing between this stage and implementation or later acceptance. It is possible, for example, that on-the-job training does not afford a distinction or does not allow users to cognitively distinguish a point at which learning transfers to application. Implications for this result will be discussed in a following section of this report.

Later Acceptance Stage (Stage 4). Later acceptance reflects an institutionalization phase during which the system becomes so familiar that it is no longer considered new. During this stage, users are unlikely to consider alternatives ways of doing certain tasks supported by the system. That is, using the system becomes the normal mode of operations during this stage. At the same time, users not accepting the system through negative experiences in previous stages, may become reliant on alternatives and/or find creative ways to avoid system use. Therefore, support for use during this stage is still important. An example item in this 4-item subscale reads, "I no longer recall how certain tasks were done before the use of the system." Scale reliability reached acceptable levels ($\alpha = .75$).

Climate Measures

The climate measures reflect the dimensions of SSC identified in Figure 3. Participants rate the degree to which they agree with statements reflecting the different climate dimensions using a Likert response scale ranging from 1 (strongly disagree) to 7 (strongly agree). Items were written at the individual-level to afford examination of relationships between SSC and individual's choice to use the system. Although a potential to aggregate responses for higher levels of analysis if agreement permits (James, Demaree, & Wolf, 1984) is also afforded, doing so would be inconsistent with the way it is conceptualized here. Furthermore, aggregating individual-level items to represent group or organizational-level phenomenon has been criticized in some previous research (e.g., James, 1982). However, future research could examine the composition of SSC and cross-level influences. Having an understanding of SSC at the individual level of analysis may help future interpretations of within and between group variability. Furthermore, the current research is interested in predicting individual use. Therefore, focusing on psychological rather than organizational climate, and therefore measuring individual perceptions, affords consistency between the level of analysis of the independent and dependent variables in the current study. Example items for each scale appear below.

<u>Participatory Climate Perceptions.</u> The participatory climate dimension of SSC reflects the degree to which leaders in the organization involve users in decisions regarding technology adoption, implementation, etc. The scale used for the current study includes 4 items modified from Patterson and colleagues (2005) involvement scale (α = .87). An example item from the current 4 item scale reads, "My feedback about the system has been solicited in my department" (α = .66).

<u>Perceived Critical Mass.</u> Perceptions of critical mass reflect the degree to which one perceives important others in the organization, including one's supervisor, use and encourage other's use of the system. Items for this scale were adapted from Klein and colleagues (2001) sub-scales for management support and subjective norms (i.e., two subscales included in their 36-item general measure of implementation practices and policies; combined α = .94), and Patterson and colleagues supervisory support scale (α = .88; (Patterson et al., 2005). An example item reads, "People that are important to me use the system." Scale reliability from the current study was acceptable (α = .74).

<u>Perceived Evolutionary Development.</u> Evolutionary development reflects a design principle in which the technology is incrementally enhanced (Boehm, 1988).

What is important in the current study is not whether the development effort was truly incremental but rather user perceptions that the organization plans to up-date the system as users encounter problems. In other words, the current study focuses on perceived evolutionary development, a climate construct influenced by information and processes that lead employees to believe the technology will be adapted to their needs. To measure these perceptions, I wrote items based on the definition of the construct; an example item reads, "I expect the system will be up-dated over time" ($\alpha = .86$).

Perceived Information Exchange. Perceived information exchange reflects the degree to which individuals' perceive information regarding the technology, implementation procedures, and related decisions is freely shared in their workplace. The 6-item scale includes 2 items from the communication sub-scale from Klein and colleagues (2001) larger 36-item policies and practices scale ($\alpha = .94$), 2 communication-related items from Patterson and colleagues (2005) involvement scale ($\alpha = .87$), and 2 additional items written for purposes of this study. An example item reads, "I feel I am well informed about changes involving the system" ($\alpha = .74$).

Perceived Job Relevance. Perceived job relevance reflects the perception that tasks related to technology use are central to one's job. The 5-item scale used in the current study was adapted from the 2 item job relevance scale used by Venkatesh and Davis (2000; $\alpha = .80$ to .95 across samples) and additional items written to reflect the definition of the construct. An example item from the current scale reads, "Tasks that involve the use of the system are central to my job" ($\alpha = .92$).

Perceived Technical Support. Perceived technical support is a climate variable that reflects the degree to which individuals perceive both technical support and hardware is available to aid their use of the technology. The 4-item scale used for the current study is based on the 5-item computer support sub-scale of Klein and colleagues (2001) larger policies and practices scale. An example item reads, "Technical support for the system is easy to access" ($\alpha = .93$).

Technology Training Perceptions. Technology training perceptions reflect the degree to which individuals perceive training is available and effective in supporting their learning and use of a technology. The 3 item scale used in the current study was modified from Patterson and colleagues (2005) training climate subscale ($\alpha = .83$). An example item from the current 3-item scale reads, "Formal training is readily available to those who want it" ($\alpha = .85$).

Workload Perceptions. Workload perceptions reflect the degree to which individuals feel they have time to learn and become familiar with a target technology despite productivity demands and other work-related time pressures. The 5-item scale used in the current study was adapted from a 5-item pressure to produce subscale from Patterson and colleagues (2005; $\alpha = .79$). An example item reads, "It is easy to find the time to learn and use the system" ($\alpha = .73$).

Individual Differences

Computer Self-Efficacy. CSE reflects one's confidence that they can effectively learn and use a system. The 3 item scale used here was adapted from work by Compeau and Higgins (1995; $\alpha = .81$). An example item reads, "I am confident using the system when no one is around to tell me what to do" ($\alpha = .85$).

Personal Innovativeness with Information Technology (PIIT). PIIT reflects the degree to which one finds technology intrinsically interesting. The 4 item scale used in the current scale was adapted from McKnight, Choudhury and Kacmar's (2002) previous work ($\alpha = .89$). An example item reads, "Among my peers, I am usually the first to try out new technologies" ($\alpha = .92$).

Technology Characteristics

Operability. Perceived operability reflects the capability of the technology to enable the user to operate and control it. Highly operable systems tend to include error tolerance and user feedback. The 4-item scale for the current study is based on Calisir and Calisir's (2003) user guidance scale ($\alpha = .80$). An example item reads, "The design of the system makes it difficult to make errors" ($\alpha = .74$).

Tailorability. Perceived tailorability reflects the degree to which the technical interface is flexible to user's changing level of expertise and needs. Two items for the current study were adapted from Lin, Choong and Salvendy's (1997) flexibility scale, part of a larger usability questionnaire (α ranged from .59 to .81; $M = .70$). An example item reads, "The display in the system is flexible, can be changed according to user preferences" ($\alpha = .74$).

Result Demonstrability. Result demonstrability reflects the degree to which the benefits of using the system are apparent and tangible to the user. Two items adapted from Agarwal and Prasad's (1997) research ($\alpha = .81$) were used. An example item reads, "I could easily describe the results from using the system to someone else" ($\alpha = .69$).

Outcome Measures

Current Use. The measure of current use is also based on the scale used by Agarwal and Prasad (1997; α = .92). An example item from the current 3-item scale reads, "I use the system whenever possible to do my work" (α = .82).

Future Intentions to Use. Intentions to use the technology was measured using a scale based on work by Agarwal and Prasad (1997; α = .81). An example item from the current 3-item scale reads, "I intend to use the system in the future for my work" (α = .67).

Utilization/Purpose. For exploratory purposes, participants also rated the degree to which they used the CMS for different purposes related to different system functionality. An example item reads, "Specifically, I use the system to post announcements" (α = .86).

Results

The analyses and results reported below are organized according to the hypotheses tested. Hypotheses are summarized in Appendix C. A correlation table including all variables in the current study appears in Appendix E.

Content of SSC (Hypothesis 1)

A slightly revised version of hypothesis 1, following the first pilot study, states, "Perceptions of critical mass, information exchange, technical support, evolutionary development, participatory climate, job relevance, social support, technology training, and workload will combine to reflect SSC, environmental cues that influence technology acceptance. Confirmatory factor analysis supported the 8 factor model as reasonably fitting the data ($\chi^2_{(467)} = 1281.28$; RMSEA = .06, $p < .000$; CFI = .90; NFI = .85). As one might expect, the factors are related (see Table 10 below). Cronbach's alpha for all items was .92.

Table 10. Correlations between SSC Dimensions and Use for Combined Sample

	1	2	3	4	5	6	7	8
1. Participatory Climate Perceptions								
2. Perceived Critical Mass	.30*							
3. Perceived Evolutionary Development	.26*	.30*						
4. Perceived Information Exchange	.64*	.44*	.44*					
5. Perceived Job Relevance	.30*	.54*	.36*	.38*				
6. Perceived Technical Support	.33*	.24*	.37*	.52*	.34*			
7. Technology Training Perceptions	.40*	.21*	.36*	.62*	.25*	.68*		
8. Workload Perceptions	.32*	.18*	.30*	.52*	.22*	.38*	.49*	
9. Current Use	.27*	.50*	.39*	.45*	.70*	.36*	.29*	.28*

Note: * $p < .001$;

When entered into a regression equation simultaneously, the 8 composite scales together account for 54% of the variance in system use and 37% of the variance in intentions to use the system in the future. Altogether, these results support predictions that the eight predicted factors reflect SSC.

SSC and Use Over time (Hypotheses 2 through 8)

Hypothesis 2 states, “Dimensions of SSC most influential to technology use will vary over time.” To address this hypothesis, I first classified the 7 university samples with sample sizes over 30 participants into stages using the stage profile survey data. To do so, I compared the average stage subscale scores for each university (see Table 11 below).

Table 11. Mean Stage Profile Ratings

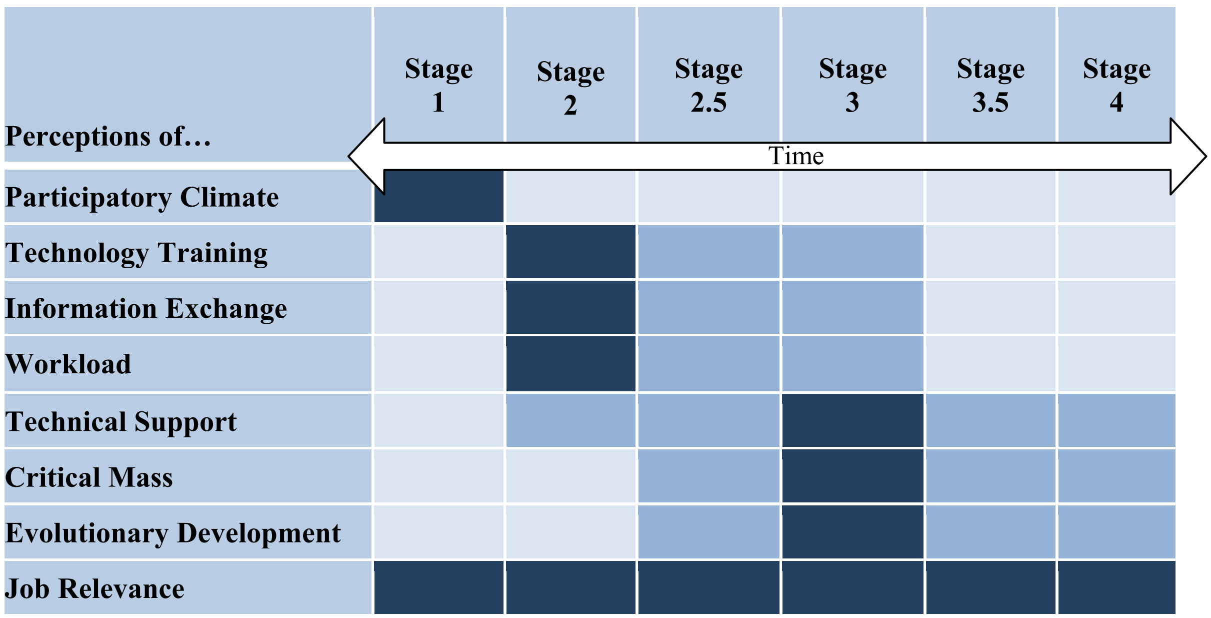
University Sample	Stage 1		Stage 2		Stage 3		Stage 4	
	M	$r_{wg(j)}$	M	$r_{wg(j)}$	M	$r_{wg(j)}$	M	$r_{wg(j)}$
A	2.73	.61	2.31	.50	**3.65**	.52	**3.02**	.41
B	NA	NA	2.74	.42	2.54	.72	**3.55**	.50
C	2.01	.69	**3.82**	.30	**4.21**	.53	2.38	.77
D	2.16	.79	**4.89**	.36	3.79	.32	1.84	.84
E	2.30	.68	2.27	.57	**3.56**	.46	**3.13**	.43
F	2.62	.78	2.19	.73	**3.30**	.41	2.71	.44
G	NA	NA	2.96	-.31	2.58	.60	**3.55**	.57

Note: Data for the stage 1 scale was unavailable for samples B and G

According to the means from Table 11, sample D represents stage 2, one sample reflects stage 3, two samples reflect both stages 3 and 4, and two samples reflect stage 4. However, it should be pointed out that the agreement (i.e., $r_{wg(j)}$) across participants from each university sample on each scale varied substantially, sometimes falling outside the commonly accepted range of < .70 (James et al., 1984).

Figure 5 below provides a modification of the stage model presented following the first phase of scale development to include the intermediate stages. Again, the lightest color cells in the figure suggest small relationships (*r* around .10) between the

SSC dimension are expected; darker colored cells suggest strong relationships are expected (r around .50) between the SSC dimension indicated and use. Cells that are moderately shaded reflected moderate (r around .25) expected relationships (Cohen, 1977, 1988).



Note: = strong expected relationship ($r \approx .50$); = moderate expected relationship ($r \approx .25$); = small expected relationship ($r \approx .10$)

Figure 5. SSC Dimensions Over time (modified to include interim stages)

The table above suggests that a strong relationship is expected between participatory climate perceptions and use during pre-implementation (i.e., stage 1; the decision-making stage). However, a small relationship is expected between this same SSC dimension (i.e., participatory climate perceptions) and use during other stages. Moderate relationships are expected between use and technology training perceptions, as reflected by the moderate shade in the corresponding cell.

If we look at correlations between SSC dimensions and system use across 7 universities arranged according to the stage within which they were classified, we do see some changes in relationships between SSC factors and use over time (see Table 12 below).

Table 12. Correlations between SSC dimensions and Use over time

Stage →	Stage 2	Stage 2.5	Stage 3	Stage 3.5		Stage 4	
Sample → / ↓ Perceptions of…	**D**	**C**	**F**	**A**	**E**	**B**	**C**
Participatory Climate	.01	.38	.34	.14	.26	.36	.37
Technology Training	.08	.27	.31	.13	.49	.34	.37
Information Exchange	.38	.52	.56	.33	.30	.48	.27
Workload	.24	.37	.42	.08	.00	.30	.31
Technical Support	.33	.33	.46	.19	.66	.39	.32
Critical Mass	.54	.33	.47	.57	.35	.54	.42
Evolutionary Development	.64	.33	.23	.24	.54	.40	.24
Job Relevance	.52	.67	.68	.78	.84	.72	.73

Note: [dark shading] = strong expected relationship ($r \approx .50$); [medium shading] = moderate expected relationship ($r \approx .25$); [light shading] = small expected relationship ($r \approx .10$)

While variation in relationships between SSC dimensions and use over time was observed for most variables, the magnitudes of relationships do not always follow the temporal pattern predicted in hypotheses 4 through 8. Inconsistent with expectations, for example, moderate relationships between participatory climate perceptions and use occurred in samples reflecting later stages. As predicted in the revised hypothesis 3 (see Appendix C), perceived job relevance had a consistently high, positive relationship with current technology use across all stages/samples. According to stepwise regression, perceived job relevance also absorbs the majority (48%) of the variance in use across subsamples. Perceived information sharing, perceived evolutionary development, and perceived critical mass account for an additional 4 percent of unique variance in system use. Remaining factors accounted for less than 1 percent unique variance in system use (see Table 13 below).

Table 13. Regression Results Explaining Current System Use

SSC dimension(s) included	**R**	$\mathbf{R^2}$	$\mathbf{R^2_{Adj}}$	$\mathbf{\Delta R^2}$	**p**
1. Perceived Job Relevance	.69	.48	.48		
2. Perceived Job Relevance AND Perceived Information Sharing	.72	.51	.51	.03	.00
3. Perceived Job Relevance; Perceived Information Sharing AND Perceived Evolutionary Development	.73	.53	.52	.01	.00
4. Perceived Job Relevance, Perceived Information Sharing, Perceived Evolutionary Development AND Perceived Critical Mass	.73	.53	.53	.01	.01

If we break down the results for each sample to reflect changes over time (see Table 14 below), we see a similar pattern of results; perceived job relevance accounts for most unique variance in almost every sample. In one sample, perceived evolutionary development accounts for more variance in use (34%) relative perceive job relevance. Even in this case, however, perceived job relevance still accounted for 13% of the unique variance in use. In some subsamples, no other SSC dimension accounts for more than .01 percent of the variance after perceived job relevance is taken into consideration.

Table 14. Explaining Current Use Across Subsamples

	SSC dimension(s) included	R	R^2	R^2_{Adj}	ΔR^2	p
Stage 2						
D	1. Perceived Evolutionary Development	.60	.36	.34		
	2. Perceived Evolutionary Development AND Perceived Job Relevance	.71	.50	.46	.13	.01
Stage 2 & 3						
C	1. Perceived Job Relevance	.71	.51	.50		
	2. Perceived Job Relevance AND Workload Perceptions	.76	.58	.57	.07	.00
Stage 3						
F	1. Perceived Job Relevance	.67	.45	.43		
Stage 3 & 4						
A	1. Perceived Job Relevance	.77	.59	.58		
	2. Perceived Job Relevance AND Perceived Evolutionary Development	.78	.60	.59	.01	.02
E	1. Perceived Job Relevance	.84	.70	.69		
Stage 4						
B	1. Perceived Job Relevance	.71	.51	.50		
	2. Perceived Job Relevance AND Perceived Evolutionary Development	.73	.54	.53	.03	.01
G	1. Perceived Job Relevance	.74	.54	.53		

It's important to note that the SSC dimensions other than perceived job relevance in the table above do not always reflect factors predicted to be central to use for the stages represented according to Figures 3 and 5. Hypothesis 5, for example, suggests that perceptions of technology training, information exchange or workload should be more influential to use relative other SSC factors, including perceived evolutionary development. So, while the current data provide support for the importance of time, the current results also suggest the relationships between SSC and time may differ from previous expectations.

The above analysis was repeated for the additional outcome variables included in the current study for exploratory purposes (see Appendix F). Correlation results were largely similar; revealing that many more SSC factors than originally predicted were moderately to highly related to both future use intentions and utilization/purpose than originally expected. Interestingly, however, perceived job relevance does not appear to have as strong a role in predicting future use intentions and utilization across all stages in comparison to current use. Some possible explanations for this and implications for conceptualizing and measuring use are provided in the discussion section.

SSC Boundary Conditions (Hypotheses 8 and 9)

Hypotheses 8 and 9 suggest individual differences, namely CSE and PIIT, and technical characteristics of the system, namely result demonstrability, tailorability, and operability, will moderate the relationship between SSC and use. To test these hypotheses, I used hierarchical multiple regression, entering a composite SSC variable into the equation first followed by the main effect for the personality variable or technical characteristic of interest, and lastly, an interaction term created by the cross-products of SSC and the moderator of interest (e.g., SSC X CSE). The table below presents the results from running the regression for each of the 5 moderator variables hypothesized.

Table 15. Regression Results for Potential Boundary Conditions

Factors entered	**R**	**R^2**	**R^2_{Adj}**	**ΔR^2**	**p**
1. SSC	.59	.35	.35		
2. CSE	.60	.36	.35	.00	.26
3. SSC X CSE	.60	.36	.35	.00	.66
2. PIIT	.59	.35	.35	.00	.53
3. SSC X PIIT	.59	.35	.35	.00	.46
2. Operability	.62	.38	.38	.03	.00
3. SSC X Operability	.63	.40	.40	.02	.00
2. Tailorability	.60	.36	.36	.00	.24
3. SSC X Tailorability	.61	.37	.36	.01	.01
2. Result Demonstrability (RD)	.66	.44	.44	.09	.00
3. SSC X RD	.67	.44	.44	.00	.59

Note: SSC = System Support Climate; CSE = Computer Self-Efficacy; PIIT = Personal Innovativeness with Information Technology

Contrary to hypothesis 8a and 8b, the results above suggest the personality variables related to computer use (i.e., CSE and PIIT) did not moderate the effects of SSC perceptions on use.

However, some support was found for the moderating effects of perceived technical characteristics (hypothesis 9). For example, perceived operability (i.e., perceived ease of use and error prevention) accounted for a small percentage of variance in self-reported use and interacted with SSC perceptions to influence use. This moderating effect is plotted and presented in Figure 6 below for ease of interpretation.

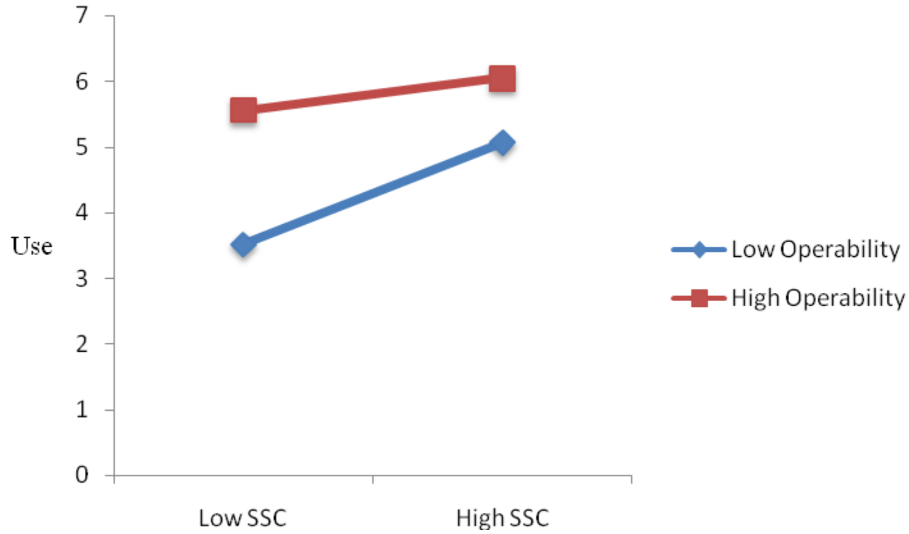


Figure 6. Moderating Influence of Operability

According to Figure 6 (above), we see that perceptions of SSC have a greater impact on use when operability of the system is perceived to be low. When the perceived operability of the system is high, SSC, although still important, has a smaller effect on use.

Although perceived tailorability (i.e., flexibility user has in the display and completion of frequently performed tasks) did not have a significant main effect on use, it appears to interact with SSC. Contrary to the moderating effect of operability, however, SSC climate appears to be more influential when tailorability is high rather than low (see Figure 7 below).

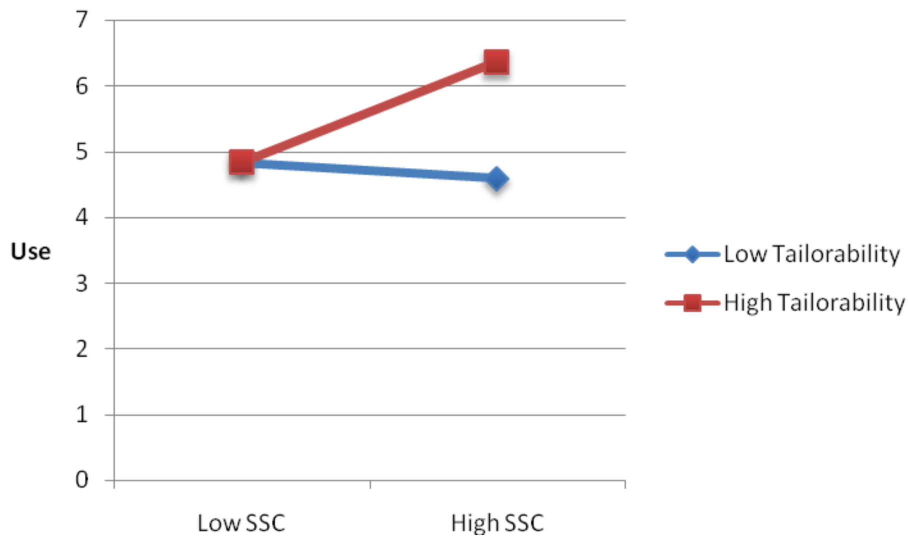


Figure 7. Moderating Influence of Tailorability

The results above suggest that SSC may help individuals better learn to tailor the system to their individual uses or styles and as a result increase their use of the system. SSC has little room to affect use when tailorability is low, however.

Although result demonstrability did not moderate the relationship between SSC perception and use in the current sample, a main effect was found, suggesting that a system that provides tangible evidence of its usefulness through outputs is more likely to be used than one that does not provide observable outputs.

Additional analyses (demographics)

Demographic variables were included in the current study for exploratory purposes. Based on correlations (see Appendix E), gender and position are both related to use as well as a number of SSC dimensions including perceived job relevance. The direction of the correlation suggests that women are more likely to perceive tasks supported by the system as job relevant ($r = .14$, $p < .05$) and (likely, as a result) also more likely to use the CMS ($r = .13$, $p < .05$) Similarly, participants in lower ranked positions (e.g., graduate student instructor, lecturers, etc.) are more likely to perceive the system as job relevant ($r = .16$, $p < .05$) and use it more often ($r = .13$, $p < .05$). According to regression results, gender accounts for unique variance above and beyond position ($\Delta R^2 = .02$, $p < .01$), suggesting the gender effects are not due to the slight tendency for women to hold lower level positions within the university.

To determine whether the strong effect of perceptions of job relevance on use might be explained by position and gender, stepwise regression was repeated controlling for these demographic variables. The results mirrored that presented in table 13. SSC factors accounted for 50% unique variance in use after controlling for gender and position. Perceived job relevance accounted for 45% unique variance after controlling for position and gender. Therefore, the effects of SSC on use cannot be completely explained by demographic variables (i.e., gender and position).

While age and teaching experience were related to a number of SSC dimensions and negatively related to CSE (see Appendix E), these demographic characteristics were not related to use, future use intentions or utilization. Similarly, race was not related to self-reported use, future use intentions or utilization. Therefore, these were not included as control variables.

Chapter 7

General Discussion

Consistent with the first hypothesis, the current study provides support for a multi-dimensional approach toward understanding how the organizational environment supports technology acceptance. Although regression analyses suggest fewer dimensions of system support climate accounted for incremental variance in use than at first expected, evidence from the first pilot study and university samples suggest technology users perceive support from their organizational environment as multifaceted. A multi-dimensional perspective of the contextual factors impacting technology use is consistent with previous work on organizational climate (e.g., Schneider, 1985). Furthermore, current results supporting the influence of SSC on use are consistent with theory and research on organizational climate as a behavioral influence in organizations (Schneider & Gunnarson, 1991). According to Schneider (1987), climate helps employees adapt their behavior by suggesting what is rewarded, supported and expected. Although further research is needed to elucidate precisely how SSC influences use, it is likely that these environmental cues (i.e., perceived job relevance, perceived information exchange, etc.) consciously or unconsciously indicate what levels of use are expected.

The results of the preliminary test of the SSC stage model also suggest that the types of support most related to use do change over time (supporting hypothesis 2). There is partial support for hypotheses indicating that certain dimensions of SSC are likely to be most influential at different stages. For example, regression results indicate that, in addition to job relevance, workload perceptions explain an additional 7% of the variance in self-reported use at a point during which users are likely training and learning to apply the technology to their work (stages 2 and 3). This is consistent with expectations based on previous TAM research (i.e., Lucas & Spitler, 1999) as well as theory noting the importance of practice time to transfer of training (Broad & Newstrom, 1992; Ford, Quinones, Sego, & Sorra, 1992). Altogether, this evidence implies organizational leaders should temporarily reduce workload pressures after implementation to allow users time to learn and practice using the system.

While the results of this preliminary investigation suggest time matters, the results also suggest the relationship between dimensions of SSC and use over time may be more complicated than originally predicted. Participants in the first pilot study, chosen for their experience with organizational change and/or technological change in theory or applied settings, were able to indicate most SSC dimensions were important to one or two stages. However, the results collected from CMS users across universities suggest many dimensions are influential over a much broader part of the system's lifespan in the organization. Many SSC dimensions, for example, had moderate to strong relationships with use in the later acceptance stage. Although it is unclear why participatory climate perceptions would be moderately related to use during later acceptance when decisions regarding the current system have been made, these findings suggest a need for future research to consider later stages of technology more carefully rather than simply focusing on the effects of environmental factors on acceptance during and shortly after implementation.

It is also possible that unique characteristics of the university samples account for some of the unexpected findings. The high level of autonomy experienced by university instructors and faculty as well as the lack of formal training may blur the effects of time.

That is, the lack of formal structure regarding activities that define the stages used in the current study may preclude finding variability in SSC-use relationships across samples. Future research could investigate alternative operationalizations for time in organizational settings with varying levels of structure to better understand changes in the need for support for technological change. Implementation of technology in military samples, for example, is more likely to involve formal, mandatory training with large numbers of users at one time. This would allow users to more reliably distinguish stages of implementation, and therefore might make SSC-use relationships more likely to follow the pattern predicted in Figures 3 and 5.

One result that stands out in the current study is the importance of perceived job relevance on individuals' decision to use a system. Job relevance, here, was defined as the centrality of the tasks supported by the system to one's overall job. Inclusion of this variable was inspired by previous research demonstrating a relationship between task structure, the routineness of the task(s) supported by the system and use (e.g., McFarland & Hamilton, 2006; Venkatesh & Davis, 2000). More specifically, research has found that non-routine tasks lead one to view the system as less likely to fit the task (Goodhue & Thompson, 1995) and also less likely to aid one's overall job performance (McFarland & Hamilton, 2006). Since it is possible that relatively non-routine tasks are important to one's job and the current study precluded a focus on any particular group of tasks, this variable is defined somewhat more broadly here. However, the conceptual similarities (i.e., routine tasks are likely to be perceived as job relevant) allow one to reasonably compare current results with that found previously.

Why is perceived job relevance so important? It is possible that lack of routine experience with the system, due to the nature of one's job and limits on the tasks which the system can support, does not allow one to learn the system effectively. Subsequent interactions with the system are then likely to be relatively difficult in comparison to those who use the system more frequently. Consistent with reinforcement theory (Skinner, 1938), negative experiences using the system are likely to reduce one's motivation to use it again. In other words, it is possible that a lack of job relevance affects use via its affect on perceived ease of use and negative experiences with the system. This would imply a need for organizational leaders to invest efforts toward making the system easier to use, perhaps via additional technical support and or training targeting infrequent users.

In addition, recognizing a lack of routine need for the system given the typical tasks one performs in his or her role within an organization may shape attitudes that the system is not important even prior to one's experience with it. In other words, job relevance may impact use via attitudes formed even prior to implementation. The high mean importance rating for job relevance in the pre-implementation stage in the first pilot study seems consistent with this explanation. This also implies a different set of potential interventions on the part of organizational leaders. For example, it might be possible for organizational leaders to positively impact perceptions of job relevance during early stages by providing information about the relevance of the system to one's overall job. This intervention strategy is similar to that used to increase transfer of training by informing trainees about the utility of the training effort prior to implementing the training (Burke & Hutchins, 2007) as well as interventions to increase one's perception of task significance (Grant, 2008). Future research is needed to understand through what mechanisms perceived job relevance affects technology acceptance in order to better understand the implications of this result for organizations.

The results of this preliminary investigation also suggest there are some potential boundary conditions on the relationships between SSC and use. Contrary to hypothesis 8, personality characteristics related to computer use (i.e., CSE and PIIT) did not moderate the effects of SSC on use in the current study. It's possible that, given the education level of the sample and subsequent likely interactions with other technologies, the range of CSE and PIIT was restricted in the current sample. Although the mean response for both CSE and PIIT scales were near the mid-point of the scale ($M = 4.31$ and 4.35 respectively), the modal response to the composite CSE scale was 6 on a 7 point scale. However, responses ranged from 1 to 7 for both factors, and histograms indicated roughly normal distributions. Therefore, it is difficult to conclude that the lack of effects were due to range restriction alone. However, future research could examine how employees in different industries with more variability in CSE (e.g., craft/ artisans or doctors versus employees in research or IT fields) might affect SSC-technology use relationships. Perhaps certain sets of individuals in different industries or even within different departments (i.e., different roles) in some organizations are more or less likely to resist technological change, thus requiring more support from dimensions of SSC.

As expected, perceptions of some of the technical characteristics of the system moderated the effects of SSC on reported use. Perceived operability (i.e., perceptions that the system is easy to operate; provides measures to prevent user errors) moderated the relationship between SSC and use such that SSC had a greater impact on use when perceived operability was low. However, there was also a main effect for operability, suggesting that a supportive climate, although helpful, cannot make up for poor system design.

In contrast to the relationship with operability, SSC appears to be more influential to one's decision to use a system when perceived tailorability (i.e., perception that the system is flexible to user's display and process preferences) is high rather than low. In other words, support from the organization does not seem to be counterbalancing perceived design deficiencies but rather has an enhancing effect with regard to the perceived flexibility of the system. It's possible that organizational support has this affect by making it more obvious how the system can be changed to fit users' differing needs and preferences. It is also possible that organizations that value individuality and innovation, such as university settings, are more likely to invest in systems that afford flexibility. Future research, perhaps including manipulations of system characteristics within similar organizational climates (i.e., examining the acceptance of different systems within one organization), could further explain the nature of these interactions.

The interactions highlight the importance of evaluating systems in context. The finding that the environment may enhance system affordances (i.e., tailorability) or compensate for a lack of perceived operability is consistent with research and theory related to transfer climate. Researchers suggest that the effectiveness of different training methods can be either enhanced or negated by the work environment (Mathieu, Tannenbaum, & Salas, 1992; Tannenbaum & Yukl, 1992). That is, the work environment interacts with the training to affect the degree to which learning transfers to the job. Similarly, the current research suggests perceptions of the work environment interact with system characteristics to impact use.

It is possible that SSC interacts with system characteristics to affect use by supplying cues to reduce the uncertainty about how employees should be applying system affordances to their job. This would be consistent with the perspective that individual differences and organizational factors affect the frame from which individuals interpret how new technology is used “including the specific conditions, applications, and consequences of that technology in a particular context” (Orlikowski & Gash, 1994, p. 178). That is, the environment may influence use by providing a frame to understand technical characteristics of the system. In this way, SSC may act to bring users’ mental models regarding the purpose and use of the technology in line with that of developers and managers.

With a growing understanding of the impact of individual differences and technical characteristics on SSC-use relationships, future research could also examine the incremental/differential impact of technology characteristics, SSC, and individual differences on technology use. This could help address a broader question for organizational leaders: Is it better to select the right employees for the technology, design the right tool, or mold the best possible environment?

Limitations

The current study provides some evidence toward the development and preliminary test of a SSC stage model. The results of this investigation need to be interpreted with caution, however, in lieu of practical constraints and other study limitations. Some examples of the limitations of the current study, implications for interpreting the current results, and associated needs for future research are discussed below.

Difficulties measuring time and technology

Although the rationale for using a stage profile based on user perceptions seems reasonable given some of the arguments raised in chapter 6, the results provide a relatively more complicated picture than expected. Not surprisingly, the results of the stage profile survey (see Table 11) did not correspond directly to the length of time the systems had been implemented in the current sample (see Table 9). The correlation between time (dummy coded as the number of months since implementation) and stage category was strong ($r = .81$; $p < .001$) indicating that chronological time is strongly related, although perhaps not a direct proxy for stages as understood by the types of events or behaviors that occur during the implementation of technology in organizations. However, the reliability of the stage 3 scale (i.e., early acceptance) was low, and a number of samples in the current study could not be cleanly categorized into one stage. This may be due to low levels of agreement across participants within certain subsamples for certain stage items (see results of rwg, Table 11). More importantly, however, this result has implications for the applicability of the hypothesized stage model (i.e., Figure 3) as a prescriptive model for organizations. If stages are not relatively easily identifiable in organizational settings, it may be difficult to apply recommendations regarding which types of support organizational leaders should invest in. Therefore, there is a need for future research regarding the conceptualization of time and technologies in organizations for the SSC stage model to be practically useful.

Self-report measured of technology use

There is some concern that subjective measures of system use do not reflect reality when compared to objective indices of use (Rice & Borgman, 1983; Straub, Limayem, & Karahanna-Evaristo, 1995). Objective measures typically include system logs representing indices such the length of time one is connected to a system (Srinivasan, 1985), the frequency of computer sessions of a particular type (Ginzberg, 1981), etc. Furthermore, self-report measures are susceptible to response bias, demand characteristics (Straub, 1989), and method bias (Campbell & Fiske, 1959; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003; Spector, 1987, 1994). Relative self-report measures, objective measures are used less often in IT-related research (Choudrie & Dwivedi, 2005; Straub et al., 1995) likely due to practical constraints such as the need to maintain users' privacy in most organizational settings. However, future research using objective use measures should be considered.

In addition, the results presented in Appendix F suggest that the influence of support changes to some degree when we conceptualize acceptance as utilization, measuring the functionality used as well as the purpose for which a system is used, as opposed to mere quantity or frequency of use. Similarly, the impact of SSC dimensions on future use intentions differed slightly from those reported for current self-reported use. Altogether, this suggests a need to better understand/conceptualize use and acceptance in future research.

Bernard (2006) proposes a typology of use, including (1) conservative use, (2) reluctant use, (3) candid use, and (4) ambivalent use. According to Bernard (2006), conservative use reflects high quantitative use, but poor qualitative input and interactions with the system. This may be analogous to poor utilization with high frequency of use. Reluctant use and ambivalent use reflect low use in terms of quantity of interactions as well as quality, and candid use reflects true acceptance of the system with high quality and quantity interactions. Intentions for future use would also be high in this scenario. Although future research is needed to provide empirical support for this typology, it is possible that operationalizing acceptance in this way would account for some of the differences found here.

Cross-sectional research design

The purpose of the current study was to find initial support for a multidimensional, stage model of SSC. Although the current study affords this to some extent, the cross-sectional design precludes a deeper examination of impact of time on relationships between the working environment and technology acceptance. Given the importance of the temporal element of this model, proposed effects of SSC may be better tested using a longitudinal research design in the future. A longitudinal design could potentially allow one to investigate of how the level of SSC and subsequent use or intentions at one stage affect SSC-use relationships in subsequent stages. For example, it is possible that successes in early stages of the technology's conception and use in an organization (i.e., early wins) support later use, making SSC less crucial in later stages. On the other hand, negative experiences in early stages may increase the need for SSC, although it is likely there will be limits to how much SSC in later stages can compensate for negative system interactions or low SSC in early stages of implementation.

Method Bias

All of the measures in the current study were self-reports, making the results subject to common method bias (CMB) also known as common method variance or monomethod bias (Campbell & Fiske, 1959; Podsakoff et al., 2003). CMB reflects the occurrence of spurious relationships between variables that may occur when the same method is used to measure correlations between variables. In other words, the variables may appear to be related, but the relationship may reflect correlated errors (Campbell & Fiske, 1959). Method bias can result from having a common respondent for independent and dependent measures, a common context in which all measures are completed, as well as commonalities in the items, such as similar response formats (Podsakoff et al., 2003), and may have inflating or attenuating effects on observed relationships (Cote & Buckley, 1987).

Some past research touts the importance of this concern (Podsakoff et al., 2003), while others suggest it is akin to an urban myth (Spector, 2006). Factor analytic research suggests common method bias has not been a major concern for previous TAM research (Pavlou, Dimoka, & Housel, 2008; Premkumar & Bhattacherjee, 2008; Shih, 2003). However, researchers using other statistical techniques suggests otherwise (Gentry & Calantone, 2002; Schwarz, Schwarz, & Rizzuto, 2008).

In the current study, anonymity was assured and measures of the predictor constructs and outcomes variables were distinct providing some psychological separation as per recommendations by Podsakoff and colleagues (2003). For a very liberal test of common method bias, I tested the fit of a single factor structure on the data. According to the results, a single SSC factor did not fit the data ($\chi^2_{(495)} = 4466.55$; RMSEA = .13, $p < .000$; CFI = .50; NFI = .47). However, this is an extremely liberal test of CMB and Podsakoff and colleagues (2003) argue method bias may still be present even if a single factor structure does not fit the data. Therefore, I also compared model fit between the 8 factor SSC model and a model including an additional 'methods' factor in keeping with methods recommended by other researchers for testing for CMB (e.g., Williams, Cote, & Buckley, 1989). As one might expect, when adding additional parameters, the model containing the 'methods' factor fit the data better ($\chi^2_{(434)} = 966.30$, $p < .00$; RMSEA = .05, $p = .23$; CFI = .93; NFI = .89). More importantly, the difference between the fit of this model and the 8 factor model presented previously was statistically significant ($\Delta\chi^2_{(33)} = 314.91$, $p < .00$). Some research suggests that since I was able to find some more complex relationships in the data (i.e., some significant interactions) and the unstandardized regression weights for the majority of the items in the current study were significant, the presence of CMB does not nullify the results (Wall, Jackson, Mullarkey, & Parker, 1996). However, I also cannot rule out method bias as an explanatory factor. Therefore, it is recommended that future research utilize study design methods to decrease the effects of common method bias, such as collecting predictor and outcome variables at separate points in time and/or from different sources.

Additional Future Research Recommendations

In addition to some of the future research recommendations made above, future research could expand this investigation by examining (a) the mediating mechanisms between SSC and technology acceptance, (b) potential additional dimensions of SSC as well as (c) multi-level effects and system integration issues.

Mediating Mechanisms

Although SSC points to organizational facilitators of technology use, providing precise prescriptions to organizational leaders wanting to increase technology acceptance requires understanding the mechanisms by which SSC affects use. TAM mediating variables (i.e., beliefs and attitudes), for example, may explain why the various dimensions of support impact decisions to use the system. Does SSC affect technology use due to an impact on perceived usefulness and ease of use? If so, which dimensions contribute more or less to which of these two core beliefs? Do these relationships hold over time? What other mediating mechanisms might better explain why and how SSC affects use?

Levels and Dimensions of SSC

SSC was conceptualized as at the individual level of analysis in the current study (i.e., psychological rather than organizational climate). Future research could explicate the nature of SSC conceptualized at multiple levels and examine cross-level relationships to determine whether or not effects of psychological climate and organizational climate are interdependent (Glick & Roberts, 1984; Mossholder & Bedeian, 1983). Within-organization variance, for instance, may have implications on the interpretation of SSC as an organizational-level variable.

For practical purposes as well as a desire to maintain parsimony, the content of SSC proposed here was based primarily on a review of research in support of one model largely investigated in the IS community, namely TAM. The brief review of other models is provided in Appendix A suggests there may be many other factors to consider. Furthermore, it is possible that different types of system require different types of support. For example, Bernard (2006) proposes that use of knowledge management systems (KMS) is determined by psychological safety and rate of episodic change in teams (Bernard, 2006). A KMS is an information system that facilitates collection, integration, and dissemination of organizational knowledge for purposes of re-use and learning (Alavi & Leidner, 1999). It is possible that psychological safety applies only to certain types of systems, such as KMS. And, empirical support for the effect of psychological safety on groupware systems like KMS is needed. Therefore, this factor was not included in the current study. Future research could continue to expand on the types of support critical to system use for different types of technology as well as different organizational environments.

Other Multilevel Effects and System Integration

In addition to examining potential multi-level influences of SSC, future research could also examine whether or not it is reasonable to conceptualize different levels of technology acceptance at the group or organizational level. It may be possible, for example, to conceptualize organizations as ambivalent or reluctant in terms of their acceptance and/or readiness to support technological change.

In addition to examining multiple levels of organizational influences, further research is needed to understand how different levels of system integration affect system usability and acceptance. More and more, systems such as CMS, are becoming integrated with other organizational systems. For example, the course management system used by at least one of the samples in the current study is linked to the university registration system. This allows all students registering for a particular course to be automatically listed in the CMS system for that course as well, saving the instructor time he or she would otherwise need to manage the course roster. Furthermore, most CMS provide multiple functionalities. Research suggests understanding the design and evaluation of such complex, integrated systems requires methods sensitive to the integration and contextual complexities (Haynes, 2009; Haynes, Skattebo, Singel, Cohen, & Himelright, 2006). Haynes (2009), for example, explains that understanding the usability of any individual application or function within a complex system "is highly determined by its integration with other applications in the distributed system" (p. 3051).

In sum, understanding technology acceptance of collaborative systems in context, such as CMS, requires an appreciation for many layers of complexity both within the organization as well as the system. Taking into account such complexity may require more in-depth ethnographic approaches and/or hybrid qualitative/quantitative approaches, such scenario-based evaluation (Haynes, Purao, & Skattebo, 2009; Haynes, Purao, & Skattebo, 2004). Future research using such techniques might be able to better shed light on the effects of organizational influences on system acceptance over time.

Chapter 8

Conclusion

The current study extends previous research examining organizational climate affects on technology use (Klein et al., 2001) by extrapolating the content of the climate variable as well as examining time in relationship to research and theory in organizational behavior (George & Jones, 2000; Mitchell & James, 2001; Zaheer et al., 1999). The results presented and discussed here provide a more concrete understanding of climate for technological support and suggest time matters in our understanding of the support for technological change. The current research also supports the importance of a number of similar factors examined in much of the IS literature. In contrast to some of the previous research, the current study couches external support in psychological terms thereby providing a way to operationalize situational attributes consistently and quantitatively for future research.

In sum, the current research provides some conceptual and methodological contributions that may prove useful in our effort to inform organizations about how they might best focus limited resources to support technological change. The current results reveal the examination of time may provide some practical ways to help organizations better invest in different types of support. However, future research is needed to better elucidate the content and impact of SSC over time.

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Appendix A

Models of Technology Acceptance/ Adoption

Diffusion of Innovations Theory

According to Rogers (1995), "*Diffusion* is the process by which an innovation [new idea] is communicated through certain channels over time among the members of a social system... [and]… *Adoption* is the decision to make full use of an innovation" (p.35-37). Variables determining the rate of adoption can be grouped into 5 categories: (1) perceived attributes of innovations, (2) type of innovation decision, (3) communication channels, (4) nature of the social system, and (5) extent of change agents' promotion efforts.

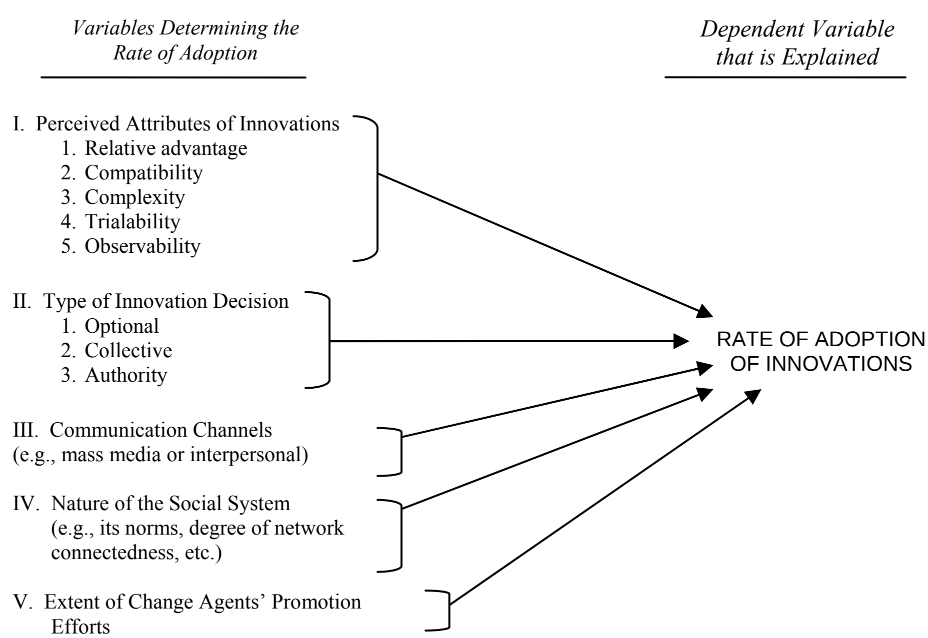

Figure 8. Diffusion of Innovations Model; from Rogers (1995) p. 207

According to Rogers (1995), 49 to 87% of the variance in the rate of adoption is explained by 5 perceived attributes of innovations: (1) relative advantage, (2) compatibility, (3) complexity, (4) trialability, and (5) observability. *Relative advantage* is the degree to which an innovation is perceived as being better than the idea it supersedes, often expressed as economic profitability, social prestige, decrease in discomfort, or savings in time and effort. *Compatibility* is the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential adopters. *Complexity* refers to the degree to which an innovation is perceived as relatively difficult to understand and use. *Trialability* is the degree to which an innovation may be considered experimental, allowing potential adopters a limited trial period, before making an adoption decision. *Observability* is the degree to which the results of an innovation are visible to others.

The theory applies to all innovations (ideas), not only technology. The level at which the theory has been applied appears to be mostly societal rather than organizational. For example, most of the research examining the impact of the attributes above was conducted using U.S. commercial farmers (Rogers, 1995). Furthermore, research examining the impact of the attributes of innovations has been equivocal. According to researchers, previous published research provides evidence for only 3 of the 5 attributes above (relative advantage, compatibility, and complexity); evidence for the importance of relative advantage and compatibility was not consistent (Tornatzky & Klein, 1982). The dependent variable, rate of adoption, suggests that support for the model is likely to be measured using a binary decision (to adopt or not adopt an innovation) and is less likely to be measured as the degree/extent of usage.

Groupware and Social Dynamics (Grudin, 1994)

Most interest in groupware development came from developers and users of single-user, commercial off-the-shelf (COTS) systems. However, problems unique to supporting groups are likely to occur when implementing groupware (Grudin, 1994). Grudin provides a summary of these new problems in addition to traditional Human Computer Interaction (HCI) issues. We can think of these problems as taxonomy of factors impacting groupware acceptance.

Challenge	**Addressing the problem**
1. Disparity in work/benefit	Increase collective benefit; make indirect benefits explicit
2. Critical Mass; mandating us is often not feasible for groupware	Reduce work required, create incentives, emphasize individual and collective benefits
3. Disruption of social processes & political structures	Work with representative users to understand workplace social issues
4. Exception handling– design is often too inflexible for practical use	Avoid decoupling of org rules at local level, developer should learn how work is done; customize when possible
5. Unobtrusive accessibility – group features used less frequently, need to be integrated w/, not obstruct other features	If possible, add groupware features to already successful, frequently used single-user features. Increase awareness and access to infrequently used features.
6. Difficulty of evaluation – complexity prevents learning from experience	"Development managers must enlist the appropriate skills, provide the resources, and disseminate the results." (p.100)
7. Failure of intuition	Development should recognize the fallibility of intuition
8. Adoption process – lower visibility of groupware requires careful implementation	Add groupware features to single-user features Or design groupware to meet user needs; understand work environment to help support strategies like training

Information System Success Model (DeLone & McLean, 1992)

DeLone and McLean (1992) suggests the accuracy and efficiency of information systems (i.e., system quality) and information quality (i.e., degree to which information transmitted conveys the intended meaning) affect use and satisfaction which then influence different types of impacts or outcomes for both the individual and organization.

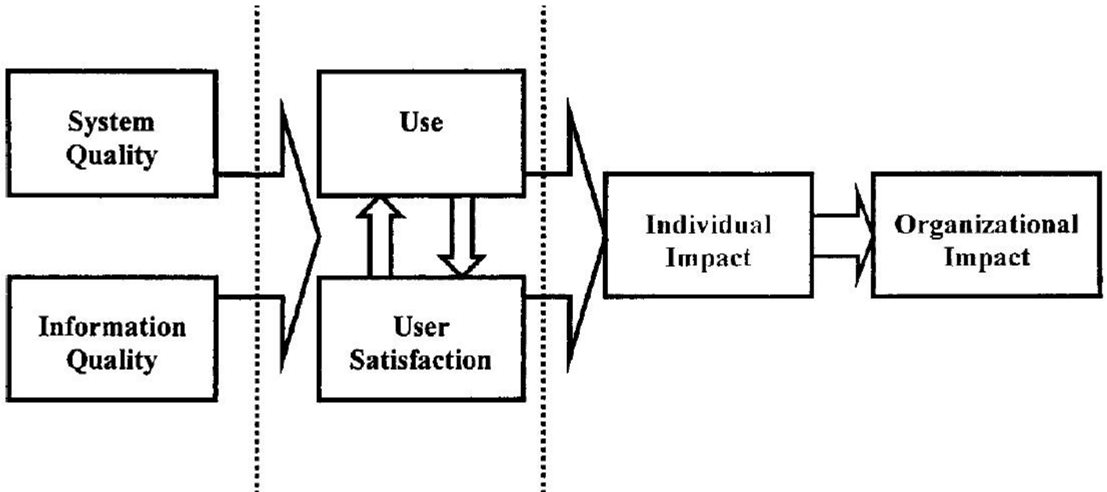

Figure 9. IS Success Model from DeLone & McLean (2003) Figure 1.

Although there is some support for this model (DeLone & McLean, 2003), this purpose was to better define dependent variables of interest and rather than understand organizational/contextual influences on use. Therefore, this was not used in the current study.

Model of PC Utilization (MPCU)

Thompson, Higgins and Howell (1991) adapted a theory of human behavior (Triandis, 1980) to the context of information system utilization. The main concepts in the model include job-fit, complexity, long-term consequences, affect towards use, social factors, and facilitation conditions. Job-fit reflects the belief that using a system can enhance performance on one's job. Complexity refers to perceptions of the ease with which the system can be learned and used. Long-term consequences refer to a perception that using the system will pay-off in the future. Affect towards use reflects feelings of joy, digust, etc. associated with use. Social factors reflects an individual's internalization of a referent group's norms including interpersonal agreements regarding use. And, finally, facilitating conditions reflect environmental factors that ease system utilization, such as technical support.

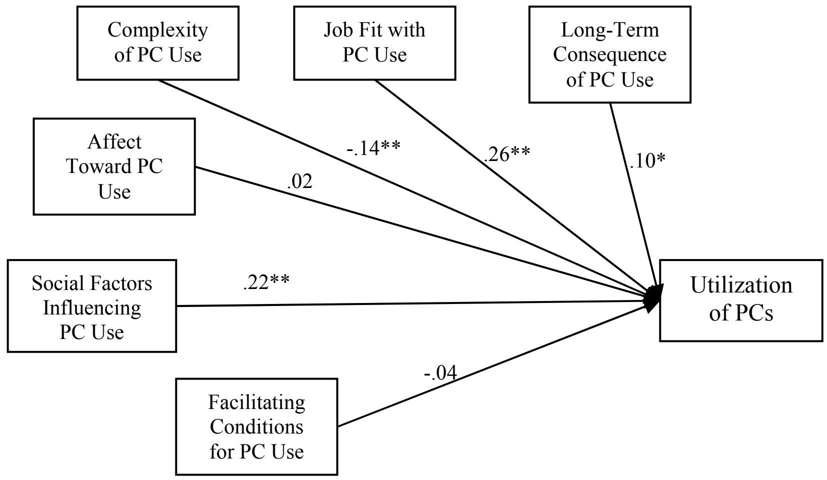

Figure 10. Model of PC Utilization (Thompson, Higgins, & Howell, 1991)

Surveying knowledge workers in a large multinational manufacturing organization, Thompson and colleagues (1991) found initial support for their scales (α ranged from .60 to .86), although correlations revealed some multicolinearity between social factors and facilitating conditions as well as between affect and consequence-related constructs. Path coefficients reported in their report are displayed above (*$p < .01$; **$p < .05$). Altogether, the variables in the model accounted for 24% of the variance in PC utilization. Further tests of this model, however, are difficult to find.

Motivational Model (MM)

In their motivational model, Davis, Bagozzi and Warshaw (1992) applied theory regarding instrinsic and extrinsic motivation to understand new technology adoption and use. The authors suggest both intrinsic and extrinsic motivation explain technology use. Extrinsic motivation to use the technology refers to the perceptions that system use will be instrumental in achieving valued outcomes for the user, such as improved job performance and pay increases. Instrinsic motivation, on the other hand, refers to motivation to use the technology for no apparent outcome other than the enjoyment in the process of use.

The theory has been applied in a handful of studies (e.g., Venkatesh & Speier, 1999). The theory applies to the case of new technology use rather than sustained acceptance, and hence has limited applicability. However, the variables in this model share conceptual similarities to other factors considered in the current study, namely perceived job relevance and PIIT.

Task-Technology Fit (TTF) Model

Goodhue developed the task-technology fit (TTF) model (Goodhue, 1988, 1998). He suggests that a good *fit* occurs when the capabilities of the technology match the demands of the task. Goodhue (1998) suggested an individuals' evaluation of TTF is determined by task characteristics, individual characteristics, and system functionality and services. He hypothesized that the correspondence between the system's functionality and task requirements leads to positive user evaluations and higher performance. Furthermore, Goodhue (1998) argues that as the task characteristics and abilities of the individual change, the system and services must change accordingly to meet new demands. Therefore, task characteristics and individual characteristics are displayed as moderating the relationship between system and services and user evaluation.

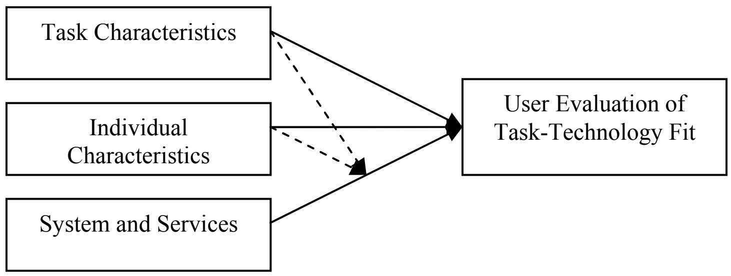

Figure 11. Task Technology Fit Model from Goodhue (1988)

Although there has been some support for the model in research (e.g., Goodhue, 1995a, 1995b; Goodhue & Thompson, 1995), a universal definition of *fit* does not exist (Dishaw & Strong, 1998). It is also possible that fit could mediate the relationship between task, individual, and system characteristics and TAM. Dishaw and Strong (1998), for example, suggest that software would be used by individuals, if and only if, the system *fit* the needs of the user.

Technology Acceptance Model (TAM)

The *Technology Acceptance Model* (TAM) extends the theory of reasoned action (Ajzen & Fishbein, 1980) and reflects how users come to accept and use technology (Davis, 1989; Davis, Bagozzi, & Warshaw, 1989). The goal of TAM, according to Davis et al., (1989) is "to provide an explanation of the determinants of computer acceptance that is general, capable of explaining user behavior across a broad range of end-user computing technologies and user populations, while at the same time being both parsimonious and theoretically justified" (p. 985). Specifically, the model suggests that when users are presented with a new software package, beliefs about the system which are learned through their experiences with it will influence their attitudes (affective response to the system) and thus decision about how and when they will use it. According to Davis (1989), the key beliefs include p*erceived usefulness,* the degree to which a person believes that using a particular system will enhance his or her job performance, and p*erceived ease-of-use*, the degree to which a person believes that using a particular system would be free from effort. It's important to note that these beliefs are perceptual concepts and not innate attributes of the technology. Furthermore, the model suggests that these beliefs are predicted to intervene between the influence of external factors and attitudes.

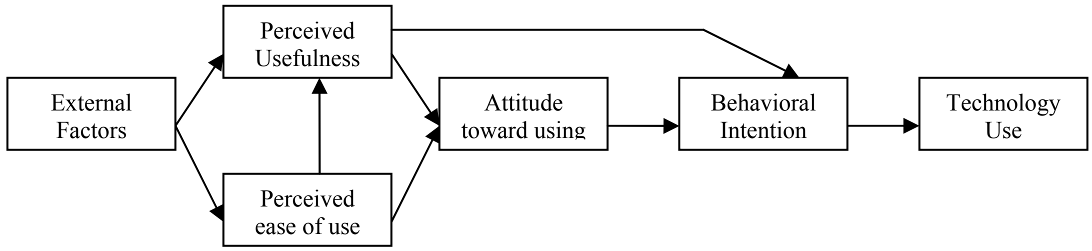

Figure 12. TAM based on Davis et al., (1989)

Davis (1989) suggests external factors might include a range of factors from individual differences to situational constraints and/or managerial interventions. Some of the external factors examined empirically in past research are summarized in Appendix B.

TAM 2

Venkatesh and Davis (2000) extended TAM to include some addition determinants of perceived usefulness and intentions (see figure below).

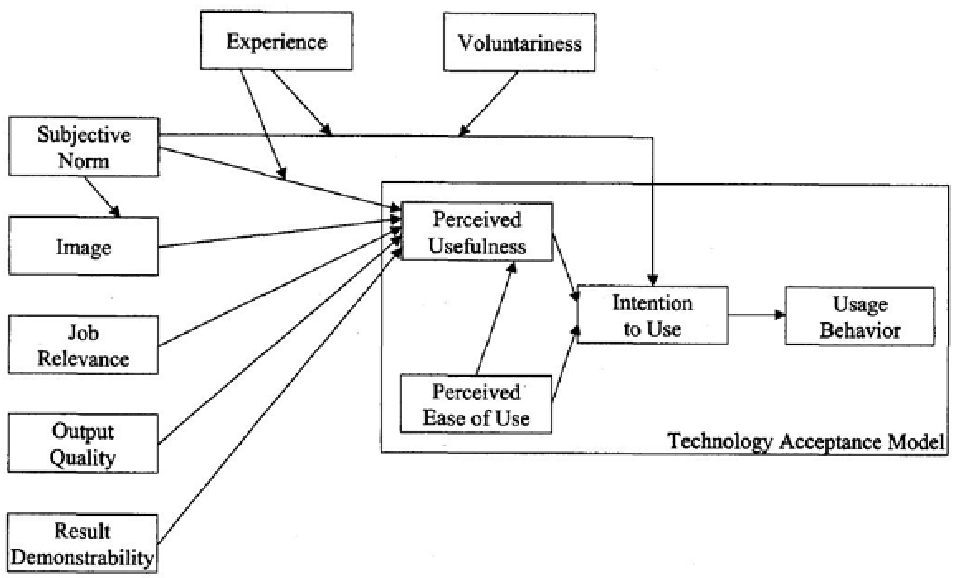

Figure 13. TAM2 from (Venkatesh & Davis, 2000)

According to Venkatesh and Davis, image reflects the degree to which use of an innovation is perceived to enhance one's social status. Job relevance reflects the perception that the system is relevant to one’s job. Objective usability reflects one’s actual (versus perception of one’s) level of effort required to complete specific tasks using the system. Output quality reflects the degree to which an individual believes the system performs job tasks well. Result demonstrability reflects the tangibility of the results of using the innovation. Subjective norm is similar to perceived critical mass and/or social influence and reflects a person's perception that most people who are important to him or her think he or she should perform the behavior in question. And, voluntariness reflects the extent to which potential adopters perceive the adoption decision to be non-mandatory.

According to Venkatesh and Davis (2000), the additional variables account for up to 60 percent of variance in perceived usefulness and up to 52% of variance in usage intentions. Additional tests of this extended model are needed. The additional variables, however, are included in the review presented in Appendix B.

Theory of Planned Behavior (TPB) & Decomposed TPB

Some researchers have used the Theory of Planned Behavior (TPB) to explain technology use, claiming TAM omits too many potential variables in favor of parsimony (e.g., Mathieson, 1991; Taylor & Todd, 1995b). Although also based on the Theory of Reasoned Action like TAM, TPB includes subjective norms, individual's perceptions of other's opinions about what behaviors are appropriate, and perceived behavioral control, a concept related to an individual's perception of the ease or difficulty of performing a certain behavior.

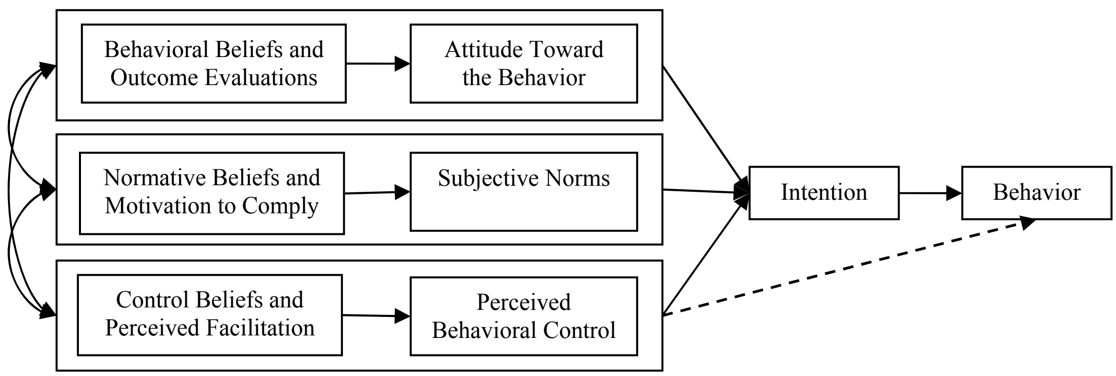

Figure 14. Theory of Planned Behavior (Ajzen, 1991)

In sum, the model above suggests that the more favorable the attitude, the subjective norm, and the perceived control, then the stronger the person's intention to perform the behavior should be.

Taylor and Todd (1995) modify TPB to the specific case of technology usage behavior, creating the Decomposed Theory of Planned Behavior, presented below:

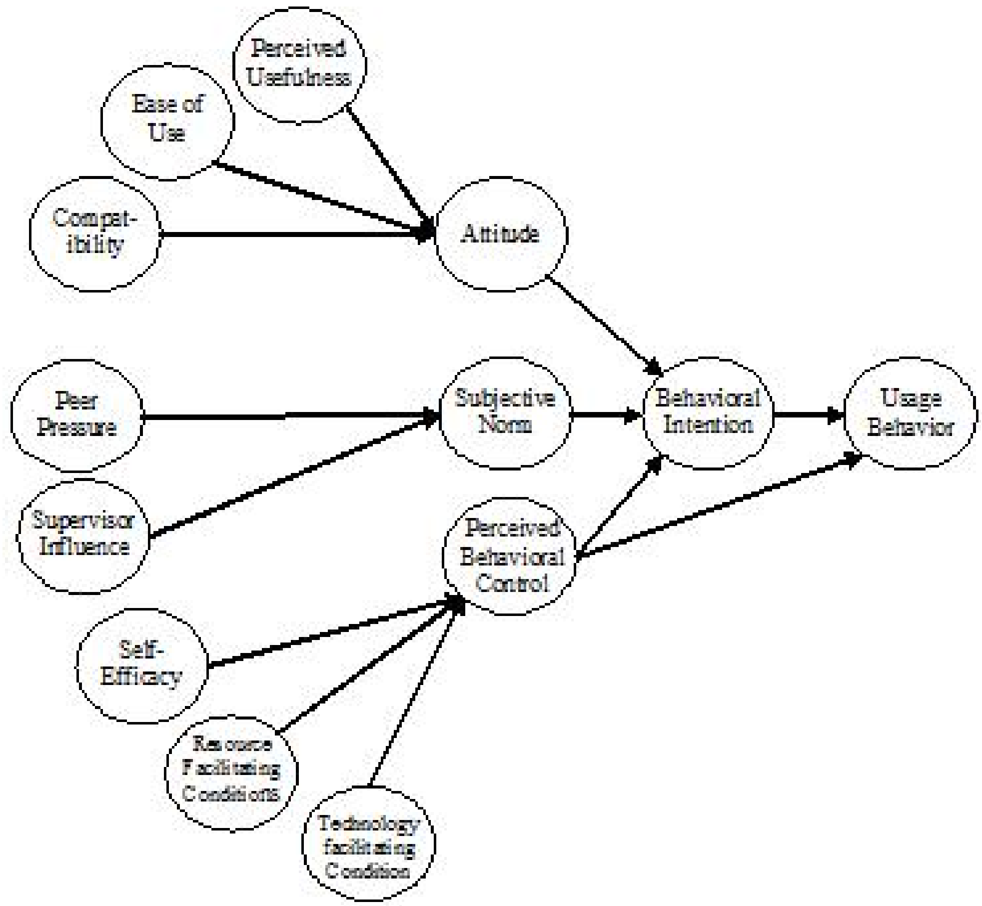

Figure 15. Decomposed Theory of Planned Behavior (Taylor & Todd, 1995)

Taylor and Todd (1995) present some evidence that this model provides slightly more predictive power than TAM (explaining 36% of the variance in usage as opposed to 34% from TAM), but this modest increase comes at the expense of complexity (13 constructs versus 5). Furthermore, this model has received relatively less support in comparison to TAM.

Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh and colleagues (2003) created a unified theory of acceptance and use of technology (UTAUT), expanding TAM with 4 core determinants of use intentions and behavior and 4 moderators (see figure below).

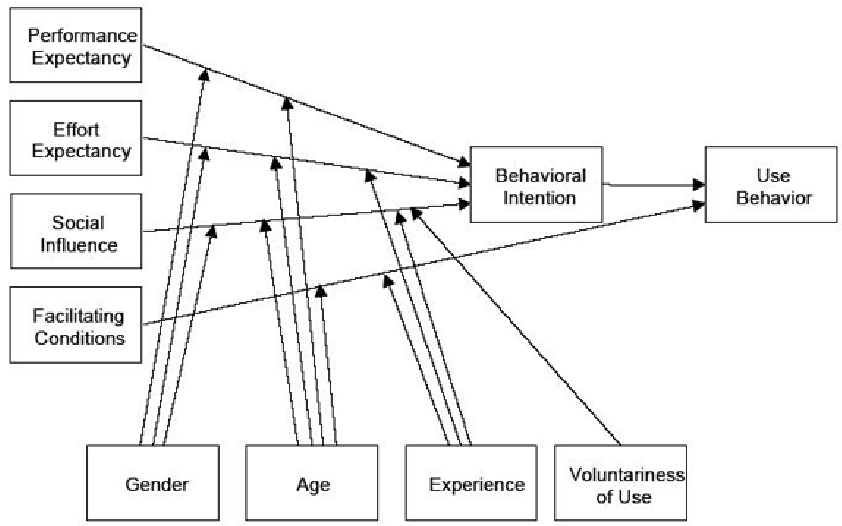

Figure 16. UTAUT from (Venkatesh et al., 2003)

Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance. Effort expectancy is conceptually similar to ease of use. Social influence is similar to the concept of perceived critical mass, the perception that important others think one should use the new system. Facilitating conditions reflect the degree to which an individual believes that an organizational and technical infrastructure exists to support system use. Voluntariness reflects the extent to which the decision to use the system is perceived as non-mandatory.

According to Venkatesh and colleagues (2003), UTAUT explains 69 to 70 percent of the variance in self-reported use of technology, more than that explained by 8 other models examined. The additional factors were included in the current review (see Appendix B).

Appendix B

Review of TAM External Factors

Factor	Definition	Findings	Source
Technology Characteristics			
Compatibility	Degree to which an innovation is perceived as consistent w/ existing values, needs, past experiences of adopters	Related to PU & PEOU	(Chau & Hu, 2001)
		Related (Rel) to Use	(Agarwal & Prasad, 1997)
		NS	(Karahanna, Straub, & Chervany, 1999)
		NS	(Taylor & Todd, 1995b)
Enjoyable/ Fun	Extent to which using a system is enjoyable, fun to use, aside from instrumentality	Proposed related to PEOU	(Davis et al., 1992)
		Rel to Attitudes & Use	(Igbaria, Schiffman, & Wieckowski, 1994)
		Related to Intentions (I)	(Koufaris, 2002)
		Related to PU, At, & Use	(Roberts & Henderson, 2000)
		Related to U	(Teo, Lim, & Lai, 1999)
		Related to PEOU	(Venkatesh, 2000)
		Proposed relation w/ I	(Venkatesh, Speier, & Morris, 2002)
		Rel. to PU, PEOU & CSE	(Yi & Hwang, 2003)
Functionality	Programmer assessment of the functions offered by the tool (Likert scale)	Related to PEOU & task-technology fit	(Dishaw & Strong, 1999)
	Technology performance –system's ability to meet order processing needs	Related to U	(Lippert & Forman, 1995)
Objective Usability	Ratio of expert to novice user's time to complete a task	Related to PEOU	(Venkatesh & Davis, 1996)
Output Quality	Evaluation term from TRA	Rel to At, inconsistently	(Davis et al., 1989)
	Data relevance, accuracy, timeliness, completeness	Related to PU	(Lederer, Maupin, Sena, & Zhuang, 2000)
	Reliability, data accessibility,	Related to PU & PEOU	(Lucas & Spitler, 1999)
	Perceptions of system performance	NS	(Venkatesh & Davis, 2000)
	Information Quality & Timeliness	2 factors via CFA, NS	(Colvin & Goh, 2004)
Relative Advantage	Extent to which an innovation offers an advantage over the previous way of performing the same task	Related to Intentions (I) NOT Use	(Agarwal & Prasad, 1997)
Result Demonstrability	Tangibility of the results of using an innovation; Degree to which results are observable & communicable to others	Related to I NOT Use	(Agarwal & Prasad, 1997)
		Related to Attitudes	(Karahanna et al., 1999)
		Related to PU	(Venkatesh & Davis, 2000)
Social Presence/ Information Richness (SPIR)*	Extent one to experiences others as psychologically present; self-report scale	Related to PU	(Gefen & Straub, 1997)
		Related to PU	(Straub et al., 1995)
System Quality	Not defined/ operationalized	NS	(Leong, 2003)
	Functionality, performance, interactivity	Rel to CSE, PU, PEOU	(McFarland & Hamilton, 2006)
Type of system	Binary; E-mail vs. Text-editor	Related to PEOU & At	(Davis, 1993)
Task Characteristics			
Job relevance	Degree to which the system is applicable to his/her job; importance & routineness of tasks the system supports to one's job	Related to PEOU & Use	(McFarland & Hamilton, 2006)
		Related to PU	(Venkatesh & Davis, 2000)
Organizational/Social Influences			
Argument of Change	Reasons given for changing system (e.g., efficiency) or the decision to adopt	NS	(Jackson, Chow, & Leitch, 1997)

Computing Support (technical support)	Availability of assistance - internal & external sources	External (only) related to PU & PEOU	(Igbaria et al., 1997)
	Perceived resources - extent one believes he/she has resources needed to use IS	Related to PU, PEOU, At, I, and Use	(Mathieson, Peacock, & Chin, 2001)
	Support services like tutorials, training, help lines etc.	Related to PEOU	(Robinson, Marshall, & Stamps, 2005)
	Resource Availability - E.g., Having enough printers and computers for everyone; Inexpensive printing, etc.	Related to Perceived Control	(Taylor & Todd, 1995b)
	Facilitating Conditions - objective presence of technical group	Related to U	(Venkatesh et al., 2003)
Evolutionary Development	Perception that the system will continue to develop or change after implementation	Case study – related w/ PU and PEOU	(Behrens et al., 2005)
Involvement	Situational = participation in design, training, procedures; Instrinsic = association w/ one's goals & values	NS or negative effects found	(Jackson et al., 1997)
Managerial Support	Mgmt support/ expectation of IS usage	Related to PEOU & PU	(Igbaria et al., 1997)
	Not defined/ operationalized	NS	(Leong, 2003)
	Mgmt encouragement & resource support	Related to PU & Use	(McFarland & Hamilton, 2006)
Organizational Innovativeness	Firm culture of openness to experience	NS	(Robinson et al., 2005)
Perceived developer responsiveness	Extent developer responds to suggestions & bugs; Social exchange Theory; cost/benefit analysis)	Related to PU and PEOU ; indirectly influenced use	(Gefen & Keil, 1998)
Social Influence; Subjective Norms	Perception that important others (e.g., managers, peers) feel one should use the technology (includes image and visibility, the belief that using an innovation will enhance one's social status as well as visibility of innovation in the use content and other's use)	Related to Use NOT I	(Agarwal & Prasad, 1997)
		NS	(Croteau & Vieru, 2002)
		NS	(Davis et al., 1989)
		Related to At & I	(Karahanna et al., 1999)
		Related to Use	(Lucas & Spitler, 1999)
		Related to PU & Use	(McFarland & Hamilton, 2006)
		NS	(Roberts & Henderson, 2000)
		Related to I	(Taylor & Todd, 1995b)
		Related to PU, I, & Image; Image related to PU	(Venkatesh & Davis, 2000)
		NS	(Venkatesh & Morris, 2000)
		Related to I	(Venkatesh, Morris, & Ackerman, 2000)
		Related to I	(Venkatesh et al., 2003)
Training/ Transitional Support	Perceived appropriateness of training and IS support	NS	(Croteau & Vieru, 2002)
		Related to PEOU	(Chau, 1996)
	Internal & External training	Related to PU & PEOU	(Igbaria et al., 1997)
	Training effectiveness	Rel to PEOU & sys qual.	(Lippert & Forman, 1995)
Trialability/ Opportunity to Experiment	Degree one can experiment with the innovation on a limited basis prior to committing to its usage	Related to Use NOT I	(Agarwal & Prasad, 1997)
		Neg. relationship w/ At	(Karahanna et al., 1999)
		Rel to PU, PEOU, & U	(Lippert & Forman, 1995)
Voluntariness/ Perceived Control	Perception (level) that use is voluntary	Related to Use NOT I	(Agarwal & Prasad, 1997)
	Binary: voluntary/ mandated	Related to I	(Croteau & Vieru, 2002)
		Related to I	(Karahanna et al., 1999)
	Belief one has control over elements of the org environment, like what parts of the technology to use	NS	(Robinson et al., 2005)
		Related to I & Use	(Taylor & Todd, 1995b)
		Related to PEOU	(Venkatesh, 2000)
		Related to I	(Venkatesh et al., 2000)
	Binary: voluntary/ mandated	NS	(Venkatesh & Davis, 2000)
Workload	No. of broker clients (control variable)	Related to Use	(Lucas & Spitler, 1999)
Individual Differences			
Age	Years	Moderates PU>I; PEOU>I; Tech>U	(Venkatesh et al., 2003)
Cognitive absorption	State of deep involvement/ flow (similar to intrinsic motivation):	Related to PU & PEOU	(Agarwal & Karahanna, 2000)

Computer anxiety	Uneasiness/ apprehension to computers	Rel. to PU, enjoyment, At	(Igbaria et al., 1994)
		Rel. CSE, PU, PEOU & Use	(McFarland & Hamilton, 2006)
		Rel. to PU, fun, Use	(Roberts & Henderson, 2000)
		Related to PEOU	(Venkatesh, 2000)
		NS	(Venkatesh et al., 2003)
Computer Self-Efficacy (CSE)	General & application specific CSE	Specific related more to PEOU than general	(Agarwal, Sambamurthy, & Stair, 2000)
	General CSE (degree of confidence one can learn & use a new system); Perceived confidence	Related to PU, PEOU, I	(Agarwal & Karahanna, 2000)
		Related to PEOU	(Croteau & Vieru, 2002)
		Related to PU & PEOU	(McFarland & Hamilton, 2006)
		Related to Prcvd Control	(Taylor & Todd, 1995b)
		Related to PEOU	(Venkatesh, 2000)
		Related to PEOU	(Venkatesh & Davis, 1996)
		Control variable	(Venkatesh et al., 2000)
		NS	(Venkatesh et al., 2003)
	Application specific CSE	Related to PEOU & Use	(Yi & Hwang, 2003)
Education	< or > bachelors	Related to PEOU	(Agarwal & Prasad, 1999)
	Level of education	Control variable	(Venkatesh et al., 2000)
Experience	Prior experience with technology	Related to PEOU	(Agarwal & Prasad, 1999)
	Past voluntary training (yes/no)	Related to PU	(Agarwal & Prasad, 1999)
	Binary, advanced VS novice users	Related to Use	(Dasgupta, Granger, & McGarry, 2002)
	Prior level and hours of use	Related to PEOU & PU	(Dishaw & Strong, 1999)
	Based on Davis et al. (1989)	Related to I	(Jackson et al., 1997)
	Prior similar experience	Related to PEOU	(Lippert & Forman, 1995)
	Prior technical knowledge	“” “” & system quality	(Lippert & Forman, 1995)
	Job performance (broker commission)	Related to I	(Lucas & Spitler, 1999)
	Prior experience	Related to CSE, PU, PEOU, & Use	(McFarland & Hamilton, 2006)
	Experiences Vs inexperienced users	TAM had acceptable fit	(Taylor & Todd, 1995a)
	Intro VS none (experimental design)	Moderates Usability>PEOU	(Venkatesh & Davis, 1996)
	Not explicitly operationalized (possibly tracked objectively)	Moderates Subj Norm>PU	(Venkatesh & Davis, 2000)
		Interacts with gender	(Venkatesh & Morris, 2000)
		Moderates PU>I & Tech>U	(Venkatesh et al., 2003)
Gender	Male/ Female	Rel. PU & PEOU, not Use	(Gefen & Straub, 1997)
		Rel to PU, PEOU, & Use	(Venkatesh & Morris, 2000)
		Moderates TAM	(Venkatesh & Morris, 2000)
		Moderated SubjNorm>I	(Venkatesh et al., 2000)
		Moderates PU>I	(Venkatesh et al., 2003)
Implementation Gap	Perceived gap between what one knows and needs to learn to use the system	Related to PEOU & PU	(Chau, 1996)
Income	Level of income	Control variable	(Venkatesh et al., 2000)
Learning Goal Orientation	Tendency to approach a task to understand Vs perform	Indirectly to PU & PEOU through enjoy. & CSE	(Yi & Hwang, 2003)
Personal Innovativeness	Trait reflecting willingness to try out any new technology	Related to cog. absorption	(Agarwal & Karahanna, 2000)
		Related to PEOU	(Robinson et al., 2005)
Playfulness	Degree of cognitive spontaneity in computer interactions	Related to cog. absorption	(Agarwal & Karahanna, 2000)
		Related to PEOU	(Chau, 1996; Venkatesh, 2000)
Role	Provider or User	Related to PEOU	(Agarwal & Prasad, 1999)
	Position in the organization	Control variable	(Venkatesh et al., 2000)
Tenure in workforce	No. years in workforce	NS	(Agarwal & Prasad, 1999)
	Length service/ work experience	NS	(Robinson et al., 2005)

Note: Rel = Related; Prcvd = Perceived; At = Attitudes; PU = Perceived Usefulness; PEOU = Perceived Ease of Use; I = Intentioned; NS = Not significant; cog = cognitive; CSE = Computer Self Efficacy; TAM = Technology Acceptance Model

Appendix C

Summary of Hypotheses and Findings

	Original Hypothesis	Modified Hypothesis following pilot studies	Supported? Yes/No/ (P)artially	Results
H1	Perceptions of 10 factors (see Table #) will combine to reflect SSC.	Perceptions of 8 factors (see Table #) combine to reflect SSC.	Yes	CFA indicates 8 factors fit the data reasonably well
H2	Dimensions of SSC most influential to technology acceptance (i.e., use) will vary over time		Yes	Variations in SSC-use relationships across samples were observed
H3	Perceptions of social support will be highly related to use across all stages/points in time.	Perceptions of **job relevance** will be highly related to technology use throughout the lifespan of technology in the workplace	Yes	A strong relationship between perceptions of job relevance and use across samples was found
H4	Perceptions of information exchange and participatory climate will be more strongly related to use intentions during stage 1 relative other SSC factors	**Participatory climate** perceptions will be more strongly related to intentions to use a system during pre-implementation (**stage 1**) relative other SSC dimensions	NA	Unable to test this hypothesis; none of the samples reflected the pre-implementation phase
H5	Perceptions of technology training and technical support will be more strongly related to system use during stage 2 relative other dimensions	Perceptions of **technology training**, **information exchange** and **workload** will be more strongly related to system use during **stage 2** relative other SSC dimensions; Perceived technical support will be moderately related to system use.	No	Relationships between the factors expected to be central to use were small to moderate, and smaller than some other SSC dimensions not central to stage 2.
H6	Perceptions of evolutionary development and workload will be more strongly related to system use during Early Acceptance relative other SSC dimensions	Perceptions of **technical support**, **critical mass**, and **evolutionary development** will be more strongly related to system use during early acceptance (**stage 3)** relative other SSC dimensions; Perceived information exchange and workload and training perceptions will be moderately related to system use.	P	Relationships between both perceived technical support and critical mass and use were strong relative most other SSC dimensions; Perceived evolutionary development was moderately related to use.
H7	Perceptions of job relevance will be more strongly related to system use during Later Acceptance relative other SSC dimensions	Perceptions of **technical support, critical mass and evolutionary development** will be moderately related to system use during Later Acceptance relative other SSC dimensions	P	Perceptions of these factors were moderate to strong but not always stronger relative other SSC dimensions
H8	CSE (H8a) and PIIT (H8b) will moderate the relationship between SSC and use		No	No main effects or interaction were found
H9	Perceptions of the result demonstrability (H9a), operability (H9b) and tailorability (H9c) of the system will moderate SSC-use relationships		P	Operability & tailorability moderated the SSC–Use relationship

Appendix D

Survey Items

Technology Stage Profile Survey	
Stage 1: Pre-Implementation Items	**Study 2 % Agreement**
11. The new system has not been implemented yet.	.89
21. A pilot version of a new system is being tested but it has not yet been implemented.	.89
14. I heard a new system has been chosen but I have not seen it.	.79
26. The department/university is currently considering replacing ANGEL.	.75
32. I expect ANGEL will be replaced within the next year.	.64
31. We are gearing up for a major change to ANGEL in the near future.	.61
1. I am expecting a new system up-grade in the next 6 to 12 months.	.50
7. Major changes to ANGEL are currently being considered.	.43
Stage 2: Implementation Items	
2. Angel was just recently introduced.	.82
6. I have just begun to use ANGEL.	.82
10. I am currently being trained or learning to use ANGEL.	.82
33. I am in the process of learning to use ANGEL.	.82
30. I have access to ANGEL, but most have not learned how to use it yet.	.75
22. I have not yet applied what I have learned about ANGEL to my job.	.54
19. The new system is not yet available for everyone to use.	*.50*
Stage 3: Early Acceptance Items	
34. Although I use ANGEL routinely now, it still feels relatively new to me.	.86
23. I am first starting to apply what they learned about ANGEL to my job.	.75
20. I am in the process of transferring what I have learned about ANGEL to my day-to-day work.	.71
25. I have started changing the way I usually do some things now that I use ANGEL.	.71
16. All training for ANGEL has been completed.	.61
18. I have not yet used ANGEL on a routine basis.	*.61*
13. I have yet to learn everything I need to use ANGEL.	*.50*
27. Some of the tasks I perform have changed since I started using ANGEL.	.50
Stage 4: Later Acceptance Items	
17. I feel as if I have always used ANGEL to do my job.	.96
24. I have used ANGEL for so long, I take it for granted.	.96
4. ANGEL has been around so long that no one thinks of it as new any longer.	.93
9. ANGEL has been around for a long time.	.93
12. Using ANGEL is so routine that I am seldom aware I am using it.	.89
15. I am so used to using ANGEL that I would not know how to do certain tasks without it.	.89
29. I am so used to ANGEL, I seldom consider alternative ways to get the tasks I use it for done.	.89
8. Using ANGEL is relatively routine for most graduate students.	*.86*
35. I do not recall how things were done before the use of ANGEL.	.86
5. Pretty much everyone that would want to use ANGEL has been introduced to it by now.	.64
28. I am no longer learning ANGEL; I am using it.	*.61*
3. Most graduate students have learned and are now expected to use ANGEL in their daily work.	*.50*
System Support Climate Survey	
Participatory Climate Perceptions	
24. I feel I do not have any say in decisions about ANGEL that affect their work. (R)	1.00
30. I feel decisions about ANGEL are frequently made over my head. (R)	1.00
64. I feel my voice/opinion about ANGEL is important to my department.	1.00
1. The department involves graduate students when decisions are made about ANGEL.	.95
9. Changes here tend to be made to ANGEL without talking to the people affected by them. (R)	.95
31. My input about ANGEL has been solicited by my department/university.	.95
56. With regard to decisions involving ANGEL, I feel I am often left "in the dark." (R)	.81

42. Feedback about ANGEL is often requested in departmental meetings.	.75
58. There is an easy way to provide feedback about ANGEL should I choose to do so.	.72
51a. I expect ANGEL will change in response to users' feedback.	*.57*
60. I have seen examples of how ANGEL has changed given users' feedback.	.48
55. The department has sought out information about how ANGEL fits aspects of my job.	.43
Perceived Critical Mass	
46. I do not use ANGEL, because no one else seems to. (R)	1.00
49. If more people in my department used ANGEL, I would also. (R)	1.00
15. Others using ANGEL think I should also use it.	.95
3. People who are important to me use ANGEL.	.91
61. The people I interact with most in my job do not use ANGEL. (R)	.91
68. The people I work with most do not think it is necessary that I use ANGEL. (R)	.86
20. My advisor stresses the importance of using ANGEL.	.57
Perceived Evolutionary Development	
6. ANGEL is still being improved.	1.00
45. I am expecting ANGEL will improve over time.	1.00
37. I believe enhancements are still being made to ANGEL.	.95
38. I am expecting ANGEL will be up-dated over time.	.95
69. I do not believe ANGEL will change even though there are some problems with it. (R)	.95
74. I think we are stuck with the current version of ANGEL until a completely new system is implemented. (R)	.95
12. ANGEL will be more useful as the bugs are worked out.	.91
19. It is clear that technical personnel are maintaining ANGEL over time.	.91
Perceived Information Exchange	
23. Information about why ANGEL was implemented was freely shared.	.95
29. There are often breakdowns in communication about ANGEL here. (R)	.95
32. Information about the benefits of ANGEL is readily shared here.	.95
8. Graduate students are not well informed about ANGEL. (R)	.81
10. Graduate students understand the reason ANGEL is being used in this department.	.81
53. I feel I am well informed about changes involving ANGEL.	.81
65. I have been clearly told why I should use or consider using ANGEL.	.72
41. Procedures used to up-date and implement ANGEL are clearly explained.	.67
76. I have been clear information about how I can learn and use ANGEL.	.62
Perceived Job Relevance	
5. In my job, ANGEL is important.	1.00
13. The use of ANGEL is relevant to my job.	1.00
17. Tasks that involve the use of ANGEL are central to my job.	1.00
28. ANGEL is important to my main job priorities.	1.00
40. ANGEL is useful for tasks that define my role.	1.00
47. ANGEL does not support tasks that are central to my job. (R)	1.00
54. The tasks supported by ANGEL are not important to my job. (R)	1.00
71. Using ANGEL is important to my overall job performance.	1.00
72. I need to use ANGEL in order to do my job.	1.00
62. It is not likely using ANGEL will affect my overall job performance. (R)	.95
Perceptions of Technical Support	
4. If a graduate student has a problem using ANGEL, they can easily find technical personnel to help them.	1.00
18. Graduate students find it hard to get help when they run into problems using ANGEL.	1.00
48. technical support for ANGEL is easy to access.	1.00
70. I am satisfied with the technical support for ANGEL.	1.00
73. I do not feel I get the technical support I need to use ANGEL effectively. (R)	1.00
27. It takes a long time to get questions about ANGEL answered. (R)	.95
39. Technical personnel is available to help when graduate students have problems using ANGEL.	.95
63. Technical support for ANGEL is effective in helping me use the system.	.95
14. Helpful manuals are available when users have problems with ANGEL.	.91
52. Technical support for ANGEL addresses my needs quickly.	.86
26. It's easy to approach other graduate students familiar with ANGEL for help.	*.43*
36. Faculty here familiar with ANGEL can be relied upon for guidance.	*.38*
Technology Training Perceptions	
7. Graduate students are not properly trained to use ANGEL (R)	1.00
11. Graduate students receive enough training when it comes to using ANGEL.	1.00

21. People are only given the minimum amount of training to use ANGEL. (R)	1.00
35. I am satisfied with the training opportunities I received for ANGEL.	1.00
50. The transition to ANGEL was easier due to the training I received.	1.00
67. I am impressed with the quality of training available for ANGEL.	1.00
59. Formal training for ANGEL is readily available to those who want it.	.95
34. People are strongly encouraged to develop their skills with ANGEL through training.	.86
43. I would recommend the training I took part in to a new graduate students needing to learn ANGEL.	.81
Workload Perceptions	
2. People are expected to do too much in a day to allow them to learn to use ANGEL. (R)	1.00
33. The pace of work is relaxed enough that people can learn and practice new skills with ANGEL.	1.00
51b. My workload does not prevent me from learning or using ANGEL.	1.00
57. My workload prevents me from learning or using ANGEL. (R)	1.00
66. I am simply too busy to learn to or use ANGEL. (R)	1.00
16. In general, my workload is not particularly demanding.	.95
22. I am required to work extremely hard. (R)	.91
44. It is easy to find the time in my current role to learn to/practice using ANGEL.	.91
75. It is clear from the workload here, that learning and using ANGEL is not our top priority. (R)	.91
25. Graduate students are under pressure to meet targets, NOT to learn to use new gadgets/programs. (R)	.70

Note: Items appearing in dark gray were removed due to low percentage agreement on the retranslation task. Items in lighter gray were removed after checking reliabilities following study 2 and 3. Items in white cells represent the scales used in the final analyses.

Additional scales

Computer Self-Efficacy

I would be confident using [the target technology] even if:

1. …there was no one around to tell me what to do as I go.
2. …I had never used a program like this before.
3. …I had just the built-in help facility for assistance.

Personal Innovativeness

1. I like to explore new technologies.
2. When I hear about a new technology, I often find an excuse to go try it.
3. Among my peers, I am usually the first to try out new technologies/software.
4. When I have some free time, I often explore new technologies.

Result Demonstrability

1. I could easily describe the outputs/results from using the system to someone else.
2. I would have difficulty explaining why using the system is beneficial. (R)

Tailorability

1. The display in the system is flexible, can be changed according to user preferences.
2. Usernames and other elements of the system display according to my preferences.

Operability

1. The system provides system status feedback.
2. The design of the system makes it difficult to make errors
3. The system provides clear and understandable error messages.
4. The system can diagnose the cause of a problem and suggest a solution.

Current usage

1. I use the system whenever possible to do my work.
2. I use the system to do my work.
3. I use the system whenever appropriate to do my work.

Intentions for future use

1. I intend to increase my use of the system for work in the future.
2. I intend to use the system in the future for my work.
3. I intend to completely switch over to the system.

Purpose/Utilization

Specifically, I use the system…

1. …to facilitate teaching face-to-face course(s).
2. …to facilitate teaching electronically delivered course(s).
3. …to facilitate teaching blended course(s).
4. …to aid research collaboration.
5. …for professional development (e.g., training or feedback exercises).
6. …to collaborate on non-course-related projects.
7. …to facilitate co-authoring papers.
8. …to schedule meetings.
9. …to schedule use of shared facilities.
10. …to send/receive e-mail.
11. …to post announcements.
12. …to distribute reading material.
13. …to receive assignments/materials from others.
14. …to distribute surveys/quizzes.
15. …to grade assignments/quizzes.
16. …to interact with others.
17. …to interact with others via message boards.

Appendix E

Correlations between all study variables

	M	SD	1	2	3	4	5	6	7	8	9	10
1. Stage 1	2.42	1.31	(.79)									
2. Stage 2	2.91	1.54	-.02	(.70)								
3. Stage 3	3.35	1.30	-.03	.29*	(.42)							
4. Stage 4	3.00	1.34	.02	-.20*	.14*	(.71)						
5. Participatory Climate Perceptions	3.30	1.17	-.02	-.03	.03	.27*	(.65)					
6. Perceived Critical Mass	5.04	1.11	-.10	-.13*	.11*	.28*	.30*	(.72)				
7. Perceived Evolutionary Develop.	5.42	1.03	-.13*	.02	.19*	.25*	.26*	.30*	(.87)			
8. Perceived Information Exchange	4.34	1.06	-.14*	-.23*	.02	.43*	.64*	.44*	.44*	(.73)		
9. Perceived Job Relevance	4.94	1.47	-.09	.05	.31*	.41*	.30*	.54*	.36*	.38*	(.91)	
10. Perceived Technical Support	4.82	1.49	.06	.09	.10*	.26*	.33*	.24*	.37*	.52*	.34*	(.94)
11. Technology Training Perceptions	4.61	1.39	-.10	-.16*	.17*	.24*	.40*	.21*	.37*	.62*	.25*	.68*
12. Workload Perceptions	3.08	1.17	-.02	-.15	.06	.32*	.32*	.18*	.30*	.52*	.22*	.38*
13. Current Use	5.04	1.39	-.12	-.07	.26*	.49*	.27*	.50*	.39*	.45*	.70*	.36*
14. Future Use Intentions	5.76	1.24	-.22*	.30*	.35*	.25*	.23*	.26*	.39*	.26*	.56*	.32*
15. Purpose/ Utilization	3.54	1.03	-.02	-.14*	.21*	.44*	.37*	.38*	.32*	.49*	.63*	.34*
16. Computer Self Efficacy	4.31	1.65	-.01	-.23*	-.06	.23*	.26*	.19*	.21*	.42*	.15*	.19*
17. Personal Innovativeness with IT	4.35	1.54	.06	-.14*	-.03	.12*	.17*	-.01	.04	.20*	.10*	.10*
18. Perceived Operability	3.29	1.08	-.08	-.05	.03	.11*	.20*	.10*	.28*	.30*	.10*	.32*
19. Perceived Result Demonstrability	4.94	1.45	-.11	-.25*	.12*	.38*	.30*	.35*	.45*	.60*	.43*	.33*
20. Perceived Tailorability	4.13	1.36	-.02	-.04	.12*	.22*	.32*	.26*	.33*	.40*	.28*	.34*
21. Years Teaching	12.73	10.56	-.03	-.18*	-.11*	-.01	.00	.05	.06	.07	.03	.03
22. Age	49.93	11.92	-.03	-.13*	-.11*	.11*	.10*	.05	.06	.12*	.05	.13*
23. Position	na	na	-.04	.10*	.14*	.10*	.04	.02	.04	.03	.16*	.09
24. Gender	na	na	-.11	.07	.04	.09	.08	.08	.13*	.07	.14*	.10*
25. Race	na	na	-.07	.03	.05	-.04	-.04	-.06	.02	-.06	-.08	-.03

Note: Reliabilities appear on the diagonal; * $p < .05$

Correlations Continued.

	11	12	13	14	15	16	17	18	19	20	21	22	23	24
11. Techn. Training Perceptions	**(.84)**													
12. Workload Perceptions	**.49***	**(.73)**												
13. Current Use	**.29***	**.28***	**(.78)**											
14. Future Use Intentions	**.25***	**.19***	**.44***	**(.59)**										
15. Purpose/ Utilization	**.33***	**.32***	**.63***	**.41***	**(.86)**									
16. CSE	**.26***	**.38***	**.24***	**.12***	**.31***	**(.85)**								
17. PIIT	**.07**	**.16***	**.12***	**.09**	**.19***	**.28***	**(.92)**							
18. Operability	**.39***	**.33***	**.05**	**.15***	**.12***	**.19***	**-.06**	**(.74)**						
19. Result Demonstrability	**.40***	**.44***	**.59***	**.29***	**.53***	**.44***	**.21***	**.19***	**(.67)**					
20. Tailorability	**.38***	**.29***	**.25***	**.26***	**.31***	**.19***	**.11***	**.45***	**.34***	**(.73)**				
21. Years Teaching	**.09**	**-.04**	**-.01**	**-.02**	**.01**	**-.12***	**-.01**	**.02**	**.05**	**.03**	**-**			
22. Age	**.09**	**.03**	**.06**	**.03**	**.11***	**-.20***	**.01**	**-.02**	**.03**	**.03**	**.68***	**-**		
23. Position	**.04**	**.14***	**.13***	**.14***	**.07**	**.00**	**-.04**	**.04**	**.06**	**.03**	**-.39***	**-.31***	**-**	
24. Gender	**.06**	**-.01**	**.13***	**.08**	**.11***	**-.02**	**-.11***	**.11***	**.06**	**.05**	**-.21***	**-.18***	**.09**	**-**
25. Race	**.05**	**.04**	**-.04**	**.09**	**-.02**	**.06**	**.00**	**.12***	**-.04**	**.01**	**-.08**	**-.13***	**.00**	**.02**

Note: Reliabilities appear on the diagonal; * p < .05

Appendix F

Results for Future Use Intentions & Utilization

Table 16. Correlations between SSC and Future Use Intentions over time

Stage →	Stage 2	Stage 2.5	Stage 3	Stage 3.5		Stage 4	
Sample → / ↓ Perceptions of…	D	C	F	A	E	B	C
Participatory Climate	.32	.11	.24	.23*	.44*	.24*	.34*
Technology Training	.39*	.23	.02	.33*	.59*	.41*	.10
Information Exchange	.43*	.31*	.22	.22*	.37*	.54*	.15
Workload	.36*	.27*	.38*	.24*	.30	.33*	.28
Technical Support	.59*	.36*	.31	.56*	.62*	.66*	.62*
Critical Mass	.39*	.15	.52*	.28*	.54*	.36*	.20
Evolutionary Development	.21	.12	.39*	.20	.36*	.30*	.30
Job Relevance	.25	.15	.40*	.09	-.04	.28*	.35*

Note: [dark] = strong expected relationship ($r \approx .50$); [medium] = moderate expected relationship ($r \approx .25$); [light] = small expected relationship ($r \approx .10$); * = $p < .05$

Table 17. Regression Results Explaining Future Use Intentions

SSC dimension(s) included	R	R^2	R^2_{Adj}	ΔR^2	p
1. Perceived Job Relevance	.57	.32	.32		
2. Perceived Job Relevance AND Perceived Evolutionary Development	.60	.36	.36	.04	.00

Table 18. Explaining Future Use Intentions Across Subsamples

	SSC dimension(s) included	R	R^2	R^2_{Adj}	ΔR^2	p
Stage 2						
D	1. Perceived Evolutionary Development	.50	.25	.22		
Stage 2 & 3						
C	1. Perceived Job Relevance	.36	.13	.12		
	2. Perceived Job Relevance AND Perceived Evolutionary Development	.43	.18	.16	.05	.05
Stage 3						
F	1. Perceived Technical Support	.53	.28	.26		
Stage 3 & 4						
A	1. Perceived Job Relevance	.62	.38	.37		
	2. Perceived Job Relevance AND Perceived Participatory Climate	.65	.42	.41	.02	.04
E	1. Perceived Job Relevance	.62	.38	.37		
	2. Perceived Job Relevance AND Perceived Critical Mass	.70	.49	.46	.11	.01
Stage 4						
B	1. Perceived Job Relevance	.66	.43	.43		
	2. Perceived Job Relevance AND Perceived Evolutionary Development	.72	.52	.52	.09	.00
G	1. Perceived Job Relevance	.74	.54	.53		
	2. Perceived Job Relevance AND Workload Perceptions	.72	.52	.48	.08	.04

Table 19. Correlations between SSC dimensions and Utilization over time

Stage →	Stage 2	Stage 2.5	Stage 3	Stage 3.5		Stage 4	
Sample → ↓ Perceptions of…	D	C	F	A	E	B	C
Participatory Climate	.36*	.48*	.09	.17	.46*	.37*	.58*
Technology Training	.46*	.33*	-.33	.42*	.40*	.38*	.34
Information Exchange	.41*	.28*	.28	.16	.39*	.36*	.13
Workload	.45*	.56*	.29	.32*	.44*	.52*	.31
Technical Support	.64*	.39*	.06	.49*	.62*	.48*	.48*
Critical Mass	.38*	.33*	.39*	.14	.52*	.37*	.13
Evolutionary Development	.20	.29*	.31	.14	.43*	.39*	.32
Job Relevance	.47*	.34*	.20	.14	.12	.35*	.28*

Note: [dark] = strong expected relationship ($r \approx .50$); [medium] = moderate expected relationship ($r \approx .25$); [light] = small expected relationship ($r \approx .10$); * = $p < .05$

Table 20. Regression results explaining Utilization

SSC dimension(s) included	R	R^2	R^2_{Adj}	ΔR^2	P
1. Perceived Information Sharing	.48	.23	.23		
2. Perceived Job Relevance AND Perceived Evolutionary Development	.57	.34	.32	.10	.00

Table 21. Explaining Utilization Across Subsamples

	SSC dimension(s) included	R	R^2	R^2_{Adj}	ΔR^2	p
Stage 2						
D	1. Perceived Job Relevance	.59	.35	.33		
	2. Perceived Job Relevance AND Workload Perceptions	.70	.49	.45	.14	.01
Stage 2 & 3						
C	1. Perceived Information Exchange	.54	.30	.29		
	2. Perceived Information Exchange AND Perceived Critical Mass	.59	.35	.33	.05	.04
Stage 3						
F	1. Perceived Technical Support	.40	.16	.13		
	2. Perceived Technical Support AND Perceived Critical Mass	.58	.34	.28	.17	.02
Stage 3 & 4						
A	1. Perceived Job Relevance	.48	.23	.23		
	2. Perceived Job Relevance AND Perceived Information Exchange	.52	.27	.26	.04	.02
E	1. Perceived Job Relevance	.62	.38	.37		
	2. Perceived Job Relevance AND Participatory Climate Perceptions	.70	.49	.46	.11	.01
Stage 4						
B	1. Perceived Information Exchange	.51	.26	.25		
	2. Perceived Information Exchange AND Perceived Job Relevance	.58	.34	.33	.08	.00
G	1. Participatory Climate Perceptions	.51	.26	.23		

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Curriculum Vitae

EDUCATION

The Pennsylvania State University, University Park, PA

- Ph.D., Industrial and Organizational Psychology, August 2009
  - Minor: Information Science and Technology, 2005
- Masters of Science, Industrial and Organizational Psychology, 2002

University of Wisconsin – Green Bay, WI

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AWARDS

- Graduate Student Service Award, Honorable Mention, April 2008
- Teaching with Technology Certificate, December 2007
- Winner, Annual Undergraduate Paper Competition in Applied Psychology, 1998.

PROFESSIONAL MEMBERSHIPS

- American Psychological Association. 1998 until present.
- Society for Industrial and Organizational Psychology. 1998 until present.
- Academy of Management. 2003 until present.

PUBLICATIONS

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