

Knowledge, Communication, and IT Use: Development and Test of an Integrated Model

ABSTRACT

Facilitating organizational use of information systems (IS) consistently ranks among the top issues facing senior IS executives. Industry accounts clearly demonstrate that some organizations are better at using information technology (IT) than others (e.g., American Airlines, Federal Express). Research accounts indicate that within the same organization, some departments use IT in more progressive ways than others. In this paper, prior research and theory in implementation, innovation, communication, and organizational learning are synthesized to develop a model that explains differences in the progressive use of information technology among departments. Progressive use of IT refers to the level of sophistication of the IT used in a department combined with the degree to which IT is used for strategic purposes -- the more sophisticated and the more strategic, the more progressive the use. Absorptive capacity, defined as the ability to identify, assimilate, and exploit external information provides the explanatory focus for the model. Qualitative and quantitative data collection were conducted in five organizations, representing four industries. Communication climate, communication network, and shared technology knowledge were found to be significant indicators of departmental differences in progressive use of IT, explaining nearly 60% of the variance. Contributions to research and practice are discussed.

Keywords: Communication climate, communication network, knowledge sharing, IT infusion

ISRL Categories: DD02, DD05, DD06, GA0101

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INTRODUCTION

Facilitating organizational use of information systems (IS) consistently ranks among the top issues facing senior IS executives (Brancheau, Janz, and Wetherbe 1996; Niederman, Brancheau, and Wetherbe 1991). Industry accounts clearly demonstrate that some organizations are better at deploying and using information systems than others (e.g., American Airlines, Federal Express) (Copeland and McKenney 1988; Senn 1998). It is also evident that within the same organization, some departments are better at using IS than others (Boynton, Zmud, and Jacobs 1994). These departmental differences are becoming increasingly critical to organizations that are attempting to deploy far-reaching, integrated systems (e.g., enterprise resource planning systems, data warehousing). Such systems are only as strong as their weakest link.

Prior research has identified a variety of communication and knowledge components associated with organizational and departmental IT use (Boynton, Zmud, and Jacobs 1994; Lind and Zmud 1991; Rogers 1995). The primary objective of this research is to improve our understanding of the relationships among those components and their impact on the use of IT at the subunit, or department, level within organizations. The unit of analysis is the department for two reasons. First, even in organizations that use IT well, some user areas lag behind, while others are far ahead (Boynton, et al. 1994). Second, subunit differences may have long-term negative implications for the *organization's* ability to sustain a strategic advantage in the market, and thus insights at the departmental level will benefit the organization as a whole.

The remainder of the paper is organized as follows. The next section discusses prior research that has examined the knowledge, communication, and IT use variables. Section three presents the research model and hypotheses, while section four addresses the research methodology and data analysis. Finally, section five discusses the findings and the implications for future research and practice.

COMMUNICATION, KNOWLEDGE, AND ABSORPTIVE CAPACITY

Communication has been identified consistently as a critical variable in the adoption and diffusion of innovations in general (e.g., Kimberly, 1981; Rogers, 1995; Rogers and Kincaid, 1981). Within the IT domain, communication has been associated with individual adoption (Rice, Grant, Schmitz, and Torobin, 1990), departmental IT innovativeness (Lind and Zmud, 1991), IT infusion (Kwon, 1990), and IT diffusion (Brancheau and Wetherbe, 1990). In explaining the role of communication, Lind and Zmud (1991) argued that communication is important to IT implementation because it facilitates knowledge sharing and, thus leads to a convergence in understanding between IS providers and users. In terms of understanding (and ultimately reducing) differences in departmental use of IS, we must understand communication differences among IS providers, and with users.

Knowledge sharing through communication is more likely to occur when a foundation of prior relevant knowledge exists (Cohen and Levinthal, 1990). Indeed, individuals are more capable of processing new knowledge when it fits within their existing cognitive structures (Ellis, 1965; Bower and Hilgard, 1981). Further, communication among individuals is facilitated when their existing knowledge overlaps to some degree, due to the existence of a common language

(Allen and Cohen, 1969; Tushman, 1977). As knowledge is shared, new, or better uses for the subunit's existing and potential information systems may be discovered. In terms of understanding (and ultimately reducing) differences in departmental use of IS, we must understand the differences in what knowledge is shared, and between whom.

Knowledge and communication do not operate independently within organizations. Rather, knowledge and communication are tightly intertwined in organizational processes in general, and in the process of innovating specifically. Absorptive capacity (Cohen and Levinthal 1989; 1990; 1994), defined as an organization's ability to identify, assimilate and exploit external information, suggests that organizations with greater levels of existing knowledge are more able to create new knowledge (Cohen and Levinthal, 1990). Organizations must have a stock of prior knowledge, without which, the value of new and potentially useful information cannot be recognized. Further, absorptive capacity suggests that the ability to create new knowledge is also a function of the mechanisms an organization has in place for sharing knowledge (Cohen and Levinthal 1990). Without the communication network and the communication climate surrounding the network, this stock of information cannot be shared (Brown and Chervany 1999). Thus, absorptive capacity focuses on the interacting nature of knowledge and communication. Although applied at the organizational level in prior research (Lane and Lubatkin 1998), absorptive capacity offers a conceptual foundation for examining sub-unit learning as well (e.g., Boynton, et al. 1994). We propose that different functional units could have varying levels of absorptive capacity, rendering them differentially able to capitalize on IT. Because of the prevalence of different knowledge sets existing in an organization, the importance

of sharing knowledge across them with respect to IS, and the need to understand how this is done, absorptive capacity provides the central conceptual focus for this study.

Cohen and Levinthal (1990) propose that absorptive capacity can be useful in understanding adoption and diffusion of innovation. Further, they suggest that it might be technological innovation specific (Cohen and Levinthal, 1994). Thus, organizations could have an absorptive capacity for manufacturing technologies that is different from their absorptive capacity for information technologies.

Initial explorations of the concept of absorptive capacity in MIS have been varied. Boynton, Zmud, and Jacobs (1994) used absorptive capacity to frame their study of IT use. Fichman and Kemerer (1997) examined the relationship between knowledge and innovativeness, in the assimilation of software process innovations. Their findings showed that related and diverse knowledge contribute to the assimilation of Object-Oriented programming languages. Brown and Chervany (1999) argued that knowledge and communication must be clearly delineated when studying IT absorptive capacity. Further, their analysis suggests that the communication component may be further broken down into structural and contextual factors: specifically, the communication network and the communication climate.

The study reported here positions absorptive capacity as a correlate to the progressive use of IT and develops an operational definition of the absorptive capacity construct for use in IS. Cohen and Levinthal's original measure of absorptive capacity has come under scrutiny as being incomplete and not entirely relevant for some industries (Lane and Lubatkin, 1998; Nichols-Nixon, 1993; Pennings and Harianto, 1992a; 1992b). In large part, these criticisms are due to the fact that Cohen and Levinthal's (1989; 1990) absorptive capacity measure is based on investment

in research and development (Cohen and Levinthal, 1989), clearly a proxy for the operational activities for which the R&D investment is used. Further, in IS, budgets are not typically allocated to R&D. Instead, R&D budgets and activities are often incorporated into other functions (e.g., IT Liaison roles, technology-specific functions), rendering these spending figures difficult to access in IS. However, even if access to R&D figures was available, total dollar spending is actually an incomplete proxy for specific programs and activities. As such, they do not provide the detail necessary to determine which behaviors lead to higher and lower levels of absorptive capacity. Thus, the identification of the observable, behavioral dimensions of absorptive capacity is necessary to improve our understanding of how knowledge and communication relate and how to apply this improved understanding.

IT Use

The study's dependent variable, progressive use of IT, was first introduced by Busch et al. (1991) to examine differences in IT *across* organizations and industries. Essentially, it refers to the degree to which IT is used for strategic purposes. We equate this type of use with infusion. Infused use occurs when the technology is used to its fullest potential throughout the organization to meet the organization's goals (Cooper and Zmud, 1990; Kwon and Zmud, 1987). A second perspective of use is innovative use. Innovative use can occur in two ways (Lind and Zmud 1991). First, an organization can use existing IT in new ways. Second, an organization can use new IT to better solve existing or future problems. Yet, a technology could be innovative and never infused. Thus, in this research, we adopt the view that progressive use means using existing IT to its fullest potential for strategic purposes.

Related Studies

Four key studies in IS have examined the relationship among knowledge, communication, and IT use. In these studies, differing views of knowledge and communication are presented, as well as distinct approaches to assessing IT use. In this section, each of those studies is delineated. We conclude with the development of a model that integrates them.

Kwon (1990) analyzed the relationship between communication behavior and MIS infusion, defined as the extent to which IS has been diffused across key tasks in the business unit. Kwon argued that interpersonal communication behaviors would be positively associated with greater MIS infusion. The empirical results indicate that some communication behaviors, specifically related to internal and external communication network behavior, are influential in determining MIS infusion.

Lind and Zmud (1991) examine the relationship among communication frequency, communication channel richness, and IT innovativeness. They argued that the reason communication is associated with innovativeness is that communication leads first to shared knowledge (i.e., a convergence in understanding), which subsequently leads to innovativeness. The empirical results support the idea that convergence in understanding of primary business activities is associated with IT innovativeness. In contrast, agreement on the **potential** of IT to support primary activities was not associated with IT innovativeness. Thus, this research suggests that shared business knowledge may be more important than shared technology knowledge for using IT innovatively.

Zmud, Boynton, and Jacobs (1987) examined the importance of the management process and interactions between users and IS professionals in facilitating IT penetration within firms.

Interactions in their study were defined in terms of "the quality of the relations between IS managers and the line managers, the knowledge that IS managers possess regarding organizational activities, and the knowledge that general managers possess regarding the potential value of IT" (p. 28). The study's results provide limited support for the importance of interactions. However, this support was associated only with the units in which IT spending was the highest in their organization.

Boynton, Zmud, and Jacobs (1994) proposed a slightly altered model in which they examined IT management practices in influencing IT use. Their model posits that *Managerial IT Knowledge* and *IT-Management-Process Effectiveness*, influences *IT Use*. They define an organization's absorptive capacity as the aggregation of Managerial IT Knowledge and IT-Management Process Effectiveness. Strong support was found for the relationship between Managerial IT knowledge and IT Use. However, communication was subsumed within the Managerial IT Knowledge construct: "conjunction of IT related and business-related knowledge possessed by **and exchanged among** IS and business unit or line" (Boynton et al., 1994, emphasis added). Their results provide further justification for the inclusion of both knowledge and communication in a model of IT use, as well as the need for greater delineation of absorptive capacity into its knowledge and communication sub-constructs.

The model that results from a synthesis of these studies is presented in Figure 1. In this model, knowledge and communication are the key factors influencing use of IT. What remains is to extend the existing factors to a finer level of detail and to determine how these factors function simultaneously.

<Insert Figure 1 about here>

RESEARCH MODEL AND HYPOTHESES

Figure 2 is the model derived from a synthesis of previous related studies (Boynton, Zmud, and Jacobs, 1994; Busch, et al., 1991; Kwon, 1990; Lind and Zmud, 1991; Zmud, Boynton, and Jacobs, 1987), the existing literature in implementation, innovation, and communication, and the concept of absorptive capacity. This model extends Figure 1 by separating the knowledge and communication variables into separate variables, delineating the communication network and the communication climate as two aspects of the communication variable, and using absorptive capacity as an organizing concept. This model states that absorptive capacity is associated with differences in the progressive use of IT within an organization.

<Insert Figure 2 about here>

Progressive Use of IT

Following from the infusion stage of Cooper and Zmud's (1990) stage model, progressive use of IT is the degree to which IT is used to its fullest potential in a department. Based on Busch, et al.'s (1991) definition, progressive use is (a) the degree to which IT is used by a department for strategic and competitive purposes and (b) how well the department uses IT compared to other departments in its organization. These two aspects of the definition are complementary because they both focus on extent of use, rather than simply examining use versus non-use.

Absorptive Capacity

The absorptive capacity for information technology focuses on the knowledge related to technology capability, business issues, as well as how this knowledge is shared. Absorptive

capacity for IT can be assessed by examining an organization's prior relevant knowledge, its mechanisms for sharing that knowledge (i.e., its communication network), and its communication climate.

Prior Relevant Knowledge

In the context of this study, prior relevant knowledge is defined as the facts and ideas that individuals in the organization have that influence their ability to recognize the importance of new information, both business problem and information technology related. Prior relevant knowledge is divided into two categories: business knowledge and IT knowledge. Business knowledge is knowledge of those items that are important to the operation of the various functional units comprising the organization. IT knowledge is knowledge of information technologies and systems.

Cohen and Levinthal (1990) argue that a pool of diverse knowledge will facilitate the process of finding novel solutions to problems. Within the MIS domain, Fichman and Kemerer (1997) have demonstrated that both diverse and common knowledge are necessary for assimilating software process innovations. Further, Lind and Zmud (1991) have shown that when user-IS relationships are characterized by convergent (overlapping) business knowledge, IT is used more innovatively. Thus, we anticipate that user-IS relationships in which there is an overlap of business knowledge and diversity of IT knowledge will find more progressive IT solutions to business problems. Overlap in business knowledge provides the necessary foundation of shared knowledge to recognize the value of IT solutions. Diversity of IT knowledge provides a broad base of prior relevant knowledge upon which to draw in order to solve business problems with IT.

H1a: Diversity of IT knowledge between the business unit and IS will be positively associated with progressive use of IT.

H1b: Overlap of business knowledge between the business unit and IS will be positively associated with progressive use of IT.

Existing theory and research provides no evidence upon which to base a prediction regarding the relative importance of diversity of IT knowledge and overlap of business knowledge in determining progressive use of IT.

Communication Network

The communication network handles “flows of information across and within organizational boundaries” (Tushman and Romanelli, 1983). Three network characteristics are commonly associated with innovation activity: boundary spanning, communication tie strength, and multiplexity of ties.

Boundary spanning activity includes interactions with individuals outside of one's typical communication group (Friedman and Podolny, 1992). According to Tushman and Romanelli (1983), a boundary spanner is someone who is both an internal and an external communication “star”, thus spanning external organizational boundaries, as well as internal departmental boundaries. Further, boundary spanners rely more heavily on information sources outside their department than non-boundary spanners (Allen and Cohen, 1969). As a result, these individuals have access to more and different information. Thus, boundary spanning activity provides access to information about new uses of IT.

H2a: Boundary spanning activity engaged in by the Business unit and IS will be positively associated with progressive use of IT.

“The strength of a tie is a ... combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie” (Granovetter, 1973). Nelson (1989) conceptualized tie strength as frequent, reciprocal contacts that “almost invariably have affective, often friendly overtones” (p. 380). He argued that “frequency of contact, friendship, and reciprocity are closely associated” (p. 386), concluding that frequency of contact provided an adequate assessment of tie strength. Granovetter (1973) argued that new information was more likely to enter social groups via weak rather than strong ties since individuals connected via strong ties are likely to have similar information sources, talk about the same things, and know many of the same people. In essence, the information they share is constrained by their similar acquaintances and perspectives, thus tending to be redundant. Weak ties, in contrast, afford individuals access to different information sources, and thus different information, suggesting that weak ties are also a means of obtaining information about new uses of IT.

***H2b:** Reliance on weak ties as a source of new information by individuals in the Business unit and IS will be positively associated with progressive use of IT.*

A multiplex linkage is one in which more than one dimension, or aspect, of life is discussed. For instance, Danowski (1980) identified the life dimensions of production, innovation, and maintenance. Albrecht and Ropp (1984) identified the dimensions of work matters, social/personal topics, and new ideas. These dimensions were expanded by Albrecht and Hall (1991a) to be: innovation, work, social/personal, and office politics/gossip. Essentially, these dimensions refer to the thematic content of interactions. For instance, innovation refers to communication regarding new ideas and practices, typically as they relate to the work place. The

work dimension refers to interaction specifically related to getting the job done. On the other hand, the social/personal dimension has nothing to do with work and is focused on conversations about life outside of work. Finally, the dimension of office politics/gossip refers to interaction about the workplace, but with no reference to really working. This study employs the dimensions developed by Albrecht and Hall (1991a).

In prior research, multiplex linkages were identified as important in the transfer of new information (Albrecht and Hall, 1991a; Albrecht and Hall, 1991b; Albrecht and Ropp, 1984; Danowski, 1980). In particular, relationships in which new and innovative ideas were discussed were also characterized by discussions of social/personal topics. Thus, when the user-IS relationship is considered multiplex, there should be a greater sharing of new ideas, ultimately encouraging new uses for IT.

***H2c:** The degree to which the relationship between the Business unit and IS is multiplex is positively associated with progressive use of IT*

Communication Climate

Communication climate is defined as the atmosphere in an organization regarding communication behavior (Putnam and Cheney, 1985). It influences what gets communicated to whom, by whom, how, and how often. The four primary characteristics of communication climate with which we are concerned are vertical communication, horizontal communication, reliability of information shared, and openness.

Vertical communication is the degree to which information is shared with superiors and subordinates. It is critical in ensuring that the IT needs of the users are communicated upward to managers who are in a position to respond to those needs. Communication with subordinates

must also be free-flowing in order that subordinates may learn about and understand information technology changes. An environment that encourages this flow of information should facilitate progressive use of IT.

***H3a:** A positive communication climate with regard to vertical communication will be positively associated with progressive use of IT.*

Horizontal communication refers to the degree to which information is shared among peers in an organization (Crino and White, 1981). In organizations, individuals in different departments often face similar problems. Horizontal communication is critical for facilitating sharing across functional areas that can lead to using IT to its fullest potential. In terms of this study, as individuals in the organization share their work and personal experiences with their peers, they may begin to see new, beneficial uses for existing information technologies.

***H3b:** A positive communication environment with regard to horizontal communication will be positively associated with progressive use of IT.*

Reliability of information refers to the quality and accuracy of the information that individuals receive from various sources in an organization (Dennis, 1974). The degree to which the information shared in an organization is perceived to be reliable will encourage an environment in which accurate descriptions of problems and solutions are shared. This should result in more, and more appropriate, applications of IT to business issues.

***H3c:** The degree to which shared information is perceived to be reliable will be positively associated with progressive use of IT.*

Openness is the degree to which individuals get the information they want and need (Eisenberg and Witten, 1987; Jablin, 1985; Redding, 1972). The more information is shared

throughout the organization, the greater the likelihood that problems and solutions are discussed. This should result in more, and more appropriate, applications of IT to business issues.

H3d: The degree to which individuals perceive that they get the information they want and need will be positively associated with progressive use of IT.

RESEARCH METHODOLOGY

The current state of knowledge regarding the differential use of IT by departments is limited. As noted earlier, only a few studies have been conducted to examine this phenomenon (Boynton, Zmud, and Jacobs, 1994; Kwon, 1990; Lind and Zmud, 1991). In terms of methodology, prior research has relied exclusively on the use of survey methods. Data acquired through survey methods are informative in the sense that they provide quantitative evidence for the general constructs and relationships of interest. However, survey data are limited in their ability to increase understanding of the interrelationships beyond those anticipated (Sieber, 1973). The current field study overcomes this problem by combining qualitative (interviews) and quantitative (survey) data collection, as recommended by a number of authors (Kaplan and Duchon, 1988; Lyytinen and Hirschheim, 1987; Sieber 1973). The qualitative data gathered during the interviews and instrument development process provide a depth of analysis not available through surveys alone. Additionally, they provide a solid foundation upon which to build a conceptually stronger survey with both theoretical and practical meaning (Sieber, 1973). Quantitative data, in the form of surveys, add precision to the analysis and provide the basis for empirical generalization.

Site Selection

Following the logic of Yin (1994) and Miles and Huberman (1994), multiple organizations in multiple industries were targeted to strengthen the generalizability of the study's results. While replication logic (Eisenhardt, 1989) guided site selection, other factors such as location, convenience, and the organization's willingness and ability to participate were also influential. Initial contact with the chief information officer (CIO), or a functional equivalent, was made by phone, after which a brief description of the study was sent to interested individuals. The five participating organizations represent four industries: Food Products (2), Retail, Defense, and Insurance. All of the organizations are large, with earnings in excess of \$500 Million.

Subject Selection

Interview Subjects

Three of the organizations agreed to participate in both the qualitative and quantitative data collection process. Interview participants were selected using a snowball sampling technique (see Babbie 1990 for a discussion). The individuals selected had to be able to discuss the organization's use of information systems, how the information systems area is viewed in the organization, and the characteristics of departments that were seen as very good users of information technology, as well as those that were not. The first set of interviewees was from the IS area, typically at the director level. They were identified by the company contact, typically the CIO. These individuals were then asked to identify others in the organization (in IS and the user areas) who would have insights and ideas about IS usage in the organization. The second and third rounds of interviews included individuals from the user areas and the IS area. The

interviews lasted 60 to 90 minutes depending on the amount of time each participant had available. Table 1 delineates the number and types of interview participants. Appendix A includes the complete set of interview questions.

<Insert Table 1 about here>

Survey Participants

All of the participating organizations were involved in the quantitative data collection process. Pairs of respondents were used to capture the nature of the IS-User relationship. Within each organization, survey participants were selected by having IS management identify key individuals in the IS organization who interact with user departments. In turn, these IS participants were asked to identify their counterpart in the user departments, with the criteria that this should be someone with whom the IS participant interacts on a regular basis to provide information systems and support. Survey data were collected in each of the five participating organizations. Overall response rates for the study were 90% of individual surveys, resulting in 75% of the pairs. Table 2 delineates the breakdown of respondents by organization.

<Insert Table 2 about here>

The survey participants were nearly evenly split in terms of gender (54% male and 46% female). Their ages ranged from 23 to 57, with an average age of 40. The respondents varied in the length of time they had been with the organization and in their current departments. Approximately 60% of the respondents were in managerial or supervisory positions, while the other 40% were in technical or administrative positions. Forty-eight percent of the respondents had a Bachelors degree, and another 35% had advanced degrees, such as an MBA or a Ph.D. Table 3 describes the respondent characteristics.

<Insert Table 3 about here>

Instrument Validation

Analysis and validation of the survey instrument proceeded as suggested by DeVellis (1991), with Bagozzi's (1980) guidelines in mind. The survey items were developed based on prior research, either existing instruments, or conceptual definitions. Table 4 delineates the construct, measures, and sources for the survey items. Descriptive statistics for each of the study's variables are presented in Table 5. The Cronbach Alpha values for each variable are presented in Table 6, and are well above the acceptable minimums (Nunnally, 1978), for all variables except horizontal communication, which did fall within the 'minimally acceptable' range defined by DeVellis (1991).

<Insert Table 4 about here>

<Insert Table 5 about here>

<Insert Table 6 about here>

DATA ANALYSIS

Inter-item correlations (see Table 7) were used to guide creation of composite (i.e., summed) variables. Because all inter-item correlations were greater than .3, a composite variable was created for the communication climate. The components of the communication network and knowledge variables did not exhibit such high levels of intercorrelation, and were thus not summed, but treated as separate variables.

<Insert Table 7 about here>

Because this is a one-stage model, multiple regression analysis was used to test the research model. In other words, the independent variables are all exogenous and the only endogenous variable is the dependent variable. Thus, there are no simultaneity problems that would cause biased estimates and indicate the need for alternative statistical measures. The combination of composite variables and sub-construct variables defined above was subjected to the multiple regression analysis, step-wise regression with forward selection. The results, shown in Table 8, provide strong evidence that the communication climate, aspects of the communication network (boundary spanning and tie strength), and aspects of knowledge (technology knowledge) are associated with progressive use of IT. This model has an adjusted R-squared of .417, thus it explains 42% of the variance in IT use across the departments in the study.

<Insert Table 8 about here>

Dummy variables for each company were created because analysis of variance indicated that there were organizational factors present. The only dummy variable that was significant in the model was for organization #2. Post-hoc analysis of the interview data further supports the findings of a negative effect associated with organization #2.

"... the number one constraint is that we've got corporate management that grew up at a time when there weren't computers and they plain and simply don't believe that a significant investment now will have significant payback in a few years. I think it's ignorance of modern information technology." [Senior level user participant]

"... IS now reports up to a director of <department> ..., it doesn't fit at all, and the person has no leverage or power so it's ... seemed like it [IT] was tacked on to something and it doesn't really matter." [User participant]

"Yea, there's great disrespect for the IS organization ... the IS department is ... blamed for the state we're in." [User participant - manager of area referred to in previous quote]

As a means of determining if the company 2 effect was masking the effect of other variables, step-wise regression was run on the data without Organization #2. The results, shown in Table 9, support the significant negative effect of company 2; the same variables are significant in both models, the signs are in the same direction, and the relative magnitudes of the standardized betas are similar. In this case, however, the model has an adjusted R-squared of .593, thus explaining nearly 60% of the variability in IT use.

<Insert Table 9 about here>

DISCUSSION

Figure 3 and Table 10 summarize the results of model testing. The findings provide support for some of the hypotheses, although some unanticipated relationships were found, while some expected relationships were not found.

<Insert Figure 3 about here>

<Insert Table 10 about here>

Anticipated Relationships Found

The regression analysis supports the importance of communication climate in explaining progressive use of IT. In fact the communication climate is the most influential factor in the model, indicating that it should be included in future studies. The findings confirm that both knowledge and the communication network variables play a role in progressive use of IT, although the relationships were not as hypothesized.

Unanticipated Relationships Found

Results of the regression analysis indicate the presence of an organizational variable associated with Organization #2. While not anticipated a priori, this is not a surprising finding. Individuals in this organization remarked in the interviews that “the big boss [their boss’s boss] does not see the usefulness of IT.” And, in fact, this organization recently lost its CIO and has no intentions of replacing him. Future research should incorporate an assessment of senior level support for IT as a control variable.

The finding that convergence in technology knowledge was significant was surprising in light of Cohen and Levinthal's (1990) discussion of the need for both depth and breadth of knowledge. Based on the conceptualization of absorptive capacity, we anticipated that divergence in technology knowledge would be positively associated with progressive use, as this would indicate that a broad range of technology solutions could be applied to the business problems. In essence, these results suggest that users need to know about information technology at levels similar to their IS counterparts. In other words, employees from the user and IS areas both need to know what these basic technologies are and what they can do. There are a number of possible explanations for this finding. One is that, over the years, the IS respondents have developed sufficient knowledge of the business, such that the primary knowledge gap now is the technology. Evidence for this exists in the interview data for one of the organizations, where individuals repeatedly cited knowledge of the business as the strength of the IS area. This was not as evident a theme in the other organizations; thus, it is likely to be only part of the explanation. A second possibility is that shared knowledge about the common, or well-known technologies provides a basis for understanding and subsequent sharing of information about

other IT possibilities. In other words, what is shared is that which both parties have in common, not that which is different (Stasser and Titus 1985). Thus, the overlapping technology knowledge provides yet another dimension of overlap that facilitates knowledge sharing (Cohen and Levinthal 1990). Another possibility is that users are simply more technologically savvy now than in the past. The following survey responses lend some credence to this possibility:

“I will think of something, or I will hear about something [technology], and then go [to the IS group] say, have you thought about this, we could use this... That’s what happened with video conferencing ... and the web.” [User respondent]

“...and what I have found to be true is that more and more people within the organization have a better and better understanding of IT.” [User respondent]

Future research should look more closely at the levels and types of knowledge in the user areas.

Another unexpected relationship is the negative association between weak ties and progressive use of IT. This finding may be due to the memories of the individuals, problems in the instrument, or the incompleteness of the theory. For instance, more than 50% of the respondents failed to complete the information for all three items related to weak ties, suggesting that they had a difficulty answering the questions about sources of new ideas (potentially a memory problem). A second possibility is that respondents were focused on face-to-face or verbal communication and did not consider email messages or other forms of communication as possible sources of new information. This would have biased the results in favor of face-to-face communications, which tend to be associated with stronger ties than other forms of communication. A third possibility is that use of weak ties may actually have a negative effect. It is possible that when information comes from too many weakly tied individuals, there is simply too much information to process, or it is confusing or conflicting (Constant et al., 1996). It may be the case that strong, rather than weak, ties are essential for infusing IT and applying it

to new ends. The following answers to the question, “where do you go to find out about new technologies,” provide some evidence in that direction:

“I’ve been around a long time, and I know a lot of people. I use other people in the organization who I know.” [User respondent]

“One of my friends.” [User respondent]

Future research should examine quantity *and* quality of information received via weak communication ties, as well as the role of strong communication ties in fostering progressive use of IT.

Expected Relationships Not Found

The most significant relationship not found in the model is that between business knowledge overlap and progressive use of IT. Lind and Zmud (1991) found a significant relationship between business knowledge convergence (i.e., the degree to which the IS and user department respondents shared knowledge of the primary functions of the department) and IT innovativeness. Reich and Benbasat (2000) found a significant relationship between knowledge (in terms of job and industry experience) and IT planning. Based on Cohen and Levinthal's (1990) conceptualization, we believed that convergence in business knowledge would provide the knowledge overlap necessary to facilitate communication between the user and the IS representative, leading to more progressive use of IT in the user area.

One possible explanation for not finding this relationship is that when business and technology knowledge are considered simultaneously, but as distinct types of knowledge, the effect of business knowledge convergence is minimized. In their examination of IT knowledge, Lind and Zmud (1991) asked about the potential of IS to support the business, not knowledge of information systems and technology as measured in this study. Thus, their findings regarding the

importance of business knowledge convergence did not take into account convergence in technology knowledge. A second issue to consider is that this study spanned several organizations, while Lind and Zmud's (1991) was conducted in one organization. Thus, it could be that the technology issues and differences are more pervasive than the business issues *across* organizations. Future research should probe more deeply into the facets of business knowledge convergence and divergence.

Divergence in technology knowledge, particularly knowledge of newer technologies, was expected to influence use of IT. One explanation for the lack of relationship between the technology knowledge of newer technologies and progressive use of IT can be found in the Interview data. Responses to the question, "Where do you go for up-to-date information about technology?" elicited some consistent responses, such as:

"Gartner, CSC, Andersen, you know, those companies that get paid the big bucks to know that stuff." [User respondent]

"We have a contract with the Gartner Group. They send us this chart [points to chart on the wall that lists the up and coming technologies]. It's great!" [IS respondent]

These responses suggest that new technology knowledge need not be housed in the organization. In this age of rapid technological change, it might be best that organizations do not rely on having the technical knowledge within their walls. Future research should examine the use of external consultants and their association with IT use in the organization.

A second reason for the lack of relationship between knowledge of new technologies and progressive use of IT can be found in these responses:

"I go talk to *Joe* [a friend who is not in the IS department, but knows a lot about technology], I've known him for years. You've gotta know the network to get things done around here." [User respondent]

“If I read about a new technology and want to know more, I go to *Ed* [the IS director]. He stays up on these things, and if he doesn’t know, he’ll find someone who does.” [User respondent]

These responses suggest that IT knowledge may be scattered throughout the organization. The key may be that individuals in the organization need to know where to find the knowledge they need. Thus, the critical piece of knowledge may be: “Who has the knowledge I need?” Or, as one interview participant put it, “If you know the right people, you’re at least comfortable asking the questions to get the information you need.” Future research should examine the relationship between the IT communication network and progressive use of IT at the departmental level.

Finally, the multiplexity of the user-IS relationship had no significant relationship with progressive use of IT. One possible explanation for this is that new ideas are shared outside of the User-IS relationships. In other words, ideas for new uses of IT may be coming from multiplex relationships *within* the user communities or *within* the IS community, and not necessarily from a multiplex relationship *between* the two communities. The following responses provide evidence that at least some of the interaction is outside the User-IS relationship:

“I’d probably go talk to my counterparts in other departments, like marketing ... and distribution.” [User respondent]

“I’d go to my counterpart in the <other business unit>... That’s my single source.” [User respondent]

Further research is needed to understand more fully the characteristics of the user-IS relationship and how relationships within the user and IS practitioner communities themselves influence IT use.

Limitations

As with all empirical research, a number of limitations can be identified. First, the possibility for common method bias exists due to the fact that the same individuals completed the survey for both the independent and dependent variables. Two characteristics of the study's design and data analysis helped mitigate the impacts of common method bias: the length of the surveys and the use of averages. Since the survey is quite lengthy, it is not likely that respondents could consciously force consistency while completing it. In addition, averaging the values reported by the IS and User respondents, serves to diminish individual biases (Rousseau, 1985). As an additional check, the correlation matrix was examined for unexpected patterns of correlation. No unusual patterns were readily detectable from the matrix, providing further evidence for the minimal presence of common method bias.

Another limitation of this study was the use of a single respondent to represent each user area. This is a weakness insofar as the person may not be truly representative of the entire department. However, user representatives were selected based on their degree of interaction with the IS respondent. Further, the constructs assessed were concerned with the characteristics of the person most likely to interact with the IS department. Thus, if the participants truly fit the established criteria, their responses should be representative of the relationship between the user department and the IS department.

The absence of time as a variable could account for some of the unexpected findings regarding the knowledge variables. It is difficult to determine which came first: IT knowledge or progressive use. Other studies have found business knowledge as either an antecedent to (Reich and Benbasat, 2000) or an outcome of (Lind and Zmud, 1991) communication when the studies

were conducted longitudinally. Clearly, future research should examine how knowledge and communication evolve in importance with the progression of time.

CONCLUSION

This study contributes to both research and practice. The model, including communication climate, communication network, and knowledge components, explains nearly 60% of the variability in departmental progressive IT use. This study is the first to demonstrate empirically the prominence of communication climate in understanding IT use. Further, this study supports earlier findings of the importance of communication network variables, although somewhat differently than anticipated. Additionally, it provides support for another communication network variable: tie strength. Although weak ties were hypothesized to facilitate progressive use of IT, the results suggest the opposite relationship. Finally, this study provides an initial operationalization of absorptive capacity for use in IS research. Future research should replicate these findings in other organizations. We hope that this study will provide a foundation for future research to extend and refine the measures presented here.

This study is the first to examine empirically the role of *technology* knowledge in explaining IT use. As a result, it raises questions about the importance of knowledge: what kind, how much, and who needs to have it. It is commonly understood that IS professionals need to know the business. So, why is knowledge, in the form of convergence of business knowledge not significant in this study? In addition, why is technology knowledge limited to common technologies? Additional research is needed to assess the external validity of this study's findings and to probe more deeply into the nature and content of the knowledge that is shared.

From the perspective of practice, this research highlights and reinforces an issue with which many organizations struggle: communication. This research suggests that organizations wishing to improve departmental use of IT should focus energy on encouraging open, reliable communication that flows both vertically and horizontally. In terms of the communication network, this research suggests that having communication focused internal to the organization can inhibit a department's ability to use IT progressively. Thus, organizations should encourage employees to look outside the organization for new ideas and uses of IT. Additionally, organizations should encourage employees to develop strong communication ties. It appears as though these kinds of relationships help departments to use IT progressively. This may be due to individuals being more comfortable talking about new ideas with people to whom they are strongly connected.

Perhaps the most significant finding for practice is that this study points to the need for users to have technology knowledge similar to that of IS personnel, at least where common technologies (e.g., client-server, local area networks, internet access) are concerned. Thus, informing and training users about the very basic, core technologies used in an organization will likely pay off in terms of progressive use of IT.

REFERENCES

- Albrecht, T. L. and Hall, B. "Relational and Content Differences Between Elites and Outsiders in Innovation Networks," *Human Communication Research*, (17:4), June 1991, pp. 535-561.
- Albrecht, T. L. and Ropp, V. A. "Communicating About Innovation in Networks of Three U.S. Organizations," *Journal of Communication*, (34:3), June 1984, pp. 78-91.
- Allen, T. J. and Cohen, S. I. "Information Flow in Research and Development Laboratories," *Administrative Science Quarterly*, March 1969, pp. 12-19.
- Babbie, E. (1990). *Survey Research Methods* (2nd ed.). Belmont, California: Wadsworth Publishing Company.
- Bagozzi, R. P. *Causal Models in Marketing*, John Wiley and Sons, New York, 1980.
- Bower, G.H. and Hilgard, E.R. *Theories of Learning*, Prentice-Hall, Englewood Cliffs, NJ, 1981.
- Boynton, A. C., Zmud, R. W., and Jacobs, G. C. "The influence of IT management practice on IT use in large organizations," *MIS Quarterly*, (18:3), 1994, 299-318.
- Brancheau, J. C., Janz, B. D., and Wetherbe, J. C. "Key Issues in Information Systems Management: A Shift Toward Technology Infrastructure," *MIS Quarterly*, (20:2), June 1996.
- Brancheau, J. C. and Wetherbe, J. C. "The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-User Computing," *Information Systems Research*, (1:2), June 1990, pp. 115-143.
- Brown, S. A. and Chervany, N. L. "How Absorptive Capacity Adds to Our Understanding of the New IT Introduction Process," *Working Paper, Indiana University*, 1999.
- Busch, E. A., Jarvenpaa, S. L., Tractinsky, N., and Glick, W. H. "External Versus Internal Perspectives in Determining a Firm's Progressive Use of Information Technology," *Proceedings of the Twelfth International Conference on Information Systems*, 1991, pp. 239-250.
- Cohen, W. M. and Levinthal, D. A. "Innovation and Learning: The Two Faces of R&D," *The Economic Journal*, (99:397), 1989, pp. 569-596.
- Cohen, W. M. and Levinthal, D. A. "Absorptive Capacity: A New Perspective on Learning and Innovation," *Administrative Science Quarterly*, (35:1), March 1990, pp. 128-152.
- Cohen, W. M. and Levinthal, D. A. "Fortune Favors the Prepared Firm," *Management Science*, (40:2), February 1994, pp. 227-251.

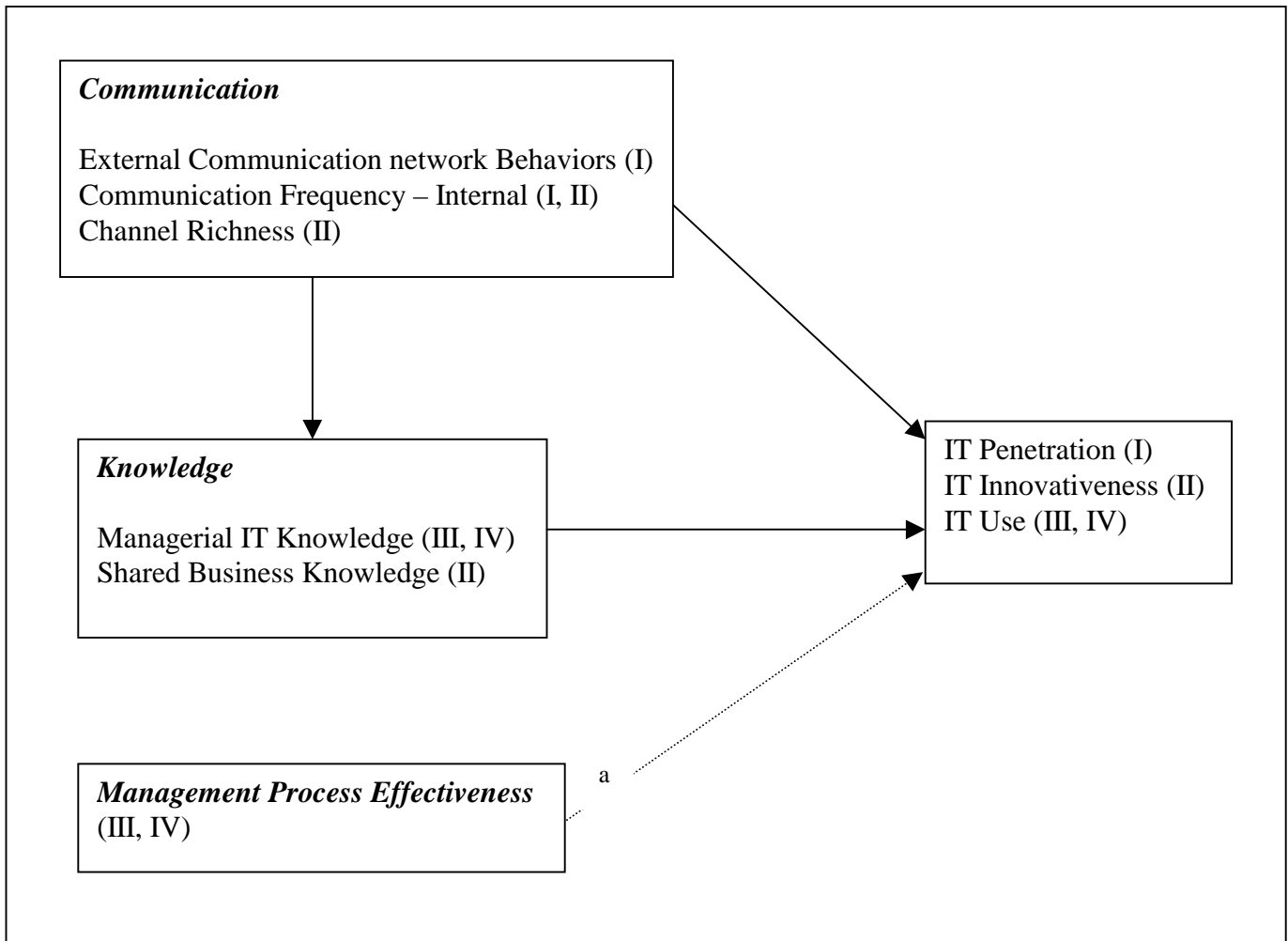
- Constant, D., Sproull, L., and Kiesler, S. "The Kindness of Strangers: The Usefulness of Electronic Weak Ties for Technical Advice," *Organization Science*, (7:2), March-April 1996, pp. 119-135.
- Cooper, R. B. and Zmud, R. W. "Information Technology Implementation Research: A Technological Diffusion Approach," *Management Science*, (36:2), February 1990, pp. 123-139.
- Crino, M. D. and White, M. C. "Satisfaction in Communication: An Examination of the Downs-Hazen Measure," *Psychological Reports*, (49), December 1981, pp. 831-838.
- Danowski, J. A. "Group Attitude Uniformity and Connectivity for Organizational Communication Networks for Production, Innovation, and Maintenance Content," *Human Communication Research*, (6:4), June 1980, pp. 299-308.
- Dennis, H. S. "A Theoretical and Empirical Study of Managerial Communication Climate in Complex Organizations," Unpublished doctoral dissertation, Purdue University, 1974.
- DeVellis, R. F. *Scale Development*, Sage Publications, Newbury Park, CA, 1991.
- Dollinger, M. J. "Environmental Boundary Spanning and Information Processing Effects on Organizational Performance," *Academy of Management Journal*, (27:2), June 1984, pp. 351-368.
- Eisenberg, E. M. and Witten, M. G. "Reconsidering Openness in Organizational Communication," *Academy of Management Review*, (12:3), 1987, pp. 418-426.
- Eisenhardt, K. M. "Building Theories From Case Study Research," *Academy of Management Review*, (14:4), 1989, pp. 532-550.
- Ellis, H.C. *The Transfer of Learning*, Macmillan, New York, 1965.
- Fichman, R. G. and Kemerer, C. F. "The Assimilation of Software Process Innovations: An Organizational Learning Perspective," *Management Science*, (43:10), October 1997, pp. 1345-1363.
- Friedman, R. A. and Podolny, J. "Differentiation of Boundary Spanning Roles: Labor Negotiations and Implications for Role Conflict," *Administrative Science Quarterly*, (37), March 1992, pp. 28-47.
- Granovetter, M. S. "The Strength of Weak Ties," *American Journal of Sociology*, (78:1360-1380), 1973.
- Jablin, F. M., "Task/Work Relationships: A Life-Span Perspective," *Handbook of Interpersonal Communication*, M. L. Knapp and G. R. Miller (eds.), Sage, Beverly Hills, California, 1985, pp. 615-649.

- Jarvenpaa, S. L. and Ives, B. "Executive Involvement and Participation in the Management of Information Technology," *MIS Quarterly*, June 1991, pp. 204-223.
- Kaplan, B. and Duchon, D. "Combining Qualitative and Quantitative Methods in Information Systems Research: A Case Study," *MIS Quarterly*, (12:4), December 1988, pp. 571-586.
- Kimberly, J.R., "Managerial Innovation," in *Handbook of Organizational Design*, P. Nystrom and W.H. Starbuck, eds., Oxford University Press, London, Vol 1, 1981, pp. 84-104.
- Kwon, T. H. "A Diffusion of Innovation Approach to MIS Infusion: Conceptualization, Methodology, and Management Strategies," *Proceedings of the Eleventh International Conference on Information Systems*, 1990, pp. 227-251.
- Kwon, T. H., and Zmud, R. W., "Unifying the Fragmented Models of Information Systems Implementation," in *Critical Issues in Information Systems Research*, R. J. Boland and R. A. Hirschheim (editors), John Wiley and Sons, Ltd., New York, 1987.
- Lane, P. J. and Lubatkin, M. "Relative Absorptive Capacity and Interorganizational Learning," *Strategic Management Journal*, (19:5), May 1998, pp. 461-477.
- Lind, M. R. and Zmud, R. W. "The Influence of a Convergence in Understanding Between Technology Providers and Users on Information Innovativeness," *Organization Science*, (2:2), May 1991, pp. 195-217.
- Lyytinen, K., and Hirschheim, R. "Information systems failures - A survey and classification of the empirical literature," *Oxford Surveys in Information Technology*, (4), 1987, 257-309.
- Miles, M. B., and Huberman, A. M. *Qualitative Data Analysis: An Expanded Sourcebook*, Sage Publications, Inc., Thousand Oaks, California, 1994.
- Nelson, R. E. "The Strength of Strong Ties: Social Networks and Intergroup Conflict in Organizations," *Academy of Management Journal*, (32:2), 1989, pp. 377-401.
- Nichols-Nixon, C. "Absorptive Capacity and Technological Sourcing: Implications for the Responsiveness of Established Firms," *Unpublished Doctoral Dissertation*, Purdue University, 1993.
- Niederman, F., Brancheau, J. C., and Wetherbe, J. C. "Information Systems Management Issues for the 1990s," *MIS Quarterly*, (15:4), December 1991, pp. 474-500.
- Pennings, J.M. and Harianto, F. "The Diffusion of Technological Innovation in the Commercial Banking Industry," *Strategic Management Journal*, (17:2), 1992a, pp. 29-46.
- Pennings, J.M. and Harianto, F., "Technological Networking and Innovation Implementation," *Organization Science*, (13:1), 1992b, pp. 356-382.

- Porter, M. E. and Millar, V. E. "How Information Gives You Competitive Advantage," *Harvard Business Review*, July 1985, pp. 149-160.
- Putnam, L. L., and Cheney G., "Organizational Communication: Historical Development and Future Directions," in *Speech Communication in the 20th Century*, T. W. Benson (editor), Southern Illinois Press, Carbondale, IL, 1985.
- Redding, W. C. *Communication Within the Organization: An Interpretive Review of Theory and Research*, Industrial Communication Council, New York, 1972.
- Reich, B. H. and Benbasat, I. "Factors That Influence the Social Dimension of Alignment Between Business and Information Technology Objectives," *MIS Quarterly*, (24:1), 2000, pp. 88-113.
- Rice, R. E., Grant, A. E., Schmitz, J., and Torobin, J. "Individual and Network Influences on the Adoption and Perceived Outcomes of Electronic Messaging," *Social Networks*, (12), 1990, pp. 27-55.
- Rogers, E. M. *Diffusion of Innovations* (4th ed.), The Free Press, New York, 1995.
- Rogers, E.M., and Kincaid, D.L. *Communication Networks: Toward a New Paradigm for Research*, The Free Press, New York, 1981.
- Rousseau, D. M. "Issues of Level in Organizational Research: Multi-Level and Cross-Level Perspectives," *Research in Organizational Behavior*, (7), 1985, pp. 1-37.
- Sieber, S. D. "The Integration of Fieldwork and Survey Methods," *American Journal of Sociology*, (78:6), May 1973a, pp. 1335-1359.
- Stasser, G. and Titus, W. "Pooling of Unshared Information in Group Decision Making: Biased Information Sampling During Discussion," *Journal of Personality and Social Psychology*, (48:6), 1985, pp. 1467-1478.
- Straub, D. W. and Wetherbe, J. C. "Information Technologies for the 1990s: An Organizational Impact Perspective," *Communications of the ACM*, (32:11), November 1989, pp. 1328-1339.
- Tushman, M. L. "Special Boundary Roles in the Innovation Process," *Administrative Science Quarterly*, (22:4), December 1977, pp. 587-605.
- Tushman, M. L. and Romanelli, E. "Uncertainty, Social Location and Influence in Decision Making: A Sociometric Analysis," *Management Science*, (29:1), January 1983, pp. 12-23.
- Yin, R. K. *Case Study Research: Design and Methods*, Second edition, Sage, Newbury Park, CA, 1994.

Zmud, R., Boynton, A. C., and Jacobs "An Examination of Managerial Strategies for Increasing Information Technology Penetration in Organizations," *Proceedings of the Seventh International Conference on Information Systems*, 1987, pp. 24-44.

Figure 1 : Model Synthesizing Prior Studies



Legend:

I: Kwon 1990

II: Lind and Zmud 1991

III: Zmud, Boynton, and Jacobs 1987

IV: Boynton, Zmud, and Jacobs 1994

a: This relationship was significant only for the unit in which IT spending was the lowest.

Figure 2: Proposed Research Model

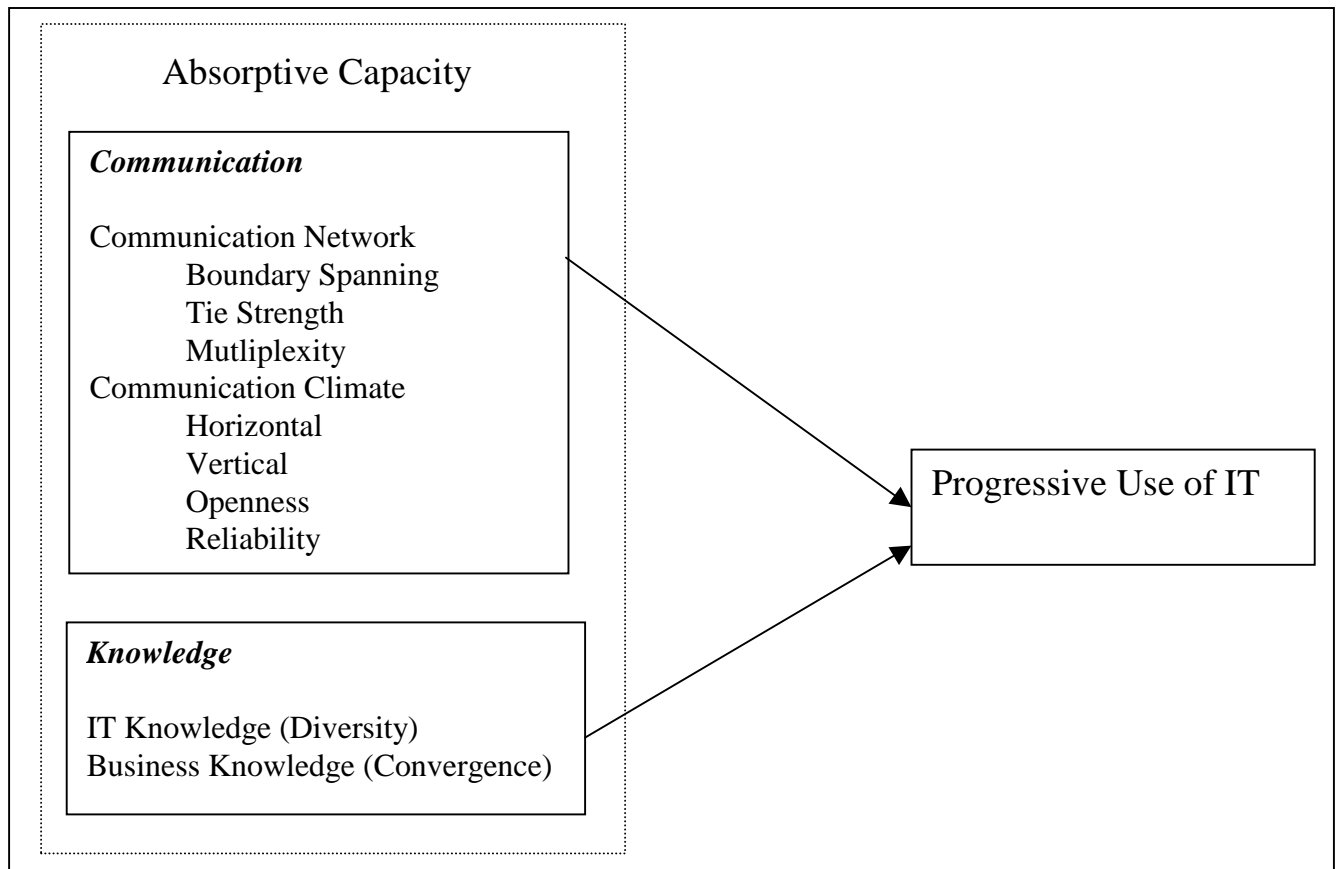


Figure 3: Final Model

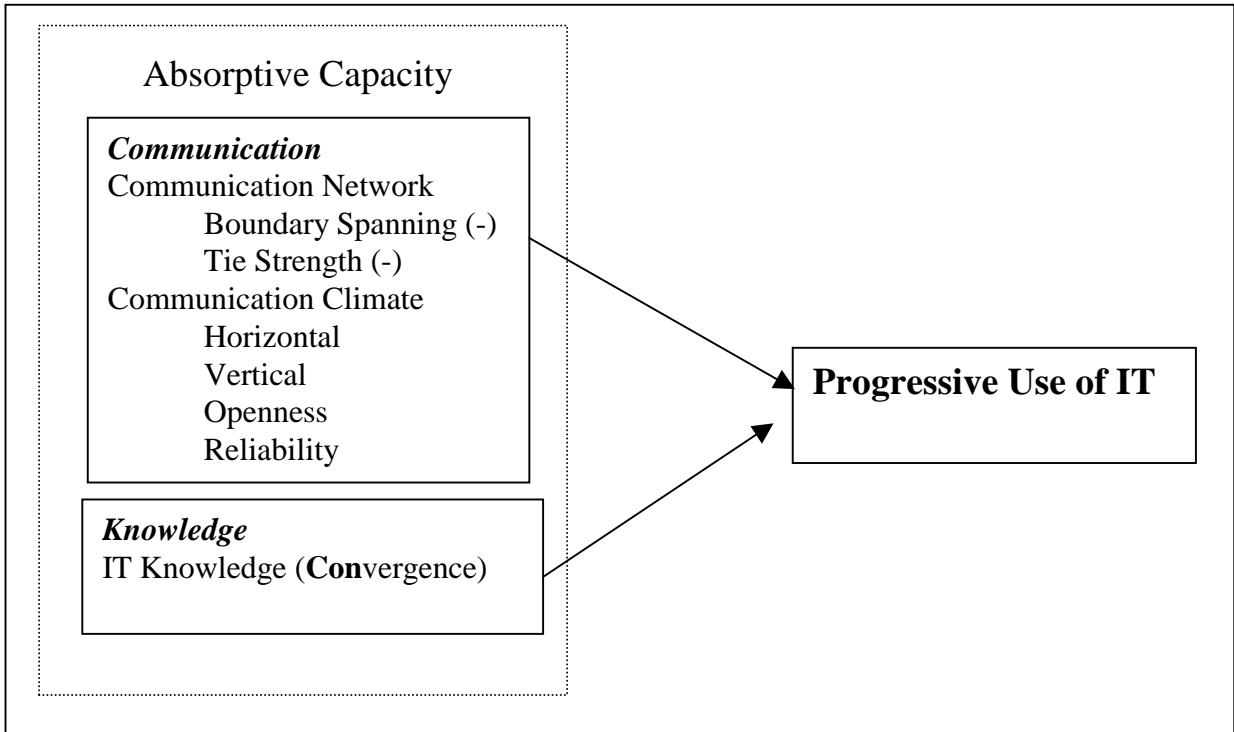


Table 1: Number and Types of Interview Participants

Organization	Number of IS Respondents	Number of User area Respondents
Organization #2	7	8
Organization #3	7 (+2 from parent IS org.)	6
Organization #4	5 (+1 from parent IS org.)	10

Table 2 : Number of Pairs by Organization

Organization Number	Number of Pairs Promised	Number of Pairs Received
Organization #1	14	12
Organization #2	20	14
Organization #3	16	11
Organization #4	10	6
Organization #5	11	10

Table 3: Descriptive Characteristics of Respondents

Characteristic	IS Respondents	User Respondents	Overall Range
Years in current job	2.8	2.6	<1-28
Years in current department	5.4	7	<1-28
Years in this organization	10.3	6.6	<1-31

Table 4: Constructs and their sources

Construct	Measures	Sources for Questionnaire Items
Knowledge	Knowledge inventory	<i>IT Knowledge</i> : List derived from Straub and Wetherbe (1989) with items added <i>Business Knowledge</i> : Lind and Zmud (1991), based on Porter and Millar (1985)
Communication Network	Questionnaire Items (likert scale) Self-reported communication behavior	<i>Boundary Spanning</i> : Allen and Cohen (1969); Dollinger (1984) <i>Tie Strength</i> : New <i>Multiplexity</i> : New
Communication Climate	Questionnaire Items	<i>Horizontal/Informal</i> : Crino and White (1981) <i>All others</i> : Dennis (1974)
Progressive use of IT	Questionnaire Items	Boynton, et al. (1994); Busch, et al. (1991); Jarvenpaa and Ives (1991), with additional items added.

Table 5: Descriptive Statistics for the Independent Variables

Construct	Min	Max	Mean	Std. Dev.
Business Knowledge – Indirect support	3	18	11.65	3.81
Business Knowledge – Primary Activities	0	17	5.98	3.78
Business Knowledge – Direct Support	0	13	4.94	3.48
Tech. Knowledge – Common	3	31	13.04	6.78
Tech. Knowledge – Newer	0	24	10.22	5.68
Tech. Knowledge – DB and DM	2	25	11.22	5.53
Boundary Spanning (FAILURE)	41.5	100	83.25	12.18
Multiplexity	33.5	71.50	57.16	8.89
Tie Strength (Weak Ties)	7.5	13.5	11.39	1.38
Informal/Horizontal	12	27	21.89	3.01
Openness	12	32.5	24.01	3.78
Reliability	13	20.5	16.48	1.73
Vertical Comm.	14.5	27	21.53	3.22

Table 6: Cronbach Alpha Values for Independent Variables

Construct	Number of Items	Alpha
Vertical Communication	4	.8972
Horizontal (informal) Communication	4	.6662
Reliability	3	.8291
Openness	3	.8620
Boundary spanning	Alpha is not appropriate for these variables due to how they were measured.	
Weak Ties		
Multiplexity	12	.9375
Business Knowledge – primary activities	6	.8983
Business Knowledge – Indirect Support	10	.9364
Business Knowledge – Direct support	3	.8975
Tech. Knowledge – Common	7	.9342
Tech. Knowledge – Newer	6	.8673
Tech. Knowledge – Database/DM	6	.8746

Table 7: Inter-item correlations of communication climate items

	Informal/horizontal Communication	Openness	Reliability	Vertical Comm.
Informal/horizontal Communication	1.000			
Openness	.480	1.000		
Reliability	.387	.504	1.000	
Vertical Comm.	.341	.485	.429	1.000

Table 8: Full Model

	Unstandardized Coefficients		Standardized Coefficients	Sig.
	B	Std. Error	Beta	
(constant)	77.936	68.029		.259
Communication Climate	1.901	.563	.385	.002
Boundary Spanning (FAILURE)	-1.408	.422	-.390	.002
Company 2 (dummy)	-39.427	11.905	-.395	.002
Tech. Knowledge – Common	-1.637	.803	-.249	.048
Weak Ties	-6.138	3.758	-.185	.110

$R^2=.480$; $R^2_a=.417$; F-value = 2.668

Table 9: Model without organization 2

	Unstandardized Coefficients		Standardized Coefficients	Sig.
	B	Std. Error	Beta	
(constant)	103.072	69.083		.148
Communication Climate	2.554	.565	.544	.000
Boundary Spanning (FAILURE)	-1.786	.436	-.525	.000
Tech. Knowledge – Common	-3.001	.873	-.445	.002
Weak Ties	-10.384	4.089	-.301	.018

$R^2=.650$; $R^2_a=.593$; F-value = 6.448

Table 10: Model Testing Summary

Hypothesis	Supported?	Unanticipated Findings
H1a: Diversity of IT knowledge between the business unit and IS will be positively associated with progressive use of IT.	No	Convergence in common technology knowledge is significant
H1b: Overlap of business knowledge between the business unit and IS will be positively associated with progressive use of IT.	No	No
H2a: Boundary spanning activity by the business unit and IS will be positively associated with progressive use of IT.	Yes/No	Failure to span boundaries is detrimental
H2b: Reliance on weak ties as a source of new information by the business unit and IS will be positive associated with progressive use of IT.	No	Weak ties have a negative influence
H2c: The degree to which the relationship between the business unit and IS is multiplex, will be positively associated with progressive use of IT.	No	No
H3a: A positive communication climate with regard to vertical communication will be positively associated with progressive use of IT.	Yes	
H3b: A positive communication environment with regard to horizontal communication will be positively associated with progressive use of IT.	Yes	
H3c: The degree to which shared information is perceived to be reliable will be positively associated with progressive use of IT.	Yes	
H3d: The degree to which individuals perceive that they get the information they want and need will be positively associated with progressive use of IT.	Yes	

Appendix A : Interview Script

I. Interviewee Questions

1. What is your position in the organization?
2. In this position, what are your major ongoing responsibilities?
3. How long have you worked for the company? In this position?

II. Business Unit Overview

1. Please describe your business unit in terms of where it fits in the larger organization and what activities are performed here.
Or For IS Respondents: Please describe the business units or departments with which you and your staff primarily interact. Please discuss where they fit in the larger organization and what activities are performed in those departments.
2. How are innovations and new ideas handled here? (are they encouraged, discouraged, rewarded, punished, ignored, etc.)

III. IT Overview

1. How satisfied are you with the information technology you have available to you?
Or for IS respondents: How satisfied are you with the information technology you have available to you, both as a user and as a provider?
2. How important is information technology to your business unit's success?
Or for IS respondents: How important is information technology to your organization's success? Describe the role of IT in your organization? What is the role of the IT department?
3. In your opinion, what are the strengths of the IT department?
4. What are the IT departments' constraints?

IV. Communication

1. Where would you go to get information about information technologies?
2. Where would you go to get business information?
3. How do business issues and information technologies come together?
4. How would you evaluate this process?
5. Describe the organization's approach to cross-department communication.
6. How would you rate the flow of information in your organization with respect to :
 - a. Vertical communication – with others at your same level.
 - b. Horizontal communication – up and down the hierarchy.
 - c. Reliability of information you receive.
 - d. Openness of information.

V. Technology Introduction

1. How would you evaluate your organization's ability to find, evaluate, and use information technology?
2. Who drives the IT introduction projects?
3. What things do you think influence how well IT is put to use in organizations?

Appendix B: Constructs and survey items

I. Technology Familiarity

Below is a list of information technologies and systems. Please rate your degree of familiarity with each of the following by circling the appropriate number.

	Completely Unfamiliar	Extremely Familiar	
1. Bio-molecular computers	1-----2-----3-----4-----5-----6-----7		(l)
2. CAD/CAM	1-----2-----3-----4-----5-----6-----7		(c)
3. Client-server	1-----2-----3-----4-----5-----6-----7		(c)
4. Computer-mediated conferencing	1-----2-----3-----4-----5-----6-----7		(o)
5. Database management systems(DBMS)	1-----2-----3-----4-----5-----6-----7		(d)
6. Data warehouse	1-----2-----3-----4-----5-----6-----7		(d)
7. Desktop publishing	1-----2-----3-----4-----5-----6-----7		(c)
8. Document imaging	1-----2-----3-----4-----5-----6-----7		(c)
9. Electronic Data Interchange (EDI)	1-----2-----3-----4-----5-----6-----7		(o)
10. Executive Information Systems (EIS)	1-----2-----3-----4-----5-----6-----7		(d)
11. Expert systems/ Artificial intelligence	1-----2-----3-----4-----5-----6-----7		(l)
12. 4th Generation Languages	1-----2-----3-----4-----5-----6-----7		(d)
13. Gamma networks	1-----2-----3-----4-----5-----6-----7		(fake)
14. Generalized decision support systems	1-----2-----3-----4-----5-----6-----7		(d)
15. High-end workstations	1-----2-----3-----4-----5-----6-----7		(n)
16. Hypertext/hypermedia	1-----2-----3-----4-----5-----6-----7		(n)
17. Integrated services digital network	1-----2-----3-----4-----5-----6-----7		(n)
18. Internet	1-----2-----3-----4-----5-----6-----7		(c)
19. Local area network (LAN)	1-----2-----3-----4-----5-----6-----7		(c)
20. Lotus Notes	1-----2-----3-----4-----5-----6-----7		(l)
21. Natural language interfaces	1-----2-----3-----4-----5-----6-----7		(l)
22. Neural networks	1-----2-----3-----4-----5-----6-----7		(l)
23. On-line external database searching	1-----2-----3-----4-----5-----6-----7		(l)
24. Query languages	1-----2-----3-----4-----5-----6-----7		(d)
25. SAP	1-----2-----3-----4-----5-----6-----7		(o)
26. Speech recognition	1-----2-----3-----4-----5-----6-----7		(n)
27. VSAT networks	1-----2-----3-----4-----5-----6-----7		(l)
28. Wide area network (WAN)	1-----2-----3-----4-----5-----6-----7		(n)
29. Wireless computing	1-----2-----3-----4-----5-----6-----7		(n)
30. World Wide Web (WWW)	1-----2-----3-----4-----5-----6-----7		(c)

Key:
c=common tech.
d=database & decision making
n= newer tech.
l=limited use
o=organization specific

II. Business Knowledge

The various departments/business units in your organization engage in a variety of activities. The following questions are intended to determine the relative importance of each activity to **your** department. In addition, we would like your opinion regarding the **potential** of information systems to support each of these activities. Please answer all of the following questions in terms of **your department**. Use the following scale to indicate your response by circling the most appropriate number:

No	A Little	Some	Great	Very Great
Extent	Extent	Extent	Extent	Extent
1-----	2-----	3-----	4-----	5-----

In your opinion, to what extent is each activity important to the success of the **your** department?

In your opinion, to what extent can information systems have a critical role for accomplishing each activity in **your** department?

Business Activities:	No Extent	Very Great Extent	No Extent	Very Great Extent
1. Procurement of goods and services.	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
2. Warehousing	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
3. Operations	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
4. Manufacturing	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
5. Order processing	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
6. Shipping and delivery	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
7. Marketing	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
8. Sales	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
9. Merchandising	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
10. Customer service	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
11. General management	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
12. Legal work	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
13. Accounting/finance	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
14. Planning	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
15. Forecasting	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
16. Office administration	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
17. Research and development	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
18. Human resource management	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
19. Training	1-----2-----3-----4-----5		1-----2-----3-----4-----5	
20. International management and administration	1-----2-----3-----4-----5		1-----2-----3-----4-----5	

Vertical information flow

1. It is safe to say what I am really thinking to my supervisor.
2. I can tell my supervisor about the way I feel he/she manages my work group.
3. I am free to tell my supervisor that I disagree with him/her.
4. I am safe in communicating bad news to my supervisor without fear of any retaliation on his/her part.

Reliability of information

1. Information received from my coworkers is really reliable.
2. Information received from my supervisor is really reliable.
3. In general, when I get information, it is very reliable.

Progressive use of IT

Self-report by business unit representative also completed by IS respondent for the department

Given the following classifications of the applications used by your department, please indicate what percentage of each type of application is currently used in your department:

Types of Applications	% of applications in our department
Type I: Information systems developed to perform the day to day tasks that are necessary for the department to run.	_____
Type II: Information systems developed to assist managers in monitoring, controlling, and planning a business’s internal activities.	_____
Type III: Information systems developed to establish or sustain a competitive position in the market place.	_____
Other (please list)	_____
	= 100%

Please rate your department’s use of each of the following types of systems:

	No use at all	Just starting	Used to some extent	Used to a great extent	Used to a very great extent
Type I:	1-----	2-----	3-----	4-----	5
Type II:	1-----	2-----	3-----	4-----	5
Type III:	1-----	2-----	3-----	4-----	5
Other:	1-----	2-----	3-----	4-----	5

Progressive use was calculated by multiplying the percent of Type III systems by the Use of Type III systems.